School of Media, Culture and Creative Arts

Digital engagement: An investigation of how Information and Communication Technology professionals engage with technology and why digital engagement affects them differently

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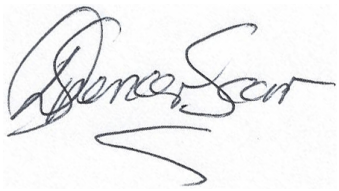
Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics (For projects involving human participants/tissue, etc) The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number # MCCA-06-12.

Signature: 

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In memory of my mother.

Abstract

The aim of this research was to examine a sample of ICT professional to develop an understanding of digital engagement. The thesis begins with an overview and discussion on the methodology. This is followed by exploring cybernetics as a theory for underpinning this research, which raises issues relating to how digital networked technology should be perceived: whether it is a tool or an environment. The discussion reveals that it is both but the discussion also reveals that three environments need to be considered in relation to digital engagement. These are the physical environment, the digital environment and the individual as an environment. Each of these is discussed in turn.

The thesis then turns to empirical research examining survey results of participants' personality and how they relate to digital engagement. This is done over two chapters, the first chapter examines a meta view of personality by using the Big-Five Factors of Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. Survey 1 also examines decision making style using the Rational Experiential Inventory. The second survey takes a deeper look at the Big-Five Factor by using the NEO-PR-I (equivalent) personality test, which tests six subscales of each of the Big-Five Factors. This is followed by original research where I draw on interview data to develop a framework for understanding digital engagement. The interview data is also used to develop a prototype instrument for measuring digital engagement. The personality results are then correlated to the digital engagement results in order to better understand the relationship between the two.

The concluding chapter brings all these threads together finding that digital engagement is the dynamic relationship between an individual and digital networked technology and is best understood as a Second Order Cybernetic system, which involves a complex arrangement of governed interacting nested cybernetic systems and the individual's awareness that they are both a 'participant in' and 'an observer of'' a positive feedback process between themself and the technology. In addition to this digital engagement is directly influenced by the individuals' level of system-awareness, which enables them to govern/manage their unique set of cybernetic feedback processes, both internal and external, in conjunction with their personal motivation. The exciting possibility of this is that some future research will reveal how raising awareness of this relationship will produce massive personal and social benefits.

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1 Introduction

This thesis investigates the relationship between people and digital networked technology to develop an understanding of the nature of these relationships and why they affect individuals in different ways. The purpose of the research is to gain insights that can be extrapolated to a wider understanding of why humans' engagement with this technology is having such a profound impact on not only the individual but also society. My primary focus, therefore, was to understand the underlying mechanisms of the individual's engagement behaviours rather than on relationships as found in online communities or networks. I was particularly interested in personality and decision-making style because when taken together these behaviours represented the individuals' uniqueness. I thought these innate behaviours would provide insights into individuals' digital engagement differences. To achieve this I explored how a sample of Information and Communication Technology (ICT) professionals understand and use digital networked technology in their daily functioning. From this investigation I have developed a framework that endeavours to map what I call *digital engagement*. I use this term throughout the thesis to describe the evolving relationship between the individual and digital networked technology. The purpose of the digital engagement framework was primarily to provide a high level representation of the digital engagement behaviours that I witnessed in my participants in a structured form that could aid understanding of digital engagement as a total system. The framework also provided a structure that enabled the classification of themes within the interviews that led to the development of a prototype instrument for measuring digital engagement.

1.1.1 My Motivation to do this Research

My interest in this topic began in the mid 1990s when I was presenting to businesses, education groups and communities on the potential of digital networked technology. My approach situated digital networked technology as more than just the devices or connectors, it also included the people who used them. I explained that how they related to the technology was going to shape their understanding of the world and therefore effect not only themselves but also other individuals that they may not even know. During the presentations I noted that regardless of the group demographic there were always some individuals who

apparently intuitively had a grasp of the potential application and uses of the technology, be it for their business, in society or at a personal level. Others in the group struggled to see the technology as anything more than a new tool that was possibly useful. Over time I noticed that the individuals in the first group used technology to advance their personal objectives and were by and large achieving more, regardless of their technology skill level. These observations led me to wonder whether the use of digital technology was enhancing individuals' ability to improve their outcomes, and thus the cause of change, or whether it was the innate nature of the individual that was predictive of their successful use and understanding of technology. This eventually led to my research question: How do Information and Communication Technology professionals understand and use digital networked technology and what might this reveal about the more general nature of digital engagement? To address this question I examine the relationship between participants' digital engagement behaviours and their personality type as well as their decision making style.

1.1.2 Background to the Research Project

This research involves three connected environments that required investigation. Firstly, there is the internal environment of the human, which can be described in general terms as encompassing all the internal systems of the individual that support consciousness and the development of the autobiographical self, resulting in the individuals' observable behaviors. Secondly, there is the relatively new environment of digital networked technology. This digital environment is where humans increasingly operate and it is the result of relationships created by the complex interactions of software[1], hardware[2] and wetware.[3] The final environment is the physical environment. This is the environment in which humans have evolved over millennia and, as part of the evolutionary process, it is where humans have developed an intuitive understanding of basic first principle concepts such as time, space and memory, all of which have aided human survival. It is within the physical environment that the first two environments exist but, as discussion in this thesis will show, in order to

[1] Software describes the various kinds of programs used to operate computers and related devices.
[2] Hardware describes the physical aspects of computers, connectors and related devices.
[3] The term wetware is drawn from the computer-related idea of hardware or software, but refers to the human element of digital networked technology.

understand digital engagement it is necessary to understand all three environments as being separate but also interacting.

Supporting research for understanding internal environments was predominantly sourced from the field of neuroscience and related to the role of biochemistry in individuals' observable behaviours. Research around observable behaviours, however, came from behavioural psychology. This cross-disciplinary approach was necessary because I wanted to understand the individual on a complex level, where the underlying mechanisms of observable behaviours were explored and quantified.

A cross-disciplinary approach however introduces problems related to terminology particularly when merging system and technology concepts with psychology, which in itself has great diversity. The terms particularly relevant to this discussion that require clarification are 'personality' and (observable) 'behaviour'. Behaviour or observable behaviours describe *all the behaviours that we see in others and ourselves*. They are the resulting manifestation of all the complex internal systems of the individual that can be seen. Psychologists have found that *some* of these behaviours are common in humans and it is these common behaviours that have been classified by psychologists into what we call personality traits. Personality is thus a subset of observable behaviours and could be considered a proxy of an individual's internal systems that has resulted in commonly identifiable behaviours that can be classified.

I selected the Big-Five Factor instrument for measuring personality because of its lexical basis. The Big-Five Factor was developed from an analysis of commonly used words that describe some observable behaviours. The premise being that humans develop words to describe what they see or experience. Current instruments to evaluate personality traits were developed within the framework of the physical environment on the assumption that personality will remain fairly consistent throughout an individual's life and that it is both heritable via genetics and influenced by the environment during early development. The implication being that once formed an individual's personality would be relatively stable.

Until recently psychologists have not needed to consider ‘personality within the digital environment’ because the digital environment had not yet come into existence or it was not considered as being sufficiently different to warrant examination of existing instruments. There is signs that this is changing. However, at the time this research was conducted, research indicated that existing personality instruments would be suitable for the digital environment and I proceeded on this basis. As my discussion will show behaviours are indeed different in the digital environment due to differences in first principle concepts. It was only when trying to understand personality types and traits using existing instruments when applied to the digital environment that I became aware of the inadequacies of the existing instruments.

Current research in behavioural psychology is linking personality to digital networks, but the focus tends to be on the relationship between amount of time spent using technology and participants’ level of involvement with digital networks, rather than on the mechanism that results in differing levels of digital engagement (Devaraj, Easley, & Crant, 2008; Korukond, 2007; Ross et al., 2009; Thatcher, Loughry, Lim, & McKnight, 2007).

As part of the observable behaviours I also wanted to understand decision-making because it is the mechanism that influences action to engage with the technology. Like personality, decision-making is a well-researched and debated topic covering many disciplines. Decision making has been researched in a number of contexts from military (Bahrami, Yuan, Smart, & Shadbolt, 2007; Shadbolt, 2009) through sociology (Hine, 2005), economics (Ariely & Carmon, 2003), psychology (Smith, Shanteau, & Johnson, 2004), neuroeconomics (Loewenstein, Rick, & Cohen, 2008; Sanfey, Loewenstein, McClure, & Cohen, 2006), decision sciences/computing (Fernandez, 2009; Saaty, 1990), and business (Ang, Dyne, & Koh, 2006; Correia, 2007; Sapsed, Bessant, Partington, Tranfield, & Young, 2002; Song & Chermack, 2008) to philosophy (Kraut, 2010; Rupert, 2009) with each discipline using their own approach to understand and theorise the decision making process.

In the last few decades there has been a move to merge the perspectives of various disciplines in order to gain a better insight into the examination of the decision making process and factors that influence it (Dubé, Bourhis, & Jacob, 2006; Loewenstein, Read, &

Baumeister, 2003b). This has resulted in a number of theories and frameworks relating to decision making (Beach, 1990; Payne, Bettman, & Johnson, 1993; Rachlin, 1935) in the form of procedural steps, analytical hierarchy processes (Dettmer, 1997; Saaty, 2008) or cyclical iterations (Boyd, 1986, 1987; Greene, 2007). Some decision making theories and frameworks originate in behavioural research using game theory (W. Lee, 1971) while others can be found in business management research such as methodologies for improving corporate decision making (Francis, 1997, 2003; W. Lee, 1971). Until recently, attempts to quantify decision-making have tended to measure specific aspects of decision making such as framing effects, status-quo and biases in individuals (Kahneman & Tversky, 1979; Stanovich & West, 2007, 2008a, 2008b; Tversky & Kahnema, 1981; Tversky & Koehler, 1994). More recently the work of Keith Stanovich draws together these fragmented threads into an overarching concept of dual process decision-making (Stanovich, 2010). It is this process of dual decision making that has influenced my research although I explain it in relation to more generally understood terms of rational and intuitive decision making.

In addition to observable behaviours, I also wanted to understand the abstract mechanisms and motivation that make an individual engage with technology. Antonio Damasio's theories and research into the relationship between human feelings, the development of mental constructs, and the influence of these aspects on behaviours played a important role in the formation of my thinking for this research (Adolphs, Tranel, Koenigs, & Damasio, 2005; Bechara, Damasio, Damasio, & Anderson, 1994; Bechara, Damasio, Tranel, & Damasio, 1997, 2005; Damasio, 1994, 1995, 2000, 2005, 2014; Damasio & Meyer, 2009). Damasio's ideas address the full range of human systems that I felt were related to digital engagement, which included: biochemistry, physiology, abstract constructs and consciousness as well as observable behaviours and memory which is required for behavioural learning. Jean-Pierre Changeux, who had similar thoughts, provided not only an extensive historical and philosophical perspective on the complex relationship between the internal systems of the human body and the brain but also provided his theory and insights into how the neurological systems led to some of the more complex aspects of humankind (Changeux, 1997). The complex arrangements he discussed were abstract thought, concept-formation, memory, and consciousness, which he proposes are built into the brain's structure in the

form of multiple assemblies of neurons that interact with incoming signals that are evaluated for retention, and are reinforced if found to be worthy. This line of thinking was important to my research and follows Donald O. Hebb's theory that neuronal structure can be altered by experience, an idea that was concisely summarized by Carla Shatz in the phrase 'neurons that fire together wire together' (Doidge, 2007, p. 63; Hebb, 2002).

The concept of learning by experience-repetition is not new but our understanding of how human *physiology* can be altered by experience is by comparison more recent. An early demonstration was in 1793 by Michele Vincenzo Malacarne where he reported more folds in the cerebellum of his trained animal but this line of research did not gain much momentum until recently (Rosenzweig, 1996, p. 4). In the late 1900s there was a resurgence of interest typified by Michael Merzenich's research where he demonstrated neuronal adaptation resulting from altered stimulus in the hand of adult owl and squirrel monkeys (Merzenich, Kaas, Wall, Nelson, et al., 1983; Merzenich, Kaas, Wall, Sur, et al., 1983). In the last two decades the development and accessibility of technology such as fMRI's[4] has enabled the observation of internal activity as well as the measurement and monitoring of living human systems. This has resulted in an explosion of new research (Pascual-Leone et al., 2011; Rossini & Forno, 2004) and the development of technology that can not only repair, manage or modify human functioning and behavior but can also aid learning (Bach-y-Rita & Kercel, 2003; Doidge, 2007; Greenberg et al., 2006; Malone et al., 2009; Marasco, Kim, Colgate, Peshkin, & Kuiken, 2011). Understanding how and why humans engage with technology in different ways could aid future research in this area.

There are two other areas of research related to the individual that provided a background for my research. The first is current research into the affect of human biochemistry on behaviors. This is a growing field of research that examines the role and affects of biochemistry on observable behaviours such as dopamine in addiction (Ernst & Luciana, 2015; Han, Kim, & Renshaw, 2015; Tian et al., 2014), reward management (Fiorillo, Tobler, & Schultz, 2003; Liu et al., 2004; Schultz, 2007; Schultz, Dayan, & Montague, 1997; Taber, Black, Porrino, & Hurley, 2012; Varazzani, San-Galli, Gilardeau, & Bouret1, 2015), or

[4] Functional magnetic resonance imaging (fMRI) is a functional neuroimaging procedure using magnetic resonance imaging, which measures brain activity by detecting changes associated with blood flow.

learning and sharing workload (Floresco, 2015; T. A. Klein et al., 2007; Schultz, Apicella, & Ljungberg, 1993). Many other biochemical affects on behavior are also being researched (Bartz et al., 2010; Damasio, 2005; Floresco, 2015; Madden & Clutton-Brock, 2010; Nagasawa, Okabe, Mogi, & Kikusui, 2012; Schultz et al., 1993; Shen, 2015).

The second area relates to the relationship within and between the environments involved in digital engagement. Because of the diversity within each of these environments the supporting background for this came from a variety of disciplines. Robert Losee's research (Losee, 1997) aided my conceptualizing of information and communication as processes that become the relationships between environments, while other research assisted in developing my theoretical underpinnings related to technology use as a tool (Gibson, 1979; Michaels, 1981; Osiurak, Jarry, & Le Gall, 2010; Smitsman, 1997). This ultimately led to my understanding of digital engagement relationships as being the result of nested cybernetic systems (Ashby, 1956; Beer, May 16, 2012; Cordeschi, 2004; Foerster, 2003; Glanville, 2004; Hayles, 1999; Krippendorf, 2008; Mead, 1968; Wiener, 1948) that operate in a second order cybernetic way (Foerster, 1991; Krippendorf, 2008).

How the individual relates to technology was also explored by examining embodiment, and cognitive extension (A. Clark, 2011; Hirose, 2002; Marasco et al., 2011; Maravita & Iriki, 2004; Rupert, 2008-2010) as well as robotics (Arsenio & Fitzpatrick, 2003; Sandry, 2015). This was necessary to formulate the parameters of the environments.

The earlier body of research related to digital technology tended to focus on what technology was and what could be done with it. More recently however there has been a shift towards why we use digital networked technology. Examples of recent research ranges from the addictive properties of technology use (Han et al., 2015; Y.-H. Lee, Ko, & Chou, 2015) and the effects of engaging with technology on the structure of the brain (Kuhn, Gleich, Lorenz, Lindenberger, & Gallinat, 2014) or chemical changes within the brain (Ernst & Luciana, 2015), to the relationship of innate attributes to technology adoption (Barnett, Pearson, Pearson, & Kellermanns, 2015; Mitzner et al., 2014). Research into the mechanism of digital engagement and why it affects individuals so differently, however, does not appear to have been addressed.

There has also been extensive research into the seamless merging of the physical and digital environments ranging from user interface to improving human functionality (Bavelier, Green, & Dye, 2010; Gallagher et al., 2013) or social behaviors (Modecki, Minchin, Harbaugh, Guerra, & Runions, 2014; Sormanen & Dutton, 2015; Turkle, 1995) and education (Bavelier et al., 2010). Generally speaking the focus has been on the integration and adoption of the digital environment into the existing framework of the physical environment. However there does appear to be differences in how concepts such as time, space, and memory are experienced in the digital environment (Castells, 2000, 2010; Mayer-Schönberger, 2009). This is discussed in greater detail in this thesis because these are first principle concepts and are therefore core to behavior development and as a consequence digital engagement.

The proposition that the digital environment should be considered distinct from the physical environment is likely to be contentious, particularly in chapters 5 and 6 where I consider digital behaviors in light of personality definitions that were developed within the context of the physical environment. Over the course of my investigation I have concluded that the source of the disagreement was generally because many behaviors cited by opponents to seeing the distinctions between environments were the more complex social behaviours, which do indeed appear to be the same in both environments. Examples of these are noted in early Internet behaviour research with Sherry Turkle's account of cyber-rape (Turkle, 1995). Research in this area has steadily grown as more people operate in the digital environment and use technology to express themselves. For example; cyber bullying, stalking and other illegal activities (Brewer & Kerslake, 2015; Cross, Lester, & Barnes, 2015; Dass, 2012; Goodboy & Martin, 2015; LYbarra, Langhinrichsen-Rohling, & Kimberly J Mitchell, 2016; Modecki et al., 2014; Pereira & Matos, 2016; Zaeem, Manoharan, Yang, & Barber, 2017), Even though there are fundamental drivers that cause these types of higher behaviours, these tend to be complex social behaviors that are shaped and defined by the social parameter of the environment in which they occur. In this thesis I examine the more fundamental behaviours that are grounded in *first principle concepts* like trust, which relies on the individuals autobiographical and core memory rather than the complex level of socially developed structures. This is a complex issue and I believe worthy of deeper

investigation. A definitive answer was not necessary for the development of the discussion; it was sufficient to present a reasonable possibility that the environments could be distinct. Regardless of whether the reader agrees or not on this point they will still find value in the finding of this research, which develops a mechanism for understanding digital engagement.

Engagement with technology is motivated by benefits derived by the participant. My observation and assessment of participants indicated that the more engaged participants were indeed deriving more benefits from technology use. This is not to say that digital engagement is the *only* way to derive benefits. Many individuals who do not engage fully with technology have found other ways to achieve what they want in life.

1.1.3 Theoretical Framework

Finding an appropriate theoretical underpinning was the most challenging aspect of this thesis and also the most rewarding. This research does indeed build on the work and insights of others and I explored many theories and theorists in an attempt to find a suitable theory that accommodated the apparently diverse and disconnected elements that I was observing. For example the 'locus of self' in the digital environment led to exploration of Don Ihde, and Martin Heidegger's *dasien,* while the concept of the self led to Harwood Fisher's *subjective self* and Antonio Damasio's *autobiographical self* (Damasio, 1994, 2005; Fisher, 2001, 2009; Heidegger, 1962, 1977; Ihde, 1979, 1990). Unfortunately most of the theories that I explored were ideal if applied to specific aspects of my research but they were not suitable for what I was discovering as the overall relationship between the individual and technology.

There appeared to be some elusive element to what I was investigating that could not completely be applied to the theories and theorists that I had investigated. When I eventually found cybernetics, which adequately described what I had identified I realized that the idea of cybernetic systems had emerged at a time (1950s) when digital computing caused a handful of experts in diverse fields to review the relationship between the different disciplines resulting in examining systems and the control mechanism of those systems. At that time digital computation was the new element that opened up the landscape for new human

thought, particularly in terms of the relationship between previously disconnected disciplines leading to the Macy conferences on interdisciplinary connections. Similarly the digital engagement phenomenon that we are experiencing coincides with the emergence of social media. Social media has had a similar affect on users but in this case it is not a handful of intellectuals, it is society in general. Anyone engaging with digital technology is potentially experiencing increased opportunities for systems awareness.

As a result of this thought process I examined systems, and system theories (R. Lewin, 1993; Ramage & Shipp, 2009). Working back from more contemporary theorists in areas such as learning systems and complexity theory I finally came to cybernetics (Beer, May 16, 2012; Cordeschi, 2004; Wiener, 1948). In addition, second order cybernetics supported my approach to the overall system of digital engagement (Foerster, 1991; Glanville, 2004; Krippendorf, 2008; Mead, 1968). Second order cybernetics embraced not only the human and technology components but also examined relationships as a complete system that could be either positive and amplify outcomes or negative and maintain homeostasis. The positive and negative system possibilities provided explanations for the varied levels of digital engagement that I observed. Second order cybernetics also factored in the vital role of awareness, which I had found permeated every aspect of the nested cybernetic systems involved in the digital engagement process. Finding cybernetics also clarified why Gibson's ecological approach had been an appealing and useful starting point for my theoretical underpinning (Gibson, 1979; Michaels, 1981; Smitsman, 1997). The ecological approach to tool use examined the relationship between the user, tool, and the environment as an interactive *system*. However as a theory for my research, tool ecology could not fully explain the varying level of digital engagement whereas second order cybernetics did, nor could it account for the amplification behaviors that I witnessed.

On reflection, the suitability of cybernetics for this research was not surprising considering that, at the time the theory was proposed, cybernetics was a foundational theory in a new cross-disciplinary field of study that was to examine control and communication between

human/animal/organisms and technology.[5] Similarly as this thesis will reveal I too am examining control and communication between humans and a new technology (digital *networked* technology) and digital networked technology is permeating most aspects of daily functioning. As a result this research is of necessity cross-disciplinary and multifaceted, which inevitably led to terminology complications. To counteract this I go to some lengths in explaining how certain terms should be understood particularly with regard to psychology.[6]

1.2 Methods and Methodology

In this research I used mixed methods, which included grounded theory to develop my prototype instrument and Framework while surveys were used for measurement of personality (discussed further below). These methods were used on a case study to maximise the discovery of unknown trends within my research data. Like all research methodologies, there are arguments both for and against case study research and it is not uncommon for opponents of the case study method to change their opinion in later research. For example, Donald Campbell, who initially resisted the validity of the case study claiming it to be of 'almost no scientific value', but later embraced the method (Campbell & Stanley, 1966, p. 6) or Hans Eysenck who initially called them anecdote producers but later changed his opinion saying that 'sometimes we simply have to keep our eyes open and look carefully at individual cases—not in the hope of *proving* anything, but rather in the hope of *learning something*! [emphasis added]' (Eysenck, 1976, p. 9). Bent Flyvbjerg examined common arguments related to case study research and grouped them into five key areas of contention (Flyvbjerg, 2006, p. 219). All things considered I decided that using mixed methods on a case study allowed me to obtain the rich in-depth practical knowledge of individuals immersed in digital networked technology on a daily basis. This I believed would aid me in identifying key elements that related to digital engagement.

[5] Digital computing had only just emerged and was having a profound impact on researchers who could now outsource computational processes to the technology. This is discussed in chapter 2.
[6] Psychology terms often have a more specific interpretation than the general understanding of the term. I have also included a glossary in Appendix 1, which denotes the source of the definition.

1.2.1 Overview of Methods and Methodology

As this research was an exploration of an emerging social phenomenon, I was acutely aware of finding a methodological approach that would allow or encourage the revelation of insights into digital engagement from the collected data that I could then examine and explain. I found using grounded theory for data collection in the interviews would be the most suitable because it assists in maximising the discovery of unknown trends within data. My aim was to determine how, why, and in what way participants used or related to the technology. Barney Glaser and Anselm Strauss described the grounded theory approach as a process where the 'three operations of collection, coding and analysis of data are carried out jointly' (Glaser, Strauss, & Strutzel, 1968). I felt that using this approach increased the chance of revealing unknown and unidentified digital engagement themes. As Kathy Charmaz argued when using grounded theory we 'can add new pieces to the research puzzle or conjure entire new puzzles - while we gather data - and that can even occur late in the analysis' (Charmaz, 2006, p. 14). The grounded theory approach allowed and encouraged a depth of understanding, at each level of my enquiry. This was essential for developing an understanding of the concept and process of digital engagement.

One of the concerns when using a case study is the risk of researcher bias. While researcher bias cannot be completely eliminated because it is after all the researcher's interpretation that is being applied, I felt that a grounded theory approach could possibly aid its reduction, as it focuses on emerging themes revealed in the data, rather than on preconceived hypotheses. I also elected to use both manual and software data analysis because I felt that the impartiality of the software system, nVivo, would act as an added balance to possible researcher bias. As Andrew Hutchison and colleagues found 'NVivo is a powerful tool that, if used appropriately, can facilitate many aspects of the grounded theory process' (Hutchison, Johnston, & Breckon, 2010, pp. 299-300). While the qualitative part of my research enabled my understanding of digital engagement and the means of measuring participants' digital engagement levels, I also needed to understand how my participants' behaviors were perceived and understood by society in general. Behavioral psychology provided a body of research and resources for doing this.

Having secured a suitable case study that would be examined using a grounded theory approach I then considered research methods that would support my requirements for understanding behaviours. My requirements were; firstly, to enable me to describe participant behaviours in general terms for universal application and understanding. My second requirement was to find a methodology that would provide the in-depth information necessary to describe and understand specific behaviours related to technology use. I therefore chose to use a mix of methods that included surveys and interviews.

The surveys were self-reported evaluations of personality and decision-making style. These instruments were sourced from the field of psychology and they provided a general classification and understanding of participant behaviors. The three in-depth interviews that I conducted with each participant were governed by the grounded theory approach and they provided the in-depth information that I required to formulate an understanding of digital engagement behaviors. I began the data collection process by emailing survey 1 as soon as written consent was obtained from participants. Once I was notified that the survey had been completed I organised the first set of interviews. This was followed by the second and then third interview, after questions had been formulated based on an analysis of the previous interviews. For most participants the entire process to this point took about three months. There were a few participants who took longer due to work related travel, which delayed the completion of their three interviews. All interviews were completed within six months. It was only after I had correlated survey1 data to my objective evaluation of participant's digital engagement that I realised I required a second more in-depth evaluation of participant's personality before I could fully understand the results. This realization occurred about six months after the final interview had been conducted. I then had to obtain further ethics approval and it was about eight months after the final interview that I emailed survey2 to available participants.

To summarise, this research uses a grounded theory approach on a case study and employs mixed methods[7] to establish two behaviours, the individual's innate behaviours and

[7] I have encountered debate in the literature as to whether personality testing should indeed be classified quantitative or not. For this research I have elected to classify personality tests as quantifiable because personality tests are a measure that has been statistically tested according to standards determined by the field of Psychology.

their digital engagement behaviours, which could then be correlated to develop an understanding of the relationship between the two. To obtain this correlation I required two behavioural measures.[8] Firstly I needed a measure that was representative of the individual as a whole, a measure of not only their external observable behaviours but also one that represented their cognitive functioning and this measure had to be understood within the context of the general population. Secondly I required a measure that represented the individual's digital engagement behaviour. As there was no established instrument for digital engagement when this research was conducted, I had to develop my own digital engagement measure. An overview of the second measure, which is original research, is provided later in this chapter (1.2.4) and further discussion can be found in Chapter 7.

1.2.2 First Behaviour Measure

A quantifiable representation of the individual was obtained by using two instruments from the field of psychology. These are personality and decision making style and both are considered valid and reliable within the Psychology disciplines[9] (Björklund & Bäckström, 2008; Epstein, 2003; Field, 2013; Goldberg et al., 2006; Robert R McCrae & Paul T.Costa Jr, 1997; Robert R. McCrae & John, 1992; Pacini & Epstein, 1999; Witteman, Bercken, Claes, & Godoy, 2009). For these instruments I sought a) an evaluation that was globally accepted, valid and reliable; b) an instrument that was not heavily reliant on interviewer skills or expertise;[10] c) an instrument that could be easily distributed completed and returned; d) a system that provided the collection and storage of data with minimal data handling by myself until *after* the interviews had been concluded;[11] and e) instruments that were not too long or daunting for participants to complete but that provided sufficient depth of information. As I was dealing with ICT professionals an online survey was the most appropriate medium; participants were comfortable working on-line and survey's could be completed in stages and at times and places convenient to participants. I considered two popular survey systems commonly used by researchers; Survey Monkey www.surveymonkey.com and Qualtrics

[8] I will use the term 'measure' which is used within the field of psychology to describe a quantitative evaluation score of an individual's behaviour because the personality instruments used in this research were developed in the field of psychology.
[9] Validity refers to whether or not the test measures what it trying to measure. Reliability refers to the degree to which the test produces stable and consistent results.
[10] As my academic and professional experience is not in the field of psychology my preference was to source self-reporting instruments rather than interpretive ones.
[11] I did not want the survey results to influence me during the interview process.

www.qualtrics.com. While the construction of surveys was similar for both systems I elected to use the Qualtrics system because their dashboard interface enabled meta-level management, distribution and data collection verification. Both surveys in this research were constructed in, managed and disseminated on-line to all my participants using the Qualtrics system.

The personality instruments selected for this research were sourced from the International Personality Item Pool (IPIP) and include the Big Five Factors[12], NEO-PR-I[13], plus four additional scales.[14] The International Personality Item Pool is a 'scientific computer-supported system that allows scientists to work with each other, facilities, and databases without regard to geographical location'.[15] Psychology students and academic researchers as well as business and governmental researchers commonly use this resource because the available instruments conform to psychology standards (validity and reliability), and the Cronbach Alpha score[16] is displayed for user evaluation (Tavakol & Dennick, 2011). All personality and decision-making instruments that I used in this research are accepted within the field of psychology and the format of the survey is appropriate for online deployment. Survey questions were not altered in any way, and execution of surveys in this research was in compliance with IPIP guidelines.

When sourcing an instrument for decision-making style I looked for a test that was not only appropriate but also similar to the Big Five Factor test in terms of number of questions and evaluation method (5 point Leichardt scale). Like the Big Five Factor, Rosemary Pacini and Seymour Epstein's Rational Experiential Inventory (REI) is a linguistically based survey[17] that uses a five point Leichardt scale and measures four separate components: 1) rational ability, 2) rational engagement, 3) experiential ability and 4) experiential engagement (Pacini

[12] See http://ipip.ori.org/newBigFive5broadKey.htm for the Big-Five Factor Markers that correspond to Costa and McCrae's Five Factor Model.
[13] See http://ipip.ori.org/newNEO_DomainsTable.htm for A Comparison between the 5 Broad Domains in Costa and McCrae's NEO Personality Inventory (NEO-PI-R) and the corresponding preliminary IPIP scales measuring similar constructs. See Appendix 1 Table 8
[14] Additional selected scales: Self-consciousness, Trust, Flexibility, and Self-disclosure were also selected from IPIP as I thought they may possibly relate to digital engagement.
[15] See http://ipip.ori.org/
[16] Cronbach Alpha score is a measure of the internal consistency of an instrument. It is how closely related a set of items are as a group and is considered to be a measure of scale reliability. The Cronbach alpha is not a statistical test, it is a coefficient of reliability (or consistency). See (Tavakol & Dennick, 2011). A measure of 0.7 is generally considered reliable.
[17] This is discussed in greater detail in Chapter 5.

& Epstein, 1999; Witteman et al., 2009). This instrument also conformed to psychology standards of validity and reliability, having a Cronbach Alpha score greater than 0.7.

In order to maintain objectivity towards participants' digital engagement behaviour I collected their personality data prior to interviews and used the nVivo system to manage the data collection. Thus I was not aware of the actual data results from the personality measures until after I had concluded the interview and initial analysis phase. The on-line survey contained 140 items and was divided into four sections. 1) Demographic items *which were not part of IPIP* (see Appendix Table 2), 2) The Big Five Factor personality test (see Appendix Table 3), 3) The REI test for decision-making style (see Appendix Table 4) and 4) four additional factors selected from the International Personality Item Pool that I thought may be relevant to digital engagement (see Appendix Table 5).

As a result of using the grounded theory process I realised towards the end of my analysis of participant interviews phase that I required more in-depth knowledge of some participants' personality types. I therefore conducted a second survey that explored the Big Five Factor *subscales*. For this I used the NEO-PR-I test. In the NEO-PR-I test there are six supporting subscales for each of the Big Five Factors giving a total of 30 subscales. Each scale has 10 items giving a total of 300 items in the second survey (See Appendix Table 6). The execution of this second online survey was again in compliance with IPIP guidelines and questions were not altered in any way. The NEO-PR-I survey was disseminated to all available participants.[18] This second survey was also constructed in and managed by Qualtrics. It should be noted that in both surveys, survey items were randomly displayed to participants.

Before settling on the Big-Five Factor and NOE-PR-I instruments, I examined a number of personality evaluation methods such as; the California Psychological Inventory which is popular in adolescent research but there are some concerns regarding its validity and reliability; the Millon Clinical Multiaxial Inventory - 3rd Ed, Minnesota Multiphasic Personality Inventory (MMPI) and the Personality Assessment Inventory (PAI) but these tests were more

[18] As there was a long delay between the two surveys there had been some changes to staff members and 4 of the original 16 participants were no longer with the company.

suited to personality disorders and clinical syndromes; I also explored the Rorschach Inkblot Test and story telling evaluation methods but these tests required specific facilitator skills and did not readily provide a quantifiable measure. I finally narrowed my options down to the Myers-Briggs Type Indicator (MBTI), Raymond Cattell's Sixteen Personality Factor Questionnaire, Eysenck's Three factors, the Big-Five Factors[19] and the NEO Personality Inventory - Revised (NEO-PR-I) all of which provided a measure of an individuals' personality. Of these I dismissed Eysenck's Three factors, the Meyer-Briggs and Cattell's Sixteen Personality Factor Questionnaire because despite being very popular in human resources these tests were too long or unsuited to what I was investigating. This left the Big Five Factor, which was selected because it tests the broad dimensions of human personality (Cooper & Pervin, 1998) and is generally held to be a complete description of an individual's personality that is stable over a forty-five-year period beginning in young adulthood (Soldz & Vaillant, 1999). It is also in part heritable (Jang, McCrae, Angleitner, Riemann, & Livesley, 1998; Loehlin, McCrae, Jr., & John, 1998) and has environmental adaptability value (Buss, 1996). Having been developed from a language base the Five Factor Model is considered universal (Robert R McCrae & Paul T.Costa Jr, 1997; E. R. Thompson, 2008).

Having settled on the Big Five Factor as my personality test I investigated over two hundred additional scales in the International Personality Item Pool (IPIP) in an attempt to find appropriate scales for digital engagement (Goldberg et al., 2006). My investigation of these additional scales considered not only what was being tested such as trust or calmness, but also whether the specific item-questions within each scale could potentially aid understanding of digital engagement. In general the questions of the IPIP scales were not suited to digital engagement investigation as they were designed for physical environment application. I did however select four scales, which I thought could possibly be useful. Two of the selected scales happen to be subscales of the Big Five Factor. These were *self-consciousness* (part of Neuroticism) and *trust* (part of Agreeableness). The other two scales were *self-disclosure* and *flexibility*. I anticipated that these four scales might provide insights

[19] The labels Big-Five and Five Factor Model (FFM) are often used interchangeably. The Big-Five is derived from the lexical approach associated with Allport and Odbert (1936), Fiske (1949), Norman (1963), Tupes and Christal (1961) and Goldberg (1981), The FFM is essentially the result of personality factors that have been revealed through the questionnaire approach in the work of McCrae and Costa (1985). While differences have been noted between the two (Saucier & Goldberg, 1996), in essence the Big-Five and Five Factor Model are sufficiently similar for this discussion.

into digital engagement behaviour because of the partial appropriateness of the item-questions.

Self-consciousness could possibly indicate the individuals' awareness of themselves in relation to their digital or physical environment and *flexibility* could indicate the participant's propensity to adapt within the digital environment, which is constantly changing. I expected that digitally engaged individuals would be conscious of themself within the environment in which they were operating and that they would more likely be able to adapt accordingly. My supposition was that individuals who were higher in self-consciousness and flexibility would be more likely to engage with technology. *Trust* I thought would show an individual's propensity to initiate relationships and *self-disclosure* their willingness to sustain relationships. As relationships are intrinsic to digital engagement I believed these scales would also be informative in some way.

How individuals make decisions impacts on their actions and I hypothesised that an individual's propensity and potential to take action would provide important insights into the iterative process of digital engagement. Therefore in addition to the personality factors, I required a measure of the individuals' decision-making style. As discussed in Chapter 5 decision-making tends to be very specific and related to particular fields of study such as economics. However the Rational-Experiential Inventory (REI), which is based on Seymour Epstein's Cognitive-Experiential Self-Theory (CEST) (Epstein, 2003; Pacini & Epstein, 1999; Witteman et al., 2009), is a self-evaluation test of an individuals' thinking style, which was described in Plato's analogy of two winged horses: One that represents rationality and the other intuition. The *rational* aspect is the conscious or logical thinking process and *experiential* is the pre-conscious or intuitive type of thinking. Each of these has two subscales: *ability,* which is the term used by Epstein to describe self-assessed effectiveness, and *engagement*, which describes frequency in use (Epstein, 2003).

1.2.3 Terminology and Limitations

A number of terms that I use in this thesis apply to a variety of disciplines such as philosophy, psychology, decision science, and technology design. This can be problematic

because the terms often have both a general and a specific meaning within their fields of study. While meanings may appear similar, the differences can create confusion. I have therefore attempted to contextualize or define terms as needed in discussions and I have also provided a glossary (see Appendix 1). Epstein uses four terms in his REI test; rational, *experiential*, ability and *engagement*. Two of these terms, *experiential* and *engagement* may cause confusion when used outside the parameter of Epstein's work in the field of psychology and thus require clarification. Instead of the more commonly used paired terms 'rational' (as in logical or deductive processes) and 'intuitive' (as in the subconscious response related to learned experiences), Epstein uses the terms rational and *experiential:* experiential being equivalent to the generalist use of the term intuitive. Within my research I have chosen to use the terms rational and intuitive.

Epstein also uses the terms ability and *engagement.* Ability is used in its generally understood context of describing ones capacity to do something and I shall use it in the same way. However the term *engagement,* which Epstein used to describe '*frequency in use'* is problematic in my discussions because I use the term *engagement* to describe *the merging process of an individual with technology*. I will therefore use the term '*iterations'* in my discussion when describing 'frequency-of-use'. This will not only reduce confusion regarding the use of the term in two different contexts but I also consider *Iterations* to be better suited to the digital environment which involves more than just the human as was the case in Epstein's use of the term 'frequency-of-use'. For example digital engagement involves not only the human iterations but also the iterations of software, devices and algorithms.

It should also be noted that, while concerns have rightly been raised regarding limitations of personality tests such as the interpretation of terms and the value of self-reporting (Falk & Heine, 2015; Shrauger & Osberg, 1981) or issues regarding the influence of age, gender and culture, current international studies such as the one led by Marleen De Bolle are building a body of research that are dispelling many of these concerns (Bolle et al., 2015, p. 171). Technology and global connectivity is a distinct asset in this regard. In their recent international study of adolescents from twenty three cultures De Bolle and associates found

that: (a) with advancing age, sex differences found in adolescents increasingly converge toward adult patterns with respect to both direction and magnitude; (b) girls display sex-typed personality traits at an earlier age than boys; and (c) the emergence of sex differences was similar across cultures. I felt confident that there was sufficient supporting research for me to proceed with the Big-Five Factor evaluation of personality and that as long as I clarified terminology the cross-disciplinary nature of my research would not be an issue.

1.2.4 Second Behaviour Measure

As I could not find an appropriate existing instrument to provide a measure of digital engagement I found it necessary to develop a prototype instrument. My prototype instrument is based on the interviews conducted for this research and, as the discussion in Chapter 7 shows, I have gone to some lengths to develop an objective instrument. Nevertheless, as a prototype, it will obviously require further research to refine it and establish its validity and reliability. In this research it was not considered possible or necessary to test further or attempt to refine my prototype instrument because my objective was not to develop an instrument for digital engagement, but rather to develop an overall understanding of digital engagement. Despite this, my prototype instrument enabled me to propose a measure of digital engagement commensurate with personality measures, thus providing a starting point for further research in the area of digital engagement behaviour. Indeed, the impetus to develop the instrument emerged from the need to cultivate a coherent understanding of digital engagement. To do this, all participant interviews were analysed so that I could identify recurring themes and concepts. These themes and concepts were then evaluated and grouped into what became my Digital Engagement Framework, which helps map and explain the process of digital engagement. The Digital Engagement Framework was made up of fifteen subsectors that were grouped into five sectors, which worked together as system.

Once I understood digital engagement as a system I was able to develop the prototype instrument by reanalysing the interviews and extracting comments that typified behaviours relating to the subsections of my Digital Engagement Framework. The multiple comments that related to each of the fifteen subsections of my Digital Engagement Framework were

then consolidated into fifteen question-statements. These fifteen statements became my prototype instrument. Based on the interviews each participant was then evaluated for each of the fifteen question-statements using the same 5-point Leichardt scale used in the personality evaluation. The results of this evaluation gave me my second measure, the participants' digital engagement measure.

1.2.5 The Case Study

I elected to use a business, as opposed to a non-commercial organisation for my case study because potential participants would more likely be exposed to current and diverse technology. My objective was to find a company where: a) there would be a high occurrence of staff members using digital networked technology as part of their work -- ICT professionals were therefore highly desirable;[20] b) there would be diversity in participant skill types and levels; c) there would be diversity in age, gender and employment level. I also had to consider the type of work done by the company because this would impact on the company's client base, which would in turn, influence how and what type of digital networked technology the participants would use. The location of the company was not a determining factor.

Four companies were approached and after preliminary discussions three were rejected. Two because the number of participants actively engaging with digital networked technology on a daily basis was insufficient and the third, a New Zealand on-line events company, because their client base was anonymous and transient. Relationships in the New Zealand company were built by the system itself not the participants that I would be interviewing.[21] The fourth company not only met my criteria but also exceeded them.

The company is a small niche consultancy business that implement and support digital network software solutions to medium and large manufacturing companies in Australia and the Asia-Pacific region. Their primary software package manages the entire manufacturing

[20] Over the course of this research there has been a dramatic change in the way businesses function. At the start of this research the companies that I approached had complex digital networked systems and only a few individuals were regularly engaged with it. During the course of this research there has been notable changes, staff in general now have a deeper and broader range of involvement with technology.

[21] On the other hand it could be argued that these potential participants built the system that builds the relationships and would therefore be in a better position to discuss the unconventional relationships.

process of their clients, through to distribution, including finance and supply chain management. In a number of cases the company also develops propriety solutions for integrating or transitioning existing client software. At times these systems are run in parallel, requiring specialized ongoing support from their programming staff. Some Client companies' head offices are in Australia with their manufacturing branch in the Asia-Pacific region, or in other instances Australia is the branch office reporting to America or United Kingdom head offices. Due to the diverse global distribution of the case company's client's, ongoing management, training and troubleshooting by the company's staff is generally done digitally via Internet technology.

The company's client base is varied, there are large food manufacturing companies,[22] manufacturers of Point of Sales devices (EFT) found in large shopping malls, smaller engineering clients such as suppliers of specialty equipment for the Fire department or even small costume jewelry manufacturers. Larger clients may have over forty linked user systems (often geographically dispersed) while others may have three or four dispersed within a single building. Some are simple single user sites. In the larger sites these systems are often integrated into other software programs, which require unique programming to integrate the different systems. Clients also have different module configurations of the manufacturing software. Standardization of hardware or operating systems and system support within the client base is not feasible.

The variables of devices, hardware, software versions and configuration of modules makes each client system unique. This is important because the clients of the case company present a diverse range of problems to the staff. In addition to this, the staff have to deal with an extremely diverse client-skill level, which range from software engineers to production line laborers. In some cases clients even speak and operate in a different language, such as French.[23] The staff also independently decides how best to use technology to solve client issues, train, or support clients, using a variety of technology options. They also have to consider the preferences and skill level of the client as well as constraints of the issue at

[22] Due to privacy issues Client names cannot be revealed but their products are popular Australian brands commonly found in all major supermarkets and shopping environments.
[23] In cases such as these the staff have to deal with clients using a different keyboard configuration.

hand. Resolving a single client issue may require a series of digital engagement touch points. For example: communication and transmission of information via smartphone, sourcing information from databases, accessing the client's computer remotely to implement fixes and finally training clients via a combination of face-to-face, phone or remote network demonstration of fixes on the client's computer. Most client issues are unique. As a result the staff cannot rely on Fordian style methods where procedures and practices can be standardised for ongoing trouble-shooting and solution sourcing. Client support relies heavily on the initiative of staff and their ability to work with and through digital network technology to support their clients.

At the time research was conducted, all staff were ICT professionals. Initially there was a total of fifteen employees[24] but later an additional member joined the staff and he volunteered to participate in the research. Gender distribution was slightly biased to male, there were 10 males and 6 females. The age spread was twenty-one to sixty-two. Employment status ranged from casual to permanent and education ranged from year 10[25] to post-graduate. Positions held ranged from general office support to CEO. This diversity was considered valuable to the research, as it would enrich data.

There were additional considerations for selecting this case, the first of which was consideration of the emotional state of the participant during the interview process. As the interviews were to be conducted in the workplace I wanted to be sure that the participant would have the least amount of work-related stress during the interview. The corporate environment of the company was generally relaxed and staff availability for interviews was flexible as they were in total control of their own work schedules. This meant that when they chose to do the interview they were not stressed and were happy to talk freely. The second consideration was the advantages and disadvantages of using a single company as opposed to multiple companies. I felt that using participants from the same company would reduce possible confounding environmental factors that may have occurred had I used multiple companies to obtain similar diversity of ICT professional participants. On the other

[24] Two of which are company directors.

[25] Survey data for education level was inaccurate; some participants inflated their education level. One showed 'College/TAFE' as their achievement level but further discussion revealed that their formal education was lower than year 10. They had however attended a few short Microsoft courses run by TAFE. The other participant showed their achievement level as 'university graduate' but further discussion revealed that they had only attained year 12.

hand I realised that the homogeneity of participants was potentially problematic with regard to causational interpretation of some of the personality data that I required for this research. For example, the same management team had recruited all staff members. After careful consideration, I felt that the selected company provided an excellent opportunity to obtain rich in-depth data on engagement with digital networked technology, provided I corrected for corporate culture.

I introduced the research project during a regular staff meeting held at the company. All attending staff members were told about the project and invited to participate in this research. During the introductory meeting the scope, aims and benefits of the research project were presented to the staff in a way that encouraged informal congenial discussion and participant's role in the study, obligation, risks and benefits were explained. Voluntary participation and privacy issues were explained and staff was provided with supporting documentation, which included; Project Statement, Research Methods, Information Sheet, Participant Consent Form[26] and a General Information Sheet. Private follow-up meetings were arranged with each attending staff member over the remainder of that day, which afforded an opportunity for them to raise any additional questions or concerns. The few concerns raised by staff members related to possible privacy issues of the company's clients. These concerns were soon allayed when it was confirmed that this research related to the participant's experience and observations of their own engagement with digital networked technology - not their clients. It was also made clear that should a participant refer to a client during interviews the client would, like them, be kept anonymous and that pseudonyms would be used for the participant. On receipt of signed consent participants were asked to complete the online personality survey. Thereafter the initial interviews were arranged. The few participants who were not at that initial meeting were contacted by phone and the project was discussed. They were invited to participate and supporting documentation was emailed to them.[27]

[26] There was an additional Company Consent Form for the directors of the company

[27] Two of the sixteen participants used for this research are no longer with the company and are not contactable. Replacement staff members were not asked to participate in this research because all primary data had been collected.

1.3 Outline of thesis

In general, Chapters 2, 3 and 4 elaborate the background in Chapter 1, but they also form part of my argument and therefore cannot be read in isolation. Chapter 2 introduces the theory that underpins the findings of this research by explaining positive and negative feedback loops and how they relate to cybernetics and second order cybernetic theory. Having identified the theoretical underpinnings of this research the chapter moves to a discussion of the external environments and focuses on the evolution of digital networked technology. Chapter 3 examines digital networked technology in more detail by exploring how individuals perceive it; as a tool used by humans or as an environment within which humans operate. I conclude that it is both. The discussion then moves to an examination of how human behaviours are being affected by our experience of differing first principle concepts (such as time, space and memory) between the digital and physical environment. Chapter 4 turns the discussion to the *internal* environment of the individual. Here the individual is examined in the three ways. Firstly, there are what I have called the *'in the skin systems'*, which are examined by discussing examples of biochemistry, neurology and physiology and how these subsystems function as an underlying base referred to as the internal milieu. Secondly, the individual is explored by looking at *'abstract systems'.* Here I particularly draw on the work of Damasio and his explanation of the role of the internal milieu in the development of the autobiographical self and the making of consciousness (Damasio, 1994, 1995). Thirdly, I examine *'observable behaviours'*, commonly understood as personality, by using existing research and instruments. Chapter 4 concludes with a discussion on neuroplasticity, which I felt was necessary to include as neuroplasticity underpins some observations in this research that will support future research.

Chapters 5, 6, 7 and 8 relate to my empirical research. Chapters 5 and 6 discuss the results of the personality survey and relate it to participant interviews to determine if there is any relationship between the participant's personality type and their perceived level of engagement with digital technology. Chapter 5 examines the first survey, Big-Five Factor, which provided some important insights relating to the relationship between digital engagement and the personality trait Agreeableness and Openness and its negative

relationship to Extraversion. The five-factor trait level did not provide sufficient depth of information to develop an understanding of why some traits resulted in digital engagement and others did not. In particular, I required more in-depth information in order to understand inconsistencies in the Extraversion results as well as the role of Conscientiousness and Neuroticism in digital engagement behaviours. This led to Chapter 6, where the second survey NEO_PR_I is examined to identify which personality subscales relate more specifically to engagement with digital networked technology. In Chapter 7 I draw on data from my interviews to identify recurring themes and concepts, which led to the development of my Digital Engagement Framework. The Digital Engagement Framework serves two purposes in this research both of which are discussed in this chapter. Firstly I discuss how it provides a structure for explaining the *process of digital engagement* and secondly how it became a basis for the development of my *prototype instrument for measuring digital engagement*. Chapter 8 ties the previous three chapters together by correlating the personality measure (the individual) to the digital engagement measure (digital networked technology) in order to come to an understanding of the relationship between the two. The correlations reveal which personality traits and subscales are more likely to lead to digital engagement and the role of decision making in the development of digital engagement. The chapter concludes by discussing the role of self-awareness in the context of second order cybernetics using an analogy of Escher's lithograph *Relativity* (Escher, 1953). Chapter 9 brings the whole thesis together in a summary of what has been discovered and proposes applications of these findings and possible future research.

2 An Approach to Understanding Digital-engagement

There are two major components to digital-engagement: the individual taking part in the engagement and the digital networked technologies with which the individual is engaging. In order to differentiate the two systems I have chosen to see the skin as the boundary or marker separating the two. Processes within the individual are referred to as the 'internal environment' and digital networked technology is seen as being part of the 'external environment'. There are however instances where determining what is internal and external becomes harder to decide, for example when digital engagement results in the outsourcing of cognitive processing or where technology becomes an integral part of the internal system as with 'deep brain stimulation' or 'pace makers'. In order to develop an understanding of what digital networked technology is I have to examine not only the elements that make up the technology, but also the relationships between the human and technology. This provides insights into the complexity of the multiple subsystems that together make up digital networked technology and the human individual, which lays the groundwork for developing an understanding of digital engagement. A complex understanding of digital networked technology, as seen in the theories of Don Ihde or Andy Clark, thus becomes necessary (A. Clark, 2003, 2009, 2011; Ihde, 1979, 1990). As digital networked technology is situated in relation to the physical environment, it became necessary to examine in what ways digital and physical environments differ from each other, because of the potential impact of these differences on human behaviours.

The diversity and complexity of these two components created challenges with regard to establishing theoretical underpinnings for this research. Nevertheless, during the development of this research it became apparent that the feedback loop[28] and users' self-awareness were importantly related to digital engagement. My search for a theory with an appropriate framework that accommodated the interdisciplinary nature of this research and the observed prominence of control and management of systems using feedback loops led me to cybernetics, which F.H. George explains could 'be thought of as a recently developed

[28] The Feedback Loop becomes a Sector of my Digital Engagement Framework discussed in chapter 7.

science, although to some extent it cuts across existing sciences', including 'Physics, Chemistry, Biology, etc.' ("Defining Cybernetics," circa 1980).

2.1 Finding a System

Cybernetics theorises the governance or control of a process as a self-regulating goal directed system. This idea certainly described aspects of my research, but it did not accommodate the important awareness that I witnessed in those participants who were more digitally engaged. However, in second order cybernetics the participant is positioned as both an observer and a part of the system in which they operate. It was this dual role of the participant that appeared to be important in describing the awareness of the more fully engaged individuals. The argument in this thesis therefore needs to draw on cybernetics and second order cybernetics to model the systems it explores.

Cybernetic theory crosses the boundaries of biology, technology and society. As a result cybernetics appeals to a variety of disciplines such as: biology, economics, general systems theory, information theory, system dynamics, dynamic systems theory, catastrophe theory, chaos theory, philosophy, social media and politics. Its roots can be traced back to the sixth century BC in Pythagoras' mathematical modeling of perceptual phenomena and in Plato's philosophical teachings when he introduced the term *kybernetike* in his analogy between steering a ship and governing a community. Examples of cybernetic systems continued to emerge, as in the float regulator for a water clock (ca. 270 BC), or the mill-hopper where the flow of grain was regulated (ca. 1588), or in Claude Bernard's idea of homeostasis (1855) and Darwin's '*The Origin of Species'*, which examines the relationship between individual organisms and their environment as a determining factor in evolution (1859) (Bishop, 2002, pp. 1-3; Braudel, 1992, p. 359; Loriaux, 2016, p. 96; Wright, 1995).[29]

The study of control and communication in systems is extensive and has led to a variety of nuanced definitions sculpted to accommodate the specific needs of disciplines, theorists, timeframes and unique circumstances. In general cybernetics could be described as the examination of design and application of principles of regulation and communication within a

[29] For more on history see the American Cybernetic Society web site http://www.asc-cybernetics.org/foundations/timeline.htm

system. The focus of cybernetics is however on the *behavior* of an object rather than the object itself. In cybernetics the overarching question is not ‘what is this thing?’ but rather ‘what does it do?’ and ‘what can it do?’ ("Defining Cybernetics,"). Norbert Weiner, who is considered to be the father of cybernetics, described it as being the scientific study of control and communication in the animal and the machine (Wiener, 1948). As digital engagement involves communication between humans and technology I found his definition to be the most appropriate for this thesis.

Magnus Ramage and Karen Shipp provide a comprehensive analysis and history of thirty system thinkers who they have grouped into seven categories, the first being early cybernetics (Ramage & Shipp, 2009). Ramage and Shipp trace the similarities and differences among the seven categories such as general system theory and complexity theory through to second order cybernetics and learning systems, highlighting the role of feedback and control within systems. It is interesting to note that while a cybernetic approach is often used to explain system behaviors, this approach is not readily recognised as being cybernetics. It appears that this unifying meta-term for interdisciplinary system analysis is in conflict with the rigidity of some disciplines as evidenced in the breakdown of the Macy Conferences[30] and the Biological Computer Laboratory (Müller, 2000). A contemporary example of this would be Catherine Malabou who does not use the concept cybernetics in her book even though she explores system relationships between the human-brain and politics (Malabou & Jeannerod, 2008). Katherine Hayles on the other hand wholeheartedly embraces cybernetics in her exploration of how we became posthuman (Hayles, 1999).

2.1.1 Cybernetics: Control and Feedback Loops

Implied in Norbert Wiener’s use of the term *control* is the presence of a goal against which the success of a cybernetic process is judged. Cybernetics could therefore be described as being the control and management of a system by means of system information evaluated against a desired output or goal. In the first decade of the twenty-first century cybernetics was generally understood to be the control of a system using a closed signaling (feedback)

[30] The Macy Conferences were a series of scholarly meetings that included individuals from various disciplines. The meetings were held in New York under the direction of Frank Fremont-Smith at the Josiah Macy, Jr. Foundation. They commenced in 1941 and concluded in 1960. The aim of these conferences was to promote meaningful communication across the various disciplines.

loop. In other words when a system generates a change in its environment and that change is reflected in the system in a way that itself triggers a system change, then a feedback loop has been formed. Importantly, these triggers and changes can manifest as either a negative or positive feedback loop.

Negative feedback loops occur when the system-generated-change is fed back in a way that the fluctuations triggered by a system-response are *reduced*. A negative feedback system tends to promote stability within the system; there is a move towards homeostasis[31] or equilibrium[32] and a reduction of perturbations.[33] Systems using *negative* feedback loops, where the optimum correction and timing is applied as a response to 'error information', tend to become very stable, accurate, and responsive systems (Cordeschi, 2004, p. 186). While negative feedback systems are commonly found in engineering, they are also found in other fields such as economics and chemistry as well as naturally occurring in living organisms (Ashby, 1956).

Unlike negative feedback loops, which tend towards stability, positive feedback loops tend to result in instability. This instability manifests in various ways such as oscillations in alternating current, chaotic behavior as seen in complex systems or exponential growth (Langton, 1990; R. Lewin, 1993). Basically, a positive feedback loop occurs when the system-generated-change is fed back in a way that the fluctuations triggered by a system-response are 'added to' *with each iteration*: there is a system gain with every feedback loop and as a result small differences are amplified. A change in a system that causes further change *in the same direction* is a positive feedback loop. It should be noted that in relation to feedback loops the terms positive and negative should be seen as an overall system gain or loss from a zero point rather than as a value judgment of the outcomes. This point becomes important later on when discussing positive feedback loops in digital engagement where the term 'positive' is not a value judgment but rather it is an indicator of amplified behaviours caused by relating to the technology.

[31] Homeostasis is more commonly used in reference to biological systems.
[32] Equilibrium is more often related to mechanics.
[33] A perturbation is a secondary influence on a system that modifies simple behavior.

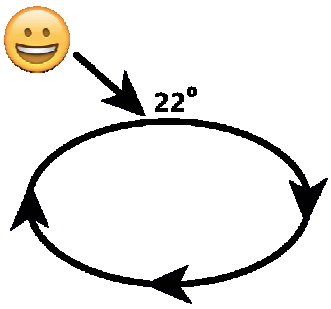
Cybernetics could therefore be said to be the observation of animal and machine system controls using feedback loops. In contrast, second order cybernetics expands this concept by proposing that the observer of a cybernetic system becomes part of the system that is under observation.

2.1.2 Second Order Cybernetics

Heinz von Foerster illustrated the difference between cybernetics and second order cybernetics in his plenary speech in Paris on 'Ethics and Second-Order Cybernetics':[34]

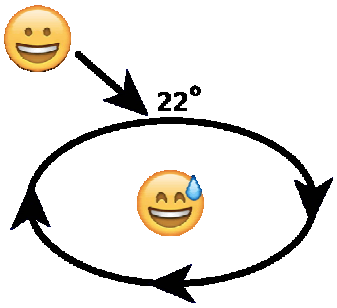
> What is new [in relation to today's cyberneticians] is the profound insight that a brain is required to write a theory of a brain. From this follows that a theory of the brain, that has any aspirations for completeness, has to account for the writing of this theory. And even more fascinating, the writer of this theory has to account for her or himself. Translated into the domain of cybernetics; the cybernetician, by entering his own domain, has to account for his or her own activity. Cybernetics then becomes cybernetics of cybernetics, or second-order cybernetics (Foerster, 1991).

The difference between cybernetics and second order cybernetics can be found in the role of the observer. In a cybernetic system the observer regulates the system by watching the feedback loop that results from input into the system, and makes appropriate input adjustments to approximate the desired outcome or goal. The observer of this system is simply initiating the regulator, or governor of the system, for a desired outcome: they are not in this instance part of the system being observed. For example: a thermostat is set to 22 degrees for optimal productivity of office workers. When the temperature drops to 21 *the system* adjusts by set increments to get as close to the desired 22 degrees as the system can manage. In this instance the observer may have set the thermostat at the start, but otherwise they not involved in the adjustments that follow.

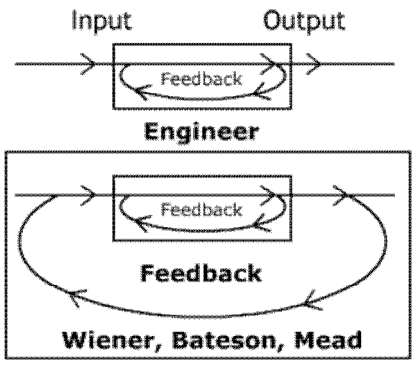


[34] This speech was originally published in French in Systèmes, Ethique, Perspectives en thérapie familiale, Y. Ray et B. Prieur (eds.), ESF editeur, Paris, pp. 41–55 (1991).

In a second order cybernetic system the role of the observer is more complex, they are both *an observer* of the system and *a participant within the system*. Using the previous example where a thermostat is set at 22 degrees: In a second order cybernetic system the observer would no longer simply allow the thermostat to manage and adjust the system. The participant, as a second order cybernetic system, would take into account their own personal experience of the room temperature and if necessary make an appropriate adjustment. For example they may have been exercising and on finding the room unbearably hot they would lower the thermostat or they may have a fever and decide to increase the temperature. The individual is aware of themself as both an observer of the system and as being a part of the system: they concurrently hold two roles, observer and participant.



Anthropologists Gregory Bateson and Margaret Mead contrasted first and second-order cybernetics with the diagram below in a 1973 interview. The top part labeled Engineer illustrates cybernetics and the lower diagram shows second order cybernetics.



Redrawn by Mark Côté, Redrawn from Co Evolution Quarterly and Cybernetics Society Conference brochure CoEvolutionary Quarterly, June 1976, Issue no. 10, pp. 32-44

This change in thinking encouraged the examination of complex systems as one complete entity. Using a second order cybernetic approach means that a related macro system and micro system need no longer be separated but could be seen as one interrelated system (Bailey, 1994, p. 163). In a second order cybernetic system the observer[35] is both the observer of a micro system but is simultaneously a participant of the macro system. This becomes important in later discussions when the individual is aware that they are both an integral part of the digital networked environment, such that they are regulated by the system, and can also function as an observer of the system, with the capacity to regulate the system.

This altered approach to viewing cybernetics was formulated approximately between 1968 and 1975 beginning with the first symposium of the newly formed American Society for Cybernetics (ASC) held during the American Association for the Advancement of Science (Glanville, 2004). Margaret Mead as the keynote speaker presented the diverse potential of second order cybernetics and the power of its circularity when she proposed that second order cybernetics should be applied to the society itself. 'Why can't we look at this society [the ASC] systematically as a system with certain requirements, certain possibilities of growth, certain constraints to some of which this society is to be responsive?' (Mead, 1968; Ramage & Shipp, 2009, p. 38). The potential multi and cross-disciplinary application of second order cybernetics appeared inexhaustible and appealing, but resistance to cybernetics remained. The universality of the concept challenged the rigidity and boundaries of many disciplines and as a consequence its uptake was slow (Hayles, 1999; Müller, 2000).

In the last decade there has been a resurgence of interest in second order cybernetics (Cordeschi, 2004; Foerster, 2003; Ison, Blackmore, Collins, & Furniss., 2007; Krippendorf, 2008; Müller, 2000). This resurgence is not surprising, due to a contemporary desire to deliberately contextualize processes within their larger framework, and has been amplified by the global uptake of technology and depth of its embedding in society, which requires understanding of integrated human/technology system-design, management and control.

[35] In cybernetics the term 'observer' is used as a general term to cover agency.

As my research developed, it became clear that I was uncovering processes that were embedded within other processes. The individual is not only a participant in their digital-engagement, but they also have to be understood as being an observer of that engagement. Second order cybernetics met all my requirements to describe the process I was witnessing and had the added advantage of accommodating the element of circularity, the positive feedback loop that amplifies behavior, which was evident in the more fully engaged individuals. While there are alternate frameworks for understanding the processes of complex systems discussed in my research, none of them were as suitable as second order cybernetic theory (Ramage & Shipp, 2009).

2.2 The External Environment

For this thesis the external environment can be considered as being the environment outside of the individual's skin. In general terms this is the physical environment in which humans operate, survive and thrive. This environment now also includes the digital environment, a recently created space in which humans operate. Due to the ubiquitous embedding of digital networked technology the digital and physical environments are increasingly seen as intersecting. In order to understand the affects of the environment on behaviour I needed to consider the particularities of each environment, and explore any differences or unique aspects that might impact on digital engagement. Thus below I consider each aspect of external environment separately.

2.2.1 The Physical Environment

For the purpose of this thesis the physical environment is the environment into which humans are born, where they have evolved instinct-responses, survival techniques over millennia and where social, cultural and belief information as well as individuals' experiences are passed on to following generations. It is in this environment that humans have developed and extended their first principle concepts such as time, space, relationships and value exchanges. It is also where experiences are refined and concepts adjusted to learned experiences.

The individual develops their identity, a sense of who they are, through their interactions with both the physical-environment and other individuals within the environment (Gibson, 1979; Hirose, 2002; Lettvin, Maturana, McCulloch, & Pitts, 1968; Michaels, 1981). Through personal interaction the individual develops a perception of their abilities and limitations. It could therefore be said that the individual is the sum of not only their engagement-experience with the physical world but also their engagement experience with their internally acquired interpretation of experiences, social and cultural beliefs (Epstein, 2003; Falk & Heine, 2015; Rocha, 2003; Smitsman, 1997). It appears that the way in which humans relate to the physical world involves both an internal process and an external process and at the center of this is the unique essence of the individual, the *autobiographical self.*[36]

2.2.2 The Digital Network Environment

Digital networks could be considered as being a combination of 1) *devices that interface with a network* (such as routers, computers, mobile phones, iPads, Wi-Fi devices etc.), 2) the *network that connects the devices* (typically a high-speed fibre optic trunk line, and radio bandwidth in the case of wireless networks) and 3) the *receiving devices*. This approach simply describes a complicated connected system of technologies. I propose, however, that a cybernetic perspective reveals the nature of the digital network as an evolving environment that is currently responding to a *positive* feedback loop where the needs of each human/technology system act as a controller of the other thereby escalating and amplifying the outcomes that have resulted in the digital engagement phenomenon. This is best explained through a consideration of the historical evolution of digital networked technology.

2.2.2.1 Devices, Connectors and Protocols

Digital information network *devices* can be traced back to the 1940s when there was a global surge in ‘electronic digital computer’ development. These electronic digital devices could be programmed to execute a sequence of logical operations automatically. In May 1941 Germany introduced Zuse Z3 a digital computer capable of information input, processing, storing and output of stored or processed information as an integrated system. Over the next three years the United States of America produced the Atanasoff–Berry Computer (1942)

[36] The autobiographical self is a term coined by Antonio Damasio, which describes the unique and changing state of consciousness or self-awareness that an individual develops over their lifetime. This is discussed in chapter 4.

and the Harvard Mark I – IBM ASCC (1944), while the United Kingdom produced Colossus Mark 1 and 2 (1944). All these were stand-alone computer systems that the user simply used to execute logical operations (Ceruzzi, 2003; Rojas & Hashagen, 2002). They were basically complex tools used by humans. However the capacity for advancing abstract constructs using this technology began influencing the researchers who were using them.

During this period, researchers from a diverse range of fields were evacuated to New Mexico to work on wartime projects. Stafford Beer recounts that it was during discussions after work that this distinguished group realised that the notion of control was common to a diverse range of disciplines and they began examining this concept. The group realised that the concept of control had some common principles that crossed the boundaries of many disciplines but as expected each expert had 'their own vocabulary and paradigms' which complicated discussions. This led the group to believe that 'they had stumbled on a new science. That there were principles of control that seemed to apply everywhere' (Beer, May 16, 2012 time 21:04 - 21:30). The outcome of these discussions led to ten post World War II cybernetics conferences.[37] Considering the dramatic technology and conceptual advancements at this time, it appears that as humans began extending their cognitive processing through technology, by automating logical operations, they began questioning universal trends that bridged disciplines (for examples of research in this area see R. Lewin, 1993). Participants of the cybernetic conferences were seeking understanding of meta-trends through scientific processes.

Over the period of these conferences technology development continued. The United States produced ENIAC, the Electronic Numerical Integrator And Computer, (originally created in 1946 and modified in 1948), which enabled and enhanced the study of complexity (a cybernetic system). United Kingdom developed 'Baby' and EDSAC, Electronic Delay Storage Automatic Computer, in 1948 and the Manchester Mark 1 (1949) while Australia produced the CSIRAC (CSIRO) (CSIRO; Rojas & Hashagen, 2002). These were all stand-alone systems with a limited number of specialised human users. These systems were not networked, the application of computing was not commercial and notably the wider public

[37] The cybernetic conferences were part of the Macy conferences and ran from 1946-1953.

were excluded from this evolving process. Development of digital computing progressed and by the end of 1954 ten large computing devices had found their way into private enterprise such as General Electric, US Steel, Du Pont, Metropolitan Life, Westinghouse, and Edison Electric Illuminating Company (Carr, 2009, p. 49). This move into the business sector introduced a slightly wider range of less specialised users to the emerging technology systems.

In the early 1950s, Jay W. Forrester identified the value of using a systematic approach in conceptualizing and controlling complex organizations involving humans and machines in real-time, where 'the machines had to be capable of making vital decisions *as the information arrived'.*[38] Unfortunately by 1954 the inflexibility of some Macy conference attendees, who came from diverse disciplines, ended open discussions and the pursuit of an interdisciplinary understanding of system communication and control as initiated in the 1940s by Arturo Rosenblueth, Norbert Wiener, Warren McCulloch, John von Neumann, Julian Bigelow, Walter Pitts, Claude Shannon, and Rafael Lorente de No. (Ashby, 1956; Foerster, 2003; Glanville, 2004; Hayles, 1999; Wiener, 1948). Instead of developing into a new science, cybernetics simply became one of a number of terms such as Ludwig von Bertalanffy's General Systems Theory, Dynamical Systems Theory or System Dynamics. Over the following decades cybernetics, as the scientific study of control and communication in machine and animal, was absorbed under the umbrella of *complexity* (Abraham, 2011).

During the 1950s and 60s large businesses, banking and government institutions increasingly adopted mainframe computers and technology continued advancing (Ceruzzi, 2003), which increased the number of users and diversity of skill levels. Hardware developed at a steady pace during the 1970s. Transistors replaced vacuum tubes, which reduced device size and a growing demand for computers resulted in component standardization. This started the trend of lowered entry cost for technology purchase, which led to the global uptake of technology. The uptake of computers by mid to upper tier businesses increased diversity in user skill levels but skills still tended to be company specific. During this period the 'minicomputer' was developed but its lifespan was short due to breakthroughs in the

[38] See 'From Cybernetics to System Dynamics' http://pespmc1.vub.ac.be/CYBSHIST.html

design of integrated circuits. Standardization and the reduction of computer size increased the number of users.

Understandably, the primary focus for individuals developing computer technology during this period had been on technology development rather than on the use of technology or the social consequences of technology use. Computers were seen as a useful tool, a contained system used by the human (Ryan, 2010, pp. 53-61). It was however the Intel microprocessor (1971) that profoundly impacted on the evolutionary process of digital networked technologies because it led to the micro or personal computer (PC) (Geisst, 2006, p. 98). The PC brought technology into the personal space of the individual. The trend of size and cost reduction resulted in computers becoming a commodity, making PC computers available to small businesses and home users. This altered considerations of technology development towards filling the needs of this new market niche. In cybernetic terms the average individual, as opposed to the expert, now became a controller within the human/technology system and contributed to driving the direction and development of digital technology. This led to, for example, improved user interfaces, development of software applications like VISICALC[39] and games[40], and increased processing power. The resulting developments made PC's not only functional but also desirable to a diverse range of potential users.

In the early 2000s there were concerns that a financially defined digital divide was occurring and that the advantageous social changes associated with digital technology would predominantly be confined to first world countries (Compaine, 2001). However, technological innovations and increased global infrastructure have lowered the entry cost of digital and networked technology to a point where financial inequity concerns have been significantly reduced if not eliminated (Branigan, 2010; Mayer-Schönberger, 2009). The United Nations reported that the uptake of mobile phones in the poorest Least Developed Countries (LDCs) had increased from 2 to 25 per 100 (Lynn, 2010). This trend of developing personal computational devices has continued and resulted in a plethora of small light-weight, hand-

[39] In 1978–79 Dan Bricklin and Bob Frankston developed VisiCalc: An electronic spreadsheet that could instantly update all fields when one field was altered. This had widespread application both commercially and academically.
[40] Examples of 1970s games are Pong, Asteroids and Space Invaders. These games were graphically simple but they provided a recreational way of engaging with technology for users of all ages.

held globally connected mobile devices that are increasingly affordable even within third world countries.

In summary, it took three decades for digital computing to become commercially useful. Size and cost reduction made computers a commodity and opened the market for both personal and business use. Increased mobile computing power and device functionality has only deepened the relationship between humans and technology.

Another important component of this relationship are the programs and systems that enabled the connection and networking of different devices, which began in the 1960s. The AT&T's Dataphone, which converted digital data to analogue signals for transmission across existing copper cable networks had the effect of accelerating digital connectivity and reduced rollout costs (Cowhey, Aronson, & Richards, 2009). In 1965 there was a move away from the 'contained technological system', as in a stand-alone computer, to a 'contained *network* of technological systems' for example, the American Airlines Sabre Reservation and Ticketing Project. The Sabre Project entailed networking more than 1,000 (dumb)[41] ticketing terminals to two IBM mainframe computers[42] and to sixteen data-storage devices. By the end of 1965, the Sabre network was able to process an unprecedented 40,000 airline reservations and issue 20,000 tickets a day. Sabre was, however, a *closed system* that used standard equipment across their entire network and had a 'single, unified chain of responsibility' (Ryan, 2010, p. 71). The Sabre system therefore typified a cybernetic system; it involved both humans and technology in a negative feedback relationship that had the single objective of efficient airline ticketing. Communication and control within this system was clearly defined and homogenized and thus controllable.

Until 1969, cybernetic systems, particularly negative feedback cybernetic systems, dominated, but this was changed with the advent of the first heterogeneous digital network, known as the ARPANET[43] backbone, created when four geographically dispersed

[41] These 'dumb' terminals had very limited internal processing and functionality and depended on the power of the mainframe for their processing.
[42] The mainframe computer is where the powerful processes took place.
[43] ARPANET is the term used to describe the network that became the basis for the Internet. It was based on a concept first published in 1967. ARPANET was developed under the direction of the Advanced Research Projects Agency (ARPA).

computers,[44] termed nodes, were connected (Bolt, Baranek, & Newman, 1981). The need to enable diverse computer networks to connect and communicate with each other resulted in the development of a new standard called TCP/IP.[45] These protocols allowed disparate systems to join the network and increased the number of nodes as well as the number of users on the ARPANET backbone by 1973 (See Timeline at Leiner et al.). By the end of the 70s digital network connectivity also included satellite and radio connections, other networks in countries other than the USA were connected with ARPANET and, on the 1st of January 1983, TCP/IP became the core protocol of a global network known as the Internet. The complex cybernetic nature of digital networked technology began to emerge. Digital networks could no longer simply be perceived as devices and connectors; they now also included the protocols that aided communication and control of the feedback process.

When the US established the ARPANET there was a notable change in network thinking. Developers were not simply concerned with connecting machines to share data. Their objective was to orchestrate use of distributed hardware services, make retrieval of data from remote databases possible and share software subroutines and packages that were not available on the user's primary computer due to incompatibility of hardware or languages. Unlike the Sabre network, ARPANET was a heterogeneous data and resource-sharing network that used software processes such as packet-switching[46] to enhance connectivity and communication between *humans* as much as between machines. In this way, humans now became an important element in this cybernetic system of digital networked technology. It is therefore necessary to consider the role of the human in the narrative of digital networked technology evolution in more depth.

2.2.2.2 Merging Humans with Digital Networked Technology

It becomes increasingly difficult to trace the evolutionary narrative of digital networks exclusively through software, hardware, or protocol development once the role of cybernetics is recognised, because the requirements of both human and technology create a

[44] Computers were at the University of California Los Angeles, SRI (in Stanford), University of California at Santa Barbara, and University of Utah.
[45] Transmission Control Protocol/Internet Protocol (TCP/IP) is the basic communication language or protocol of the Internet and can also be used as a communications protocol in private networks.
[46] Packet-switching a mode of data transmission where the message is broken into numerous parts that are sent independently, over an optimal route for each of the packets. All packets are then reassembled at the destination.

positive feedback loop which drives an exponential development of the system as a whole. For example, once the initial geographically dispersed super computers of ARPANET were connected; geographically dispersed users could communicate with a level of success that encouraged them to increase their use of the network. The program SNDMSG[47], which had been used like a post-it note between users on specific stand-alone-computers, was now of limited use. Ray Tomlinson adapted this software enabling it to send electronic messages to any computer on the ARPANET network regardless of geographical location or computer configuration. For this he used a file transfer protocol called CYPNET (Schnoll, 2004). This simple modified software program is now known as email and in the context of cybernetics, email acts as a controller that manages human/technology relationships in unprecedented ways. But it was not just human need, as in the example of email that drove the development of digital networks, it was also human *inadequacies*.

The increasing number of numerical IP address of computers was not easy for humans to remember and, as a result, the 'humanizing' of the numerical system began. In 1983 the University of Wisconsin addressed the problem by developing the Domain Name System (DNS) (Ryan, 2010). The DNS allowed human friendly names to be directed to a server where the human friendly name was translated by software into its corresponding computer friendly number, thereby concealing the 'difficult' numerical address from the human user. This humanizing trend in digital networks made its next major leap with the introduction of NCSA Mosaic in January 1993 (Ryan, 2010). Mosaic was the first web browser that was able to display pictures and text in the same window transforming the predominantly text based web pages, which were visually boring, into an exciting magazine-like experience. As Gary Wolfe wrote:

> With Mosaic, the online world appears to be a vast, interconnected universe of information. You can enter at any point and begin to wander; no Internet addresses or keyboard commands are necessary. The complex methods of extracting information from the Net are hidden from sight. Almost every person who uses it feels the impulse to add some content of his or her own. Since Mosaic first appeared, according to the NCSA, Net traffic devoted to hypermedia browsing has increased ten-thousandfold (Wolfe, 1994).

[47] SNDMSG was the original electronic mail program used for a single multi-user time-sharing computer running of the TENEX operating system. It is regarded as the first networked email.

While there were a number of other notable non-human developments in digital networks during the late 1980s and 90s, it was the 'humanizing' of the network (as shown above) that resulted in a dramatic increase in human participation and content publishing. Inevitably the increase and diversity of content became a problem to navigate or browse, making a tool for searching the information necessary.

The first search 'tool' that dramatically enhanced humans' ability to access information on digital networks, was Archie (1990), a software program that allowed users to download the entire directory listing of files available using File Transfer Protocol (FTP) sites. Due to the initial limited number of files at that time, users were able to manually search this list. The following year a protocol, Gopher (1991), was designed for distributing, searching, and retrieving documents. This led to the development of two new search tools, Veronica which searched file names and titles stored in the Gopher index systems and Jughead, which was a tool for obtaining menu information from specific Gopher servers. While these tools assisted humans in navigating information on the digital network, specialized catalogues that contextualized the content of the files was still maintained by humans (Hock, 2001). In June 1993 Matthew Gray developed the first web robot, a piece of software that automatically generated an index called 'Wandex'[48] (Halavais, 2009; Ledford, 2009). These examples show humans in a positive cybernetic feedback loop where human communication desire is driving the process, but where is the goal? This issue of a goal becomes important, as I will show in Chapters 7 and 8.

The narrative continues as the volume of information on the network increased and triggered human desire for sophisticated interpretive tools, which could satiate their growing just-in-time appetite for information. The first search tool to address this was WebCrawler, which 'read' and indexed *all the text content* of network files not simply the file name or title. Users could now *search for any word on any webpage*. This breakthrough resulted in a flood of new search engines and their associated robots such as Lycos, Excite, Infoseek, Inktomi, Northern Light, and AltaVista (Halavais, 2009; Hock, 2001; Ledford, 2009). Five of these services were incorporated into the Netscape browser in 1996 ("Browser Deals Push

[48] The purpose of the robot was to measure the size of the digital network, which is now known as the World Wide Web.

Netscape Stock Up 7.8%," 1996) thereby providing easy access to different search services.[49] This not only helped satiate the growing just-in-time information-appetite of users but it also satisfied humans' propensity for inquisitiveness and resourcefulness particularly with regard to using tools to make their life easier (Choi, 2009). For the rest of the 1990s there was a flurry of search services, some a blend of robot indexing and human catalogue as in Yahoo! and others such as Inktomi, which were purely robot based. Each service was trying to find the optimal blend to engage humans with the technology (Hock, 2001; Ledford, 2009).

The holy grail of search services was, however, not simply finding the optimal graphic or loyalty interface; it was rather to return relevant results in a timely fashion. Larry Page and Sergey Brin's unique perspective moved digital network searching the next level. Instead of simply indexing content, Page and Brin looked at search results' *relevancy* in the same way that humans evaluate the information of other humans. In other words the more a human trusts or respects someone the more likely it is they will value and use the information they receive from them. Using this concept Page and Brin set about developing a search tool that evaluates the relevance of web site content in relation to the website's social capital (Conley & Udry, 2010, pp. 39-40). In addition to this revolutionary approach, they realised that humans wanted just-in-time information when searching, as opposed to persuasion or distraction. To accommodate this, the graphical interface of their service was clean and uncluttered. Page and Brin's launch of Google search, in September 1998, marked the beginning of yet another landmark in the evolution of digital networked technology (Edwards, 2011, pp. 25-30), which further enhanced the role and relevance of the human user in this cybernetic system. To support this complex 'relevancy search service', Google developed hardware systems that were controlled by software capable of storing and delivering the entire Internet from its multiple mirrored databases located in Google 'server farms' around the globe at an unprecedented speed (Carr, 2009, pp. 64-67). Google search and Google's subsequent projects typify a positive feedback system fuelled by human desires or needs

[49] Each search service provided its own unique algorithm, blend of human and robot indexing and search interface. These differences resulted in different ranking of search results.

and modified by the human as the controller of the cybernetic system. In evolutionary terms all of this has happened within the 'blink of an eye'.

Continued developments in digital content and knowledge management within the digital environment provided the impetus necessary to move humans to the next level of digital network integration. Referred to as Web 2.0, these developments involved a new set of web-based platforms that allowed non-technical users to take control of the customisation and management of their own online presence. All users, novice to expert, were able to and increasingly expected to manage, create or edit their own data. These web-based systems enabled novice users to participate actively in the digital environment in the form of blogs, small business websites, and social networking sites (Neis & Zipf, 2012). Network enabled content management systems enhanced communication and multi-media sharing particularly at the personal level. Just as the DNS and Browsers humanised digital networks so too did content management systems. Anyone connected to the digital network could now be an active participant, unlike in the 1990s where most human engagement with digital networks was in a passive browsing capacity. The new millennium heralded increased interactive participation for the novice user.

As more humans participated with digital networks the global rollout of embedded infrastructure increased dramatically. By the mid 2000s digital connectivity was ubiquitous, affordable and embedded in mobile technology and the introduction of social media made novice user participation easy and engaging. The novice user now became an important contributor to the system. In January 2007 the Apple iPhone was released (Mather, 2007; Ryan, 2010, p. 49). Just as Google had transformed digital network search so the iPhone transformed devices and software. Mobility, stability, connectivity, versatility and ease of use became standard expectations of digital networked technology users. The appeal of these devices was further enhanced by the emergence of 'apps' as a means of consuming software.[50]

[50] Apps are small specific software applications that run on digital networks and devices (particularly mobile devices) as opposed to larger software packages, which often incorporate a range of specially designed apps.

In the early 2000s apps tended to be substantial software packages such as Microsoft Office; however, in the latter part of the 2000s they became smaller mini programs developed for specific uses and were suited to mobile devices. These cheap easy-to-use tools had a profound impact on digital engagement because they enabled customisation of devices to meet an individual's personal needs or wants. Individuals could create, communicate, be entertained and participate at a sophisticated level with minimal entry cost and friction. The rapid development of cheap, easy to use, function-specific apps fuelled digital engagement and sealed the cybernetic relationship of the individual to digital networked technology. Many users of smart phones were now in an ever-deepening, unique and very personal cybernetic relationship with digital networked technology.

This history reveals the evolutionary development and associated layered complexities of the term *digital networked technology*, suggesting the inadequacy of attempting any broad overarching definition. How humans engage with digital networked technology is a complicated and evolving amalgam of hardware, software, and protocols that is driven and controlled by human needs and wants. It is therefore important to examine the user who interacts with, relates to, and can be regarded as a part of, this technology.

3 What is Digital Networked Technology?

As Chapter 2 shows, digital networked technology is a complex amalgam of hardware and software within which human individuals also play key roles. During my interviews it became apparent that participants perceived and experienced digital technologies differently. In some cases the participant's perception was that the technology was simply a tool that they used, whereas for others the relationship was considerably more than that, since they felt emotionally invested in the technology and deeply involved in its use.[51] It therefore became important to examine whether digital networked technology is best regarded as a tool (because it is something used by humans), an environment (because it is something within which humans operate), or whether it is both (depending on the individual), or is some form of amalgam.

A body of literature certainly supports the view that technology is a tool to source information (Dubowicz & Schulz, 2015; Eysenbach & Köhler, 2003; Fox & Duggan, 2013; Hesse, Moser, & Rutten, 2010) as well as being an environment for education or retail (Bavelier et al., 2010; Moore, 2003 ; Selwyn, 2011; S.-L. Wang & Lin, 2007; S. Wang & Tamada, 2010). However, over the course of this research I found that an individual's understanding and acceptance of digital networked technology as being a tool and/or an environment was related to their level of digital engagement. This chapter therefore examines a range of different approaches to and understandings of networked technology as both a tool and as an environment. I first look at the literature that approaches technology primarily as a tool, before moving on to consider ideas of technology as an environment. A scenario is developed to illustrate how differences within environments can be indicated by differences in behaviours, and also how the individual's experience and understanding of environmental differences informs the decisions that they make. Finally, the chapter considers behavioural difference within the physical and digital environments at a societal level. The differences discussed throughout are considered in relation to the themes identified in my research.

[51] My participant Ann typified this behaviour and examples of this are discussed in greater detail throughout the thesis.

3.1 Is it Simply a Tool Used by Humans?

Unlike other animals that display humanlike characteristics, such as the social behaviours of primates, it is the human's ability to create tools that enables their advanced communication (telephone), ability to share ideas over time and space (printing press), and to create complex social structures (United Nations). Physiologically humans' opposable thumb and erect body freed their hands and enabled the manipulation of objects making humans prime candidates for tool making. Humans also have a highly developed brain making them capable of rational thought, abstract reasoning and problem solving. In addition to this humans have the capacity for self-awareness and introspection (Carlson & Buskist, 1997).

It is well known that other primates such as chimpanzees use and make tools in the wild and solve sophisticated problems (Wolfgang, 2001). However research done by Daniel Povinelli revealed that chimpanzees have limitations (Povinelli, 2003). In particular, when it came to 'abstract causal variables that govern objects and their relationships in the physical world' chimpanzees experienced difficulty (Johnson-Frey, 2003). This is different from humans where a causal relationship of understanding emerges in early infancy (Spelke, Breinlinger, Macomber, & Jacobson, 1992). It appears that humans make and use tools not only for implementing sensorimotor transformations[52] but also to satisfy abstract perceptual reasoning.[53]

3.1.1 A Theory for Understanding Tool-Use

In his research into visual perception James Jerome Gibson found that using an ecological approach to investigating tool-use provided better insights than traditional methods (Gibson, 1979). An ecological approach considers the fluid relations and interactions between an organism and its environment as well as the organisms' relationship to other organisms: This constitutes a complex system. To fully understand a complex system it is necessary to study not only multiple elements as individual components, but also to embrace 'the synthesis of

[52] The process by which sensory stimuli are converted into motor commands is called sensorimotor transformation: This process is vital to any biological organism or artificial system that requires the ability to interact in an environment.

[53] Perceptual reasoning skills are the skills one uses to learn and store new information from the environment as opposed to recall skills. Perceptual reasoning is fluid reasoning where spatial processing, visual-motor integration, and the ability to learn new information by the examination of a problems using visual-motor and visual-spatial skills to organize thoughts in order to develop and test solutions.

both elements and its result' (Fuller, 2005, p. 2) as additional components of the system, as well as the interaction of elements over time (Michaels, 1981). Using an ecological approach to develop an understanding of digital networks as a tool is therefore ideal because it embraces the concept of multiple elements as well as synthesized elements, fluid relationships that emerge from element interactions and the impact of the environment on both relationships and environment.

A. W. Smitsman proposed that tools shape and reshape our environment; they alter the action potential of the human body, which evolves in tandem 'with the evolution of implements for perceiving and acting'[54] (Smitsman, 1997, p. 301). Tool-use also conveys insights between generations and humans of different skill levels. In Chapter 2's discussion of the evolution of digital networked technology I illustrated how technology was able to fulfil humans' natural drive to develop tools that could assist in resource sharing, communication over time and space as well as in cognitive processing which supported the individual's ability to perceive and act. This suggests that digital networked technology is indeed a tool.

Early tool-use research focused primarily on understanding the cognitive mechanisms of human and primate intelligence in order to differentiate humans from other species and was therefore of limited use to this research. Research papers into infant tool-use development were more useful and showed tool-use as a complex process involving the human, the object/tool and the environment (Conally & Dalgleish, 1989, p. 911; Leeuwen, Smitsman, & Leeuwen, 1994; Newell, Scully, McDonald, & Baillargeon, 1989, p. 829). In the last decade there has been a notable amount of related research particularly in the field of robotics, cognitive science and artificial intelligence as researchers try to create 'thinking machines' that respond appropriately to stimuli (Arsenio & Fitzpatrick, 2003; Bahrami et al., 2007; A. Clark, 2003, 2011; C. D. Harvey, Collman, Dombeck, & Tank, 2009; Rupert, 2009; Sandry, 2015).

The definition of tool-use varies between and within disciplines. In the field of cognitive neuroscience, a suggestion is that tools are manipulable objects used to transform the users' ability into repeatable actions, in order to achieve a specific outcome (i.e motor-to-

[54] Action becomes the third component of my Digital Engagement Framework as discussed chapter 7.

mechanical transformations) (Frey, 2007, p. 368). Computer Science researchers St Amant and Horton propose a similar view but accentuate the externality of the tool saying that the transformation can be either an altering of the physical properties or it may include abstract properties such as the flow of information (St. Amant & Horton, 2008, p. 1203). Christopher Baber from the field of Ergonomics concurs, suggesting that tool-use involves manipulable objects used to alter the environment in order to achieve a goal but added that tool-use also 'represent an extension of the users themselves' (Baber, 2003, p. 8). Overall the common property of tool-use appears to be *the use of manipulable objects to alter the environment in order to achieve a goal.*[55] These properties also apply to other fields of study such as Primatology where van Lawick-Goodall states that tool-use is 'the use of an external object as a functional extension of mouth or beak, hand or claw, in the attainment of an immediate goal' (van Lawick-Goodall, 1970, p. 195).

When it comes to considering digital networks as a tool for human use, the three common properties discussed above do hold. Digital networks are certainly manipulable via software code, programs and applications, or hardware such as processors and routers. Additionally, they have profoundly altered the environment in which humans function, from the way humans socialize and work to the way humans read books. Finally, the purpose of digital networks has been to achieve human's fundamental need to communicate or share resources and information.

Other aspects of tool-use can however be problematic when applied to digital networked technology, such as the externality of tools as suggested by St Amant and Horton. Consider work being done on Deep Brain Stimulation (DBS) in chronically depressed and Obsessive–Compulsive Disorder patients (Greenberg et al., 2006; Malone et al., 2009). DBS devices are not normally part of the human body, but they nonetheless present a problem for Gibson's proposition that a tool should be graspable and transportable (Gibson, 1979, p. 41). The DBS electrode is arguably not graspable in the traditional sense of the word, but then neither is an app or a blog and yet these types of tools do conform to the initial three common properties of tool-use: *they are manipulable and they alter the environment in order*

[55] The goal/motivation becomes the fifth component of my Digital Engagement Framework as discussed in chapter 7.

to achieve a goal. Gibson also says that a tool, when in use, becomes 'a part of the user's own body, and thus is no longer a part of the environment of the user. But when not in use, the tool is simply a detached object of the environment' (Gibson, 1979, p. 41). This suggestion of Gibson certainly does apply to a DBS electrode which, when in use, is totally enmeshed with the user's body but will simple become a piece of wire when not in use, but does Gibson's enmeshment property apply to digital networks? For the purpose of advancing this discussion a readily recognisable digital network device, the smartphone, will be used as an illustration.

Initially a smartphone can be seen as a device in an environment. However as a user engages with it through customization and by adding personal details, it starts becoming an extension of the user. The smartphone becomes an outsourced memory bank, entertainment device or a means of communicating. At some level of digital engagement the bonding between the individual and the technology is sufficiently intense and emotionally laden that it becomes a part of the user as opposed to simply being an object in the environment, this relates to Smitsman's first concept of tool ecology, i.e. human's use of tools not only shapes but also reshapes our environment (Smitsman, 1997).

The discussion now turns to Smitsman's second basic concept: that the action potential of the human body evolves in tandem with 'the evolution of implements for perceiving and acting' (Smitsman, 1997, p. 301). Smitsman says action will exploit environmental properties but it requires the human's perception to see the potential within the object: 'one cannot act without perceiving' and 'one must act in order to perceive' (Smitsman, 1997, p. 303). Or as Gibson wrote:

> The affordances of the environment [or tool] are what it offers the animal [human] ... I mean by it something that refers to both the environment [or tool] and the animal [human] in a way that no existing term does (Gibson, 1979, p. 127).

The recent explosion of technological devices over the last two decades has increased interest in the use of the term 'affordance' as designers and programmers have grappled with the challenge of communicating the uses or functions of digital networked technology

products to the user. Gibson's definition has resulted in some conflicting views or interpretations of the meaning of 'affordance'. Donald Norman for example says:

> The term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. … Affordances provide strong clues to the operations of things. … Knobs are for turning. Slots are for inserting things into. … When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed (D. A. Norman, 1999, p. 9).

Norman's inclusion of 'actual properties of the thing' into his definition and his proposition that 'affordances provide strong clues to the operations of things' creates confusion and ambiguity about the term 'affordance' as it was originally proposed by Gibson. In Gibson the power of affordance-perception is contained within the observer who through his or her own action, or observation of the action of others, confirms and reveals affordances of the thing being observed. Norman on the other hand apportions a level of affordance-perception influence to the thing being observed.

In the early 2000s, Norman's refinement of the 'affordance' definition was very appealing to the Human Computer Interface (HCI) community who were grappling with ways and means of imparting the affordances of digital networked technologies to inexperienced users. Designers at that time had to create explicit visual or audio clues to entice action from the less experienced users who were unfamiliar with the computer interface and required affordance clues such as forward and back arrows or buttons for clicking (Nielsen, 1999). While Norman's nuanced definition has value, particularly within the area of design and HCI, the global uptake and ubiquitous embedding of technology has resulted in 'Black Box' technology, where the affordances and actual functionality of the technology is never fully understood by the user. It is important to note that the term Black Box is not used here in the context of David Warren's 'flight data recorder', but rather in line with James Clerk Maxwell's *gedankenexperiment* (thought experiment) as discussed by Norbert Weiner (Glanville, 2009; Wiener, 1948, p. 57). In this sense the internal workings of a Black Box can remain as an unknown for the user, such that affordances are only revealed through action. 'Black Box' technology is best understood using Gibson's definition where the affordance-perception is contained within the observer, rather than the thing, and the observer must perform an

action to confirm or reveal affordances of the thing being observed. This becomes important in digital engagement when the individual perceives the technology's affordance and the perception initiates an action to engage with it.[56]

The concept of the 'actual properties of the thing' as proposed by Norman in his definition has become problematic with current digital networked technology. Once again, it is useful to employ the example of the smartphone, which starts out as a rectangular slab that you can hold in your hand. It has something that discretely resembles a button, which to some may have the affordance property of 'pushability', but buttons have traditionally been associated with a raised button rather than a recessed button: This reduces the button's obvious affordance. The smartphone slab can therefore initially present as a 'Black Box' to the inexperienced user.

As Ranulph Glanville explains, if the Black Box is taken as an allegory then the 'blackness' attribute of the box indicates 'that we can see nothing: it is dark. By extension, the blackness is taken to indicate that we do not know what is inside the box and cannot see what (if anything) is within' but the term box also indicates an awareness that 'there is some mechanism inside the box, even if we cannot see it' (Glanville, 2009, p. 153). The level of assumption and revelation of affordances will vary over time from person to person, and proof of the utility of a Black Box requires some form of action if anything is to be revealed, as per Gibson's definition.

Depending on the user's *perception and action* level the Black Box, or smartphone, over time becomes a communication device, calendar, camera, map, entertainment device or any number of additional tools. The complexity level of how the smartphone is used will depend on the user's *perception level of possible affordance* of the device and the their *willingness to take action*: How they will engage? The nature of the individual therefore affects the affordances revealed. It appears then that in some way the innate ability of the individual needs to be factored into any discussion about digital engagement.[57]

[56] The role of this becomes clearer in chapter 7 when the Digital Engagement Framework is discussed.
[57] The Individual is discussed in chapter 4.

Unlike traditional tools, digital network devices have an additional level of complexity because when not in use they do not simply revert to being an object as in the unused stone of a primitive hammer. When not in use the smartphone still acts on behalf of the user. For example: It continues to collect emails from the server and notifies the user if they do not respond, it stores information and holds alert notifications until acknowledged.[58] In other words when not in use *digital network devices do not revert simply to being an object in the environment* as suggested by Gibson. The more the smartphone works on behalf of the user the more synthesized the human/device system becomes.

Gibson says that the synthesis of a tool and the body alters the perception and action capacity of the body. Once a tool is synthesized with a body the boundary between the body and its environment is altered (Gibson, 1979, pp. 40-41). In digital networks we certainly see that the more the user synthesizes with technology the more their perception and action capacity is enhanced. For example, as a user becomes more familiar with their smartphone they increasingly outsource their short-term memory to their device, such as appointments, alarms and telephone numbers. As the synthesis deepens so the user's perception of the device's potential alters, they begin exploring the less obvious affordances of the device such as Internet connectivity and applications like social network sites, news feeds and maps. The user is now not only synthesized with their device but is synthesized with others: This type of extended synthesis apples to human and non-human entities such as the computer-arrays on Google server farms in a way that makes digital networked technology less tool-like.

Smitsman, who saw the limitations of tool-use definitions, suggested that the concept of tool-use should be extended to include 'use of another person's actions and gestures to perform a task' (Smitsman, 1997, p. 304). This extended scope of Gibson's tool-use definition certainly assists with regard to current hand-held mobile technology, which I referred to earlier as 'Black Box' technology. Consider the swipe action that up until very recently was required to activate an iPad or iPhone. The 'Black Boxiness' of the technology conceals its affordances. Unlike a slot, which imparts the affordance of putting-in or slightly raised button,

[58] This is not like a passive diary or calendar. The smartphone is proactive and will continue to engage with the user once engagement has been initiated. e.g. Reminders set.

which prompts the action of pushing, a typical smartphone requires observation or instruction to initiate or reveal its affordances. This lack of affordance awareness in some is humorously illustrated in the iPad chopping board meme where a father receives an iPad from their technology aware child and uses it as a food chopping board (Zhardanovsky, 2014). Without observation or instruction the technology's new user draws on their existing experiential knowledge, which is part of their 'autobiographical self'[59], and in this case comes to the wrong conclusion. The autobiographical self is discussed in more detail in Chapter 4.

The revealing of less intuitive affordances through participant action is clearly illustrated in the following example of the Josh Groban fan club, which was used by Clay Shirky to describe cognitive surplus (Shirky, 2010). Josh Groban, a popular singer, had a website built to provide his fans with promotional material. Iinitially the perceived affordance of the website was disseminating information. Once there, fans found they could exchange information with other like-minded fans. The revealed affordances resulting from the initial action of the fans was that the web site provided a means of communication and filtering of the general public to likeminded people: Josh Groban fans. These fans were invited to become members. Further action on the part of the fan in the form of signing up revealed the affordance properties of active participation (contributing to discussions) and self-publishing (in the form of comments, photo's, birth date etc.). The following paragraph reveals how ongoing action on the part of the fans revealed even more affordance opportunities although they do become less obvious and could be argued. In essence however the example demonstrates that increased digital engagement reveals affordances of digital networked technology.

In 2002 Josh's fans wanted to buy Josh Groban a twenty-first birthday gift. Online discussions among the fans lead to the decision to raise money for charity in his name (Shirky, 2010, pp. 65-69). These discussions among fans revealed the web sites affordance properties of collaboration and altruism. The network of fans raised over a thousand dollars that was handed over to the David Foster Foundation, which pleased their idol. This motivated the young group of fans, now called the Grobanites, to continue raising funds. The

[59] The term autobiographical self is a term used by Antonio Damasio to describe the perception of oneself that results from experiential learning over a life time (Damasio, 2000).

Grobanites, all amateurs, continued engaging with digital networked technology but at an even deeper level. They worked out how to build an on-line auction site, in order to raise even more money for charity in the name of Josh Groban. Each action of the fans revealed more affordance properties of the technology and by 2011 the Grobanites had raised a million dollars in Josh Groban's name (Grobanites, 2011). The potential affordance properties of digital networked technology were not initially intuitive nor were they obvious to the Grobanites but deepening digital engagement increasingly revealed the affordances. This example demonstrates how digital networked technology does not entirely conform to the traditional concept of a tool. It also reveals a relationship between digital engagement and value exchange[60], which becomes an important element in my Digital Engagement Framework.

The value exchange provided by fans to the web site (building the image of their idol) was in some way different from traditional concepts of value exchange. Participants certainly obtained value (friendship and camaraderie) by freely contributing; they also found a sense of utility (providing information about their idol) and possibly exchange value (self-expression) but, on the website, there was no inducement, particularly financial, for their valuable contribution that developed the public image of Josh Groban. In 2002, the value exchange widened to include social altruism in the form of the charity-gift given in his name. The thousand dollars raised (cost to fans), pleased their idol (reward for fans), which encouraged more fund raising. This value exchange was so great that it mobilized activist behavior disproportionate to the initial expectations of all parties. Through exploration of the affordances of digital networked technology the fans altruistically continue raising millions. This type of value exchange is certainly different from traditional value exchanges.

The discussion in this section demonstrates how digital networked technology could definitely be classified as a tool in the more traditional sense. However, I have also shown that there is much more to digital networked technology when it is understood as an ecological framework. This supports the idea that it should be considered as part of a more complex system of interacting elements. If the tool must have some initial meaning to

[60] Value Exchange becomes the fourth component of my Digital Engagement Framework as discussed in chapter 7.

activate user-behaviour in order to reveal affordance properties then it is necessary for the user to have some level of self-awareness[61] as well as a more general awareness of that which is external to them. In other words the individual needs to have some awareness of both their internal and external environments. Gibson's idea of a unified system 'makes clear not just that a relation exists [between the human and the tool] but that the environment itself forms part of the behavioral organization' (Smitsman, 1997, p. 302). The question then is what exactly is the environment? For non-digital tools there is a simple answer: the environment is the physical world in which we find and use our tools. However digital networked technology does not behave in quite the same way because on one level we use digital networked technology in the physical world, but we can also be understood to operate within the digital environment. It is therefore necessary to examine digital networked technology as an environment.

3.2 Is it an Environment

Before continuing to the discussion of digital networks as an environment it is necessary to comment on some changes in perception of digital networked technology use over the last few decades. Broadly speaking, around the 2000s the perception was that an individual 'went on line', they 'logged on' and when finished they 'logged off'. This terminology implies that the digital networked environment was something 'other than' or separate from the physical environment. Today, however, these phrases are seldom used in the same way. People say 'Google it' or 'go online' and the phase shift from connection and disconnection is positioned as being seamless.

Does this mean that individuals operate in *one unified environment* or are they simply sufficiently skilled and perceptually aware enough to smoothly transition from one to the other? Or is it purely the sophistication of technology that unifies or divides the environments? In other words, is it a function of the system or the individual that enables the apparent continuum? This question is at the heart of my investigation into digital

[61] Awareness becomes an important aspect of my Digital Engagement Framework, which is discussed in chapter 7. It is also critical when considering digital engagement in the context of second order cybernetics.

engagement. To begin unraveling this issue I will start by introducing some broad social perspectives.

3.2.1 Broad Perspectives of the Digital Environment

Examining digital networked technology from the broader social perspective suggests that there has been a progressive change in perception over the last few decades. Initiated by the introduction of Tim O'Reilly's term Web 2.0 (O'Reilly, 2005) the stages of progression have come to be referred to as Web 1.0, Web 2.0 and Web 3.0. These categorisations have been discussed from many different perspectives in order to illustrate and explain changing social perceptions of the digital networked phenomenon over time. The following four approaches illustrate a few of the diverse approaches. Christian Fuchs (Fuchs, 2008) divides the progression by type of activity; whereas Christophe Aguiton and Dominique Cardon (Aguiton & Cardon, 2007) take a more behavioral approach and examine the underlying motivation, and Felix Stalder (Stalder, 2002) explores a shift in power. The fourth example is Matthew Allen (Allen, 2012) who examines digital networked technology through its historicity.

Fuchs suggested that Web 1.0 was the cognitive web, a pool of information that one could access. It was a tool for thought. Web 2.0 he saw as the communication web. Digital networked technology had now evolved into a medium that enhanced and amplified communication at a global level. Finally, Fuchs proposed that Web 3.0 was the cooperative web; one that he felt was still emerging at the time of writing. Web 3.0 would consist of existing digital technologies as well as those still to be developed. These technologies would not only support, but would also enhance human cooperation (Fuchs, 2008).

Aguiton and Cardon viewed Web 1.0 users as being more conducive to utilitarian activities that involved pursuing personal interests such as searching, buying or selling. Web 2.0, they proposed, not only enabled but also promoted altruistic activities such as sharing information within communities. They suggested that Web 2.0 was about building and maintaining relationships; which they described as 'weak cooperation' (Aguiton & Cardon, 2007).

Stalder built on the idea of 'weak cooperation' by examining the shift of power towards the *long tail*[62] in Web 2.0. In particular, Stalder points out that cooperation is usually a difficult goal-focused process that requires negotiation and that market or hierarchical decision–making is necessary to ensure scalability of collaborative groups (Stalder, 2002). Web 2.0 has provided evidence of the power of 'weak co-operation' and scalable collaborative systems in groups such as Wikipedia, Facebook and Flicker. These groups do not require market or hierarchical decision-making. Evidence of these 'weak co-operation' collaboratives can also be found in loosely bonded dynamic groups that have emerged as the result of disaster events (Yates & Paquette, 2011).

Matthew Allen presents his perspective in a Kafkian or Deleuzian way by starting from the middle (Allen, 2012; Brod, 1948; Gilles Deleuze & Felix Guattari, 1987). He demonstrates how the recorded history of the Internet began not in the 1980s when it was indeed first experienced, but rather that defining Web 2.0 provided a hinge point around which 'the past was written into the present of the internet so as to create a historical terrain' (Allen, 2012, p. 106). Allen continues by saying that Web 1.0 and Web 2.0 implies a Web 3.0, which Michael Gideon says arises 'when using the internet becomes so casual, so much as part of your natural life, that you don't think about it any more' (Gideon, 2011).

The common theme throughout these examples of digital networked technology as an environment is that it is an evolving process (Web 1.0, 2.0, 3.0), which affects human interactions. The current body of research ranges from user interface to simulations as well as human behaviour and the general approach is that the digital and physical environments are, can, or should be seen as a continuum. Some examples are how cyber rape or bullying can be as traumatic as physical environment rape or bullying (Cross et al., 2015; Turkle, 1995), the integration of hand gesture interaction to deliver more natural, creative and intuitive methods for communicating with computers as summarised by Rautaray and Agrawal's survey (Rautaray & Agrawal, 2015) or the use of virtual reality to overcome

[62] The origin of the term 'long tail' is taken from statistical distributions such as the Pareto distribution, named after Vilfredo Pareto a civil engineer and economist many other types of observable phenomena. Generally speaking the graph of such a distribution will start high and quickly drops off as a concave curved line, approaching zero along the X-axis. Events at the far ends of the axis have an increasingly low probability of occurrence. The Pareto principle applies in many cases, which gave rise to the 80/20 rule: 80% are accounted for by the first 20% of items in the distribution. It should be noted that the Pareto distribution is not strictly 80/20 it may vary.

disabilities (Coyle, Traynor, & Solowij, 2014; Morina, Ijntema, Meyerbröke, & Emmelkamp, 2015).

In general the research trend has been to focus on the cohesion of the two environments and the seamless integration and adoption of the digital environment into the existing framework of the physical environment. However, this effort to make the digital environment a more natural environment to the user could also be seen as indicating that the two environments are different and need to be merged. As the discussion below will show, some research proposes that digital networks have created a new environment that is in some ways different from the physical environment: an environment where traditional concepts such as time and space are challenged or are in some way different.[63]

3.2.2 Preparation Scenario

First, it is worth considering whether the rules governing the physical environment can be seamlessly transferred to the digital. If the same basic rules apply then maybe they can be treated as a seamless coherent whole. Using a scenario where there are definitely two different sets of rules can clarify this challenge. The following scenario illustrates the altered human behaviours that result from recognising that two proposed environments are indeed different. A scuba diver and a rock climber both have identical physical laws of gravity ($g = GM/r^2$) but differences in their respective environments (water and air) will profoundly affect how they behave should they be asked to jump off a hundred meter high ledge within their respective environments. The scuba diver will happily 'jump' off because there is buoyancy in his/her environment. The rock climber on the other hand will be reluctant, seeing death as the inevitable conclusion should he/she jump off the ledge. While gravity is the same for both parties within the physical environment, the way they experience the effects of gravity is profoundly different within each environment. This environmental difference therefore has a profound affect on their behaviours.

[63] The Oxford English Dictionary describes an environment as the conditions that affect the behavior and development of somebody/something
(http://www.oxforddictionaries.com/definition/learner/environment)
and a concept is an idea or mental image that corresponds to some distinct entity, or to its essential features, or determines the application of a term and thus plays a part in the use of reason or language.
(http://www.oxforddictionaries.com/definition/english/concept)

The above scenario illustrates how human behaviours and outcomes are different depending on the environment in which they operate. It also illustrates how experience and understanding of environmental differences enable individuals to make informed decisions that optimise their behaviours and, as a consequence, the outcomes of those behaviours. The scenario also indicates that differences are likely to be evident or related to first principle human concepts. It is therefore important to look at the particularities of digital and physical environment and investigate whether in terms of individuals' use and approach to technology there are differences, either conscious or unconscious.

3.2.3 Basic Human Concepts

As Eric Margolis and Stephen Laurence point out, concepts, as elements of thought, are crucial to psychological processes, but 'the nature of concepts—the kind of things concepts are—and the constraints that govern a theory of concepts have been the subject of much debate' (Margolis & Laurence, 2014). Despite this debate, using a conceptual approach to understanding an emerging phenomenon can certainly be advantageous as it provides insights into the phenomenon through an understanding of its components. The following discussion will therefore proceed based on the classic or common understanding of basic human concepts such as time, space and memory rather than by using a particular discipline or theoretical approach.

3.2.3.1 Time[64]

Traditional time, or 'clock time', is generally accepted in the western world as being a linear concept, a measure by which we organise our lives. For most people throughout the ages, time has been regarded as a dimension which is marked by change, be it biological, celestial, or the state of the altered objects surrounding one as they, or you, move from point A to B ("The Oxford Companion to Philosophy," 1995). This traditional concept of time has been the metronome of both individuals and societies. As Lewis Mumford, an American philosopher of technology and science suggested, '[w]ithout clocks and the precise timing of activities,… industrialized societies could not exist' (as quoted by Giddens, 2006), but what of time in the digital network environment?

[64] I have discussed this topic with regard to its effect on leadership in the new digital paradigm. (Spencer-Scarr, 2014, p. 8)

According to Castells, time in the digital network environment has taken on a different form. Castells uses the term 'timeless time' to explain the compressed and de-sequenced form that time appears to take within the digital environment. A good example to illustrate this is the withdrawal of cash by a tourist from an ATM on an island resort half way around the world from their home bank. A transaction like this requires numerous calls on different bank databases and exchange rate calculations: a mammoth task in a non-digital network environment that would have taken hours if not days to process in the traditional physical world environment. However, the tourist standing at the ATM is likely to feel frustrated having to wait all of ten seconds for their transaction to be cleared and the cash dispensed. What has altered in this situation is the tourist's perception of time when operating in the digital environment. While there has only been a 'clock time' delay of ten seconds, the perception of the frustrated tourist is that the transaction should be 'near instant' because it is taking place in the digital networked environment. The perception of time in the digital network environment has therefore been compressed. Heidegger's discourse on standing-reserve could be applied to how users perceive financial networks in the digital network environment, which Heidegger suggests are expected 'to be immediately at hand, indeed to stand there just so that it may be called for' (Heidegger, 1977, p. 17).

Castells also points out that '[e]limination of sequencing creates undifferentiated time which is tantamount to eternity' (Castells, 2010, p. 494). The de-sequencing of time, Shiv Visvanathan suggests in his discussion on Castells, creates 'instantaneous or eternal time' (Visvanathan, 2001). In contrast, I would argue that it may be more accurate to say that the compression and de-sequencing of time in the digital network environment results in users experiencing *both* instantaneous and eternal time, these things often being experienced simultaneously. An illustration of instantaneous time would be global financial markets where geographically dispersed humans interact in 'real-time'.[65] 'Eternal time' on the other hand is a result of the operational behaviours of the digital network environment. In the digital network environment information is easily copied identically, shared, stored and archived by humans, hardware and software in multiple places on the network without the initiator's knowledge or awareness. The effect of this is that the information could potentially exist for

[65] The actual physical world time during which a process or event occurs.

eternity and prove impossible to delete.[66] All information on the digital network could therefore be said to have the potential to exist in eternal time.

In 2001 Scott Lash wrote about Technological time in relation to cyclical and narrative time.

> Cyclical time, … is really slow. Narrative time, … is quite a lot faster. Technological time …[on the other hand] out-paces them. Technological time does not so much question progress; it is too fast for progress. … We improve so fast in technological time that improvement itself is thrown into question. Technological time is too fast for the cause-and-effect of Newtonian time. Invention is so fast that we outpace the logic of cause-and-effect (Lash, 2001, p. 111).

Geoffrey West proposes that humans' perception of time has changed as a result of 'the collective that we have constructed by coming together and interacting' through and with networked technologies. 'The clock that we [now] actually work by, live by, … is getting faster and faster' (West, 2015). West suggests that our unbounded growth requires accelerating cycles of innovation to avoid collapse. As such, time in the digital networked environment appears to be perpetually speeding up, it increasingly accelerates. In other words time is no longer bound to biological or celestial entities but rather to the *evolutionary innovation of technology*.

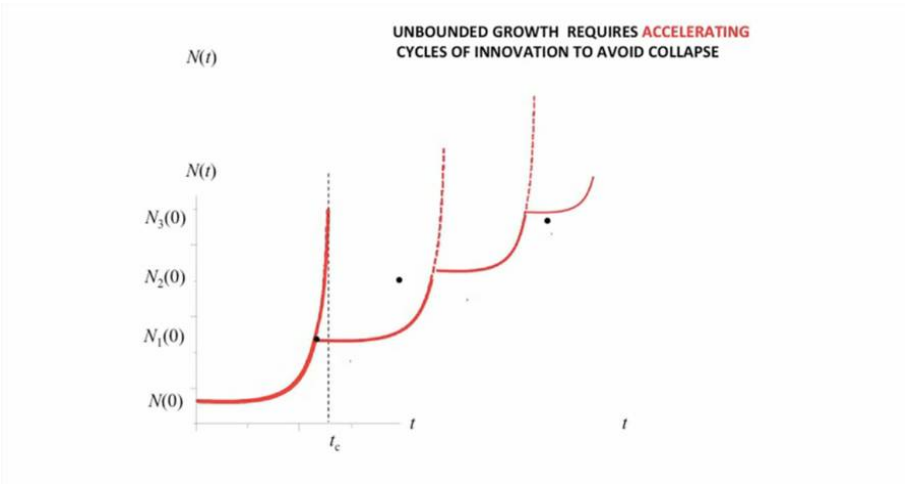


Image from Geoffrey B. West's presentation at a multidimensional workshop held at the European Organization for Nuclear Research (CERN) (2015, January 8, 2015 16:35).
uTube Video "On a Technological Highway" Retrieved from *http://www.tallbergfoundation.org/video/on-a-technological-highway/*

[66] The inertia surrounding evaluation of information before storage augments the amount of information stored within the digital networked environment.

From this discussion we see that when operating within the digital networked environment, the concept of time does indeed appear to be different. This differing concept of time is important for developing an understanding of digital engagement because the concept of time underpins and affects many other basic human concepts such as memory, space and self-perception.

3.2.3.2 Memory

Viktor Mayer-Schönberger reminds us that a key component of traditional memory is time and that in the physical environment memory will naturally fade as time passes. Mayer-Schönberger proposes that 'digital remembering negates [traditional] time' by retaining exact vivid memories for as long as a digital network environment exists (Mayer-Schönberger, 2009, p. 113). Apart from the potential impact of digital memory on individuals, digital memory has an unprecedented potential to affect social memory.

The canonising of humanity's culture and historical narratives, as well as individual and collective memories, has traditionally been the domain of memory institutions such as museums and libraries. But as Guy Pessach argues 'the transformation from tangible or analog preservation to digitized cultural retrieval tends to result in partial and gradual privatization of society's memory institutions' (Pessach, 2008, p. 73). This is a potential double-edged sword. On the one hand it offers the utopian view of decentralised and democratised memory institutions and social remembering practices: Digital networks and the process of digitisation make more information available to more people in more formats. On the other hand privatisation of memory institutions may compromise a democratic vision of social remembering due to memory institution biases, be they human or algorithmic or even related to the motives of commercial enterprise.

In addition to this, digitisation of information has the potential to fragment and possibly decontextualise societal memory. For example, this may be an effect of the subtitled parodies of Adolf Hitler's last days in the Berlin bunker, as depicted in the 2004 Second World War film 'Downfall' (Boutin, 2010; Rohrer, 2010). Although these memes are

harmless, they exacerbate the fragmentation and decontextualisation of information within the digital environment.

Regardless of whether one takes a positive or negative view of the impact of digitisation on memory, there does appear to be sufficient evidence that memory within the digital network environment is in some way different from traditional memory. This is important to human decision making[67] as memory plays a key role in evaluation and validation of incoming information. This different experience of memory within the two environments is therefore relevant to the notion of digital engagement.

3.2.3.3 Space

In the physical environment one can passively occupy space and there is some physical resistance in moving from one space to another. Space in the digital environment is ephemeral and described by Castells as a 'space of flows', a space which he says provides the 'possibility of organizing the simultaneity of social practices without geographical contiguity' (Castells, 2000, p. 14). Stalder expands on this saying 'it refers to a specific social condition, rather than nature in general'. It 'is that stage of human action whose dimensions are created by dynamic movement, rather than by static location' (Stalder, 2002, p. 1).

This 'space of flows' being a series of non-hierarchical connected nodes, can be described as a rhizomic system. Gilles Deleuze explains:

> [T}he rhizome connects any point to any other point, … it brings into play very different regimes … It is composed not of units but of dimensions, or rather directions in motion. It has neither beginning nor end, but always a middle (milieu) from which it grows (Gilles Deleuze & Felix Guattari, 1987, p. 21).

It is a system of middles, containing nodes that will prosper and grow proportional to their network contribution. It has no central power and a node gains and retains 'power' proportional to its ability to perform useful and reliable functions for the network. Passivity or inactivity results in redundancy. In a rhizomic system it is necessary that the node be connected to the system, because from the network perspective if a node is not connected

[67] Decision making as the core behaviour of action becomes an important aspect of my Digital Engagement Framework, which is discussed in chapter 7. It is also critical when considering digital engagement in the context of cybernetics.

then it does not exist. Michel Callon and John Law point out that within the digital environment 'there is no difference between the person and the network of entities on which it acts. Or between the person and the network of entities which acts through the person. Network and person: they are co-extensive' (Callon & Law, 1997, p. 169).

Unlike the space of physical environments, which can be statically occupied, space in the digital environment is created and retained *only by action and relationships*: be they human or non-human actions. This concept of space is certainly different from the traditional concept of space, which can be passively occupied.

3.2.3.4 The Locus of Self

This brings me to the concept of the locus of self within the digital environment. In his discussion of the location of one's being Heidegger used the concept of *dasein* (being). For Heidegger all *being* takes place in time, which he says is constantly changing, presenting new possibilities for individuals to capitalize upon. Heidegger perceived time as being sequential. It is this sequential biological, seasonal or clock time that brings changes and he felt it should be embraced not resisted. Heidegger proposed that an individual was placed in a time and its related environs and that the individual should extract and experience what was relevant to them for the duration of that time because it would inevitably change (Heidegger, 1962). If Heidegger's concept of 'being' is used in conjunction with Castells concept of 'timeless time' (Castells, 2000, p. 13), a conceptually new way of 'being' in a de-sequenced, instantaneous and eternal state emerges. The ability to be 'present', albeit virtually, in a geographically boundless landscape in 'near instant' time for eternity in a dynamic and fluid space is certainly a different concept for individuals operating in the digital networked environment.

From the discussion above it appears that there is a reasonable argument for the digital environment to be considered as separate from the physical environment because of the way in which the individual *experiences* first principle concepts within each of the two environments differently. Since first principle concepts are fundamental to the formation and expression of behaviors within a specific environment, environmental differences will

inevitably affect the individuals' behaviours.[68] As a consequence of digital networked technology becoming embedded in society, many individuals now operate within both environments whether they are aware of it or not. For example, email etiquette is different from SMS or letter writing and a lack of awareness of this can lead to inappropriate behaviour and associated social consequences. A further example is that pressure to purchase can be affected by different marketing techniques within the two environments. In the physical environment, marketing tends to be generalised persuasive marketing, whereas digital marketing uses metadata analysis to tailor marketing to individual behaviours (F. Harvey, 2014). The growing trend for individuals to have to function in dual environments is increasing daily and touches more aspects of an individual's life. For example medical and research monitoring (Zao et al., 2014), education (Correia, 2007; Moore, 2003 ; Selwyn, 2011; S.-L. Wang & Lin, 2007; S. Wang & Tamada, 2010) and simulations (R. Lewin, 1993, pp. 84-105; Minar, Burkhart, Langton, & Askenazi, 1996). As the depth and breadth of this duality increases and affects the behaviours of individuals we see its impact on society as a whole.

3.3 Dual Environments Affecting Behaviour

A number of key factors affecting people's behaviour emerge from the literature (and are also found in my data discussed in later chapters). These relate to: value exchange, motivation, response to feedback, the impact of instant gratification and the shift of power to the long-tail. They are introduced here in a broad sense to illustrate behavioural changes at the level of the individual that also affect behaviour at the societal level.

In this thesis the concept of 'value exchange' is approached from two angles, the first being the idea of social capital; and the second, the more traditional one, being that something is exchanged by its owner, for something that the owner perceives to be of greater value. The concept of value exchange (while often associated with the Marxian concept of 'exchange value') is in fact a basic human concept explored by philosophers as far back as Aristotle (Kraut, 2010) to contemporary economists and marketers. It is common human behavior to trade some of what one has for things one needs or wants. In the physical environment

[68] Refer to the scenario of the scuba diver and the rock climber discussed earlier in this section.

value exchange is predominantly associated with commodities, which have four attributes: value [relative worth], utility [quality or condition of being useful], exchange value [quantified worth of one's goods or services expressed in terms of the worth of another] and price [amount expected, required, or given in payment for something] (Nicholas, 2012). In the physical environment the concept of value exchange is learned at an early age in the form of sharing (Rheingold, Hay, & West, 1976). Rarity increases value (C. Thompson, Barresi, & Moore, 1997), which effects price. Exchanging what you have for what you want is a means to increase your perceived worth. However, in the digital environment value exchange is not quite the same as this, and can superficially appear irrational, illogical or even chaotic.

In the digital environment there has been an ever-decreasing entry cost, which has resulted in previously unthinkable transactions, such as online purchasing of physical commodities, and an ongoing user-expectation that prices in this environment will be less. This expectation is exacerbated by the fact that early digital environment commodities were in most cases intangible and in digital form, such as music or information. Initially, free entry, participation or access to commodities such as free on-line news, free downloads and 30-day free trial versions of software, was actively encouraged to attract participation. These necessary tactics were due to undeveloped business models on how to capitalise the digital environment. Companies gave their 'product' away for free until they could work out how to commodify their product in the emerging environment. Consider the trajectory of Google as an example. Google gave many of their services for free such as 'Google Analytics', which is a system for measuring and monitoring web site activity. The value of 'Google Analytics' to the user was quite substantial and Google could have quite justifiably charged for the service. However, by giving 'Google Analytics' away for free Google was able to accumulate search behavior data that they then used to develop their Google Advertising model, which was a more lucrative revenue stream (Edwards, 2011). This model of 'things for free' in the digital environment created a persistant user-expectation that digitally related activities should incur little to no cost, a sentiment that has fueled a trend of entitlement and aided the *long-tail* power shift, which is discussed below.

In addition to the traditional commodity-related value exchanges, we need to consider the role of social capital, which involves value accumulation resulting from relationships. To demonstrate this I return to the example of the Josh Groban fan club discussed earlier in the chapter. While this example may appear unexceptional by today's standards, it was quite remarkable at the time and it does demonstrate the three relationship forms that social capital takes: bond, bridge and link (Keeley, 2007, p. 103). The bond relationship is found in the fans common identity, the bridge relationship is seen in the enhanced image of the idol through improved public relations and the link relationship is seen in the relationship to benefactors of the funds raised. Using the same example but applying traditional value exchanges, all four attributes of value exchange manifest in unexpected ways releasing exceptional value to multiple parties. Participants found value in friendship and camaraderie as well as a sense of utility and self-expression by providing information about their idol. Unlike traditional value exchange in this digital example no payment was expected, required, or given for the valuable contribution by fans. The digital value exchange then widened to include social altruism when the network of fans continued to raise funds.

It could be argued that this example is similar to examples found in the physical environment such as fund-raising drives by traditional charity organisations but I propose that there is a difference. The sheer friction of time and space on similar projects in the physical environment would tend to absorb energy rather than focus and amplify behaviours as seen in the digital example where value exchanges were initiated, escalated, enhanced, and sustained by the technology and as a result of the individuals' digital engagement.

Motivation may appear different in the digital networked environment. What motivates an individual to engage with digital networked technologies can, as seen above, appear irrational when viewed from a traditional perspective, such as value exchanges. Motivation stems from human needs and wants that develop within the individuals' known framework and understanding of their environment. Where the environment is familiar and understood the individual has developed a way of harnessing their motivation to attain their goals. But as I have discussed the digital environment presents the individual with new and unfamiliar concepts that are likely to affect or alter their understanding of motivators creating stress or

confusion as the individual attempts to attain their goals under changed circumstances in the different environment. Apart from having to accommodate the complexities of dual environments the individual's motivators are also shaped and influenced by the interaction of many internal components such as their personality, decision-management style, and responsiveness to feedback,[69] which in turn are influenced by the environments in which they are operating.

Responding to feedback is a basic survival process: a physical environment example is recoiling from a hot object. Individuals who are better able to respond and learn from feedback within their environment are thus more likely to thrive because repeated learning iterations strengthen neuronal pathways (Doidge, 2007; Merzenich, Kaas, Wall, Nelson, et al., 1983; Merzenich, Kaas, Wall, Sur, et al., 1983) and lead to intuitive responses. In the digital environment the intensified speed and frequency of feedback iterations, which can be both destructive and constructive, has the potential to amplify the individuals learning process despite the reduced physical-risk experienced within the digital environment. This is due to the internal environmental responses and is discussed in Chapter 4. Therefore understanding how the feedback process manifests in the digital environment is relevant.

The feedback process in both the digital and physical environments is the same, it is a cyclical process where repeated iterations tend to reinforce decisions made and the repetition in turn affects behavior. The feedback process can be described as an outcome that is evaluated against a predetermined goal, and a decision made to take an action, typically to modify the input, that will optimize the chance of attaining the desired outcome. How or in what way one makes decisions can therefore lead to a positive or negative feedback loop, which in turn leads to homeostasis or chaos of the feedback system. This basic feedback system becomes important in later discussions when it is explained as being part of nested cybernetic systems that, when taken together, form a second order cybernetic system. It is therefore necessary to examine those aspects of social behaviors in the digital environment that are being affected by or are affecting digital engagement.

[69] Discussed in Chapter 4.

The social trends discussed above are being reinforced and enhanced by digital technologies that play directly into the individuals' new found sense of self worth by supplying a feedback loop of micro rewards, which heightens desire and the expectation of instant gratification. This occurs in two ways, firstly by lowering the investment threshold of receiving gratification thereby making it easily available to more people, and secondly by the way in which the rewards are dispensed. In the digital networked environment micro rewards are dispensed frequently in the form of sought-after-information at a mouse click.

Samuel McClure and associates showed that immediate reward increased activity in areas of the brain that are heavily supplied by the dopamine system (Newlands, Anderson, & Mullin, 2003). Dopamine plays a major role in reinforcing behaviors by creating a sense of pleasure within the individual when it is released. The continuous micro rewards during online activity releases a steady stream of dopamine that result in an escalating sense of well-being: engagement deepens and intensifies. When contrasting this to the benefits of delayed gratification where motivation demands specific abilities of the individual to continually and accurately imagine the reward in order to delay their desire for gratification (Samuel M. McClure, 2004), it becomes easy to see how digital networks feed individuals' need for instant gratification. Postponing pleasure for your future self becomes harder because your future self is a stranger to you (Parfit, 1971).

The frequently dispensed micro rewards that an individual receives after minimal cost investment, such as putting in a search query or sharing a photo, makes it difficult for the user to disengage. The process is iterative and thus reinforces the individual's expectation of micro rewards: the desire and action leading to instant gratification. This is very different from the physical environment where chronological time and the friction of physical-space impose constraints on our expectations. The instant gratification of the digital environment is a powerful illustration of how a feedback-loop can have an amplifying effect on an individual's behavior.

It should also be noted that, once digital engagement has been initiated, the technology is designed to enhance its relationship with the user. Digital technology is not a passive entity; as mentioned earlier, it will continue to act on the user's behalf by sourcing, storing and

notifying the user of related information such as emails and calendar notifications. In many cases this creates a user dependency relationship that is changing human behaviors (Seo, Park, Kim, & Park, 2016; Uner, Bicer, & Piskin, 2015).

The traditional hierarchy of power has been challenged throughout society. This is evident in technology use where power distribution laws are being altered. In February 2003 Clay Shirky noted in his essay on Power Laws, Weblogs, and Inequality that 'We are all so used to bell curve distributions that power law distributions can seem odd' (Shirky, 2003). He demonstrated how suitable the power law distributions such as the Pareto distribution[70] are far better suited to the behavior in the digital environment. Chris Anderson took up this theme and examined its implications from a market perspective realising that there were two distinct markets: The traditional market, which focused on the head of the curve, and the emerging market, which he called The Long Tail (Anderson, 2004a, 2004b, 2006). Anderson was aware of a power shift towards the long tail of the market distribution.

> To be precise, what I coined was the notion of looking at the tail itself as a new market. The use of the proper noun (including "The") is not incidental, but is intrinsic to the observation that we have historically looked at the market at the head of the curve in isolation, and we can now shift our gaze to the right and see that the tail is another market. … two markets--The Head and The Long Tail; one familiar, the other long ignored but now emerging (Anderson, 2005).

What may have started as a noisy secondary market in 2005, has in many cases taken over the shaping of corporate behavior. Companies now find that failing to appease and satisfy this market can undo all of the traditional marketing they do. For example the social pressure put on the American company Chick-fil-A concerning marriage equality (Brydum, 2014).

A shift of influence towards the long tail was clearly seen in politics during the lead up to the 2008 United States presidential campaigns where candidates found digital engagement was necessary to reach formerly inactive voters (D. Clark, 2007; Cox, 2015; Graff, 2008; Granick, 2006; Grossman, 2008). Making information transparent to the long tail challenged

[70] The Pareto distribution was named after Vilfredo Pareto a civil engineer and economist who observed a power law probability distribution that is now used in descriptions of social, scientific and many other types of observable phenomena. Generally speaking the graph of such a distribution will start high and quickly drops off as a concave curved line, approaching zero along the X-axis. Events at the far ends of the axis have an increasingly low probability of occurrence. The Pareto principle applies in many cases, which gave rise to the 80/20 rule: 80% are accounted for by the first 20% of items in the distribution. It should be noted that the Pareto distribution is not strictly 80/20, it may vary.

candidates and made politicians and governing bodies more accountable (Stelter, 2008; Tynan, 2008). Lawmakers and the military are also experiencing difficulties in their effort to manage the power-shift to the long tail (Greenemeier, 2008). While those in authority would like to use the easy global dissemination of information to their advantage, they can no longer control the rank and file who has equally easy access and ability. This trend appears to be global (Browne, 2008). These samples of media reports show a social trend away from a 'top-down opaque hierarchal system' to a 'bottom-up transparent lateral system'. It demonstrates a global shift towards the long tail that is altering the knowledge-power balance. Becoming aware of this power-shift led me to examine where the power lay within digital engagement. I stopped focusing on the external environment and began examining the role and power of the internal environment on the process of digital engagement.

The search for, retention, concealing, sharing, destroying, preserving, commodifying, manipulating and developing of, knowledge has driven humans for millennia. As Sir Francis Bacon said 'knowledge is power' (Simpson, 2016), and humans like what they can do with power. Knowledge is comprised of two parts: Firstly, there is information or data; and secondly, there is something that processes the data into meaningful and useable knowledge. Traditionally humans did the processing of data to knowledge but processing is now increasingly outsourced to technology such as agents, algorithms or software and this is creating a power shift. As to where and how the power boundaries lie, this varies from individual to individual and, as my research goes on to show, it is the individuals' awareness that will influence their level of digital engagement.

Social networking and Content Management Systems resulted in a dramatic shift of knowledge-power towards the majority, the long tail, who have become active contributors to the knowledge base as well as becoming prolific information seekers. Digital networked technologies have provided the opportunity to support or disrupt authorities in an unprecedented way and its effectiveness is contributing to a change in some individuals' sense of self worth. This sense of self worth is also being fed from another source, mass customization, which should also be kept in mind as this discussion proceeds.

Mass customization, which is the production of goods and services with near mass production efficiency, has the potential to meet individual customer's needs (Internet World Stats), while retaining monetary prices similar to those of mass-produced products. This strategy creates an increased value-perception in the customer because their specified needs or wants are being met without trade-offs in cost, delivery and quality (Fertik, 2013; Valz, 2006). When this is combined with global 'me-centric advertising', typified by L'Oréal's 'Because I'm worth it' slogan (L'Oréal, 2012), one can see how the general public develop a heightened sense of increased worth. At about the same time as the 'me-marketing' surge began, the online social media explosion started: The public could now not only access information but they could easily share and comment on information (Picard, 2015). They had a platform and could be heard (L. F. Lee, Hutton, & Shu, 2015). The long tail could express their views and the marketers who would customize products for their perceived needs were hearing them. At the same time traditional mass marketing was supporting their increased sense of self worth with the 'me-centric advertising' creating a heady combination of entitlement, self-worth and self-promotion.

From this discussion we see that how the individual perceives and experiences an environment will affect their behaviour. The discussion has also illustrated how individuals' altered behaviours affect society. Understanding the individual thus becomes important and is discussed in the following chapter.

4 The Internal Environment

Having examined the external environments in the previous two chapters I now turn to what I call the internal environment. The phrase internal environment is used in this thesis to represent the multiple subsystems of the individual from the neurological, biochemical, and physiological, to those that influences the making of consciousness and the resulting autobiographical self with its related behaviours. Having an overview of the individual as a complex group of subsystems aids understanding of the process of digital engagement and why this is experienced differently by each individual. I have grouped the internal environment into three system groups: firstly, 'in the skin systems', for example neurological, biochemical, and physiological systems; secondly, 'abstract systems', like consciousness and finally 'observable systems' such as presented behaviors. These are major areas of scholarly interest that have a long history of research.[71]

History has revealed repeated evidence of human awareness of interrelated systems 'within the skin' and that equilibrium maintenance was desirable despite these systems not being fully understood.[72] Until the last few decades the functioning neurological, biochemical, and to a lesser degree physiological systems, have largely been a 'black box'.[73] Most human knowledge in these areas has been based on observation or examination of animals or the non-living. Technology has changed this with the development of new devices, miniaturization of devices, high-speed database access, increased computer processing power, and resource sharing. These developments have made it possible to observe *functioning living* organisms using systems such as Functional Magnetic Resonance Imaging (fMRI) or Position Emissions (PET). This has led to an exponential growth in highly specialised and diverse areas of research as humans explored the complex detail functioning of the internal universe of the living human body.

[71] For example as in Edwin Smith's papyrus scroll (circa. 3000 B.C) which exhibited an awareness of communicating systems within the internal environment of the human body (Breasted, 1991). The scrolls demonstrate an awareness of a correlation between motor control, body functions, speech and injuries to the head and brain.

[72] For example: Democritus (c. 460 – c. 370 B.C.) held the view that all sensation was based on 'psychic atoms' spread throughout the body enabling 'exchanges between the brain, the other organs of the body, and the world outside'. And Aristotle's observation of the convergence of blood vessels towards the heart, which in part led him to abandon Plato's role of the brain as the seat of thought in preference for the heart (Changeux, 1997, pp. 5-6).

[73] A 'black box' in this context is a device whose internal mechanism is usually hidden from or mysterious to the user. But the term is now used to describe anything that has mysterious or unknown internal functions or mechanisms.

Understanding the underlying mechanism of the human individual is important because these systems affect not only the biochemistry that leads to the development of consciousness. Neuroplasticity and behavioural learning are also key to understanding the significance of digital engagement and its affect on both the individual and society. Examining neuroplasticity and memory provides insights into how the human individual changes and adapts through their interactions with the environment (both internal and external). This is important when considering digital engagement as a second order cybernetic system, because the individual has to be aware of internal system changes and have the capacity to modify behaviours in order to optimise their outcomes within the larger system.

For this thesis I have taken a broad approach to system processes because I am concerned with *how the systems relate* rather than getting lost in arguments regarding the detail of *what the systems do*. I have therefore based the next two sections, 'In the skin' and 'Abstract' systems, on the *outcomes* of selected current research.[74] As the body of research, supporting history, and counter arguments is too vast and complex to be meaningfully summarised here; I present instead an overview of key concepts and findings that are most relevant to my research. With regard to the final section 'Observable system', which is presented through human behavior, I have relied on current research from the field of psychology.

4.1 In the skin systems: Neurological, biochemical, physiological.

It would certainly be convenient to deal with the individual as a sentient being and not delve into the underlying chemistry and processes that are the platform on which consciousness operates. However, this research is concerned with how people engage — both consciously and unconsciously -- and must therefore deal with what appears to be instinctive, irrational or chemically induced in order to understand the observable behaviours of digital engagement. While a summary of all the relationships is unrealistic, a simplified overview will provide some insight and background into the intricacy of these relationships and enable

[74] Of particular note are Antonio Damasio, Jean-Pierre Changeux, Michael Merzenich and Mark Rosenzweig although many others have contributed to the formation of my ideas.

further discussion. As this discussion progresses I will illustrate how the biochemistry of the individual creates cybernetic feedback loops which could be negative and lead to homeostasis and stability of the individual's system, or could be a positive feedback loop and result in amplified behaviours.[75]

Many specialised research areas are dedicated to 'in the skin' systems, such as cardiology, chiropractic, and endocrinology, but it has only been the last fifty years that neuroscientific research and associated technological advancements have provided the discoveries necessary to advance many of the enduring discussions on the relationships between internal systems of the human body. As Jean-Pierre Changeux noted, the expansion of our knowledge in this area is 'matched only by the growth of physics at the beginning of the century [1900s] and molecular biology in the 1950's' (Changeux, 1997, p. xvi).

'In the skin' systems encompass the skeleton connected by joints that are moved by muscles, circulatory and digestive systems, and organs, all of which are made up of biological tissue that is made up of cells. Cells are made up of numerous molecules that combine to create the cytoskeleton, nuclei and organelles, all of which are bound by the cell membrane. This creates an 'in the skin' (cell) system within the 'in the skin' (human body) system. As Antonio Damasio puts it, the 'complexity of structure and function is daunting when we look at one of those cells in operation, and staggering when we look at an organ system in the body' (Damasio, 1994, p. 86). Similarly when considering the human body as an environment it is the relationships between these diverse components that result in an environment.

The relationship between the components are usually viewed as firstly the sensory/neural system and secondly the internal more primitive system. The sensory/neural system takes sensory signals from the external environment interface (touch, sound, sight, smell etc.) to the brain and then from the brain to the appropriate parts of the body for a response. The older more primitive system is the bloodstream, which carries chemical signals to and from all parts of the human body. Both systems, however, work together to ensure the survival of

[75] The example of Ann Klinestiver a Parkinson's disease sufferer illustrates this and is discussed later in this chapter.

the human individual. For example the complex physiological responses to sensory stimuli that result in fight or flight behaviours, or the instinctive removal of a limb from a hot object, or the reluctance to do something based on a 'gut feeling'.

There is a constant relationship between the individuals' internal environment and input from the external environment. Damasio (1994) explains this type of interaction in relation to the neural activity that is stimulated in the eye via the retina, the ear where the cochlea and vestibule are activated, and through skin terminals such as taste buds and nasal mucosa. All these input points transmit 'signals to circumscribed entry points in the brain, the so-called early sensory cortices of vision, hearing, somatic sensations, taste and olfaction' (Damasio, 1994, p. 91). As these signals reach the brain there is a lot of cross-signalling which results in a response to the stimuli that is transmitted to the appropriate body parts for a physiological response, for example to run from the approaching predator or remove your hand from the hot object.

This simple outline does not, however, incorporate the vital role of the *internal milieu*, a term first used by Claude Bernard to describe the interstitial fluid, and its physiological capacity to ensure homeostasis of the tissues and organ components of a multicellular organism (Damasio, 2000, p. 138; Reddi, 2014, p. 6). This *internal milieu* is important when considering the individual as a cybernetic system and becomes important when considering digital engagement as a second order cybernetics where the internal environment of the individual affects their relationship with the external digital environment. Consequently, further consideration of the biochemistry of the human body is relevant to this discussion. The *internal milieu* is a system that uses a closed signalling feedback loop where control of the feedback loop system is known to have occurred by a system change. In other words, the system generates a change as a response to an input that has altered the *internal milieu*, or threatens to alter the homeostasis of the *internal milieu* environment.[76] For example the 'sweat response' to abnormally high body temperatures that may cause death or brain tissue damage.

[76] See Chapter 2

Damasio explains: ‘Life depends on those biochemical processes being kept within a suitable range, since excessive departure from that range, at key points in the composite profile, may result in disease or death’ (Damasio, 1994, p. 118). This illustrates the conscious or unconscious goal of the human body as a cybernetic system, which is survival. Damasio describes the complex network of signalling of chemicals such as hormones and neuropeptides, which are carried through the bloodstream or axons to the brain for processing, as well as more covert signals such as levels of hormones, potassium ions or red blood cells. As Damasio explains, chemical regulation is especially complex:

> The production of hormones released by the thyroid and adrenal glands, without which we cannot live, is controlled partly by chemical signals from the pituitary gland. The pituitary is itself controlled partly by chemical signals released from the hypothalamus into the bloodstream near the pituitary, and the hypothalamus is controlled partly by neural signals from the limbic system and indirectly from the neocortex (Damasio, 1994, p. 119).

The complexity and impact of chemical signalling within the body is overwhelming but developing a general understanding of its role and influence is necessary because as discussions will show, chemical signalling affects behaviours related to digital engagement.

Consider the array of behavioural effects of the single hormone oxytocin, which is known to affect lactating breasts, birth contractions, drug addiction, generosity, depression, empathy, learning, and memory. In general oxytocin affects bonding, social behavior and emotions. Oxytocin has been found to reinforce trust and bonding in humans (Bartz et al., 2010; Nagasawa et al., 2012). The social and survival consequences of this single hormone example is staggering. This hormone, a chemical, can increase trust among people and make them more cooperative as suggested in research on meerkats (Madden & Clutton-Brock, 2010), or increase the social skills of autistic people (Guastella et al., 2010). In theory, if all humans took ‘oxytocin supplements’ then humankind might bond, trust, and live in cooperative harmony, but that is not the case. Oxytocin is only one small component of the complex ‘in the skin’ cybernetic system and the way oxytocin affects the human is far more complex (Shen, 2015). By understanding the properties of components and the relationships of components we can begin to understand the more complex system and its relationship to other systems. As Kurt Schwitters said when talking about collages ‘[p]arts no longer exist

simply as discrete bits that stay separate; they set in play a process of mutual stimulation that exceeds what they are as a set' (Fuller, 2005, p. 1). To understand the system we need to know its parts.

Unlike oxytocin, which is a neuromodulator that 'induces a calm, warm mood that increases tender feelings and attachment and may lead us to lower our guard' (Doidge, 2007, p. 119), dopamine is a neurotransmitter that *excites* or when reduced, results in lethargy (Ernst & Luciana, 2015). Dopamine triggers action (Liu et al., 2004). Barry Richmond explained this with his case study of monkeys. The monkeys had been trained to do a simple lever-release task to obtain food. In normal circumstances monkeys, and humans, tend to work better nearer to the time of a reward and are less productive when they have a lot of time to get the job done. In order to change this behavior, the monkeys were injected in the brain with a substance that blocked the receptors that normally sensitise cells to dopamine: the chemical neurotransmitter involved in reward perception. The monkeys were then set to work on the simple lever-release task, but the reward was set to be released a long way into the future. With the suppression of receptors that affected dopamine levels the monkeys had difficulty perceiving the amount of work necessary to efficiently receive their reward. As Richmond explained, 'The monkeys became extreme workaholics, as evidenced by a sustained low rate of errors [...] irrespective of how distant the reward might be…This was conspicuously out of character for these animals' (Flintoft, 2004, p. 723).

Dopamine also influences impulse control (Taber et al., 2012) and is illustrated in the not so uncommon case of Ann Klinestiver. Ann, a Parkinson's disease[77] sufferer was put on to a drug that increased the amount of dopamine in her system by making surviving dopamine neurons more effective at transmitting the dopamine. Ann recalled, 'at first the drug was like a miracle … all my movement problems just disappeared'. However over time Ann required increasingly higher doses in order to function normally. As the doses increased Ann developed compulsive gambling behaviour, which nearly destroyed her relationships and her financial standing. Ann was then taken off the dopamine agonist and her Parkinson's movement problems returned but her gambling compulsion stopped. As she said 'I still think

[77] Parkinson's is a disease of the dopamine system.

about the slots, but the obsession isn't there. Without the drug I don't need to play those damn machines. I'm free' (Lehrer, 2009, p. 59).

Dopamine certainly appears to play a part in impulse control and current research using new neuroimaging technology shows its relationship to addictive online behaviours. Results from functional neuroimaging and other neuropsychological studies were presented by Brand and associates which demonstrate that control processes, such as cue-reactivity, craving, and decision making, are particularly reduced when individuals with Internet addiction are confronted with Internet-related cues (Brand, S.Young, & Laier, 2014). Tian and associates also examined individuals with Internet gaming disorder and reported evidence of biochemical activity within the orbitofrontal cortex that they suggested could explain loss of control and compulsive behavior in internet gaming disorder subjects (Tian et al., 2014). Using dopamine and serotonergic medications, Han and associates found that partial recovery of gaming addiction may be possible (Han et al., 2015). The study of biochemical activity is a relatively new field of research that has only recently gained momentum as a result of new technologies, but it is significantly underexplored with regard to digital engagement. Dopamine and oxytocin do however appear important in relation to digital engagement: Oxytocin in the role of relationship building and dopamine with regard to the depth of engagement that some people experience. Serotonin on the other hand moderates the individuals' mood or outcome of their feelings.

Serotonin (5-hydroxytryptamine, 5-HT) is a neurotransmitter chemical found in the human body that carries signals along and between nerves. It is mainly found in the brain, bowels and blood platelets. As serotonin cannot cross the blood-brain barrier it is manufactured in both the brain and the intestines but serotonin that is used inside the brain must be produced within the brain. In general, serotonin is concentrated in the gut, travelling around the body in the blood (with the exception of to the brain, see above). For example, when there is a wound, serotonin is released by platelets resulting in vasoconstriction, the narrowing of arterioles, which reduces peripheral blood flow and aids the formation of blood clots although it can also cause the release of other chemicals, such as dopamine which triggers an action response to apply pressure to restrict the blood flow. Serotonin also plays an important role

in mood modification by influencing biochemical levels within the body and can be viewed as a controller of homeostasis in the cybernetic system of an individual (Damasio, 2000, pp. 67-79).

Internal serotonin levels can be affected by external environmental stimuli such as light, exercise and diet. Serotonin levels can also be moderated by drugs including selective serotonin reuptake inhibitors (SSRIs) such as fluoxetine (Prozac), citalopram (Celexa) and sertraline (Zoloft), the less commonly used MAOI (monoamine oxidase inhibitors) and isocarboxazid (Marplan), which prevents serotonin breakdown. There are also illicit mood-altering drugs such as Ecstasy, Cocaine and LSD, which cause a massive rise in serotonin levels.

Normally once a neurotransmitter has transmitted its neural impulse it is reabsorbed. This process could be considered a negative feedback loop where the homeostasis of the system is regulated by the removal of the input once the message has been received. SSRIs inhibit the re-absorption of serotonin neurotransmitters and result in an increase of serotonin levels in the synapse in the brain, which elevates the users' mood. This SSRI example demonstrates a positive feedback loop where there is amplification or 'adding-to' within the system. These positive feedback loops can create instability as was demonstrated in Ann's dopamine situation above or can result in total breakdown as seen in Zoloft and Prozac suicide cases (Boseley, 2000; Pfizer, Revised December 2012). In the digital environment, biochemically induced positive feedback loops are not necessarily as dramatic as those experienced in the physical environment. For example, the feelings that result from micro rewards are also the result of a biochemical response to an action taken by the individual but they tend to be less extreme compared to the stimulation resulting from a physical environment action. For example the positive feeling one gets from pursuing and finding information compared to the feeling one gets when purchasing a desired object. The exact science behind neurobiological stimulation is still under investigation but what is evident with regard to the biochemical effect of micro rewards is not the strength of the reward but rather the speed and frequency of its dispensing which primes the individual for a learning process.

These three biochemical examples give an indication of the multiple complex relationships of human biochemistry. They also show, albeit briefly, the role of the internal milieu in maintaining homeostasis for survival as well as how our biochemistry can influence human behaviour within the physical environment: Oxytocin, which influences relationships,[78] dopamine which affects action,[79] and serotonin that has an impact on mood.[80] All our 'in the skin' systems work together in a complex way to ensure survival of the system that is the human individual. In the next section, I discuss the abstract systems of the individual, which are influenced by the internal milieu of the human body.

4.2 Abstract systems: Consciousness/Awareness

The mental constructs that an individual formulates are a crucial part of digital engagement because, as I will discuss later in this thesis, digital engagement is a second order cybernetic system that requires the individuals' awareness of themselves as operating within their environment. Understanding how or why an individual develops their mental constructs that lead to consciousness/awareness will assist in understanding digital engagement as a process.

Plato used the allegory of a chariot pulled by two winged horses to explain the human 'mind', which, as the following discussion shows, is a component of the internal milieu of the human. The charioteer represents the rational brain that guides the human. One horse, the noble horse, represents moral impulse such as righteous indignation while the other represents human's irrational passions or appetites. (Plato, 1925). But what exactly is the charioteer that moderates the rational and irrational aspects of the self, and where is the charioteer, this governor or controller located?

Rationality has been strongly associated with decision making and is generally used to describe a particular style of thinking that can be traced back to Socrates in the Golden Age of Greece circa. 500 BC. The Socratic method of discovering the truth is to question until the essences or source of an issue is disclosed. This method of questioning, logic and reasoning

[78] This becomes important in the Tool-Use and Value-Exchange Sectors of my Digital Engagement Framework: Chapter 7.
[79] This becomes important in the Action Sector of my Digital Engagement Framework: Chapter 7.
[80] This becomes important in the Tool-Use and Motivation Sectors of my Digital Engagement Framework: Chapter 7.

has underpinned western philosophy and is commonly believed to lead to good decisions (Andersen & Hepburn, 2015; Mark, 2009). While the value of logic and deductive reasoning is important we see its limitations in the following two examples where something more than pure reason is needed to make an optimal decision. In both these cases decisions were made at a level other than the consciously reasoned level and these examples are introduced to highlight how important such processing is and therefore must be addressed to progress this discussion.

In the first example extreme rational decision making was required to over-ride a strong primitive survival response. After total hydraulic failure, which made a United Airlines flight 232 from Denver to Chicago impossible to fly in the normal way, the pilot was forced to make an emergency landing at Sioux City on 19th July 1989. Using counterintuitive logic and reasoning Captain Haynes and his crew fought against their instinctive response. They had to reverse their normal logic and accelerate when heading towards the ground to create the lift they needed. These actions defy normal human survival instinct but by using counterintuitive logic and reasoning they balanced the thrust power of the engines and the lift of the wings to successfully manoeuvre their crippled plane and land it with minimal loss of life (Krause, 2003; Lehrer, 2009, pp. 120-127). In this example using rational thinking to over-ride instinct was the better decision but as the following example shows it is not always the best method to make decisions.

In 1991 Michael Riley was serving on the HMS Gloucester monitoring the radar when he saw a blip off the Kuwaiti coast indicating that an object was approaching the USS Missouri at a speed of 550 miles per hour. The ‘blip’ was within the airspace frequently used by American A-6 fighter jets that were supporting the Marine ground invasion but for some reason the ‘blip’ triggered a fear reaction in Riley. Unfortunately due to the circumstances there was no way for Riley to verify if the blip was a Silkworm missile or a friendly aircraft and he had to make a quick decision. Riley instinctively ordered the release of two Sea Dart surface-to-air missiles. As it turned out the blip was indeed a Silkworm missile and the general opinion was that Riley had made a lucky choice. It was only after Gary Klein, a cognitive psychologist, had investigated Riley’s case in detail that his decision could be

explained (G. Klein, 1999, p. 36). Typically Riley would see a returning A-6 airplane appear on the edge of his screen after a single sweep of the radar. However the Silkworm blip did not appear within the first sweep because it was masked by ground interference due to its low altitude. The Silkworm blip was in fact not visible until the third radar sweep, which was only eight seconds later than a typical A-6 would have been. Riley had responded intuitively not rationally, he *felt* that something was wrong with the 'blip'. Based on Wolfram Schultz's research into dopamine and responses we know that dopamine neurons generate patterns based on experience (Fiorillo et al., 2003; Schultz, 2007; Schultz et al., 1993). This is what happened to Riley, like Schultz's monkeys in his 1993 research, Riley was physiologically conditioned to expect the normal blip sequences even though he was not conscious of it. The change to this sequence triggered a dopamine related physiological response that triggered his action to fire. Riley was responding to a 'fear feeling' generated by his internal milieu. It was only later analysis that explained the abstract constructs that Reilly had been developing.

Surprise or the unexpected focuses response in the anterior cingulate cortex (ACC), which is involved in the detection of errors. This area is dense with dopamine neurons. When the dopamine neurons make a mistaken prediction, the brain generates a unique electrical signal, known as error related negativity. The ACC assists the control and communication between what we know and what we feel. This means that if the ACC is startled by some stimulus it forces the individual to notice the unexpected event (Lehrer, 2009, p. 38).

The ACC alters consciousness while simultaneously preparing the body for action such as a racing pulse which is

> the brains way of saying that there's no time to waste. This prediction error is urgent. But the ACC doesn't just monitor erroneous predictions. It also helps remember what the dopamine cells have just learned … It internalizes the lessons … [experienced] making sure that neural patterns are completely up to date (Lehrer, 2009, p. 38).

Riley's response exemplified this. This becomes important with regard to digital engagement because the brain's response to stimuli forms learned neural patterns based on the

frequency of repeated of stimuli, which occurs frequently in the digital networked environment.[81]

An experiment by Antoine Bechara, Antonio R. Damasio, Hanna Damasio and Steven W. Anderson, which is known as the Iowa Gambling Task, demonstrates the human capacity to know something before we are consciously or logically aware of it (Bechara et al., 1994). In this experiment there were four decks of cards, two black and two red. These were presented face down and the player was given $2000 play money. The object of the exercise was for the participant to make as much money as possible by turning over cards, one at a time, from any of the decks. The cards would instruct the participants as to whether they had won or lost money. Unknown to the player the decks were rigged. Two decks were high-risk; they had bigger payouts and penalties resulting in a net loss. The other two decks were conservative with smaller payouts and penalties but resulted in a gain. Bechara and associates found that participant sampling at the beginning of the task was random and on average players turned over fifty cards before drawing solely from the lucrative decks and about eighty before they could explain why they selected those decks. On average participants were *intuitively aware* long before they were *cognitively aware*. Participants were instinctively responding to minute changes within their internal milieu.

One of the Iowa Gambling Task researchers was Antonio Damasio. He was specifically researching emotion and had connected participants to a machine that measured electrical conductance of their skin while they were playing. The theory was that higher levels of conductance signal are associated with nervousness and anxiety (emotions) and that the participants would show conductance fluctuations in relation to their feelings towards the deck of cards from which they were about to select a card. The researchers found that participants recorded electrical conductance readings as their hand approached the negative deck after turning about ten cards. Participants were physiologically aware of the situation at 10 cards which was long before their external behaviours demonstrated awareness (fifty card turns) and even longer before their externally expressed consciousness which took over eighty card turns. As Bechara et.al reported ‘results also suggest that the biasing effect

[81] Discussed in Chapter 2 and 3.

of the value mark operates covertly, at least in the early stages of the task' (Bechara et al., 1994, p. 14). Our 'in the skin' responses are indicative of covert internal controllers that are working in a feedback relationship with the external environment by raising our awareness or consciousness.[82]

Damasio pursued this line of investigation in his book *Descartes' Error* (1994) where he argued that human capacity to experience emotions and feelings affects human reasoning. This led to his Somatic Marker Hypothesis and his subsequent theories on the making of consciousness (Damasio, 1994, 2000). Damasio explained 'an emotion is a collection of changes in body state and brain state, induced in myriad organs and in some brain circuits, under the control of a dedicated brain system, which is responding to the content of one's thoughts relative to a particular entity or event' (Damasio, 2001, p. 103). Damasio proposed that emotion is a specific collection of changes in the body and brain as opposed to being a subjective feeling such as happiness or fear, and that each specific emotion is triggered by the individual's perception of the object or event. These emotions are the individual's thoughts or memories of similar experiences in their past. They are the individuals' unique biases based on their past experiences in similar circumstances, for example the feeling of comfort or companionship from a familiar smiling face or the feeling of fear when encountering a scowling authority figure.

The results of these internal changes within the body, which Damasio terms somatic or body states, may be visible from the external environment such as variations in facial expression and posture. Other are invisible, for example a biochemical change as described previously, physiological as in changes in heart rate, or muscle contraction to remove the body from danger (Damasio, 1994, pp. 114-222). These somatic or body states result in changes within the brain that corresponds to the release of neurotransmitters, which may include dopamine, serotonin, noreadrenaline, and acetylcholine. The change within the brain results in mental representations (abstract constructs), or as Damasio refers to them 'maps' of the body state changes (Damasio, 1994, pp. 165-222; 2000, pp. 321-322). Each map corresponds to a specific set or pattern of bodily states that relates to the input data such as seeing a scowling

[82] Awareness becomes important in all aspects of my Digital Engagement Framework but particularly in Tool-Use and Action.

authority figure. These maps elicit the individuals' subjective experience of a feeling which could be described as a snapshot, or image, of the individuals' internal chemical response to incoming stimulation. This shapes our perception and aids our survival in an important way. Demasio describes this more fully when he discusses how feelings give us a glimpse of what goes on in our flesh, as a momentary image of that flesh gets juxtaposed to the image of other objects and situations, and, in so doing, modify the comprehensive notion we get of those other objects and situations. By dint of juxtaposition, body images give other images a quality of goodness or badness, of pleasure or pain. … Emotions and feelings are closely linked to the behaviors necessary for survival. … In general terms, then, emotions and feeling help achieve homeostasis, albeit indirectly, and assist, in so doing, with communication among individuals of the same and other species (Damasio, 1995, pp. 158-160). The final crucial piece of Damasio's contribution to this discussion is his proposition on the making of consciousness, which he suggests is intrinsically woven into the fabric of feelings. A summary of Damasio's theories of consciousness is relevant here because consciousness/awareness is a key element in decision making and decision making is central to action. Action, as will be discussed later in this thesis, is the Sector that links the individual to digital networked technology making the two components function as a system. Therefore understanding how an individual comes to a level of consciousness/awareness is important.

Damasio proposed that the creation of Core Consciousness is the result of the modification of the non-homuncular Proto-Self[83], which he defined as being '*a coherent collection of neural patterns which map, moment by moment, the state of the physical structure of the organism'* (Damasio, 2000, p. 154 Italics in the origional text). The Proto-Self has its integrated map of the body's essential homeostatic regulatory data updated or modified by maps of incoming data from objects in both the internal or external environment. This results in the emergence of a 'second order' map of how the Proto-Self has been modified by the incoming maps of the objectual data. It is this second order map that constitutes a representation of the Proto-Self, which does not require language or cognitive processing. It

[83] Unlike the traditional homuncular view of the brain and neural system, the non-homuncular Proto-Self is the (base or primitive) self that is created non-consciously from the physiological state of the entire organism's response to current stimuli. It should be viewed as collection of representations of the multiple dimensions of organism current state.

is a direct biochemical response to the individuals' experiences and concerned only with the present moment. It does not require language or memory and cannot reflect on past experiences nor project itself into the future (Damasio, 2000, pp. 149-159, 168-184). The Proto-Self gives rise to Core Consciousness, which is 'a simple biological phenomenon; it has one single level of organization; is stable across the lifetime of the organism; it is not exclusively human; and it is not dependent on conventional memory, reasoning, or language' (Damasio, 2000, p. 16). As Damasio says core consciousness is the feeling of knowing a feeling.

Unlike Core Consciousness, Extended Consciousness is a complex biological phenomenon that requires a vast use of conventional memory and is developed over the organism's lifetime. Extended consciousness is based on the core essence of the individual but is connected to the individuals' 'lived past' as well as to their 'anticipated future'. It is the consequence of the individual's ability to learn and retain all their experiences 'previously known by the power of core consciousness' and 'the ability to reactivate those records in such a way that … they too can generate "a sense of self knowing," and thus be known' (Damasio, 2000, pp. 196-197). Extended consciousness therefore requires the ability to hold multiple memories (maps or neural patterns), which describe the unique experiential history of the individual over substantial periods of time and have sufficient working memory to manipulate them intelligently. Damasio used numerous neurological case studies to advance his proposition of Core Consciousness and Extended Consciousness. He explained the individual's capacity to function without Extended Consciousness by examining patients suffering from Transient Global Amnesia in the form of migraines, trauma and Alzheimer disease. He also refers to Anosognosia and the interesting condition Asmatognosia where a patient lacks recognition of their body. In the latter case the patient knew she was alive and thinking but was unaware of her body. As Damasio said 'without the narrative of core consciousness and without the transient core self that is born within it, we would have no knowledge whatsoever of the moment, of the memorized past or of the anticipated future that we also have committed to memory' (Damasio, 2000, p. 218). In humans the Proto-Self, Core Consciousness, Extended Consciousness, and capacity for memory all form the basis of Damasio's concept of the Autobiographical Self.

In an interview Damasio described the Autobiographical Self as being built up over time based on the fundamental levels of self, such as the Proto Self and the Core Self. It is the collection of a lifetime of events that are constantly being sorted and stored by the individual. This creation of an Autobiographical Self requires an extensive capability for creating, sorting and storing of the individuals' unique and specific memories in terms of their emotional value. The Autobiographical Self is not static, it is constantly being updated, sorted and pruned of redundant data to make the individual more adaptive in situations. The more the individual knows the more likely it is they will be able to create solutions that may otherwise have seemed insurmountable. For these reasons Damasio believes humans needed larger brains, and larger brains allowed humans to adapt not only to their environments but also to the complexity of their relationships to other humans (Damasio, 2000, pp. 196-197).

The following table is my summary of Damasio's proposed ideas regarding feelings that result in the creation of consciousness, or awareness as I refer to it in this thesis

Level	Self	Consciousness	Description
Complex		Extended Consciousness	This occurs when working memory holds both a particular input object and objects in one's autobiographical self and the result generates a response at the level of core consciousness.
	Autobiographical Self		The Autobiographical Self requires; core consciousness, conventional memory to sort, store and retrieve autobiographical memories *and* 'working memory to make the autobiographical self explicit, that is, to display the autobiographical self in extended consciousness' (Damasio, 2000, p. 217).
		Autobiographical Memory	Autobiographical Memory is the organized record of the main aspects of the individual's biography.
	Core Self		This is a transient but conscious sense of self that emerges from core consciousness. It is a transient entity that is continuously recreated for every object with which the brain interacts. The core self operates in the presented moments.
		Core Consciousness	A specific wordless knowledge of the organism change of state by an object. Core Consciousness is a 'sense of self in the act of knowing an object is an infusion of *new* knowledge, continuously created within the brain as long as "objects" actually present or recalled, interact with the organism and cause it to change' (Damasio, 2000, p. 25).
Basic	Proto-Self		A non-conscious collection of representations of the multiple dimensions of current organism state.

Generally speaking, an individual's identity refers to what Damasio call the autobiographical self, which is the first layer of self that humans are consciously aware of. But the autobiographical self is itself the cumulative result of stored and processed outcomes of the individuals' unique lower level internal milieu responses or feelings, their core consciousness, which in turn comes from the core and proto self. As correct interpretation of stimuli leads to survival, core consciousness is fundamental to the process of evolution (Damasio, 2000, p. 219). This becomes important in the digital networked environment where stimuli of the internal milieu can be dispensed via micro rewards frequently, consistently, and over longer periods of time than is generally possible in the physical environment. While the rewards may be small in the digital environment, the cumulative effect of the frequent and repetitive stimulation can be more effective on neuronal wiring. Damasio also points out that our extended consciousness, which results from the autobiographical self, is a consequence of all the lower level systems experienced in the past and abstracted into constructs that are applied to future responses. Thus our behavioral learning at the lower levels of the internal milieu can potentially be amplified by the frequency of digital environment iterations.

4.3 Observable system: Presented behaviours.

Having developed some understanding of the complexities of systems that result in a range of diverse and unique permeations of individuals' behaviours that result from 'in the skin' and 'abstract' systems, I now discuss the observable system. These are the observed common behaviours of individuals that are more generally referred to as personality. Understanding the individual at this level is necessary because personality acts as a controller/governor of all information between the external and internal environment and is thus necessary for understanding digital engagement. The individuals' personality interprets and regulates information between the two environments.

Individuals tend to act consistently in a variety of situations providing a recognisable order and regularity to their behaviour, which can be identified in the individual's thoughts, feelings,

relationships and social interactions (Damasio, 2014). It is this consistent organised pattern of behaviour that is referred to as *personality.* Personality can be described as the sum total of the individual's physical, mental, emotional, and social characteristics that arises from within the individual and (Judge, Simon, Hurst, & Kelley, 2014) remains fairly consistent throughout their life (Robert R. McCrae & Jr., 1994). As Damasio argued, personality, traits or temperament, are 'already detectable around the time of birth. Some of those traits are genetically transmitted and some are shaped by early developmental factors' (Damasio, 2000, p. 222). Research has shown that personality is both heritable (Jang et al., 1998; Krueger, Markon, & Thomas J. Bouchard, 2003; Loehlin et al., 1998) and influenced by the environment (Buss, 1996; Stauffer, Maggiori, Froidevaux, & Rossier, 2014).

In the light of the previous discussion personality could be further described as an individual's set of observable behaviours that result from internal systems taken in conjunction with the environment in which the individual operates. Personality is thus an indicator of the mechanism of the individual's internal system and the environment. If personality is taken in this context it may be useful in providing insights into digital engagement.

4.3.1 Personality

There are extensive theories, research and instruments for personality classification that extend back as far the Greek physician Galen[84] who believed that personality was affected by four types of body fluid (Howart, 1988). This was in a way an association of behaviours with the internal milieu of the individual. Modern researchers view personality differences in degrees, referred to as personality traits or type (Carlson & Buskist, 1997, p. 454). Since the mid-1930s researchers have increasingly turned to natural language as a source for determining personality attributes for a scientific taxonomy. The idea being that words are developed by humans to describe commonly occurring things. As Stafford Beer explained what we now call 'biology' was still biology even before it had the name (Beer, May 16, 2012). Humans invent terms to more easily communicate frequently occurring things within their environment, for example the variety of words used by the Inuit to describe snow. To

[84] Galen: AD 129 – c. 200/c. 216. Galen's personality theory involved four personality types—Choleric, Sanguine, Phlegmatic, Melancholic and was believed to be affected by the levels of the four fluids in the body.

survive their frozen environment the Inuit required multiple descriptions of snow types whereas a single word for snow is sufficient for occupants of warmer climates.

From an unabridged English Language dictionary Allport and Odbert identified about 18,000 words that could be used to 'distinguish the behavior of one human being from that of another' (Allport & Odbert, 1936, p. 24). In order to identify recurring themes the researchers analysed and consolidated the 18,000 words to over 4,000 words and then to a more manageable number (Allport & Odbert, 1936). The underlying idea was that 'only when we know how to describe an individual's personality will we be able to explain it' since people invent words to describe distinctions they notice and language is a reflection of the observations of a culture (Carlson & Buskist, 1997, pp. 451-453). By using the identified descriptive words in surveys, researchers have been able to extrapolate personality groups.[85] Trait theorists suggest that the most basic personality traits range from three to sixteen traits. Working from Allport and Odbert's list of adjectives, interviews and observations of his subjects, Raymond Cattell developed a questionnaire, which ultimately led to identification of his sixteen personality factors, referred to a *source* personality traits (Cattell, 1946). Cattell's approach however attracted some fundamental criticisms and non–replication of factors which are of concern. Barrett and Kline for example strictly followed the Cattell methodology but they were not able to confirm the sixteen factors on a group of 491 undergraduates (Barrett & Kline, 1982). They found some factors that were sufficiently reliable and valid Additional inconsistencies emerged such as found in Rossier and associates more recent study using a sample of 386 general population participants (Rossier, Stadelhofen, & Berthoud, 2004). They found that the five-factor model and its associated subscales were more reliable than Cattell's model. This, plus additional research, led me to reject Cattell's personality instrument for this thesis.

Hans Eysenck on the other hand identified three factors; extraversion, neuroticism and psychoticism (as in aggressive, egocentric and antisocial, not as in mental illness). Eysenck's three factors are, however, bipolar dimensions meaning that each of the three factors has an opposite dimension: extraversion is the opposite of introversion, neuroticism

[85] The empirical research for this thesis used a similar approach to develop a measure of digital engagement. See Chapter 7.

the opposite of emotional stability and psychoticism would be the opposite of self-control (Eysenck, 1997). Unlike Allport and Cattell, Eysenck's theory is based primarily on physiology and genetics which, considering my interest in 'in the skin' systems, may have been ideally suited to my thesis. Eysenck was however primarily interested in *temperament*, which is the genetically based aspect of our personalities that is present from birth. Eysenck did not exclude the possibility of environmental influence on personality but it was not a major concern for him. As my interest was both 'in the skin' systems and the environment, I felt that I should only use Eysenck's instrument if another more suitable instrument could not be sourced. The five-factor model, which is discussed below, was eventually selected because it was equally suitable and has consistently proven to be reliable and valid (Yu, 2009).

Distinctions in Allport and Odbert's list of personality-related adjectives were analysed into themes by Ernest Tupes and Raymond Christal in 1961 and then later by Warren Norman. Norman finally consolidated the themed adjectives into five groups in 1963 s (W. T. Norman, 1963; Wiggins, 1996), or factors, are Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Loehlin et al., 1998; Robert R McCrae & Paul T.Costa Jr, 1997; Robert R. McCrae & Jr., 1994; Paul T Costa Jr & Crae, 1992; Paul T. Costa & McCrae, 1995). These five factors, when taken together are generally[86] held to be a complete description of an individual's personality that is stable over a 45-year period beginning in young adulthood (Soldz & Vaillant, 1999, pp. 208-232). The traits are in part heritable (Jang et al., 1998, pp. 1556-1565; Loehlin et al., 1998, pp. 431-453) and believed to have environmental adaptability value (Buss, 1996, pp. 180-207). As the five factors have been developed from a language base they are held to be universal. Considering all these factors I felt that the five-factor system provided a practical, valid and reliable means of measuring and evaluating of my participant's observable behaviours that could then be used to develop an understanding of digital engagement.

[86] Challenges regarding the validity and reliability of measuring personality and the instruments used to measure it persist particularly as more information is revealed in the field of neuroscience and genetics. However, despite having originated within the field of psychology, the use of the five factors as a personality measure has now spread to other fields of research such as education, human resources, marketing and neuroscience.

There are however two Five Factor systems: the Big-Five and the Five Factor Model (FFM). These are often used interchangeably. The Five Factor Model is associated with the emergence of personality factors through the McCrae and Costa questionnaire approach whereas the Big-Five is derived from the lexical approach of Allport and Odbert (Fruyt, McCrae, Szirmák, & Nagy, 2004). This instrument assesses 30 specific subscales that make up the five factors. There are six subscales for each of the five factors. My thesis incorporates the results of both the Big-Five Factor and their associated subscales that are equivalent to the NEO-PR-I instrument (Paul T Costa Jr & Crae, 1992).[87] This is discussed in greater detail in Chapter 6.

Due to the relative newness of digital networked technology and the resulting digital environment, personality instruments have primarily been developed for application and measurement in the physical environment.[88] It is reasonable to expect an individual's personality to be much the same in both the digital and physical environment, for example a scuba diver's personality does not necessarily change when they are in the water or on land. Based on this premise the instruments developed within the physical environment were presumed to be suitable for digital application. However, as I discuss in this thesis, there are differences between the digital and physical environments, which may affect individuals' core concepts, and consequently their behaviours. Thus the current personality instruments and structure of personality hierarchy may not always be valid or reliable within the digital environment. A significant amount of analysis and evaluation is required to investigate this further, with some relevant research emerging recently (Barnett et al., 2015), although it is often incidental to the research focus (Mitzner et al., 2014).

While the personality evaluation provided a measure and understanding of my participants' overall behaviours I felt I also needed a specific measure and understanding of how an individual takes action. Action however requires a decision, I therefore needed to understand and measure my participants' abilities to make decisions.

[87] See Appendix 8 for a comparison between the 30 facet scales in Costa and McCrae's NEO Personality Inventory (NEO-PI-R) and the corresponding Preliminary IPIP Scales measuring similar constructs, which was used in this research.
[88] This is discussed in Chapters 5 and 6.

4.3.1 Decision making

The controllers of a cybernetic system require action (or in-action) to initiate a moderating feedback loop. As an individual's action (or in-action) is contingent on their decisions I felt that decision making was as important as personality in developing an understanding of my participants' digital engagement behaviours. This required a valid and reliable decision making instrument. As illustrated earlier in this chapter both rational and intuitive decision making styles play a role in human survival, I therefore considered that individuals' decision making *styles* could provide insights into their likely responses in a given process situation.

Like personality, decision making is a well-researched and debated topic covering many disciplines. Decision making has been researched in a number of contexts from military (Bahrami et al., 2007; Shadbolt, 2009), through sociology (Hine, 2005), economics (Ariely & Carmon, 2003), psychology (Smith et al., 2004, pp. 1-70 and 163-240), neuro-economic (Loewenstein et al., 2008; Sanfey et al., 2006), decision sciences/computing (Fernandez, 2009; Saaty, 1990), and business, particularly human resources and marketing (Ang et al., 2006; Correia, 2007; Sapsed et al., 2002; Song & Chermack, 2008), to philosophy (Kraut, 2010; Rupert, 2009), with each discipline using their own approach to try and understand or theorise the decision making process. In the last few decades there has been a move to merge the perspectives of various disciplines in order to gain a better insight into the decision making process and factors that influence it (Dubé et al., 2006; Loewenstein, Read, & Baumeister, 2003a).

There are a number of well-established theories and frameworks relating to decision making (Beach, 1990; Payne et al., 1993; Rachlin, 1935). Many of these are variations of procedural steps, analytical hierarchy processes (Dettmer, 1997; Rahman, 1998; Saaty, 2008) or cyclical iterations such as Boyd's OODA Loop (Boyd, 1986, 1987; Greene, 2007).[89] Traditionally decision making theories and frameworks tended to originate in behavioural research (W. Lee, 1971), such as game theory, while others can be found in business

[89] Boyd's OODA loop is a framework that was developed by Colonel John Boyd and refers to the decision cycle of observe, orient, decide, and act, which was used to advantage military fighter pilots. This system has however been widely adopted in the business environment as a strategy for decision-making.

management research such as methodologies for improving corporate decision making (Francis, 1997, 2003).

Within this large pool of research there are numerous valid and reliable tests such as those developed by Amos Tversky (Tversky & Kahnema, 1981; Tversky & Koehler, 1994) and Keith Stanovich (Stanovich & West, 2007, 2008a, 2008b). Generally these tests tend to establish a measure of specific aspects of decision making such as framing effects, status quo and biases in individuals, rather than providing an overall measure of *how* an individual makes decisions: In other words evaluation of the individual's decision making *style*.

Humans have evolved two decision making styles, the rational decision making style (or rational thinking) which is managed by the frontal cortex and is responsible for reason, intelligence and morality, and the intuitive decision making style (or intuitive thinking) which is managed by the more primitive parts of the human brain; including the brain stem, diencephalon and the limbic region (Changeux, 1997; Damasio, 1994). As discussed previously both rational and intuitive thinking styles are the behavioural manifestations of the 'in the skin' neuronal systems but as noted earlier western knowledge tends to privilege rational thinking.

The increased interest in thinking styles over the last decade, relates to enhancements and availability of MRI's[90], which enable researchers to more accurately view active neural activity: For example the firing of dopamine neurotransmitters (the reward neurotransmitter) and levels of oxytocin (the commitment neuromodulator) (Doidge, 2007, pp. 71, 106-119). In other words technology advances are enabling understanding of the working internal milieu of the individual. Evidence from cognitive neuroscience and cognitive psychology are coming to a consensus that the brain has two different types of cognition, a trend endorsed by theorists from 'a diverse set of speciality areas (including cognitive psychology, social psychology, cognitive neuroscience and decision theory)' (Stanovich, 2010, p. 127). Stanovich proposes that there are two types of brain processing: Type 1, which is a fast automatic type of processing that is triggered by stimuli and does not require conscious

[90] Despite the origins and development of MRI's going back to Nikola Tesla's Rotating Magnetic Field in 1882 it is only in the last two decades that fMRI's have become readily available for general research.

deductive processing and Type 2, which is slow and 'computationally expensive'. (Stanovich, 2010, p. 129). Type 1 processing could therefore be equated to intuitive thinking/decision making and Type 2 to rational thinking/decision making. Based on this I sought an instrument that would evaluate the overall rational and intuitive decision making *style* of my participants because it is aligned with the biological underpinnings that I have discussed, rather than an instrument that measured specific aspects of decision making based other parameters.

Shane Frederick's cognitive reflection test was considered for this research (Frederick, 2005). This short test provides a behavioural measure of whether people rationalise their decisions or trust their intuition and is as effective as more lengthy tests and is in line with Stanovich's thinking of dual process decision making (Stanovich, 2010, pp. 94-160). However, Frederick's cognitive reflection test could not provide sufficient data necessary to develop a deep understanding of the role of decision making in digital engagement as being part of a cybernetic system. The test was too short for my purposes.

I therefore turned to Rosemary Pacini and Seymour Epstein's Rational and Experiential Inventory (REI) test. The REI test evaluates decision making styles in relation to personality, basic beliefs, and the ratio bias phenomenon.[91] In a number of ways this test is similar to the Five Factor test; the REI test is a linguistically based test using a five point Leichardt scale and measures four separate components of decision making (Pacini & Epstein, 1999; Witteman et al., 2009).

By using the personality (Big-Five Factor and NEO-PR-I) and decision making (REI) evaluation of my participants I obtained not only an understanding of my participants' observable behaviours in the context of the wider populations' perception of commonly observed behaviours but I also had a *measure* of these behaviours. This measure was later correlated to a measure of their digital engagement and is therefore important.

[91] The ratio-bias phenomenon is an evaluation of a purely logical decision compared to the actual decision and considered to provide systematic evidence of irrationality.

4.4 Neuroplasticity and Memory

Earlier I illustrated how necessary it is to understand the internal systems that are effected by stimuli from both internal and external environments and how the stimuli affects the ability of an organism to subliminally store abstract mental constructs that depict the internal milieus' responses to the stimuli[92] and how this aids the organism's survival. The ability to translate all these responses into retrievable autobiographical memories provides even greater survival advantage to the organism because they refine the organism's responses for specific, improved outcomes. For example a baby bird or human's instinctive withdrawal response to a large rapidly approaching object is generally an excellent survival strategy. However the autobiographical capacity to distinguish 'mother' from 'other' creates an even greater advantage because one may nurture while the other may destroy. This raises questions of how much and what type of input information is advantageous to humans, particularly with regard to the digital networked environment where the environment is not only new but it is also an abstract construct that relates to humans at the abstract level. Therefore understanding the human mechanism for abstract construct building, retention and management become important particularly as these are affected by stimuli.

Historically, due to philosophical and theological influences that were in part supported by early exploration of how the brain functioned, it was believed that the brain had designated areas for specific functions and these did not change over time (Changeux, 1997, pp. 3-37). For example, in the late 1700s Franz Joseph Gall believed in the innate development of the different parts of the brain. Each section, he proposed, corresponded to a different mental faculty. Gall's aim 'was to analyze cerebral functions and localize them without the help of introspection'. His thinking had little room for the role of sensations or feelings as discussed in the previous section of this thesis. 'In Gall's view, man possessed a great number of "moral and intellectual faculties," which he accepted as innate, essential, and irreducible. … Every aspect of behavior had its own "organ" confirmed to a precise area of the highest functional division of the brain – the cerebral cortex' (Changeux, 1997, p. 14). Cerebral localisation flourished around the early 1900s resulting in Brodmann's map, which provided

[92] For a more comprehensive discussion in regard to this see (Changeux, 1997, pp. 5-6) and (Malabou & Jeannerod, 2008, p. 3).

‘precise functional localization [that] replaced the naive naming of faculties, [and] was based not on an approximate cranioscopy but on undeniable anatomical and functional criteria’ (Changeux, 1997, p. 21). Brodmann’s map is still used today.

Despite the initial strong trend towards the belief in localised functioning of the brain, a few researchers proposed alternative views. As early as 1793, in the *Journal de Physique*, Italian anatomist Michele Vicenzo Malacarne claimed positive findings for his experiment on the brain size of trained animals. Using pairs of birds from the same clutch of eggs and a pair of dogs from the same litter Malacarne provided intensive training to only one of each pair while the other received none. After a few years Malacarne dissected the subjects’ brain and found that there were more *folds* in the cerebellum of the trained animals indicating an association between brain structure and the experience that resulted from the extensive training they had received. And in 1809 Jean Baptiste Lamarck proposed that special regions of the brain develop through appropriate use of related faculties (Rosenzweig, 1996, p. 4).

During the late 1890s Alexander Bain suggested a connection between memory and neural junctions, now known as synaptic junctions. Bain wrote that ‘for every act of memory, every exercise of bodily aptitude, every habit, recollection, train of ideas, there is a specific grouping or coordination of sensations and movements, by virtue of specific growths in the cell junctions’ (Bain, 1873, p. 91). In 1894 Santiago Ramon y Cajal took this a step further suggesting that it was likely that mental exercise would lead to greater growth of neural branches thereby enhancing the brain. Cajal even considered the issue of the brain’s size appearing to remain constant despite increased neural branching due to training. Cajal wrote,

> You may well ask how the volume of the brain can remain constant if there is a greater branching and even formation of new terminals of the neurons. To meet this objection we may hypothesize either a reciprocal diminution of the cell bodies or shrinkage of other areas of the brain whose function is not directly related to intelligence (p. 467) (cited in Rosenzweig, 1996, p. 6).

In 1949 Donald O. Hebb noted evidence of neural change, which led him to revive the ‘hypotheses about conditions that could lead to the formation of new synaptic junctions and

underlie memory' (Rosenzweig, 1996, p. 7). It was about ten years later that Mark Rosenweig and colleagues proposed that a neurochemical analysis of specific brain regions might provide insights into plasticity of the brain. This led to a series of experiments at Berkley that revealed measurable changes in both the neurochemistry and neuroanatomy of subject's brains. During the late 50s and early 60s Rosenweig and associates found 'significant correlations between levels of activity of the enzyme acetylcholinesterase (AChE) in the cerebral cortex and the ability to solve spatial problems' (Rosenzweig, 1996, p. 7). Over the following decade a number of researchers such as Edward Bennett, Marian Diamond, David Krech, Joseph Altman, Gopal Das, Edward Geller, Arthur Yuwiler, James Zolman, validated these findings, showing that training or differential experience did indeed produce measurable changes in the brain. They found that differential experience created weight differences, which although small, were extremely reliable and that the difference were not uniformly distributed throughout the cerebral cortex (Altman & Das, 1964; Bennett, Diamond, Krech, & Rosenzweig, 1964; Geller, Yuwiler, & Zolman, 1965; Greenough & Volkmar, 1973). This becomes interesting with regard to digital engagement where as discussed earlier there is an increase in frequency of stimuli that trigger biochemical responses: there is training with biochemical response.

Another study by Torsten Wiesel and David Hubel revealed a reduction in the number of cortical cells when external input was denied during the formative periods, which implied neuroplasticity during critical developmental periods (Hubel & Wiesel, 1963, 1965; Wiesel & Hubel, 1963a, 1963b, 1965a, 1965b). The study investigated 'the highly specific response properties of cortical cells [that] emerged during postnatal development' (Wiesel, 1981). This is also important because of the increasingly early age that users engage with technology. This has been exacerbated by intuitive hand gesture control of devices (Hsiao & Chen, 2016). About one hundred years had passed since Malacarne's insights into neuroplasticity but eventually neurochemistry and neuroanatomical adaptability, or as we now refer to it, neuroplasticity, had been scientifically proven.

Neuroplasticity took another dramatic leap forward with Merzenich and associates who argued that neuroplasticity could occur beyond the critical period demonstrated in Hubel and

Wiesel's experiment. This they proved in their owl and monkey amputation experiments (Merzenich, Kaas, Wall, Sur, et al., 1983). Merzenich and associates made a detailed micromap of a monkey's-hand-map in the brain thereafter they amputated the monkey's middle finger. After several months Merzenich remapped the monkey's brain to find that the brain map for the amputated finger no longer existed and 'the maps for the adjacent fingers had grown into the space for the middle finger' (Doidge, 2007, p. 61). In another paper during the same period Merzenich and associates noted that subjects clearly revealed, 'that this projection system [the mind maps] retains a self-organizing capacity in adult monkeys. They [the mind maps] suggest that processes perhaps identical to a part of the original developmental organizing processes (by which details of field topographies are established) are operational throughout life in this projection system in primates' (Merzenich, Kaas, Wall, Nelson, et al., 1983, p. 1). This is important with regard to digital engagement because how we engage with digital networked technology ultimately affects the development of the autobiographical self particularly when the engagement begins in the formative years. Rosenzweig points out that although 'the capacity for these plastic changes … remain in older subjects, the cerebral effects of differential environmental experience develop somewhat more rapidly in younger than older animals, and the magnitude of the effects is often greater in the younger animals. Also, continuing plasticity does not hold for all brain systems and types of experience' (Rosenzweig, 1996, p. 10). Other researchers such as Mark Baer, Wolf Singer and Andreas Kleinschmidt showed they were able to chemically restore adult visual cortex plasticity by infusing accetylchlorine and noradrenaline. Further work showed that inhibiting the glutamate NMDA receptor could prevent plasticity (Kleinschmidt, Baer, & Singer, 1987) .

The discussion thus far has examined how a stimulus affects individuals' internal systems and their ability to adapt. Now I examine research where technology has specifically been used to promote neural adaptation. This is important because humans are increasingly interfacing their brain with digital networked technology and the resulting iterations can be both frequent and intense. These circumstances of increased frequency and intensity create a learning environment that is conducive to behavioural learning, neural modification and ultimately the development of the autobiographical self. The impact of digital engagement on

neuroplasticity of the individual could potentially lead to dramatic shifts in social behaviours. There are already indicators of this in altered social behaviours resulting from engaging with digital networked technology and social media in particular (Han et al., 2015; Y.-H. Lee et al., 2015). Examples of recent research ranges from the addictive properties of technology use and the affects of engaging with technology on the structure of the brain (Kuhn et al., 2014) or chemical changes within the brain (Ernst & Luciana, 2015), to the relationship of innate attributes to technology adoption (Barnett et al., 2015; Mitzner et al., 2014). Understanding the mechanism of digital engagement will aid not only individual participants but also researchers and stakeholders in the digital networked environment to manage digital engagement in a socially responsible way.

In the 1960s, Paul Bach-y-Rita successfully demonstrated how appropriate external stimuli could change the brain. The stimuli came from a device that he had invented, which allowed blind people to see, perceive shadows, and distinguish between close and distant objects. To do this Bach-y-Rita used sensory substitution. The success of Bach-y-Rita's work implied the brain's capacity to adapt - that the brain was plastic and would respond to technical device stimulation (Doidge, 2007, pp. 1-26). In a review of Human Machine Interface (HMI) research Bach-y-Rita and Kercel concluded that '[s]ensory substitution studies have demonstrated the capacity of the brain to adapt to information relayed from an artificial receptor via an auditory or tactile HMI' (Bach-y-Rita & Kercel, 2003, p. 544). They anticipated three paths of future development, which in many ways have come to pass. The first was the development of robust inexpensive technology that would be accessible to a wide range of users. Mobile technology and global network infrastructure has certainly done this. Secondly they saw the possibility of using technology to expand human sensibilities, for example, enabling the use of night vision apparatus without interfering with normal vision. This has been demonstrated in Google Glass and military night-scopes. Finally, they anticipated that technology, as a human machine interface, had the potential to enable a range of non-invasive low-risk experiments with human subjects to gain a deeper understanding of brain plasticity and cognitive processes. This has certainly happened with regard to fMRI technology.

There has been a dramatic increase of research into neuroplasticity due to enhanced capabilities and easier access to advanced technology such as MRIs. For example Eleanor Maguire and associates' observation of the changes in posterior hippocampi of London taxi drivers due to their enhanced experiential learning in relation to spatial representation of their environment (Maguire et al., 2000), and subsequent hippocampi related research into perception, learning and memory (Zeidman, Mullally, & Maguire, 2014). There is also emerging research into environmental learning, which examines active neurological learning using an fMRI while participants navigate a virtual reality world (Auger, Zeidman, & Maguire, 2015). As the individual is exposed to various stimuli, brain plasticity allows for functional and structural adaptation that underlies learning and memory. Lindsay Oberman and Alvaro Pascual-Leone argue that the mechanisms of plasticity change over the lifespan with different slopes of change in different individuals. Plasticity, they propose, is not limited to any specific age (Oberman & Pascual-Leone, 2013; Pascual-Leone et al., 2011). If digital engagement is indeed affecting our internal biochemistry, then understanding its effects are important. While my comments may appear to align with Susan Greenfield who said "[t]he digital world is an unprecedented one and it could be leaving an unprecedented mark on the brain" (Rivett, 2014), my focus is different. I am less concerned with the physiological impact of technology, than with the innate nature of the individual as a cybernetic system that will adapt and adjust to and with technology as a system. Human engagement with digital networked technology may in effect be our unwitting experiment with brain plasticity and, while it may be non-invasive, it may or may not be risk free because brain adaption can manifest in both positive and negative ways. Understanding the mechanics of digital engagement will shed light on how and why it affects individuals differently and understanding the process will assist in the development of methods for the management of technology. This requires understanding the relationship between the two components (individual and technology) and is accomplished by correlating a measure of the individual (personality) and a measure or their digital engagement. This is discussed in the following three chapters.

5 Measuring the Individual: Survey 1

In this chapter I move from the broader theoretical and critical contexts of previous chapters to provide details of participants within my case study. The first survey that I conducted with my participants provides an overarching perspective of observable behaviours. Psychologists call these subsets of individual's observable behaviours 'personality traits'. Personality traits are commonly found behavioural groupings. Each individual will display behaviours of every group to a degree but some will dominate. How behaviours are grouped is ultimately determined by the theory or instruments used to evaluate the behaviours but regardless of the method used there do appear to be identifiable groups.

In this thesis I have used the Big-Five Factor classification, which provides five distinct groups: Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. I also included the Rational Experiential Inventory, which evaluates rational or intuitive decision-making. Four additional scales that were considered possibly related to digital engagement were included but as the discussion will show they did not add anything of importance to the discussion. This overview analysis of behaviours provided a necessary starting point for understanding behaviours. It also coincidentally supported my proposition that behaviours at some level were different in the digital environment.

Survey 1 used simple questions to gather a response on a 5-point scale for each of the traits. For example when measuring Extraversion the participant was asked whether they agree or disagree to statements like "I am the life of the party."

The chapter begins by discussing my participant interviews, which I use to illustrate personality behaviours within the digital environment. I then describe the Big Five personality factors and four selected subscales, as well as the Rational Experiential Inventory (REI) subscales, which were in my first survey. The personality descriptions are as they are understood specifically within the field of Psychology. The order of factor descriptions will follow the mnemonic 'ocean' which is commonly used in psychology to remember the five factors Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. I then

examine the range[93] of Survey 1 results to see which, if any, factors were more common within my sample group of ICT professionals. I begin this analysis by examining the factor that had the highest number of high scoring participants (Agreeableness) and then that of the lowest (Extraversion). These are then compared to Openness, which was the lowest score of the only high scoring Extravert. I finally discuss the remaining two factors Conscientiousness and Neuroticism.

5.1 The Interview Process

The data for the qualitative part of this research came from three separate interviews that I had with each participant totalling over thirty hours. The interview sessions lasted between 25 and 80 minutes and the interviewing period for each participant was spread out over three months. The total interview period of all participants spanned six months due to work commitments of participants. At the end of each interview all participants agreed to my use of any supplementary discussions in this thesis.

The Apple iPad was used to record interviews partly because of its recording quality and mobility but mostly because it was unobtrusive and blended into the company environment. Interviews were conducted in a number of locations including conference rooms and private offices. In all cases, the door was closed, participants were relaxed, and dialogue was not inhibited. The interview schedule was freeform and flexible. Participants informed me of which day they would be in the office and they organised an interview schedule among themselves that suited their commitments for that day. As a result most interviews were conducted without interruptions and participants were at ease.

During the interview each participant was led through the set questions for that specific interview. The structured nature of the first interview was beneficial in a number of ways. Firstly, it gave a standardised starting point for all participants to answer the same questions in the same order. This provided a baseline for me to categorise how and in what way my participants engaged with digital networked technology. Secondly, the structure of the interview put participants at ease as they realised that everyone would be asked the same

[93] I use the term 'range' to describe the variation between the upper and lower limits of a particular scale.

questions. The first interview provided rich information regarding *uses* and *perceptions* of digital networked technology. (See Appendix: 12). This relaxed yet reassuring entry point for the interview process laid the groundwork for the second interview, which involved only five open questions that required more discussion. (See Appendix: 13). This second interview was more challenging for participants as it explored *why* they used technology and, more importantly, how they were *experiencing it,* something most participants had not considered. Having gained the confidence of participants in the first interview, all participants appeared willing to explore and discuss the challenges presented in the second interview. The second interview resulted in rich data and more personal insights into individual's digital engagement. The third and final interview provided an opportunity for each participant to address all themes and concepts that I had identified from the first two sets of interviews. (See Appendix: 14). The structure of the interview process was designed to elicit deep, meaningful and intelligible responses and it appears to have met these objectives.

Keeping in line with Kathy Charmaz' 'initial coding' process (Charmaz, 2006, 2008) my preliminary examination of each participant's interview was done as soon as possible after the interview. I also made notes of relevant issues or impressions obtained during casual conversations with participants. These usually took place while waiting to do an interview or during staff meetings, which I had been invited to attend. The interviews are discussed in more detail in Chapter 7.

5.2 Description of Big Five Factors.

It must be emphasised that the personality tests used for this research were originally designed to measure physical world behaviours, *not behaviours in the digital networked environment*. As such, the generally accepted meaning and understanding of these factors can only confidently be related to personality behaviours within the physical environment.[94] The following descriptions are based primarily on the Handbook of Personality[95], but have

[94] As a result of this and emerging research I do not believe that current personality instruments can be used with confidence to evaluate individuals who operate within both physical and digital environments. I propose that new or modified valid and reliable instruments, which are not within the scope of this research, need to be developed. In addition I have come to question contemporary claims of personality stability throughout ones life particularly in more fully engaged individuals.

[95] These descriptions are primarily based on The Handbook of Personality edited by Robert I Hogan, John A Johnson and Stephen Briggs (1997) Academic Press but have been supplemented with additional readings quoted in this thesis.

been supplemented with additional readings cited in Chapter 4. The definition of personality-related terms follows the field of psychology (see glossary) rather than a common understanding of the term although in many cases these are similar. It should also be noted that every individual possesses all five factors to a greater or lesser degree and all factors are viewed as a continuum with an individuals' personality score falling somewhere between the two extremes of each factor (Carlson & Buskist, 1997; Field, 2013).

5.2.1 Openness

The assumption is that when using an Openness instrument one is testing Openness. However there are two main forms of Openness: 'Openness/intellect' and 'Openness to experience'. In many situations these are used interchangeably particularly outside the field of psychology. The differences between these two versions can however be important; one version examines a propensity for *intellect pursuits* and the other a *pursuit of experience*. The differences are found in the bias of wording in some item-questions as well as the weighting of questions that either support *intellect* or *experience*.

In most cases the differences are likely to be insignificant and either version can be used to determine a general measure of an individual's Openness. For this research however the difference proved notable and is discussed below. This thesis uses the Openness/intellect as the primary definition, which is more suited to this research, but I will also include the 'Openness to experience' definition, which does play a part. Twelve of my participants were tested on both the Openness/intellect and Openness/experience tests and four only did the Openness/intellect test, as they were no longer available for the second test.

Openness/intellect describes a cognitive style that differentiates creative or imaginative individuals from more down-to-earth, unimaginative or practical individuals. A person scoring higher on the openness scale will be more individualistic: tending to act and think in new or creative ways. Higher openness scorers think in abstract concepts through the use of symbols or metaphors and enjoy the challenge of 'the complex'. Depending on the individuals' abilities their abstraction capability may take the form of geometric thinking, mathematics or logical problem solving. If they are more artistic then the abstraction ability

may take the form of metaphorical use of language or one of the many visual or performing arts. Definitions of **Openness to experience** describe behaviour as being very similar to the above definition but there is an emphasis on a preference for *variety of experiences*, or for seeking the different and new.

At the other end of the continuum individuals who score lower on Openness tend to be less individualistic and are more conservative with narrow or more common interests. The less open prefer simple, straightforward and obvious as opposed to complex, ambiguous, and subtle. They will prefer familiarity to novelty and will be resistant to change.

5.2.2 Conscientiousness

Conscientiousness refers to the way in which we control, regulate, and direct our impulses. Individuals who are high in conscientiousness will tend to achieve high levels of success through focused planning, persistence and avoiding trouble. Individuals high in Conscientiousness are viewed as being reliable but may appear to be compulsive perfectionists and workaholics. Intelligence is generally associated with the ability to think about future consequences before acting on impulse. As such the conscientious individual will often be positively *perceived* as intelligent because they will tend to display contemplation, organization, planning and tenacity in the pursuit of long-range goals in the face of short-term impulse benefits. They may however not necessarily be high scorers of intelligence.

5.2.3 Extraversion

Extraversion describes individuals who have a pronounced engagement with the external world.[96] They enjoy, and thrive on being with other people and in larger groups they will draw attention to themselves, be assertive and talkative. The extravert will tend to be enthusiastic, action-oriented, energetic, and will often experience positive emotions. In contrast introverts lack the external display of energy and exuberance of the extravert and will tend to disengage from the social world for periods of time: This withdrawal should not be interpreted as shyness or depression: Introverts are content with their own company and

[96] In this research the external world would be regarded as the physical environment.

simply need less stimulation than an extravert. They will present as quiet, low-key or deliberate.

5.2.4 Agreeableness

Agreeableness reflects an individuals' concern with cooperation and social harmony. The individual will tend to have an optimistic view of human nature and believe that people are generally honest, decent, and trustworthy. They value their relationships with others and will therefore tend to be considerate, generous, helpful and friendly. The highly agreeable individual may be willing to compromise their own interests to suit others. In contrast the disagreeable individual will place their self-interest over others and are less likely to extend themselves for other people. Scepticism in the less agreeable may cause them to appear suspicious, unfriendly, and uncooperative.

5.2.5 Neuroticism

Individuals with high scores in neuroticism are emotionally reactive and likely to interpret ordinary situations as threatening, and minor frustrations as extremely difficult. They have negative emotional responses that persist longer than those with low scores. Their difficulty in regulating emotional responses can inhibit their clarity of thought, decision-making processes and stress management. They may primarily experience a specific negative feeling such as anxiety, anger, or depression, but are unlikely to experience several of these emotions simultaneously. By contrast individuals who score low in neuroticism are *less* emotionally reactive. They tend to be calm, emotionally stable, and free from persistent negative feelings. Low scoring individuals on the factor Neuroticism are often referred to as being stable.

5.3 Description of Additional Personality Scales.

The following descriptions are of the four *additional* personality subscales that were selected for their possible relation to digital engagement as an attempt to find an *existing measure* that could possibly relate to digital engagement.

5.3.1 Self-consciousness - a Subscale of Neurosis.

The personality factor self-consciousness describes the capacity of an individual to exercise introspection and the willingness to learn more about their own fundamental nature, purpose and essence. From this description I felt the self-consciousness scale would in some way be relevant to digital engagement because individuals who have the *capacity* for introspection and a *willingness* to learn more about themselves in relation to the environment in which they operate would likely be more adaptive and have the potential to capitalize on digital networked technology affordances. I felt that the ability to self-reflect was possibly an intrinsic part of the digital engagement process.

While the description of the scale was potentially suitable, evaluation of the actual item-questions[97] for this scale raised some concerns. In general the item-questions evaluated conditions within the physical environment. For example 'Find it difficult to approach others' and 'Am easily intimidated'. These item-questions could possibly be related to the digital environment but the virtual nature of the environment reduces (physical) consequences and the individuals' ability to read traditional engagement cues. This made the relevancy of these and similar item-questions debatable within the digital environment. On the other hand some of the item-questions within the self-consciousness scale were potentially useful for personality evaluation within the digital environment such as 'Stumble over my words'. Overall item-questions were better suited to the physical environment. Despite my reservations I used this scale. It had a Cronbach alpha of 0.8, which indicated that the scale was considered to be a valid instrument for evaluating an individual's self-consciousness and at the time this was the closest instrument that I could find to measure self-awareness, which I thought would be necessary.

5.3.2 Trust - a Subscale of Agreeableness.

Trust describes the 'dependence upon or faith and assurance in the worth, authenticity, or value of something or someone. Trust is thought by most psychological researchers to be a

[97] An item-questions in this context is a statement that is part of a set of questions used to evaluate a personality factor. The participant then evaluates each statement (item-questions) on a Leichardt scale (1) being not at all like them to (5) being very much like them.

main element in mature unions with other people, whether therapeutic, social, or intimate'.[98] As with self-consciousness some item-questions of the trust scale were potentially good for personality evaluation within the digital environment such as 'Believe that others have good intentions' but again most item-questions were more suited to the physical environment.

5.3.3 Self-disclosure

Self-disclosure is the revealing of oneself to another usually for the purpose of initiating or developing a relationship. In the physical environment self-disclosure is executed in numerous ways, for example our mannerisms, the clothes we wear, our choice of transport or vocabulary. Human signalling and understanding of these disclosures has evolved over time. In the digital environment signalling and understanding of disclosures are still evolving at a dramatic rate and new social behaviours are developing (Engel, Woolley, Jing, Chabris, & Malone, 2014; Shangguan & Huang, 2014).

5.3.4 Flexibility

Flexibility describes an individuals' ability to adapt to different situations and to embrace change. The flexibility item-questions were again mostly oriented to the physical environment and as a result I do not believe that I obtained a true measure of my participants' flexibility with regard to digital engagement. A more accurate instrument would require extensive research, which is not in the scope of this thesis. I did however feel it was worth including this instrument on the off chance that it might provide insights.

5.4 Description of REI: The Decision-making Scales

Instead of describing the four scales as four separate entities I have grouped them into two; Rational and Experiential (in discussions I will use the term intuitive rather than Epstein's term experiential as discussed earlier in Chapter 4). Each group has two aspects; ability and engagement (in discussions I will use the term iterations rather than Epstein's term engagement as discussed earlier in Chapter 4).

[98] See http://psychologydictionary.org/trust-1/" title="TRUST 1">TRUST 1

5.4.1 Rational Ability and Rational Iterations.

The rational thinking style is described by Seymour Epstein as being 'an inferential system that operates according to a person's understanding of the rules of reasoning and of evidence, which are mainly culturally transmitted' (Epstein, 2003, p. 161). This factor has two subscales 'rational-*ability*' which relates to the individual's means, skill or proficiency in performing rational thinking and 'rational-*iterations*' that evaluates frequency-in-use of a person's rational thinking.

5.4.2 Intuitive Ability and Intuitive Iterations.

Epstein explains intuitive thinking style as being 'preconscious, automatic, rapid, effortless, holistic, concrete, associative, primarily nonverbal, and minimally demanding of cognitive resources' (Epstein, 2003, p. 160). He explains that It encodes information as memories of individual events as well as in a more abstract and general way. The intuitive thinking style also has two subscales 'intuitive-*ability*' which relates to the individual's means, skill or proficiency in performing intuitive or preconscious thinking and 'intuitive-*iterations*' that evaluates the frequency-in-use of a person's preconscious or intuitive thinking.[99]

5.5 Survey 1: Results and Discussion

In the background I discussed observable behaviours as being an external manifestation of the internal systems of an individual. These observable behaviours are commonly known and understood as being *personality* and *decision-making style* both of which have a large body of supporting research. In this section of my thesis I use the specific terms *personality* or *decision-making style* because I am describing concepts from the field of psychology but where I examine the process of digital engagement I will use the term *observable behaviours* as a phrase that encompasses both parts.

As I was still formulating the concept of digital engagement and its possible relationship to personality I decided that a purely statistical analysis would be less informative than considering the rich interview data in relation to the survey results. I therefore examined

[99] Epstein describes preconscious as being between the conscious and sub conscious. It is that part of ones memory that can readily be recalled but is not in the active conscious mind of the individual.

Survey 1 results to identify trends or patterns and explored these trends in relation to the interview data. I used this approach because of the small size of my sample group and its homogeneity. A purely statistical analysis may have masked findings and hidden possible insights. Recent research using large sample groups is coincidentally substantiating my findings. As the discussion progresses you will note that I became increasingly aware that the Big-Five Factor was insufficiently fine grained to *explain* the trends being revealed. The Big-Five Factor provided an excellent overall indicator of relationships between personality and engagement with technology but not *why* there were differences even when profiles were similar. This was particularly apparent in the discussion below about Dan and Max. It was only by the end of this analysis that I decided I needed a more detailed investigation of participant's personalities.

The table below shows the range[100] of Big Five Factor personality results of all my participants: Pseudonyms have been used. To aid discussion I have labelled the continuum in the following way. In each table yellow indicates the participants who scored highest in the specified category (VH), green are those who scored second highest (H), blue are middle scorers (M), grey scored fourth (L) and white were the lowest scorers (VL) of that category.[101]

Table 2 Big Five Factor Results: Survey 1
All Participants Scores Ranked Highest to lowest for each Factor

Openness	Ben	Tim	Dan	Fay	Max	Sue	Con	Kate	Tom	Ann	Bob	Ivy	Roy	Eva	Sam
Conscientiousness	Con	Roy	Ann	Bob	Kate	Sam	Tom	Ben	Eva	Fay	Ivy	Sue	Tim	Dan	Max
Extraversion	Sam	Ann	Eva	Dan	Max	Con	Ben	Bob	Fay	Ivy	Kate	Roy	Sue	Tim	Tom
Agreeableness	Ann	Dan	Eva	Fay	Ivy	Kate	Max	Sue	Tom	Ben	Con	Roy	Tim	Bob	Sam
Neuroticism	Bob	Ivy	Ben	Dan	Eva	Roy	Tom	Fay	Kate	Max	Sam	Sue	Tim	Ann	Con

Highest Score	VH	H	M	L	VL	Lowest Score

The first important observation of these results was the distribution of Agreeableness scores, which was weighted to the higher end of the continuum; nine were highest scores (VH) and there were no lowest scores (VL). This weighting to the high-end of the range indicated that there was a relationship between individuals who were higher in Agreeableness and the ICT

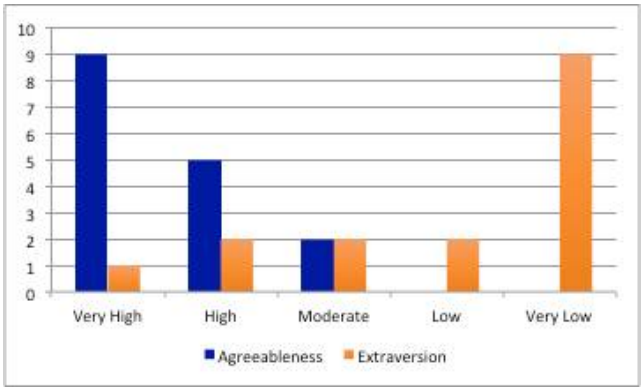
[100] I have use the term range to describe the variation between upper and lower limits on a particular scale
[101] Participants' actual scores were *not* used because at this stage as it was the relative value that was being examined.

industry and therefore possibly to digital engagement. The second important observation was the large group of nine lowest scores (VL) in Extraversion and only one individual who score Extraversion as their highest score (VH). These observations suggested a possible relationship between these two factors that warranted further investigation. As the other three factors, Openness, Conscientiousness and Neuroticism all had a varying range of scores I decided to begin by examining Extraversion and Agreeableness to see if there was a relationship between the two factors that could be supported by the interview data.

5.5.1 Agreeableness and Extraversion

The following graph is an extract of Table 1 above showing only the Agreeableness and Extraversion data.

Graph 2 Agreeableness compared to Extraversion



The range of Agreeableness scores showed that all participants in this sample group displayed Agreeableness behaviours at a moderate to very high level in their everyday activities and over half of these participants were at the maximum level (VH). Of the remaining participants, over half were at the high level (H). As my sample group were ICT professionals these results suggested prima facia that people higher in Agreeableness would gravitate to the ICT industry. It did occur to me that the high occurrence of Agreeableness in this sample group could have been a result of the hiring preference of the company. However in a follow-up discussion management confirmed that personality was

not a major recruiting consideration for this company except in the case of sales staff: Job competency and skill level of employees was the primary criteria.[102]

Examination of the Extravert scores showed nearly three quarters of the participants had diminished extravert behaviours; scoring from moderate (M) to very low (VL). From these results it appeared that individuals who score higher on Agreeableness and lower on Extraversion were likely to be attracted to the ICT industry.[103] However as the following discussion will show the explanation is not that simple. Closer examination showed that the (VH) Agreeableness individuals were not necessarily averse to extravert behaviours.

Table 3 Agreeableness & Extraversion: All Participants Score Ranked Highest to lowest for each Factor

Extraversion	Sam	Ann	Eva	Dan	Max	Con	Ben	Bob	Fay	Ivy	Kate	Roy	Sue	Tim	Tom
Agreeableness	Ann	Dan	Eva	Fay	Ivy	Kate	Max	Sue	Tom	Ben	Con	Roy	Tim	Bob	Sam

Highest Score	VH	H	M	L	VL	Lowest Score

Unlike Fay, Ivy, Sue, Kate, and Tom, who had Agreeableness and Extraversion at the extremities of their personality range (VH and VL), participants Ann, Eva, Dan and Max scored very high in Agreeableness (VH) and had extraversion as either their secondary or tertiary trait (H or M) making the difference between their Agreeableness and Extraversion traits less important. Observations based on these scores were corroborated in participants' interviews where the latter group displayed a preference for *physical* interaction with other humans rather than using technology. As seen in the examples below, Ann, Eva, Dan and Max all had a preference for face-to-face interaction: a preference that is strongly indicative of the Extraversion subscale gregariousness.

In Ann and Eva, who both scored (VH)-Agreeableness and (H)-Extraversion, we find that Extraversion appears to have moderated their (VH)-Agreeableness tendencies by raising the importance of face-to-face contact. Ann feels that face-to-face is essential for relationship

[102] As this research is about developing an understanding of digital engagement it is believed that management's comments regarding hiring preferences are sufficient at this time. However, it is recommended that any future research in this area should specifically address environmental influences as a possible confounding factor.
[103] People who use digital networked technology for their livelihood.

building while Eva feels that social interaction should not be done digitally it should be face-to-face.

> Ann i1q3: "I definitely think that face-to-face.. I think that public relations is all about meeting touching feeling seeing that person."

> Eva i1q1: "Exactly it [digital networked technology] is not for passing the time of the day... I like to pass the time of day face-to-face with somebody."

Both Max and Dan scored (VH)-Agreeableness and only (M)-Extraversion. Max, who is only moderately skilled in technology by comparison to Dan, resents the influence of technology and feels that it gets in the way of social contact.

> Max i1q1: "I know that I don't really like them [digital networked technology] but its like the only way that I can contact, people keep in touch with people now days, because everyone else does use it … you can't avoid it. You have to."

Dan on the other hand loves technology and is highly skilled in digital networked technology but he is passionately against technology when it comes to human contact and relationship building.

> Dan i1q1: "I love them [digital networked technology] you know it's my life both in business and in personal life… Where I start deviating is with certain applications such as social media … I find people get way too caught up in social media. Especially things like Face Book, Twitter … I've had arguments with friends; I've had knocked down arguments with family over it, 'I posted on your [page] and you didn't reply' and I'm like, why didn't you ring me? [indicated using a telephone]"

This suggests that both a highly skilled and a moderately skilled participant find technology an intrusion on relationship building. Now compare Dan's comment to Fay who has (VH)-Agreeableness and (VL)-Extraversion.

> Fay i1q1: "I have actually found that with Facebook through my iPhone I at least feel connected to people...it [digital networked technology] … emotionally frees me from feeling socially isolated."

In all four higher scoring Extraversion participants, Ann, Eva, Dan and Max, there was a clear preference for the *physical proximity of others* with regard to their relationship to other humans, and a distinct frustration with technology. In all four cases the high or moderate Extraversion score was moderating the participants very high Agreeableness. Fay on the

other hand typified the behaviours of participants with (VH)-Agreeableness and (VL)-Extraversion. In these cases engagement with digital networked technology was embraced and perceived as advantageous.

The (VH)-Agreeable-(VL)-Extraversion group, which was more than half of the (VH)-Agreeableness group, showed negative extravert behaviours in both interviews and in general work situations. For example during weekly staff meetings Kate, Ivy, Sue and Fay were not particularly vocal in these larger group situations. However over the course of my data collection period I observed that they were quite open and willing to converse in smaller groups of two or three people. This (VH)-Agreeable-(VL)-Extraversion group was particularly open and chatty in the interviews and all four participants were eager to share their ideas and experiences. This behaviour was different to the (VH)-Agreeable-(H)&(M)-Extraversion group (Ann, Eva, Dan and Max) who became more verbose and vibrant in the larger group setting. Overall participants in the (VH)-Agreeable-(VL)-Extraversion group had a more leisurely demeanour with moderated moods. There was however one participant in this group who was particularly interesting: Tom.

Tom displayed many of the (VH)-Agreeable-(VL)-Extraversion behaviours but at times his behaviours became extreme. For example at he would become quite unapproachable, almost reclusive and withdrawn, while at other times he would be gregarious and assertive.[104] Despite clearly falling into the (VH)-Agreeable-(VL)-Extraversion group Tom's inconsistent behaviour made me realize that there could be some underlying factors that I did not understand. It became apparent that understanding the relationship between engagement and personality would require a deeper examination of personality traits at the subscale level. This is discussed below in Chapter 6. I concluded that while the Big Five Factor was providing indicators of personality traits that were useful for developing a general understanding of digital engagement, I would require more specific personality indicators if I was to obtain an understanding of anomalies such as Tom.

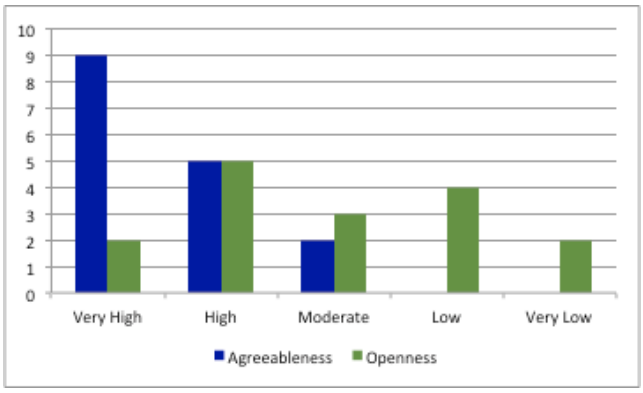
[104] These observations were made during company staff meetings to which I was invited and by observing general interaction of staff members during the interview period when I had to wait for participants. In addition to this there were numerous occasions during the organization of the second survey where I had the opportunity to observe behaviours. Although sporadic the total time frame that I was able to observe participants in their work environment was over one and a half years.

From this initial review of data it appeared that the pairing of higher Agreeableness personality traits with low Extravert behaviours could possibly be indicative of individuals with a propensity for digital engagement. In other words, using this instrument, the Agreeableness personality trait appeared more suited to the digital networked environment than the Extraversion trait. Extraversion on the other hand appeared to be more suited to the physical environment.

5.5.2 Openness in Relation to Agreeableness and Extraversion

In this sample group there was the only one participant, Sam, who scored Extraversion as their highest score.[105] Following the grounded theory approach of developing themes or trends as they were revealed, I decided the next factor that I should examine in relation to Agreeableness and Extraversion was Sam's lowest score Openness. I also felt that Openness was likely to relate to the digital environment because the environment is an abstract construct as well as being an unprecedented reservoir of information and experiences. These attributes appeared to be ideally suited to the description of an individual scoring high in Openness. The following is a graph of Openness and Agreeableness.

Graph 3 Agreeableness compared to Openness.



With Openness being related to intellect I had anticipated a bell curve but found instead an 'M' profile. The significance of the Openness results was not the weighting of the results to the high end of the scale as in Agreeableness or the low end as in Extraversion rather it was the dip in the middle that provided interesting insights.

[105] Research for this thesis required a relatively small sample group in order to obtain the rich information essential for development of theories and understanding of digital engagement. Unfortunately having a smaller sample group resulted in an inadequate spread of results: Exemplified by only one high scoring Extravert. This highlights that future research should use a larger sample group.

Table 4 Agreeableness & Openness: All Participants
Score Ranked Highest to lowest for each Factor

Openness	Ben	Tim	Dan	Fay	Max	Sue	Con	Kate	Tom	Ann	Bob	Ivy	Roy	Eva	Sam
Agreeableness	Ann	Dan	Eva	Fay	Ivy	Kate	Max	Sue	Tom	Ben	Con	Roy	Tim	Bob	Sam

Highest Score	VH	H	M	L	VL	Lowest Score

As existing research has shown that high scorers on the Openness subscale 'intellect' tend to score higher than low-intellect scorers on a standardized intelligence test (Young, Quilty, Peterson, & Gray, 2014), I expected to see some form of higher intellectual ability in participants with a higher Openness score.[106] Of the two highest scorers in Openness Tim is a registered member of Mensa as such he has a confirmed IQ in the top two percentile. Ben was the other high scoring participant and despite not having a university education, he is expert in solving complex problems that requires abstract thinking, which is an indicator of higher intellectual ability. Of those participants who valued openness as secondary trait (Dan, Fay, and Max) all have a university degree, while Joe and Sue have started but had not yet completed university due to work priorities.

In summary, all five participants with higher scores in Openness showed evidence of intellectual ability. High scorers of the Openness personality trait were consistent with my expectations that there was possibly a link between Openness, Agreeableness and digital engagement: In other words high scorers of Openness, particularly where the instrument was Openness/intellect as this survey was, would likely be comfortable operating within the abstract nature of the digital networked environment. On the other hand the lower scorers on the Openness trait did not show any particular trend related to intellectual ability: Ivy, Roy and Sam all have university degrees while Bob, Ann and Eva do not. This made my previous assumption less feasible and once again indicated that while the Big Five Factor was providing good general indicators, I required more specificity in regard to personality traits in order to obtain any meaningful insights into the relationship between personality and digitally engaged ICT professionals.

[106] As intelligence testing was not specifically part of the original research I was reliant on other indicators of intellectual ability, impediments or reduced ability. Indicators were level of academic achievement or related information obtained in recorded interviews or from discussions

Examination of the dip in the graph did revealed some interesting environmental complexities that supported my decision to use a mixed method approach to develop an understanding of digital engagement and its possible correlation to personality type. The three participants in this group were Tom, Kate and Con. Both Tom and Kate had learning or educational problems; Tom has dyslexia[107] and aggressively uses technology such as 'spell check' and '*intelliSensing'*[108] to compensate for this. Kate on the other hand had a very limited education due to economic and environmental constraints, but has used digital networked technology to compensate her limited education. In the following extract Kate describes in a very convoluted way how condescending or judgemental looks drive her to digital solutions.[109]

> Kate i1q5: "Sometimes I will have a problem … and I can't work out what the problem is…[she then describes how she approaches the appropriate staff member and explains the issue] … he will just sort of look at me [dismissively]... That is the hard part. I have got to overcome that sort of personality thing."

Both Kate and Tom proactively use digital networked technology to overcome their shortfalls; Tom to overcome dyslexic errors (e.g. spell-check) and Kate to compensate for reduced crystalized intelligence as demonstrated in Kate's following comment.[110]

> Kate i1q5: "I don't like anyone thinking [a question that I ask] is silly. So I [would rather Google it]. But sometimes I … don't quite understand [what the answer] means so I'll [have to] Google that." [Interviewer: So you are using technology as an educational tool.] "Yes … a lot of the time I actually use Google to find the answer. [She then gives an example of Googling an error message and concludes with}… I have no idea what it all means but I found out what it is."

In the interviews Con, the third participant in this group, displayed indicators of the personality trait Openness when relating to seeking information as seen in the following comment.

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[107] There was little to no remedial assistance for students at the time that this participant was at school.

[108] IntelliSense: While the term originally applied to Microsoft applications it has now become more widely used to explain an application that helps the user by making decisions automatically. The application analyzes activity patterns and can derive the next step without the user having to explicitly state it. Automatic spelling correction, Google prompts and suggested shortcuts fall under the IntelliSense umbrella.

[109] This comment has been severely edited to make it readable. Much of what Kate expressed was in hand gestures and facial expressions.

[110] Crystalized intelligence is the intelligence one acquires over a life span as opposed to liquid intelligence, which is the innate ability for abstract thinking and reasoning.

> Con i1q3: "I am not shy to drill down and find the answers. How things work. I always find that I like to know how things [hands indicate complex dynamic arrangement] and why things work...under the hood is where it is relevant."

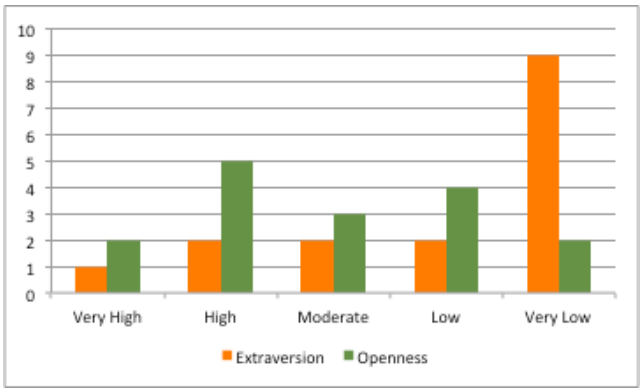
Comments like this could have indicated high Openness (H or VH) but Con also made it quite clear that he preferred dealing with *people* and *things,* which relate more to Extraversion.

> Con i1q6: "There is always a sense of satisfaction with learning something new and achieving something in doing it. … I was out there riding my bike in the dirt tracks and building mud tunnels and stuff like that.. I was sort of very hands on. But I have always been very hands on no matter what it is sort of get my hands dirty."

Con showed a strong preference for the concrete as opposed to the abstract, which is a important indicator of a *low scorer* in the Openness subscale *intellect*. This possible relationship to the subscale 'intellect' further supported my belief that a deeper investigation into personality subscales was necessary.

I then examined Openness in relation to Extraversion to see if that provided insights. As discussed above the fairly even range of Openness was not particularly distinctive, Extraversion on the other hand provided a higher number of very low scorers (VL) on the Extraversion scale and only one who scored very high (VH).

Graph 4 Openness compared to Extraversion



Insights into this pair of results were found by examining Eva and Sam who scored lowest on the Openness scale. In Extraversion, Eva scored high (H) and Sam very high (VH).

Table 5 Openness and Extraversion: All Participants Score Ranked Highest to lowest for each Factor

Openness	Ben	Tim	Dan	Fay	Max	Sue	Con	Kate	Tom	Ann	Bob	Ivy	Roy	Eva	Sam
Extraversion	Sam	Ann	Eva	Dan	Max	Con	Ben	Bob	Fay	Ivy	Kate	Roy	Sue	Tim	Tom

Highest Score	VH	H	M	L	VL	Lowest Score

Interviews with Eva revealed some important *environmental* issues that probably contributed significantly to moderating many of her Openness subscales such as adventurousness, liberalism and emotionality as well as intellect and artistic interests. On the other hand her imagination trait was aggressively used. Eva, a blonde fair skinned woman, grew up in a remote part of a third world country during the 1960s and 70s. She was one of two daughters of a missionary. Eva displayed emotional stress as a result of the social and cultural differences. On the one hand she enjoyed her social interaction with the indigenous children but the contrast of the western culture at home eventually led to her rebellion. In addition to this her education was not consistent and her early years of education were of a third world standard. Unlike her mother and sister, Eva became rebellious and used her imagination as a form of escape particularly in the form of reading. This means of escape continued throughout her life. Unfortunately reading material during her childhood was limited and controlled by her father. This exacerbated her feeling of isolation.

> Eva i2q4: "I started reading when I became a teenager …I never told you I actually grew up in [a remote part if a third world country] … I loved my Mills and Boons, and I used to read a lot with my gas lamp…[Eva then reminisced about her mother and sister and how her escape in reading added to her feeling of isolation.] … And the interesting thing is that my sister and my mum was very, very creative and she…I didn't inherit that from her, she used to embroider the most beautiful stuff and knit and whatever. They used to sit in the lounge listening to [the] Radio. All the stories and I used to be in my room reading my Mills and Boons, and listening to them laughing and really enjoying the thing, and I was always the outsider. I was wrapped up in my books."

Her father was very focused, domineering, religious and strict. As a result of her father's calling, resources such as education for his daughters, finance, and social opportunities were limited.

> Eva i2q4: "My father was very, very strict…very, very strict and I wasn't allowed to wear jeans and I was not allowed to wear make up, and I wasn't allowed to go out with boys, and I wasn't allowed to go to cinema, and I wasn't even allowed

> to go to the [local store] that had a juke box, because my dad said it was den of iniquity. So I grew up I think with a lot of rebellion and hate. ... I just went overboard."

Despite Eva's restricted youth and her rebellious phase Eva became highly competent in a complex software package. Significantly Eva's business skills were self-taught, particularly those relating to digital networked technology.[111] This raised the question, what could Eva have achieved with a less limiting background? Eva's business achievement certainly suggests that she has capacity to have achieved more academically but evidence of intellect and other Openness subscales were masked or retarded by Eva's formative environmental issues and the resulting insecurities that she felt. Eva is a clear example of nurture vs. nature, demonstrating how environmental factors can affect innate potential.

As discussed earlier there was an important relationship between very high Agreeableness scores and ICT professionals: Eva scored highest on Agreeableness (VH) and this could explain her career advancement utilizing this particular software. Eva was comfortable with digital networked technology to a point that she became emotionally invested in it.

> Eva i1q7: "My emails… in fact if we go offline I can't cope. … I'm just where is the email come back where is the email."

The intensity of Eva's relationship with digital networked technology raised the questions How much influence, if any, did digital technology have on moderating her Openness personality trait and, if so, was it possible that the digital environment could influence other traits? These questions were certainly interesting and worthy of research but as they were not directly aligned with my thesis question they were not directly addressed. They did however influence the direction of my enquiry as will be revealed during the remainder of this thesis.

Sam, the (VH) Extravert participant, loved his technology and was totally enmeshed with it. He enthused about using Facebook, SMS, and Google search. Typically he would use technology frequently throughout the day.

[111] Eva's first formal tertiary education since leaving school was at the age of 55+.

> Sam i1q1: "I'm online every day … I use Facebook all the time, I love the social media. … its a big part of my life."

Sam's passionate adoption of digital technology was *not* consistent with my findings that high Extraversion was indicative of a lower propensity to engage with digital technology. However the interview data did reveal that Sam's initial reaction to digital networked technology was consistent with my finding that Extraversion was negatively related to engaging with technology: Sam was initially *not* interested in using technology.

> Sam i1q2: "Yeah Um ... I guess initially it was there ... I didn't even consider it as being … a tool."

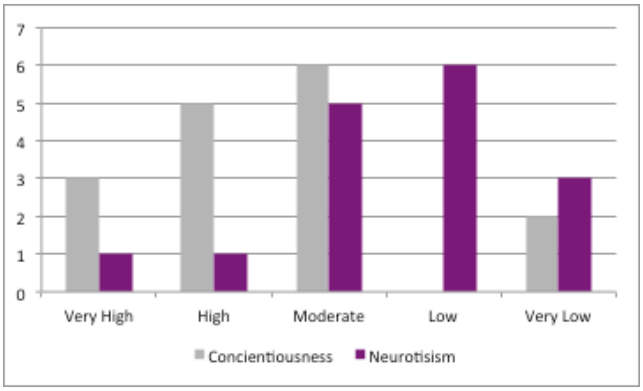
It therefore occurred to me that there was some other influence that had changes Sam from being disinterested inn technology to being an ardent proponent of it. Was it the technology itself or was it Sam's personality? As I had already examined Agreeableness, Extraversion and Openness the two factors left that could be considered as an explanation for Sam's inconsistency[112] was either Conscientiousness, Sam's second highest personality trait or Neuroticism Sam's second lowest score. Both of these are discussed below. At this point it is pertinent to note that in Chapter 6 Sam's Conscientiousness subscales are discussed in detail as being moderators of his Extraversion trait. It was only through the analysis discussed in this chapter that the significance of obtaining subscale data was revealed. I required the interview data as well as Survey 2 before I could fully explain why Sam's behaviour did not conform to my findings in Survey 1.

5.5.3 Conscientiousness and Neuroticism

Unlike Openness, which has a symmetrical distribution, Conscientiousness seems to tend to the higher scores whereas Neuroticism tended to the lower scores. This distribution was similar to the Agreeableness/Extraversion pair.

[112] All personality traits should be considered as a continuum as such it is the interplay between the factors that provides the insights.

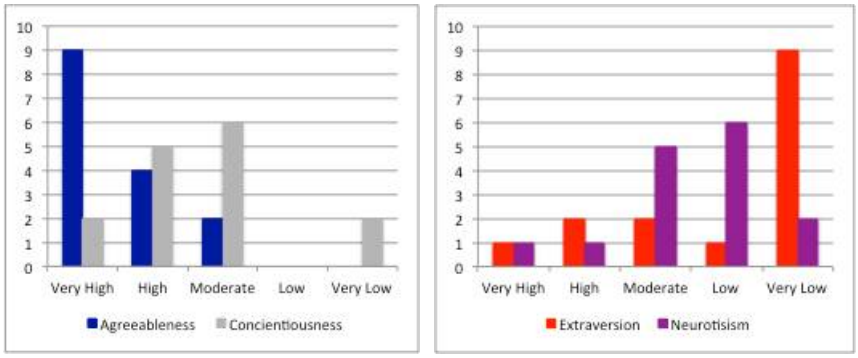
Graph 5 Comparing Conscientiousness to Neuroticism



In my sample of ICT professionals, where digital engagement was more likely, there was a distinct high-end weighting of both Agreeableness and Conscientiousness. Having identified the relationship between Agreeableness and digital engagement the significance of the role of Conscientiousness begins to emerge. The less digitally engaged an individual is the more they have to work at engaging with the technology as such a propensity for conscientiousness helps the process of engaging. This raised the question of why conscientiousness should taper off at the very high end of the range. Some clarity on this emerged with regard to decision making style and its effects on the outsourcing of intuitive behaviours to technology (discussed in Chapters 7-8). The amplifying effects of Conscientiousness on digital engagement will became clearer in the discussion of Sam in the following chapter.

Extraversion and Neuroticism were both weighted to the lower range. Like Conscientiousness, Neuroticism appeared to be centred to the mid ranges but at the lower end of the scores where the digitally engaged were more likely to be found. Exploration of the interviews did not reveal clear explanations for this relationship but there were some indicators as found in discussions with Tim where Neuroticism appeared to act as a moderator of digital engagement behaviours, which the remainder of this section illustrates.

Graph 6 Comparing Agreeableness to Conscientiousness and Extraversion to Neuroticism



Examination of participants who scored Conscientiousness as their lowest personality trait, Dan and Max, confirmed my earlier conclusions regarding the value of the Big-Five Factor's usefulness as an indicator of digital engagement.

Table 6 Conscientiousness: All Participants Score Ranked Highest to lowest for each Factor

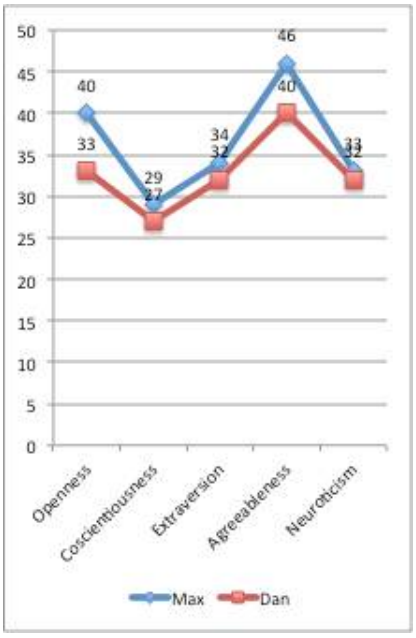
Conscientiousness	Con	Roy	Ann	Bob	Kate	Sam	Tom	Ben	Eva	Fay	Ivy	Sue	Tim	Dan	Max

Highest Score	VH	H	M	L	VL	Lowest Score

Not only was the environmental background of Dan and Max similar[113], they also had similar Big Five Factor profiles.

[113] Both participants were in their twenties, have university education and come from an upper middle class background where they were exposed to digital networked technology from late primary education. Their family lives are stable and they have solid relationships with friends both on and off line. Dan is actively involved with digital networked technology as a career (digital network engineer) and Max is actively engaged with technology in his creative and social outlets (music and research). While the activities may appear different the intensity of engagement is similar.

Graph 7 Results for Survey 1: Max and Dan



In the graph above we see Agreeableness was Dan and Max's primary personality trait by a substantial margin[114] followed by openness. The difference made their Agreeableness personality trait notably dominant in relation to their Openness trait. Dan and Max's third and fourth traits were extraversion and neuroticism with a difference between the two of only one point making neither the Extraversion nor the Neuroticism trait dominant. In both Max and Dan Conscientiousness was their lowest score suggesting that Conscientiousness may negatively influence other behaviours. It should also be noted that the difference between the three middle scores was greater in Max. I therefore expected to see more pronounced trait behaviour differences in Max than in Dan. This was verified in the interview data as seen in the following example where Max is aware of the role that digital networked technology plays in feeding his need for new experiences. The following is Max's response to how he feels when he finds information while searching on the Internet.

> Max i1q3: "I feel like why didn't I know about this before." [Interviewer: So it is a sense of satisfaction?] "Yeah, yeah cause I feel like.. it might sound a bit weird but it helps develop who you are in a way."

Max also displays reduced extravert behaviours such the need for face-to-face interaction as compared to Dan.

[114] Dan by 7 points and Max by 6 points.

> Max i1q3: "There is less [indicates face-to-face interaction].. I don't know there is definitely more interaction. All your friends that you can think of they are right there for you to talk to or ask them something. I think I probably speak to 10 people on Facebook max that's pushing it and some people have like 100 friends but I bet they only speak to 20 of them."

Dan on the other hand is quite vocal about his dislike of social interaction online: He definitely has a preference for face-to-face.

> Dan i1q1: "I'm one of these weird people in their mid 20s that hate social networking because I think its **anti**-social-networking to be honest.. but as far as computer networks are concerned, obviously being a networking engineer I kind of love them." [He then continues with] "… my main concern is the fact that today society is moving towards an online presence and its dropping social interaction so much that people can't see it happening." [he continues with numerous examples and expressions of his dislike of online interaction.] "it really annoys me because they say that it is making people more social but its alienating people to the point that if you don't go and checkup [Facebook] then you're the one that is at fault because you didn't go and follow everybody else…" [He was very passionate about this and his commentary on this topic lasted over eight minutes.

Despite the similarities of the Big Five Factor scores and environmental conditions there were still glaring differences in the way these two participants engaged with digital networked technology. This once again indicated that examination at the subscale level of personality was necessary for understanding.

Unfortunately investigation of the interviews did not provide anything particularly conclusive or noteworthy with regard to Neuroticism except for Bob who scored the highest for Neuroticism. Bob like Eva (see the Openness discussion) appeared to have been notably influenced by environmental issues. Bob's reason for initially engaging with technology was to connect with his father who left him and his mother at an early age: For Bob father/son time was synonymous with the computer.

> Bob i1q2: "My dad … he was always getting on the computer and showing me things and that sort of stuff." [Interviewer: So he was interested in them?] "Yeah, … he is not around anymore ... I haven't seen him for a while Yea but it was always getting on the computer and playing games and stuff with me."

Bob was eager to participate in the research project but was monosyllabic in his responses, very withdrawn and unmotivated. The only times he became animated was when talking about the approval he received when finding answers on his smart phone as illustrated in the

following comment. Bob's motivation for digital engagement appeared to be approval driven rather than enquiry driven as in Dan.

> Bob i2q5: "It is about knowing how to get the right answers … you have got to search for the right thing to get what you are looking for. I was watching my step dad trying to find who was the coach for the roosters in 2002 and he just couldn't get it. … So I pulled out my phone and had it in two seconds."

The interviews indicated that both Conscientiousness and Neuroticism had an influence of on the other personality traits but there did not appear to be anything noteworthy with regard to digital engagement. For example Tim who was high in both Openness and Agreeableness should have been quite comfortable in the digital environment but he was also overly concerned with the negative behavior of others in the digital environment.

> Tim i2q2: "On the Internet there is a disconnect … people can get away with bad behavior and so they do. People tend to be worse than they need to be, therefore the negative penalties are greater than the positives in cyberspace compared to the real world. There is a distortion in that way."

And Ann who was high in Agreeableness and should have been comfortable in the digital environment found the lack of orderliness distressing.

> Anne i2q4: "Do you think you can find your way back [to the original page] again? Not in hell! You just … lose the back button. Because somehow the back button doesn't work anymore. And so, to me, in my way of thinking its very messy filing, VERY MESSY not well sorted out!"

It appeared that Neuroticism was equally influential in moderating or supporting behaviours in both the digital and physical environment but Conscientiousness somehow seemed to be more influential in the digital environment. Insights into the influence of Conscientiousness became much clearer once I had the subscale data.

5.6 Survey 1: Conclusion

Overall results of Survey 1 showed that higher Agreeableness scores indicated a propensity to digital engagement. There was also a strong contra indication with regard to high Extraversion scores: High Extraversion scores indicated a lower digital engagement propensity. Openness and Conscientiousness appeared to influence behaviours in the digital

environment but further examination of the role of Big-Five Factor subscales was necessary. High Openness scores appeared to support digital engagement particularly when associated with high Agreeableness and especially where there was evidence of possible higher intellect. High Conscientiousness scores appeared to relate to digital engagement but how and more importantly, why, was not clear from Survey 1 data. Conscientiousness in particular required further investigation at the subscale level. Neuroticism did not appear to be particularly noteworthy in relation to digital engagement and appeared to play a similar role in both the digital and physical environment.

While the Big-Five Factor may be a good predictor of physical environment behaviours, it may not be suitable for the digital environment for two reasons. Firstly the instrument item-questions do not specifically probe digital environment behaviours. The current item-questions were developed for examination of behaviours in the physical environment and the assumption is that behaviours are consistent in both environments. This as discussed in Chapter 3 may not be the case. Secondly, the descriptions and general understanding of the five personality traits and how they relate to each other is once again physical environment centred. For example, item-questions do not probe the expression of Extravert behaviours in a virtual environment. A possible item-question could investigate how the individual feels about ‘likes’ or ‘friend’ buttons in social media. Deeper investigation of both item-questions and personality descriptions within the digital environment is I believe necessary particularly as there is a different risk/benefit calculation to online activity that is not addressed in the current instruments.

As the development of valid and reliable instruments was not within the scope of this research my challenge was to continue use existing instruments for deeper investigation of the Big-Five Factors. I therefore used the NEO-PR-I personality test as discussed in Chapter 4. The NEO-PR-I provided me with an evaluation of the six subscales of each of the Big-Five Factors discussed above.

6 Survey 2 Subscales of Big Five Factors: Descriptions, Results and Discussion

I originally thought that the Big-Five Factor would provide sufficient data for my research but, as discussed in the previous chapter, this was not the case and I required a more detailed analysis of my participants. I needed to examine the commonly found behaviours of the five personality groups at a finer level. This thinking was confirmed by Costa and McCrae who noted that the focused attention on the Big Five factors, which had until recently been considered the highest level of personality hierarchy, was at times 'to the detriment of the specific traits that define these factors' (Paul T. Costa & McCrae, 1995, p. 21). Investigating my participants' subscales was therefore essential if I was to gain insights into their digital engagement behaviours. I had to understand not only how these subscales[115] were construed within the field of psychology[116] but also I had to explain how these subscales could possibly manifest in the digital environment and whether my assumptions could be supported by the interview data.

This chapter examines the six subscales of each of the five factors in order to identify which, if any, of the subscales are more notably related to digital engagement. Each subscale is firstly described in terms of the field of psychology, because this is how the behaviour is presented within the physical environment. I then discuss how that subscale could possibly present within the digital environment and examine it against data from the interviews to see if and how it presents, or does not present, within the digital environment. While this subscale investigation may appear excessive at times it was essential in formulating my thinking at a number of levels, the most notable being that we cannot simply transfer current instruments, perceptions or assumptions from the physical to digital environment. There are differences that should be considered and accommodated.

Based on my conclusions in the previous chapter, regarding the Big-Five Factor, I anticipated that the currently accepted collection of six subscales might not necessarily be

[115] I have used the IPIP Scales Measuring Constructs similar 30 facet scales in Costa and McCrae's NEO Personality Inventory (NEO-PI-R). (See Appendix 8 for a comparison between the 30 facet scales in Costa and McCrae's NEO Personality Inventory (NEO-PI-R) and the corresponding Preliminary IPIP Scales Measuring Similar Constructs.)

[116] The descriptions of these terms are necessary because at times the general understanding of a term may differ from where the instrument was developed i.e. within the field of psychology.

applicable to digital environment at the question-item level. Overall, the more I examined established personality instruments in relation to the digital environment the less confident I became about their validity and reliability within the digital environment. DeYoung and Gray's recently proposed neurobiological classification of personality supported my concerns and was better aligned to my 'in the skin' systems approach to developing and understanding of digital engagement. DeYoung and Gray proposed two higher-order factors Stability, which they suggest is made up of Neuroticism, Agreeableness and Conscientiousness, and Plasticity that is made up of Extraversion and Openness (DeYoung & Gray, 2009).

Unfortunately, of the original sixteen participants only twelve were available for this second survey (NEO-PR-I). The following table lists the Big-Five Factors and their associated subscales.

Table 7 Table of Big Five Factor factors and their associated subscales.

Oenness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
O1 - imagination	C1 - self-efficacy	E1 - friendliness	A1 - trust	N1 -anxiety
O2 - artistic interests	C2 - orderliness	E2 - gregariousness	A2 - morality	N2 - anger
O3 - emotionality	C3 -dutifulness	E3 - assertiveness	A3 - altruism	N3 - Depression
O4 - adventurousness	C4 - achievement-striving	E4 - activity level	A4 - cooperation	N4 -self-consciousness
O5 - intellect	C5 - self-discipline	E5 - excitement-seeking	A5 - modesty	N5 - immoderation
O6 - liberalism	C6 - cautiousness	E6 - cheerfulness	A6 - sympathy	N6 - vulnerability

Each factor and its associated subscales will have a brief description and discussion, which explores the described behaviour in relation to the interview data. This is followed by an examination of the Survey 2 results in relation to the discussion.

6.1 Agreeableness Subscale Discussion

The subscales of Agreeableness are: trust, morality, altruism, co-operation, modesty and sympathy.

The general understanding of Agreeable individuals in the physical world is that they tend to be trusting and approach relationships assuming that most people are fair, honest, and have good intentions. These are traits that enhance the individuals' ability to initiate, build and maintain relationships. While the resulting relationships are generally beneficial to both

parties it is not uncommon for the very high scorer of Agreeableness to be so 'agreeable' that they become disadvantaged in the relationship.

High scorers in the Agreeableness subscale **altruism**[117] are described as individuals who find helping others genuinely rewarding and are usually willing to assist those in need unprompted. When one considers the nature of the digital networked environment[118] we see that the subscale altruism is indeed suited to the digital environment because at a fundamental level the digital environment has evolved and thrives on altruistic behaviours.[119] This behaviour is somewhat different in the physical world where marshalling and maintaining control of resources is key to prospering be it at a cellular level or at the wider organism or organisational level (Conner, 1991; Floresco, 2015).[120] It therefore seems probable that those who are higher in altruism are more likely to thrive in the digital networked environment. Tim describes his altruistic behaviour towards unknown parties in the blogosphere.

> Timi1q3: "That's a payoff… **friendship** even though there is no interaction. They don't even know that I have good feelings towards them."

Participant Roy discusses the benefit of altruism in the digital environment.

> Roy i3q1: "In my job technical blogs about how people solve certain problems are a collective memory … A shared memory. … me and a lot of our peers couldn't do our jobs without access to this shared memory of experiences."

Individuals' with high **trust** scores tend to approach situations with the assumption that most people have good intentions, are honest, and fair. Low scorers on the other hand view other people as hostile and devious and suspect others are driven by selfish motives. David Clark and Marjory Blumenthal illustrate how the lack of trust in the digital environment tends to result in the invoking of a non-human third party, which is used in a similar way in the physical environment to 'friend referral'. In the digital networked environment the trusted establishment could be a 'bank verification' or 'software system' such as eBay's star rating

[117] Robert Winston provides a range of manifestations of altruism with practical examples.(Winston, 2002, pp. 207, 226, 301-212, 362-207) and Richard Dawkins provides insights into altruism at the genetic level (Dawkins, 1987).
[118] See Chapter 3.
[119] See section in the Grobanite example in Chapter 3. This is also discussed in Clay Shirkey's book (Shirky, 2010).
[120] Altruism in the physical world has been a complex behavior to explain in the light of survival instincts but as Robert Winston explains this behavior has evolved as a survival instinct not necessarily survival of the individual but rather of the group (Winston, 2002).

(D. D. Clark & Blumenthal, 2011, pp. 375-378). For example Ben relies heavily on third party referral despite his developed skills in online semiotics.

> Ben i2q5: "Trust is a leap of faith ... I sort of make judgments based on the [physical environment] size of the organization and my perceived reputability of them." [Interviewer: So you look to the real world for affirmation?] "Yeah … Like securities certificates and that sort of thing. … on eBay for instance [there is] feedback on people that have bought from them [eBay]. You wouldn't buy from eBay if somebody didn't have a star rating but you would be comfortable buying from somebody that had a high star rating because they have been proven over a period of time. **And eBay is a large organization**. [Emphasized by participant.]"

Ben then described what illustrates a trust environment and concludes that he no longer has to consciously process this evaluation.

> Ben i2q5: "You are looking for security certificates, you are looking to see if their website is secure and properly set up, you are looking for the fact that they have been around for a while, that they are not fly-by-night, they are not brand new… or bad English, bad spelling" [Interviewer: Too much color?] "Yeah … its all that sort of thing but it is now processed so 'I don't even think about that anymore."

While trust behaviours apply equally to both the digital and the physical environment, it is the differences between the two environments that appear to affect outcomes. Clark and Blumenthal's partial list of software functions required to elicit trust demonstrates the difficulties that humans have with regard to trust in the digital environment (D. D. Clark & Blumenthal, 2011, p. 377).

Humans have developed a complex repertoire of interpreting semiotics as a result of their evolutionary process in the physical world. It is through successful understanding and interpreting of signals, signs and cues that humans have not only survived but also thrived and learned to build trust relationships. Individuals such as participant Sam demonstrated this by describing how he draws on physical world experience to develop trust relationships in the digital networked environment.

> Sam i2q5: "You only ever trust someone online if they are a reputable business [within the physical environment] or someone that you know who is a reliable source. I wouldn't trust anyone else really just because of the accessibility … [Interviewer: ,,, so for trust you refer back to real world..] … yeah its pretty hard to trust an individual that you don't know online."

High scorers on the subscale trust approach new relationships with an open and optimistic attitude. Even though there are times when this attitude will be abused, the open/optimistic approach is conducive to, and even encourages, the establishment of relationships. This positive approach tends to compensate for many existing human inadequacies with regard to reading digital semiotics. High trust scorers will therefore tend to be advantaged in the digital environment due to their personal exposure to a wider range of semiotics resulting from relationship building rather than developing a dependency on specified digital-semiotics of third parties where personal learning is reduced.[121] There appear to be two aspects to this interplay 1) reduced semiotics leads to caution 2) increased exposure to a wider range of semiotics leads to trust.

Individuals who score higher in trust may have an advantage not only in potential to build digital-relationships and acquire a range of digital semiotics but they will more readily embrace digital situations and engage with others for example Fay:

> Fay i2q5: "I think I probably grant trust a little bit more because there's more ways of checking. … [On[the internet … you tend to find that people will put their information up there … safe behind their anonymity. So you tend to get more of what they are actually trying to say. … they are giving up more of who they are and what they actually think, you can make a better judgment call. There is the argument that you lose … the non-verbal cues and yes you do lose those but you know you can also check up to see who owns the domain, you can actually cross reference across their twitter account … the internet can be used to assess somebody and whether they are trustworthy in a way that you can't really do when you meet somebody in the street … you can't go back and [check] whereas you can do that on-line. You can actually check things."

Fay, who turned out to be highly digitally engaged, very high in the Agreeableness factor, and also in the subscale trust, was asked if she thought that the digitally aware person has a better concept of web or digital cues.

> Fay i2q5: "I think because we are social animals we find ways of trying to assess things, we do find ways to check things. What works for me doesn't work for someone else. … I might look at it [online advertising] and say no I'm not going to listen to you because you have got something else going on. To me it [a specific type of advertising] is the equivalent of a smirk in the middle of a conversation. So you do develop your own ways. … it would have been acquired over time."

[121] In general, humans still struggle with the diverse and ever-changing symbology within the digital environment such as an animated icon denoting transmission of data or simple static error messages. More than that many humans struggle with lack of physical environment visual cues, which humans' have always relied on for relationship development. It must be noted that in many ways digital-semiotics are improving for example: the improved ability of individuals to evaluate personal identity profiles, photo tagging and the use of basic symbols such as icons, emoticons, formatting and subject lines.

Con displays his high level of trust in a discussion of black hat techniques[122] used in online marketing.

> Con i2q5: "I haven't had any bad experiences but I guess I have a little bit more faith" [Interviewer: Sounds to me like you are a very trusting person.] …"Yeah yeah "

Individuals' who score high in the agreeableness subscale, **cooperation**, show a tendency to dislike confrontation. When discussing cooperating with others to solve problems Kate became agitated resorting to non-verbal communication.

> Interviewer i1q5: "So what you are saying is that you try and solve the problem yourself using technology [Participant gives an affirmative nod and interviewer continues] then only if you need to you go to people [Participant gives an affirmative nod]"

With encouragement she began explaining and revealed how intimidating the physical environment was for her.

> Kate i1q5: "That's the hardest part … it is their reaction … it is the look on their face."

The high scoring individuals in the subscale **Cooperation** are described as being willing to deny their own needs or will compromise in order to ally with others. In the physical world where resource-accumulation is a primary strategy for survival, high scoring cooperative individuals who compromise themselves, or their resources to win favour are likely to be at a disadvantage unless they can use cooperation to secure their situation. Participant Ivy who scored high in Agreeableness and cooperation illustrates this conflict. Her work is in the digital environment and could easily be done remotely however she will compromise her online billing because clients tend to be physical environment oriented and they have difficulty valuing the work being done offsite in the digital environment.[123]

> Ivy i1q2: "…[If working] on site we would be charging the time that it really takes. If we do it remotely we consultants feel that we cannot charge the time that it

[122] Within the digital environment Search Engine Marketing is referred to as using either black hat techniques, which are generally devious and manipulative methods of driving traffic to websites. White hat services focus on quality of content and creating reciprocal relationships with reputable linked sites.

[123] This was a recurring theme with consultants, particularly those who scored high on the Agreeableness Factor. Further research is necessary on this topic.

> really takes. We charge less. …. When we are off site it is a lot more stress because we need to be effective and efficient because they can't see us."

On the other hand in the digital environment high scores in cooperation can be greatly advantageous because the founding spirit of the digital environment is collaborative, and cooperative, traits that are more supportive of the agreeable personality.[124] In addition to this the virtual and asynchronous nature of the digital environment reduces the physical threat of confrontation. That is not to say there is 'no confrontation' in the digital environment, the threat to ones physical being is simply muted.[125]

As discussed at the start of this thesis, anti-social behaviours such as bullying and stalking are certainly evident and growing. This may be a product of the sheer volume of participants online and the reduced physical risks to themselves for anti-social behaviour. These types of complex behaviours are however not the focus of this thesis but they do need to be recognised.

A high scoring individual in the subscale Cooperation is likely to be more comfortable managing the risks in the digital networked environment.

High scorers on the **morality** subscale are candid, frank, and sincere. In dealing with others, these individuals are generally not manipulative or pretentious. High morality can be very advantageous in the digital networked environment because it is likely to result in a consistent digital footprint.[126] A consistent digital footprint enhances trusting relationships as each verified iteration and medium is encountered. For example an online search for a specific individual may reveal numerous tagged photos, comments, documents, affiliations, database records and video clips spanning many years. As explained by Fay previously in the discussion on trust, these touch points provide both a breadth and depth of information for evaluation that is conveniently accessible and returned in an incredibly short space of time. In contrast, access to information in the physical world is constrained by the physical

[124] See Chapter 3.
[125] There are arguments that an individual can suffer physiologically in the digital environment as exemplified in Sherry Turkle's Cyber Rape but it is arguably not to the same *physical* extent that would occur in the physical environment. (Turkle, 1995)
[126] The collection of data available in the digital networked environment that relates to that individual.

friction of time, space and human activity.[127] For this reason someone who scores high in morality is more likely to naturally develop a consistent and cogent digital footprint which will elicit the trust of others within the digital environment thereby enhancing the potential to develop constructive relationships within this environment.[128] In the following extract from a discussion about personas in the digital networked environment, Max demonstrates a high level of morality and his frustration or dismay at deceptive behaviour in the digital environment. When asked if he was a different person in the digital environment he replied:

> Max i2q5: "No I think I am the same person I don't like to do that. Other people do. Even when its putting in your personal basic information … But I don't see the point … that is very fake."

While altruism, cooperation, trust and morality, refer to external relationships with others, the subscale **modesty** is a descriptor of the individuals' internal relationship or their concept of self: It is an evaluation of the individuals' internal belief about who they are. Individuals high in modesty prefer to not reveal their superiority.[129]

In the physical environment modest behaviours could easily be construed as weakness in an environment where survival has largely depended on assertion, posturing and accumulation of resources. In the digital environment where semiotics is not readily understood, modesty can be advantageous as it is likely to elicit relationship development and collaborative behaviours. In addition to this, if the individual is consistently modest their non-threatening behaviour will persist across multiple media, time and iterations and due to consistency it will strengthen trust relationships. These observations of modesty also hold true in the physical world but due to the lower number of iterations experienced within the physical world the opportunity for trust development by this method is reduced. High scorers of modesty therefore appear to be more advantaged in the digital environment than they are in the physical world.

[127] In the physical world the number of verification-iterations, variety of accessible mediums and level of convenience in accessing information within a similar time frame is drastically reduced and would most likely result in only partial information.
[128] Some criminals will proactively simulate morality to elicit trust in the digital environment but deviant behaviour is not within the scope of this research. This research is looking at inherent personality traits and its correlation to digital engagement.
[129] In this research I control for the possibility that modesty can be derived from low self-confidence or self-esteem and examine individuals innate modesty.

In the physical world people who score high on the final agreeableness subscale **sympathy** will be tender hearted and compassionate, feeling the pain of others vicariously and will easily be moved to pity. In the physical world this attribute can easily deplete the emotional reserves of the sympathetic individual when confronted by others in need of sympathy. The virtual and asynchronous nature of the digital environment however tends to be a more constructive environment for the high scoring sympathetic individual as technology creates an emotional buffer for the individual. The lack of physicality tends to encourage and increase reflective and considered support by the high scoring individual while reducing their emotional depletion. The digital environment has the potential to be more conducive to constructive expressions of sympathy than the physical world. As such the agreeable subscale sympathy appears more suited to the digital networked environment. The following comment by Fay illustrates both the quantity and the quality of sympathy received in the digital networked environment as compared to the physical world.

> Fay i1q1: "You wouldn't see them [the physical environment support network] till next week when you met for coffee. Whereas now the actual level of daily interaction with my support network, all be it not in person [Facebook] has increased dramatically."

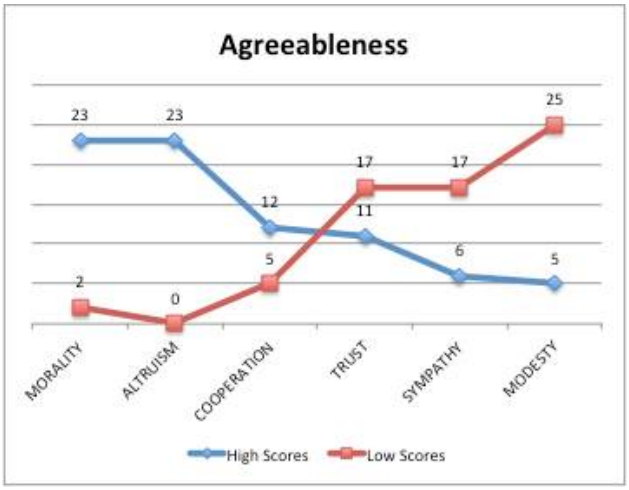
Many aspects of the digital networked environment, such as social media and discussion boards, thrive on altruistic and cooperative behaviours. In the digital environment where visual cues and semiotics are limited the individual who scores high in trust will have an advantage because they approach digital engagement in an open and optimistic way which is likely to lead to increased constructive interactions and likely more iterations which aid semiotic verification. A high morality score is likely to result in a consistent digital footprint and if coupled with a high modesty score the resulting online persona will more readily elicit the trust of others, increasing the likelihood of constructive relationships. Finally the digital networked environment works to the advantage of the sympathetic nature of the agreeable person because in the digital environment the agreeable person can exercise their sympathy while retaining some emotional distance.

A person scoring high in Agreeableness will be more comfortable and at a distinct advantage in the digital environment because all six subscales appear to improve performance in this

environment but were any of the Agreeableness subscales more important than others in relation to digital engagement.

6.1.1 Results of Agreeableness subscales

Graph 8 Agreeableness Subscales showing highest vs. lowest scores[130]



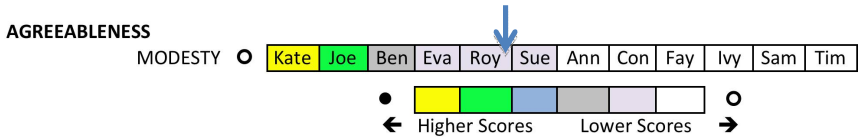
The graph above shows the relative significance between the high and low scores for each of the sub scales. For altruism, all 12 participants scored higher scores and for morality the majority scored very high, which indicated both were important subscales for digital engagement. Similarly lower modesty should be considered important.

The results of the two high scores were in line with my expectations for these subscales with regard to the digital environment as they described an individual willing to assist those in need unprompted and who are candid and tend not be manipulative or pretentious. These behaviours would be advantageous in the digital environment as they appeal to concepts of exchange, community and relationship building, which is integral to the digital environment. The importance low modesty score was unexpected.

[130] Values were allotted 3 points for (VH) or (VL), 2 for (H) or (L) and1for (M) scores. Then the three higher scores were added and three lower scores were added. E.g. For Altruism: High score - 6 (VH)+ 14(H)+3(M)=23 and 0 Low scores. For Morality: High score – 18(VH)+2(H)+(3)M=23 and 2 Low scores. The totals of the higher and lower scores were then graphed

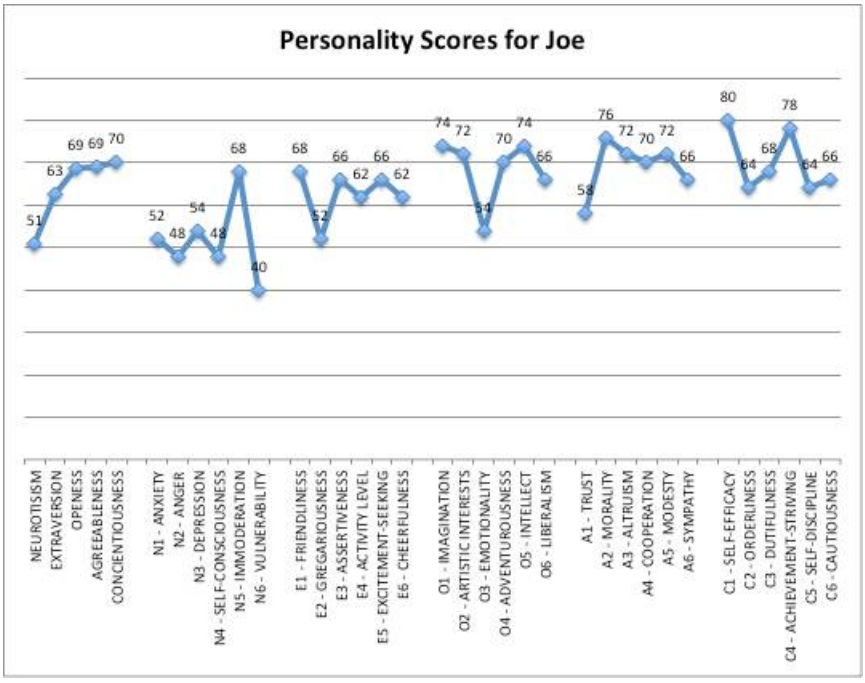
In the physical environment the subscale modesty describes the individuals' internal relationship or their 'concept of self'. I had incorrectly assumed that a high level of modesty would be required to retain a concept of self within the digital networked environment but after examination of participants who were fully engaged, the reverse appears to be correct. It is the individual who is less sure of their concept of self that will investigate a different and evolving environment and be open to adaptation to the environment. Therefore a lower modesty score is more likely to be found in a more digitally engaged person. Examination of the modesty scores showed only one anomaly, Joe.

Table 8 **Results of Agreeableness Subscale Modesty: All Participants of Survey 2.**



In the composite graph below we see that Joe scored high on Agreeableness, Conscientiousness and Openness (graph 9). In addition to this his interviews indicated fully engaged behaviours but instead of scoring low on modesty (A5) it appeared as his second highest score. On deeper examination of his scores we see that there is little difference between his top four scores for the Agreeableness subscales (A2-A5), this reduces the significance of their rank order. In addition to this it is necessary to consider Joe's exceptionally high self-efficacy score (C1). Joe's exceptionally high belief and confidence in his ability to achieve his goals through self-control and common sense would indeed have counteracted any trend towards low-modesty.

Graph 9 Results for Survey 2: Joe



Conclusion: *With regards to the Agreeableness factor it appears that key subscale indicators of digital engagement are high scores in altruism and morality as well as the lower modesty scores.*

It is likely that individuals high in Agreeableness may be more sensitive to online offence (troll behaviour) but it appears that this behaviour is influenced by the Neuroticism subscales which is discussed later. I will now examine Extraversion, which as discussed in the previous chapter, had strong negative relationship to digital engagement.

6.2 Extraversion Subscales

The subscales of Extraversion are: gregariousness, assertiveness, activity level, excitement seeking, friendliness and cheerfulness.

Extraversion describes an individual who is very comfortable in *physical proximity to others*. The potential to connect with others in and through the global networked environment could possibly mean the digital environment is ideal for this personality type. However the lack of physicality could be a major deterrent. Investigation of the subscales revealed insights as to

why some higher scoring extraverts in my sample group are more comfortable in the digital networked environment than others and why in general extraverts are more comfortable within the physical environment as opposed to the digital networked environment.

In the physical environment high scorers in the Extraversion subscale **activity levels** are described as being physically energetic people and high scorers of **excitement seeking** require high levels of stimulation, they are risk and thrill seekers. Both these subscales imply physical environment behaviours[131] and do not appear to be easily transferrable to the digital environment. Whether the virtuality of the digital environment is sufficiently simulating for the psychology descriptor requirements of the subscales *activity levels* and *excitement seeking*[132] is a challenge for this discussion. If these subscales only apply to extraversion within the physical environment then there is a possibility that extraversion in the digital environment cannot be adequately measured at this stage due to the lexical limitations of the question statements.[133] Alternatively it could mean that the personality factor Extraversion is more suited to the physical environment.

High scorers on the Extraversion subscale **gregariousness** thrive on the *physical* proximity of others. Typically the low scorers on gregariousness tend to be overwhelmed by physical proximity of others especially in crowd situations. Depending on the individual's level of gregariousness they will have more or less ability to cope with 'crowd contact' and they will balance their exposure to physical contact with private or reflective time. Typically, low scorers find crowds stressful while high scorers find them stimulating. The asynchronous and virtual nature of the digital environment is thus more conducive to lower scoring individuals in this subscale. Low gregarious scorers would find the reduced physicality less taxing (Nussbaum, Hartley, Sinatra, Reynolds, & Bendixen, 2004). The high scorers on the other hand who rely on their ability to instantly interpret physical environment semiotics would likely find the digital environment frustrating. The physical environment thus appears

[131] See Appendix Table 6. After the survey Tim, Ann, Kate and Eva cited some of the item-questions relating to these subscales asking how the questions could possibly be related to the digital environment.
[132] While there is a significant amount of research into aspects of the physiological experiences of individuals within the digital environment, research tends to be in terms of specific activities such as gamming (Bavelier et al., 2010; Han et al., 2015; Y.-H. Lee et al., 2015) or virtual collaboration (Gaved & Mulholland, 2010; Vengerov, 2007) rather than addressing similarities or differences of these specific subscales within the digital networked environment.
[133] This would require specific research and is not part of this thesis. It is however suggested that this is followed up in future research.

to suit the high scoring gregarious individual and the digital networked environment appears more suited to low scorers as it is more controlled with regard to physical proximity of others. At the time of writing this thesis research relating directly to asynchronous environments, such as discussion boards and personality subscales was minimal. Research that was sourced tended to incidentally relate to personality factors but not to the subscales.[134] Compare Con and Tim's comments. For gregariousness Con scored moderately (M) and Tim had a low score (L); both are highly skilled in digital networked technology but Tim is more digitally engaged than Con.

> Con i1q1: "I suppose I am more face-to-face … I have just always preferred to talk to someone rather than punching out a three-paragraph e-mail's or something like that."

> Tim i1q4: "Usually it is an email contact … you don't just pick up the phone … there is an email first because that is polite and it gives them a chance to reply. and then after that … a more direct contact by phone … Or physically meeting."

Assertiveness is described as speaking out, taking charge and directing the activities of others. Assertiveness is relatively easy to identify in the physical environment where an individual's physical presence and sheer volume of voice can be heard and their take-charge actions observed. In the digital-environment the asynchronous and collaborative nature of the environment makes an assertive personality more difficult to identify or understand. It can be argued that individuals could assert themselves by 'speaking out' as in a blog or in comments but the asynchronous nature of the environment encourages the reflective comments of others, which cannot be interrupted by the more assertive personality.[135] The digital environment in general creates more opportunity for the less assertive person to be 'heard' and less opportunity for the assertive person to dominate through vocalization or actions. This is seen in Roy's discussion of how he relates to his mentor.

> Royi1q2: "I noticed that … [it] has become a lot easier to communicate [with her online]... When I talk on the phone to her…, she'll go bla bla bla and I can hardly get a word in edgeways. … being a quieter person I don't tend to talk that much, so I'll email … that has helped us communicate … it has brought us a lot closer."

[134] The lack of subscale related research is discussed in more detail in Chapter 8.
[135] The asynchronous nature of the digital environment is changing due to advances in technology, bandwidth and infrastructure, for example live video streaming, but there is still a difference

The last two subscales of extraversion are **cheerfulness** and **friendliness**. Both subscales are an external expression of an internal emotional state that the individual uses in the course of relationship development or maintenance. In the physical world this is generally expressed through a complex assortment of visual cues, physical actions and social practices that have evolved over millennia. As such cheerfulness and friendliness behaviours are more easily expressed and understood in the physical world making these subscales more suited to the physical environment. On the other hand the digital environment is still developing and appears less suited to these subscales. Kate for example cannot relate to the expressions of cheerfulness and friendliness in the digital environment.

> Kate i2q2 "The symbol of the smiley face … it says anything like thanks for calling me or thanks for doing this and it was great and I'll pay you next Thursday ... no It is not really a symbol that I actually relate to. The symbols don't really mean anything. … not anything that is actually meaningful."

In summary, for Extraversion it appears that the digital environment is not conducive to the assertive subscale because the digital environment tends to foster 'turn-taking' thus the assertive person cannot easily gain an advantage through dominating or interrupting dialogue although there are the exceptions. On the other hand the asynchronous nature of the digital environment makes it easier for the less assertive person to voice their opinion.

The subscales activity-level and excitement-seeking evaluation instruments appear to be biased to physical world behaviours and appears that it cannot be not easily applied to the digital environment. What is clear is that those individuals who score lower on the subscales activity level and excitement seeking are likely to be satisfied with the low activity levels associated with the digital environment and the micro rewards they receive in the digital environment may well provide sufficient biochemical response to act as a substitute for physical world activity and excitement seeking.[136] It is likely however that the frequency of micro rewards provided by the digital environment could potentially be addictive to the high scorer of excitement seeking.

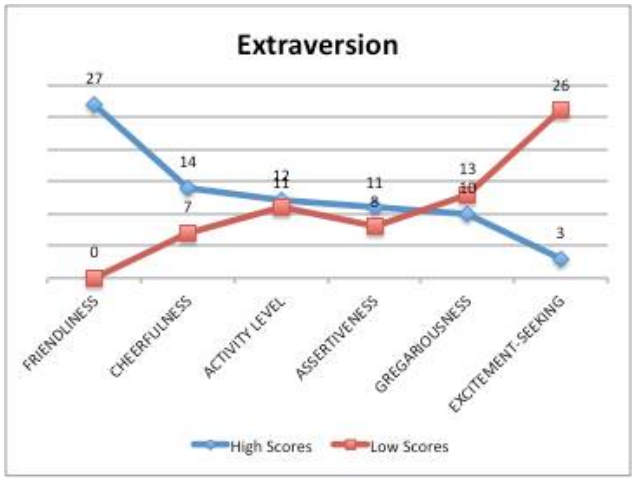
The final two subscales friendliness and cheerfulness are reliant on the extravert's ability to express an emotional state and the ability of the recipient to be able to interpret the emotion

[136] See Chapter 4 particularly discussion related to dopamine.

according to commonly understood expressions of that emotion. In the physical environment an extravert is generally skilled in this regard. The digital environment however is by comparison new and the ability of humans to express and interpret emotions in the digital environment is still evolving. The extravert appears to be more advantaged in physical environment situation but in the digital environment is either less advantaged or somewhat disadvantaged. If this is indeed the case then a person scoring high in Extraversion is likely to be more disadvantaged in the digital environment than a low scorer of the Extraversion subscales. I now examine results of the Extraversion subscale survey to see if this hypothesis holds.

6.2.1 Results of the Extraversion subscales

Graph 10 Extraversion Subscales showing highest vs. lowest scores



In terms of differentiation of this group, the two important subscales of Extraversion were high friendliness and low excitement seeking. My approach to understanding the Extraversion subscales was influenced by the numerous descriptions of Extroverts being individuals who have a pronounced engagement with the external world. I therefore *incorrectly* viewed friendliness as being the ability to *express* feelings of goodwill towards others rather than viewing it as *possessing the emotional state* of goodwill-feelings towards others. On reflection I have adjusted my opinion and believe that friendliness is indeed conducive to digital engagement. If one approaches friendliness as being the capacity to

genuinely like other people and have the ability to easily form close, intimate relationships then the digital environment can indeed be rewarding. This is exemplified in participant Sue, a digitally engaged person who satiates her friendliness trait through blogging where she develops close and intimate relationships with poets globally.

> Sue i1q2: "I find it really stimulating … when you see what other people go through you realize that people all over the world regardless of where they are or who they are, where they live there's so many similarities that runs through the different cultures. And I find that really interesting."

With regard to excitement seeking my expectation that low scores would be more conducive to the digital environment was correct and results reflected this.

Conclusion: *With regards to the Extraversion factor it appears that high friendliness and low excitement-seeking scores are indeed key subscale indicators of digital engagement.*

6.3 Openness Subscales

The subscales of Openness are: intellect, artistic interests, imagination, adventurousness, liberalism and emotionality.

In the physical world the subscales *artistic interests* and *intellect* are seen as being central to the personality factor openness. A high scoring individual in the subscale **intellect** is described as being enthusiastic in the exploration of new and unusual ideas or concepts and they particularly enjoy intellectual challenges. The intellect subscale appears to be especially suited to the digital networked environment because the dynamic nature of the environment provides a stream of new ideas and areas for the individuals' exploration and self-expression.

In the physical environment individuals with high scores in **artistic interests** display heightened aesthetic sensitivity: an interest in and appreciation of the arts, and appreciating beauty in nature and traditional art forms. While the question-items of this subscale are suitable for evaluating artistic interests in the physical environment their application in the digital environment is problematic. An understanding of how artistic interest is experienced and expressed in the digital environment is not sufficiently developed. This is illustrated in

the sample question-items below, which are generally easier to understand as relating to artistic interests in context of the physical environment. (See Appendix 1: Table 9 for full list).

Table 9 Question-items for the NEO-PR-I subscale Artistic Interests

Factor	Subscale	Item-question	Keyed
Openness	artistic Interest	Enjoy the beauty of nature.	+ keyed
		Do not like art.	– keyed
		Do not enjoy going to art museums.	– keyed
		Do not like poetry.	– keyed

It could be argued that in the digital environment artistic interests take on a different form as 0's and 1's are creatively structured at higher levels into complex strings that result in an environment where humans can satiate their artistic interests in new ways. In the following extracts we see Tom expressing aesthetic appreciation within the programming environment [137] and Sue who shared her creativity in the form of poetry.

> Tom i1q2: "It has provided a way of creating things in an administrative environment. You know you can still do your creativity but you can do it behind the desk as opposed to having to get out and make things. So from that point of view it has changed the way that you can express yourself … You do it in a more administrative environment as opposed to a working [tactile] environment."

and

> Sue i1q2: "For example, if you write a poem and you put it up there [on her blog] … other people pick up a completely different meaning from it because of their experiences and their ways of seeing … I don't get to have those conversations other than on digital networks."

At its core artistic interest behaviours are similar in both environments but the expression and descriptors of artistic interest is very different. This difference requires item-questions that are not reflected in the evaluation statements of the NEO-PI-R personality test. (See Appendix Table 9 for artistic interest item-questions). The questionable validity of whether the current artistic interest subscale is indeed evaluating participant's digital environment artistic interest is a concern, particularly when considering that *artistic interests* together with intellect are considered to be central to the personality factor Openness. The item-questions

[137] Tom also enjoys expressing his love of nature and creativity in making things from recycled wood.

for the subscale intellect on the other hand was lexically more appropriate for examining the digital environment. (See Appendix 1: Table 10 for intellect item-questions).

In the physical environment the individual who scores high in **adventurousness** will be eager to try new activities, travel and experience different things. In many ways the digital networked environment is ideal for individuals who score high on this subscale particularly if they also score relatively high on intellect and imagination because intellect and imagination can create a construct that supports the expression of adventurousness albeit in a virtual space.

The **imaginative** individual tends to find the physical environment boring and mundane as such they sometimes escape to a fantasy world. The dynamic nature and vast potential of the digital environment provides an unprecedented opportunity to stimulate and fulfil this need of the imaginative individual.

> Fay i1q1: "My iPhone or my iPad means that when I can find two seconds of peace and quiet I can escape to somewhere else."

In the physical environment the Openness subscale **liberalism** refers to an individual's readiness to challenge authority, convention and traditional values. Extreme versions of this attribute may manifest as an empathy with law-breakers and enjoyment or appreciation of ambiguity, disorder or chaos. As discussed in the background, the digital networked environment is of its very nature unstructured, it gives the appearance that one can be anonymous and, by comparison to the physical environment, the digital environment is unpoliced and it is difficult to enforce consequences for participants' actions. Overall its free flowing rhizomic structure gives the appearance of disorder, even chaos, and it certainly challenges traditional authority and convention. Authority figures struggle to contain, manage or understand the nature of this unstructured evolving environment.

The personality subscale liberalism appears to be very suited to the digital environment especially in its extreme form where many of the aspects of liberalism can be expressed

constructively or at the very least with reduced social consequences.[138] Alternatively in the physical environment expressions of liberalism can often receive negative social reaction such as the hostility towards the Occupy movement (Gautney, 2011). However, as with artistic interests, the item-questions were not suitable for examining liberalism within the digital-environment, making the results for the liberalism subscale debatable. (See Appendix 1: Table 11 for liberalism item-questions and additional information and references related to the development and validity of the IPIP instruments).

The final subscale for Openness is **emotionality**. In the physical environment high scorers in emotionality are aware of their feelings and can readily access them.[139] Emotionality refers to the *awareness and access of feelings,* not necessarily the expression of them externally as seen in the Extraversion subscale cheerfulness, which is discussed below. Emotionality in the physical environment is likely to be viewed positively in individuals who are higher in artistic interests or sympathy where the individual's awareness and access of feeling is generally innocuous. But high emotionality in conjunction with high anger or anxiety may well be viewed negatively as the awareness and access of these feelings are likely to lead to negative social behaviour (being considered temperamental or highly-strung). Because emotionality in the physical environment can be a double-edged sword I suggest that this personality subscale tends to be supressed in some cultures and individuals. In the physical environment individuals will not readily express emotionality for fear of judgement or penalties. However, in the digital environment the perceived buffering or distancing between the individual and others appears to reduce supressed emotionality as seen in the trend of over sharing (Agger, 2012).

In the following extract we see how Kate, one of the least engaged participants, struggles with emotionality within the digital networked environment.

> Kate i1q1: "Emails cause so many fights.. arguments … because people misread and it is all to do with your feelings at the time."

[138] An example of this is the overwhelming response to Kony 2012 where participants could challenge a warlord without physical risk (Paine, 2012).
[139] This becomes important in later discussions when the individual is considering as second order cybernetic system. High emotionality indicates an individuals' awareness of their internal response and processing of stimuli.

On the other hand Tim, who is very engaged, is aware of the difference in emotional expression in the digital networked environment.

> Tim i2q1: "People in the real world behave according to social norms that they have learned and that have been ironed out in the school yard and in the market place. They know that there is a cause and effect if they are being rude. Whereas on the Internet there is a disconnect … people can get away with bad behaviour and so they do. People tend to be worse than they need to be."

Like Kate, Tim is also uncomfortable with the overexpression of emotionality in the digital networked environment but he has a level of understanding of its causes. There is also positive expression of emotionality within the digital-environment as seen in Sue's poetry activity.

> Sue i1q2: "In the whole creative writing space … it is quite fascinating because you have a way of looking at things and seeing … if you write a poem and you put it up there, in your mind there is a reason why you wrote that poem and there is a meaning to it and then you get other people coming in and they pick up a completely different meaning from it because of their experiences and their ways of seeing. It is quite fascinating to get that insight into the way other people work [think]."

Overall the Openness factor appears to be compatible with the digital networked environment. Liberalism and emotionality can be expressed more freely with fewer detrimental consequences and often in a more constructive way. The continually evolving complex diversity of the digital networked environment is ideally suited to satiate the artistic interests, imagination and adventurousness subscales of openness all be it in a new and often abstract way. Finally of all the subscales *intellect* appears to be the most ideally suited to the digital networked environment as it involves an individual's preference and capacity for abstract constructs and information seekers, which is intrinsic to intellectual pursuits. Fluid abstract constructs are everywhere in the digital networked environment.

6.3.1 Results of the Openness Subscale

My original premise that the Openness factor was associated with digital engagement was indeed correct, however my initial reasoning was not quite right. My focus had been on the technology as an environment and the inadequacy of the instrument. This led me to underestimate the role of mental constructs in digital engagement. On reflection I realized that the three subscales intellect, imagination and artistic interests are all associated with a

capacity for abstract thinking and the ability to create and hold abstract constructs. As the digital networked environment is largely an abstract construct it is not surprising that individuals who score higher on these subscales will find the digital environment less confronting than low scorers. See table 10 below where I have introduced a 'significance evaluation measure' that is based on the weighting of the range for each subscale.[140]

Table 10 Significance Evaluation of Openness Subscales

OPENNESS

INTELLECT	●	Fay	Tim	Ben	Joe	Roy	Con	Sam	Ann	Sue	Eva	Ivy	Kate
EMOTIONALITY	◆	Fay	Eva	Kate	Con	Sue	Sam	Ann	Ivy	Tim	Ben	Roy	Joe
IMAGINATION	◆	Ben	Joe	Sam	Tim	Ann	Sue	Fay	Eva	Kate	Roy	Con	Ivy
ARTISTIC INTERESTS	◆	Ann	Sue	Ivy	Sam	Eva	Fay	Joe	Kate	Roy	Con	Tim	Ben
ADVENTUROUSNESS		Kate	Roy	Tim	Ben	Sam	Joe	Ivy	Con	Fay	Ann	Sue	Eva
LIBERALISM	○	Ivy	Joe	Ann	Eva	Kate	Fay	Tim	Ben	Sam	Sue	Roy	Con

● ○
← Higher Scores Lower Scores →

Significance Key:
- ● Higher scores in this subscale are significant to digital engagement
- ◆ Higher scores in this subscale are important for digital engagement
- ○ Low scores in this subscale are significant to digital engagement.

The weighting of emotionality to higher scores within this sample group confirmed that the more digitally engaged individuals find the digital-environment more suitable for their emotional expression.

At this point it is pertinent to discuss liberalism in more detail, as it is a good illustration of the recurring problem that I had with regard to an instrument designed specifically for the physical environment. As the table below shows eleven of the twelve participants scored liberalism at the low end of the range and only one in the high range – this distribution was an anomaly.

Table 11 Significance Evaluation of the Liberalism Subscales

OPENNESS

LIBERALISM	○	Ivy	Joe	Ann	Eva	Kate	Fay	Tim	Ben	Sam	Sue	Roy	Con

● ○
← Higher Scores Lower Scores →

[140] The highest scores (yellow) were allocated a value of 3, green 2, and blue 1. These were then summed to establish an overall score for the high score for the specified subscale. The lower scores were allocated 1 for the grey, 2 for the lilac and 3 for white. These were then summed to establish an overall score for the low score for that subscale. The highest scoring subscale is noted with ● and the lowest with ○. Those marked ◆ are considered to be important subscales to digital engagement. The high and low score are also represented in linear graphs in this chapter.

After completing the survey, in a social discussion, Ann and Kate asked me what *politics and religion* had to do with digital engagement and between them cited the following checked item-question (5 of the 10 liberalism items). Joe contributed to the conversation asking why some questions related to criminals and cited 4 of the 10 liberalism items. Nine item-questions were so jarring that participants had specifically remembered them from a pool of three hundred questions.

Table 12 Question-items for the NEO-PR-I subscale Liberalism

Factor	Subscale	Item-question	Keyed
Openness	Liberalism	✓ Tend to vote for less conservative political candidates.	+ keyed
		✓ Tend to vote for conservative political candidates.	– keyed
		✓ Believe in one true religion.	– keyed
		✓ Believe that too much tax money goes to support artists.	– keyed
		✓ Like to stand during the national anthem.	– keyed
		Believe that there is no absolute right or wrong.	+ keyed
		Believe that criminals should receive help rather than punishment	+ keyed
		Believe laws should be strictly enforced.	– keyed
		Believe that we coddle criminals too much.	– keyed
		Believe that we should be tough on crime.	– keyed

It could be argued that the item-questions for liberalism explored a general willingness to respect or accept behaviors or opinions different from one's own and therefore should be transferable to the digital environment. But the fact that of three hundred randomly presented item-questions nine of the ten liberalism questions had been identified as problematic for my participants made me question the validity of the subscale. After analysis I came to the conclusion that the current item-questions for liberalism were unsuitable for evaluating '*an openness to ideas within the digital environment*' and the results from this survey did not measure psychological liberalism in the digital environment. This was a recurring issue with many of the survey subscales but was particularly the case with liberalism.

Conclusion: *With regards to the Openness factor it appears that the key subscale indicator of digital engagement is high intellect. The subscales artistic interest, imagination, and emotionality are also very important because the weighting towards the higher score was pronounced.* The results of the liberalism subscale were not considered useful to this research.

6.4 Conscientiousness Subscales

The subscales of Conscientiousness are: self-efficacy, orderliness, dutifulness, achievement-strivings, self-discipline and cautiousness.

The subscale **self-discipline,** which is generally seen in the physical environment as being a constructive and positive attribute, describes two important features 1) the ability of an individual to overcome *reluctance to begin a task* and 2) the *ability to persist with a task* until its completion despite distractions or difficulties. Both these features are necessary for self-discipline because once '*reluctance to begin a task'* has been overcome, the inherent friction of the physical environment, such as time, space, or inertia requires the individual's '*persistent behaviour'* in order to attain success. In this regard self-discipline is a highly advantageous personality trait with regard to achieving goals.

In the digital networked environment self-discipline works in much the same way; however, there is a possibility for behaviours to be amplified in those scoring high in self-discipline, because of the non-passive nature of digital technology. In other words, once an interaction is initiated in the digital networked environment the nature of the technology aids the persistence of the task by the way it reaches out to the individual. For example post-it notes are passive but digital reminders are active and likely to advantage an individual higher in self-discipline who will respond to the proactive reminders. There is the perception that digital reminders will aid those who are low in self-discipline because the reminder is more active and less easy to overlook than a passive post-it note. This may well be the case as long as the individuals' reluctance to begin a task is not too high but if they are highly reluctant to initiate or persist with a task, as individuals with low self discipline tend to be, then the effects of reminders (digital or analogue) are reduced.

High self-discipline in the digital environment can be a double-edged sword depending on the perceived value and outcome of the task. Consider the down side of being self-disciplined about promptly answering emails. For example Eva and Roy who scored moderately on self-discipline. Eva becomes emotionally distressed at the thought of not

being able to respond to her email. Her prompt answering of emails may have started out as simple self-discipline behaviour, but the engaging nature of the technology has evolved the relationship to an emotional dependency.

> Eva i1q1: "My emails … in fact if we go offline I like can't cope. … I'm just where is the email, come back, where is the email. … So yeah definitely the email."

Similarly participant Roy, who is very engaged, has a deep connection to his emails.

> Roy i1q1: "Some people go 'good morning where are my glasses, where is my coffee' I go where is my keyboard … I have got to respond to people's emails and my wife is the same. … So a lot of organizing happens asynchronously on email."

In the physical world this attribute is primarily based on the individual's ability to initiate a task and then persist to a conclusion. In the digital networked environment, I suggest it is the individual's ability to overcome a *reluctance to engage with technology* that is the main issue, because the non-passive nature of digital networked technology will aid and possibly discipline the individual in the persistence of self-discipline.[141] This is illustrated in the discussion on Sam in the Conscientiousness results below in 6.4.1.

High scorers on the **achievement-striving** subscale tend to have a strong success oriented direction in life and they could become single minded and obsessive. When this subscale is applied to the digital environment the nature of the technology[142] and the inherent nature of the individual[143] creates an amplification system.[144] The focused nature of the individual and the non-passive nature of the technology will increase the frequency and intensity of iterations between the individual and the technology. The outcome of this interaction would tend to enhance behaviours both bad and good depending on the goals or activities of the individual: For example addictive gambling (Bavelier et al., 2010) or as in the case of Sam who has a successful career in social media marketing (see results below).

> Sami1q3-i2q4: "I check Facebook 20 plus times a day I'm always on my phone" and "I enjoy it … social media, I'll come up with an idea and I can see how it

[141]From research in this thesis it appears that the biochemical responses to micro-rewards in the digital networked environment are likely to counteract self-discipline of low scorers in this subscale. Further research would be necessary to establish if this does indeed hold with individuals who score very low on the self-discipline scale.
[142] Technology is no longer passive, waiting to be used by humans. It 'reaches out' and interacts with humans.
[143] The individuals' propensity to become single minded and obsessive.
[144] A positive feedback loop.

> performs instantly … I can create that engagement instantly and I can see how people react to certain things."

High scorers in the **self-efficacy** subscale have a belief in and are confident of their ability to achieve their goals through self-control and common sense. In the physical environment this confidence is generally well founded and built on the individuals' understandings of who they are within their environment: their autobiographical self. In the digital networked environment applying this subscale may become problematic due to the discussed differences in physical and digital environments where core human concepts are challenged. It is not yet clear whether the self-efficacy subscale is more suited to the physical world environment or the digital networked environment but there does appear to be unanticipated risks in the latter. If the individual is not aware of differences between the two environments the confidence that they have developed within the physical environment may be challenged or not transferable to the digital environment. This may have a detrimental affect on them that they may not fully understand.

An individual with a strong sense of moral obligation and duty will tend to score high on the **dutifulness** scale. This could be a positive attribute in the digital environment if the individuals' behaviour manifests as moral obligation and the behaviour becomes more socially aware, similar to some of the Agreeableness subscales. However if the emphasis is towards *obligation*, then the individual may be frustrated by the lack of governance, regulation and orderliness within the digital networked environment. In these circumstances the digital networked environment may not be as comfortable for those scoring higher on dutifulness. Kate who has dutifulness as one of her three highest subscale scores is driven by a social obligation to respond to emails as soon as they come in, even if it is just to say she will respond later. It is not surprising that Kate expresses physical agitation when discussing this issue in the interview.

> Kate i2q4 "I can send Ben an email…but he won't respond to it for like 4 or 5 hours. So I have … physically get out of my chair walk into his office and say.. I have sent you an email… [she point out that for Ben] It is not important to quickly respond."

This leads to **orderliness** the fifth subscale of Conscientiousness. Orderliness describes individuals who are well organized and thrive on routines and schedules. As with dutifulness this attribute can be both good and bad in the digital networked environment. It is problematic with regard to the unstructured nature of the digital networked environment, where the lack of order will perpetually confront and destabilize the individual. However, the utility of the digital network can be extremely advantageous to high scoring orderliness individuals, by providing unprecedented tools and opportunities for organization and management. Ann, who had orderliness as one of her higher subscale scores, saw the digital networked environment as one big filing system.

> Ann i2q4 "To me I see my entire computer filing system as nothing more than a digital version of what I used to do in a filing cabinet." Then later she continues "the internet has become such a very secure filing system"

A high scorer on the **cautiousness** scale will consider possibilities before taking action. In the physical environment where rationality has been given more credence this subscale is generally perceived as beneficial because the consideration of possible outcomes tends to reduce risks (Stanovich, 2010). On the other hand it must be acknowledged that there are numerous instances where instinctive responses are superior to a consideration of possibilities (Lehrer, 2009).

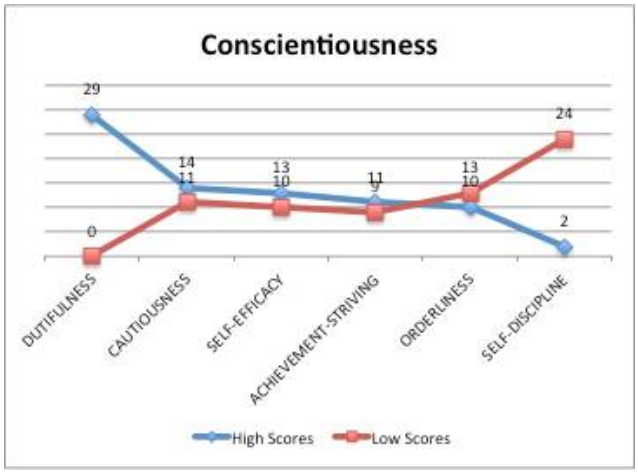
In the digital networked environment there is a different problem for high scorers on the cautiousness scale that relates to Deleuze's concept of the rhizomic nature of the digital environment which demands the action of participants in order for them to be considered part of the system (G Deleuze & F Guattari, 1987). Enhanced consideration of possibilities before taking action is likely to reduce interaction and result in less iteration within the digital environment.

To summarize the conscientiousness subscales, with regard to digital engagement, two of the conscientiousness subscales, *self-discipline* and *cautiousness* could potentially contradict each other within the digital environment. The subscale self-discipline could assist the individual in initiating digital engagement particularly if there is a strong motivation to engage but on the other hand cautiousness could hinder self-discipline. Self-discipline could

also be enhanced by high scores in the subscale achievement-striving. High scorers in the subscale orderliness and dutifulness are likely to be conflicted about the digital environment due to the apparent disorganized nature of it which is known to challenge traditional established conventions and institutional practices.[145] High scoring orderliness individuals are however likely to be very open to using technology with regard to the organizational aspects of their lives. This is likely to be in the form of information dissemination, calendar sharing and communication. High scorers in self-efficacy would have built up a belief in their ability to achieve their objectives, which at this stage of human evolution is still primarily grounded in the individuals' experiences within the physical environment and has evolved over time. In the digital environment core concept differences[146] such as value exchange may unsettle this belief and feed cautiousness. Overall, depending on the interplay of the Conscientious subscales, the high scoring individual is likely to exhibit enhanced behaviours in the digital environment.

6.4.1 Results of the Conscientiousness Subscale

Graph 11 Conscientiousness Subscales showing highest vs. lowest scores



[145] For example the effect of file sharing systems on copyright, tax and gambolling laws or censorship.
[146] Discussed in Chapter 3.

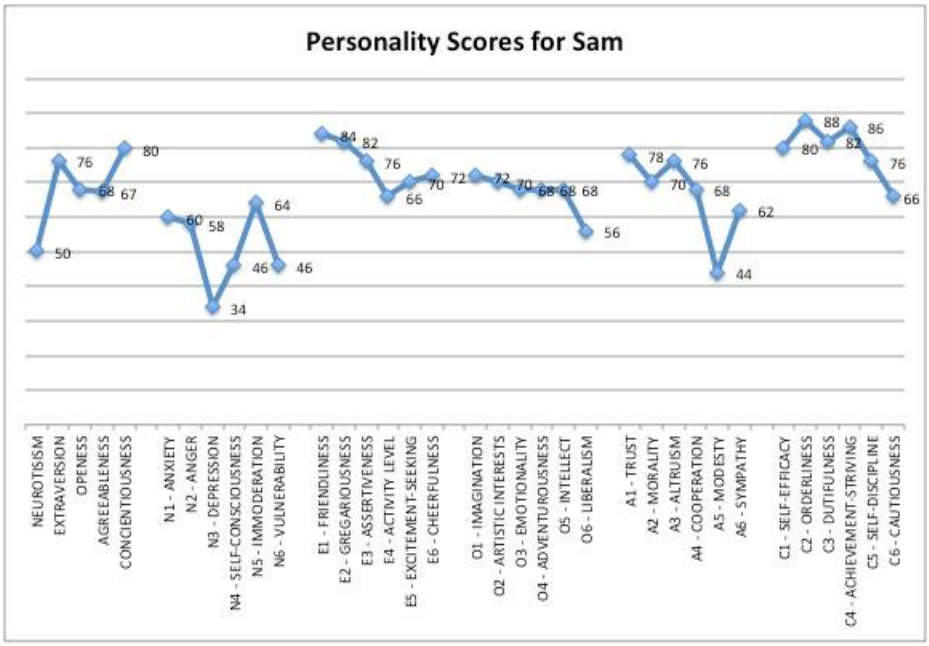
Surprisingly four of the six subscales were evenly weighted between the high and low scorers (see graph above).[147] The other two scores indicate that my hypothesis should be high dutifulness and low self-discipline is indicative of this sample group: ICT professionals. While some of my subscale hypotheses were later shown to be correct others like dutifulness as noted here was less accurate.

I had focused on *moral obligation* and not paid sufficient attention to the role of duty, particularly with regard to social conventions. From the results and related analysis I have come to the conclusion that the Conscientiousness subscale appears to play an important role in modifying or amplifying behavioural outcomes within the digital networked environment and that Conscientiousness is best examined in conjunction with other subscales: This is illustrated by examining participant Sam.

Sam's overall Big-Five Factor score [148] showed Extraversion as a high score (76) and Agreeableness as his lowest score (67). According to results of this research, Sam's profile clearly indicated that he should *not be digital-engaged*. Sam's interview history supported this and revealed an indifference to digital networked technology. However in the interviews some of Sam's behaviours also presented as being a fully engaged person *but only within a narrow range.* He was only fully engaged with his smartphone and social media. To gain insights into this contradiction I examine the subscales of Sam's highest Big-Five Factor personality trait: Conscientiousness (score 80).

[147] One of the low scorers on self-efficacy revealed in confidence that she was seeking help regarding situational induced low self-esteem. I therefore view the self-efficacy score as evenly weighted between high and low scorers.
[148] See graph below – first set of five results on the left.

Graph 12 Sam's Personality Scores showing: Big-Five Factor, Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness



Despite the fact that Sam was introduced to social media in his late teens he did not engage with it in any notable way until he acquired his Apple iPhone in 2007. The mobility and user-friendliness of the iPhone afforded benefits to Sam's Extraversion subscale traits Friendliness (score 84) and Gregariousness (score 82). Sam could now easily organize face-to-face activities through his iPhone. However the more Sam used the iPhone the more the iPhone *engaged with him* via social media updates, social engagement reminders and SMS's. This type of engagement appealed to his orderliness subscale (score 88) via calendar reminders and this re-enforced his predisposition to dutifulness (score 82): If someone SMS'ed him he responded immediately which elicited further responses and more iterations. This intensifying iterative interaction accelerated and amplified Sam's engagement with the technology.

Sam was also interested in marketing as a career and his deeply embedded relationship with the smartphone enabled him to be immanently suited to online marketing. As a career opportunity this appealed to his achievement striving subscale (score 86). The consequence of his match to online marketing increased his daily engagement iterations in both work and

recreation resulting in a heightened engagement with digital networked technology but only within this narrow range; social media and the smartphone. When I asked Sam if he used his laptop he dismissively answered 'I'd say 5%' then immediately reverted to passionately discussing his smartphone. '[but] a lot of people are using mobile devices to engage with social media' then a short while later 'I check Facebook 20 plus times a day I'm always on my phone. … it's the convenience'. (Sam-i1q3-9)

In the example of Sam, we see someone who displayed *no* innate affinity with digital technology but this changed after his initial engagement with a device that fed a major personality trait (Extraversion). In Sam's case the technology, which is designed to encourage interact and engage with the individual, reached out with increasing iterations and deepened his engagement. Sam's engagement was disproportionately amplified because it reinforced his very high Conscientiousness subscale traits. This resulted in an accelerated and intensified synthesis with the technology in an individual whose innate propensity for digital engagement was minimal, but only within a narrow range of technology. While Sam appeared to be 'fully engaged' he did not have the same depth of awareness or level of consciousness of his relationship with the technology that the other fully engaged participants had, he was not managing or in control of his relationship with the technology. Fortunately in Sam's case, behaviours resulting from his digital engagement are seen as positive and constructive because they are aligned with socially sanctioned goals,[149] but they could just as easily have been negative behaviours such as gambling or online game addiction.

There were no general explanations that became obvious for self-discipline being so low within this sample group. Unlike the liberalism subscale, the question-items were generally appropriate for both the digital and the physical environment. A case-by-case examination revealed possible explanations as being higher immoderation or lower self-efficacy, which may have acted as moderators that resulted in the low self-discipline result.

[149] Sam is no longer with the company and currently holds the position of Social Media Executive for a leading media company in Australia, Sam has not yet turned 30.

Conclusion: *With regards to the Conscientiousness factor it appears that key subscale indicators of digital engagement are high scores in dutifulness and counter intuitively a low score for self-discipline. The latter requires more research to establish why this should be the case.*

6.5 Neuroticism Subscales

> *The subscales of Neuroticism are: self-consciousness, anxiety, anger, depression, immoderation and vulnerability.*

In general, high Neuroticism refers to a tendency to experience negative feelings.[150] People scoring high in neuroticism are emotionally reactive and respond emotionally to events that would not affect most people. Their reactions tend to be more intense than normal, ordinary situations are perceived as threatening, and minor frustrations as hopelessly difficult.

The **self-conscious** subscale describes individuals who are uncomfortable around others due to their sensitivity about how others will evaluate them: They are overly fearful of criticism, rejection and ridicule. As a result the high scorer of self-consciousness tends to be awkward in physical environment situations. It is important to note that self-conscious is different from self-awareness: Self-consciousness is defined as 'cognizance of the autobiographical character of personally experienced events' ("Glossary of Psychological Terms,").

The nature of the digital environment acts as a buffer between the individual and others. This creates a safer space in which the self-conscious individuals can express themselves. In the following comment Roy, who scores highly on the Neurosis scale, is generally very shy, polite, quiet and reserved. Here he demonstrates how being part of a digital environment aids his self-expression.

> Roy i3q12: "I think [in the digital environment] we become less defensive and more comfortable with expressing opinions to a wide group of people. … I just told them what I thought."

[150] Neuroticism should not be seen as a condition marked by mental distress, emotional suffering, or an inability to cope effectively with the normal demands of life which was the interpretation used by Freud.

This behaviour was very unusual for Roy within the physical environment where he would conceal or curtail his feelings as seen in the following comment where he reverted to being overly self-conscious.

> Roy i3q12: "I thought afterwards that I had been ungracious I thought I was right but ungracious."

The buffer created by the digital environment appears to reduce the fears and sensitivities of the self-consciousness.

The ability to evaluate and regulate interactions in the digital environment also applies to high scorers of the subscale vulnerability and anxiety; High scorers on the **vulnerability** subscale are panicked or confused in situations demanding rapid responses and high scorers on the **anxiety** subscale tends to be in a constant state of fearfulness. In both these subscales the virtual and asynchronous nature of the environment acts as a barrier that will aid higher scorers. The subscales self-consciousness, vulnerability and anxiety all appear to be better suited to the digital environment than the physical one.

Anger describes individuals who are sensitive to being treated fairly (by the individual's measure of fairness). The individual becomes resentful and bitter when their expectations are not met. This subscale may not always be expressed due to the moderating influences of other personality factors such as agreeableness. Anger is, however *felt* by the individual when their expectations are not met. If anger is expressed in the physical environment it is likely to have negative physical consequences but the digital environment provides a physically safer place for the expression of anger. The asynchronous nature of the environment also allows for 'turn taking', which provides a buffer or 'cool-off' period between interactions: For example social or political comment in blogs or the more negative troll-behaviour.[151] Tim, who scores very low on anger, is sensitive to displays of anger.

> Tim i2q1: "On the Internet … people can get away with bad behavior and so they do. People tend to be worse than they need to be therefore the negative penalties are greater than the positives in cyberspace compared to the real world. There is a distortion in that way."

[151] Troll behaviour is when one deliberately makes offensive or provocative online posting with the aim of upsetting someone or eliciting an angry response from them.

High scorers on the **immoderation** subscale have difficulty resisting urges and cravings and will more easily succumb to short-term pleasures, which often result in over indulgence. In the digital environment high scores on this subscale can encounter problems because the micro reward system of the digital environment feeds the immoderation trait at the biochemical level as discussed in Chapter 4.

Depression is the final subscale of Neurosis and describes individuals who tend to feel sad and dejected. In high scorers for depression, there is a propensity to reduced energy and they may have difficulty initiating activity. In the physical environment this behaviour tends to result in increased isolation of the individual that could potentially escalate the depression. In contrast, the digital environment potentially provides a greater pool of people with whom the individual can connect and communicate when they are able. This could reduce feelings of isolation as demonstrated by Fay.

> Fay i1q1: "The end result is that I have actually found that with Facebook through my iPhone I at least feel connected to people. Its not the best connection, its not the most supportive but I can at least post up there that I am struggling and my friends who I can't see because they are in a different state will actually post back and say 'Its ok you are doing a good job.' It's very reassuring and...it at least emotionally frees me from feeling socially isolated."

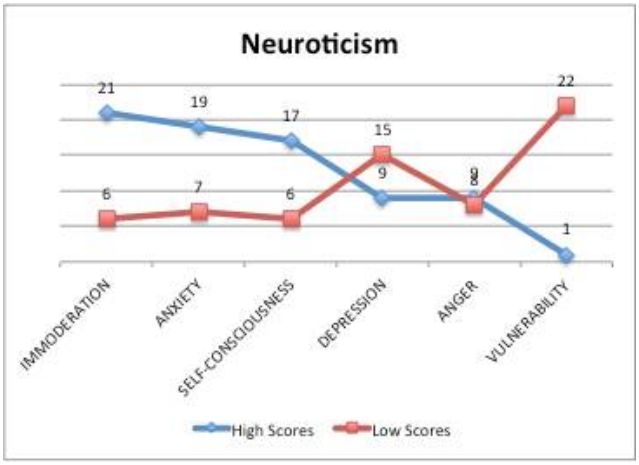
The digital environment increases opportunities for seeking support that would be difficult in the physical environment. On the other hand the digital environment could be problematic because the support found on-line may not be appropriate and the over-sharing of depression-feelings may exacerbate depression in the individual seeking support. The digital environment appears to provide both positive and negative opportunities for the depression subscale.

To summarize the factor for Neuroticism, self-consciousness is certainly conducive to engagement with the digital networked environment as it provides the space and opportunity for individuals to express themselves safely and reduces their fear of ridicule and rejection. The global reach of the digital environment also increases possibilities of finding like-minded groups, which potentially reduces self-consciousness. Individuals who score high in the

subscale vulnerability and anxiety are better able to evaluate and regulate their interactions with others in the digital environment as opposed to the physical environment but the expression of anger may be easier in the digital environment. For those scoring high on depression the digital networked environment does not necessarily provide advantages. Finally, high scorers in immoderation are likely to experience difficulties in the constructive management of digital technology due to the micro-reward basis of online interactions.

6.5.1 Results of the Neuroticism Subscale

Graph 13 Neuroticism Subscales showing highest vs. lowest scores



Overall the results of Neuroticism concur with my hypotheses for these subscales. High immoderation and low vulnerability are the most important subscales with anxiety being of secondary significance. The high immoderation scores were consistent with my concerns about the influence of micro rewards and was substantiated in the interviews where most participants volunteered that they struggled to manage the addictiveness of the technology once they started using it. This was often expressed as ‘I lose track of time’ or ‘I waste time’. With regard to the vulnerability subscale, I had anticipated that it would be relevant but had not expected it to be such a strong indicator of digital engagement. On reflection it is clear that the speed and constant change surrounding the digital environment is better suited to low scorers on the vulnerability subscale because they are less likely to be panicked or confused by the dynamic nature of the environment.

Anxiety was unfortunately not sufficiently dealt with in the interviews to reveal possible causes for this high score. I had initially considered anxiety to be related to inter-personal relationships and had not considered anxiety as being related to the dynamic nature of the digital environment. This did however come out as an unexpected strong theme in the interviews. Unprompted comments were made by participants relating to increased levels of anxiety caused by the dynamic evolving nature of technology and their struggle to keep up with developments as well as the lack of client understanding of working remotely.[152] Consider the anxiety level of Tom, a programmer who supports multiple customers on different programs and software versions. When Tom is asked to add, edit or modify some code he has to recreate the exact digital environment that the client had when the code was last developed, which could have been recent or many years ago.

> Tom i1q7: "That's the frustration … the pain of change. I mean … [when I] upgrade my laptop it is a nightmare because I know that I am going to new technology [and] the customers that I have got are still stuck on old technology [and] I have still got to try and support them. [On the other hand when] the normal guy upgrades his desktop or laptop it takes a couple of weeks to learn where to click a few buttons but that's the end of his problem."

Whether the higher anxiety scores are a result of the participants' engagement with digital technology or whether higher anxiety trait people are drawn to digital networked technology is not sufficiently clear from my data. However, as none of the participants scored Neuroticism as their highest Big-Five Factor score, I propose that the recorded level of anxiety in this sample group is a consequence of work related tasks and not an explanation for why they have gravitated to IT as a profession.

[152] There appeared to be an expectation of clients that billable time for remote work would be substantially less. As a result when an ICT professional worked remotely they felt pressured to reduce billings, which would create a level of anxiety. This is a significant area for future research because it appears to be affecting not only the well being of ICT professionals but I suspect it is affecting productivity.

Table 13 Significance Evaluation of the Neuroticism Subscales

IMMODERATION ●	Ann	Ben	Eva	Joe	Sam	Tim	Roy	Sue	Fay	Ivy	Con	Kate
ANXIETY ◆	Ivy	Con	Fay	Tim	Joe	Ann	Sue	Eva	Kate	Roy	Ben	Sam
DEPRESSION	Kate	Roy	Eva	Joe	Tim	Ben	Con	Ann	Sam	Fay	Ivy	Sue
SELF-CONSCIOUSNESS	Fay	Sue	Ben	Con	Ivy	Kate	Roy	Sam	Eva	Joe	Tim	Ann
ANGER	Sam	Con	Fay	Ben	Ann	Sue	Ivy	Joe	Kate	Roy	Eva	Tim
VULNERABILITY ○	Sam	Ann	Ivy	Roy	Ben	Eva	Fay	Sue	Tim	Con	Joe	Kate

● ○
← Higher Scores Lower Scores →

Key: ● Higher scores in this subscale are significant to digital engagement
◆ Higher scores in this subscale are important for digital engagement
○ Low scores in this subscale are significant to digital engagement.

Conclusion: *With regards to the Neuroticism factor it appears that key subscale indicators of digital engagement are high scores in immoderation and anxiety with low scores in vulnerability.*

6.6 Summary: Notable Factors and Subscales.

As is evident from this analysis, the Agreeableness factor occurs more frequently in my sample of ICT professionals than other factors. My discussion also shows that individuals in my sample group who were low in Extraversion were more comfortable with digital networked technology and the digital environment. As ICT professionals generally appear to be more engaged with technology, it is reasonable to assume that high Agreeableness may well correlate to digital engagement. With the exception of Sam, participants who scored higher in Extraversion appear to have difficulty managing their relationship with the technology. This suggests that higher Extraversion could be associated with individuals who are less likely to be digitally engaged.

From this analysis the factors Openness, Conscientiousness and Neuroticism appear to influence other factors. For example Openness appears to have an amplifying affect on individuals who are higher in Agreeableness. I propose the reason for this is that the subscales associated with abstract constructs in Openness are appealing to, or at least more compatible with the Agreeableness subscales within the digital environment.

From my results, high Conscientiousness appears to counteract or even overcome an individual's impartiality to engaging with technology as in the case of Sam. Conscientiousness enables the individual to initiate engagement and encourages responses

that results in amplified behaviours: It is the diligence of the high scoring Conscientiousness individual that sustains the process of digital engagement and lays the groundwork for an ongoing relationship with the technology. The extent of the moderation is dependent on the subscales.

In Neuroticism most of the subscales relate to 'feelings'. When considering the potential affect of frequently dispensed digital environment micro rewards on the bio-chemistry of an individual, the moderating or amplifying influence of Neuroticism subscales becomes important (Fiorillo et al., 2003; Han et al., 2015; Schultz, 2007; Schultz et al., 1993; Schultz et al., 1997; Taber et al., 2012). The subscale immoderation appears to be particularly susceptible to behaviours affected by chemical changes as evidenced by the positive feelings described by Tim when engaging with digital networked technology.

> Tim i1q2: "So now when you transfer into another world browsing or some digital connection you actually have other powers and abilities those must affect you. Not quite sure why."

From this discussion I have identified the following subscales within the Big-Five Factor that appear to relate to digital engagement.

Table 14 List of Important Subscales to Digital Engagement

High scores are very important		Low scores are not important		High scores are Important	
Morality	A	Modesty	A	Anxiety	N
Altruism	A	Self-Discipline	C	Emotionality	O
Dutifulness	C	Excitement-Seeking	E	Imagination	O
Friendliness	E	Vulnerability	N	Artistic Interests	O
Immoderation	N				
Intellect	O				

Having identified how the Big-Five Factors are relevant to digital engagement and which subscales are more important, I will now discuss how I developed my Digital Engagement Framework and how it was used it to establish digital engagement measures for my participants.

> Anne i2q4: "Do you think you can find your way back [to the original page] again? Not in hell! You just … lose the back button. Because somehow the back

> button doesn't work anymore. And so, to me, in my way of thinking its very messy filing, VERY MESSY not well sorted out!"

It appeared that Neuroticism was equally influential in moderating or supporting behaviours in both the digital and physical environment but Conscientiousness somehow seemed to be more influential in the digital environment. Insights into the influence of Conscientiousness became much clearer once I had the subscale data.

6.6.1 Survey 1: Conclusion

Overall results of Survey 1 showed that higher Agreeableness scores indicated a propensity to digital engagement. There was also a strong contra indication with regard to high Extraversion scores: High Extraversion scores indicated a lower digital engagement propensity. Openness and Conscientiousness appeared to influence behaviours in the digital environment but further examination of the role of Big-Five Factor subscales was necessary. High Openness scores appeared to support digital engagement particularly when associated with high Agreeableness and especially where there was evidence of possible higher intellect. High Conscientiousness scores appeared to relate to digital engagement but how and more importantly, why, was not clear from Survey 1 data. Conscientiousness in particular required further investigation at the subscale level. Neuroticism did not appear to be particularly important in relation to digital engagement and appeared to play a similar role in both the digital and physical environment.

While the Big-Five Factor may be a good predictor of physical environment behaviours, it may not be suitable for the digital environment for two reasons. Firstly the instrument item-questions do not specifically probe digital environment behaviours. The current item-questions were developed for examination of behaviours in the physical environment and the assumption is that behaviours are consistent in both environments. This as discussed in Chapter 3 may not be the case. Secondly, the descriptions and general understanding of the five personality traits and how they relate to each other is once again physical environment centred. For example, item-questions do not probe the expression of Extravert behaviours in a virtual environment. A possible item-question could investigate how the individual feels about 'likes' or 'friend' buttons in social media. Deeper investigation of both item-questions

and personality descriptions within the digital environment is I believe necessary particularly as there is a different risk/benefit calculation to online activity that is not addressed in the current instruments.

As the development of valid and reliable instruments was not within the scope of this research my challenge was to continue use existing instruments for deeper investigation of the Big-Five Factors. I therefore used the NEO-PR-I personality test as discussed in Chapter 4. The NEO-PR-I provided me with an evaluation of the six subscales of each of the Big-Five Factors discussed above.

7 A Digital Engagement Framework and Measure

In this chapter I discuss how my understanding of digital engagement evolved through the identification of themes and supporting subthemes. This led to the development of my Digital Engagement Framework, which helped me to represent my data as an intersection of the individual and technology. Using both my data and themes identified in my Digital Engagement Framework I also developed a prototype instrument for measuring digital engagement. This prototype instrument allowed a more objective and structured measurement of a scale of engagement from less engaged to more fully engaged.

Due to the relative newness of digital engagement I did not want to approach this research with preconceived hypotheses, I wanted the research data itself to reveal insights and possible explanations for this new phenomenon. As discussed in chapter 1 the grounded theory approach proved to be an ideal methodology for this as it encouraged the identification of themes that related to digital engagement from the data itself. (Charmaz, 2006; Glaser et al., 1968).

Most interview questions were open-ended to encourage rich in-depth discussion and insights into the emerging phenomenon of digital engagement. Questions for the first interview focused primarily on *what* technologies participants used, *how* they used digital network technology, and the participant's history with the technology (Appendix 1: table 12). Analysis of the first interview led to the development of questions used in the second interview. Questions used in the second interview were all open ended and designed to discover how participants *experienced* their engagement with digital network technologies and *why they engaged* with it (Appendix 1: table 13). The participants' awareness of how they experienced first principle concepts within the digital environment was explored. This included concepts such as time, space, and value exchange. Emotional triggers were also examined during the second interview.

The grounded theory approach involved examination, comparison, conceptualisation and categorisation of behaviors and attitudes of the recorded video. My analysis of the first two interviews revealed recurring concepts and themes, it also highlighted areas that required

further exploration in my final interview. From this analysis I developed my third and final interview questions. These questions explored concepts or issues that had been raised by individual participants during the first two interviews. Using this method of question development I ensured that all identified areas of interest raised by participants during the interviews were explored with all participants before the interview process concluded. As a result, the final interview had a mix of open, closed and hypothetical questions (Appendix 1: Table 14). This approach proved useful because participants' responses confirmed a number of common themes and concepts: such as builder behavior vs. consumerism or difficulties regarding value exchange within the digital networked environment.

Further analysis of the interviews was done both digitally, using the nVivo software (Hutchison et al., 2010), and manually. The manual analysis entailed identifying concepts, both specific and implied, from the interview transcripts and additional notes that I had made related to participant behaviour over the interviews period. These were then collated into themes and sub-themes that made coherent sense in explaining what I was observing in digital engagement. The two methods of analysis were necessary because they provided different perspectives (interpretive and subjective), which revealed a more complete set of insights. The digital method of analysis enabled firstly, the development of interviews questions, and secondly, it facilitated the identification of key themes that explained what I was seeing as behaviours relating to digital engagement. As themes had already been identified in the digital analysis, my manual method of analysis focused on identifying *statements* that described different levels of digital engagement. The statements resulting from the manual analysis were used to determine a subjective measure of my participants' digital engagement, which, after comparison and correction using the Digital Engagement Framework, was then correlated to participants' personality measure in order to develop an understanding of the relationship between the two. Below I provide more details about what each analytical process entailed.

7.1 Digital Analysis Leads to the Model

The digital method of analysis was conducive to rapid extraction and categorisation of data, as well as the identification, organisation and reorganisation of themes and trends across a

wide range of data inputs such as Video, transcripts and notes. The extraction of data involved identifying extracts of information from source material[153] that I felt related to digital engagement and then allocating each extract to its related theme/s (node/s).[154] If no appropriate node existed then one was created for it and the extract allocated. Using this method of processing the interview data I was able to identify recurring issues that were raised by participants at the conclusion of each set of interviews. This assisted me in formulating questions for subsequent interviews. Analysis of interview one led to questions for interview two and analysis of both one and two led to the questions for interview three.

Six months after the final interviews were concluded I again used the extracts of information, but this time I used the nVivo system it to help me identify *key themes* related to engaging with technology. The nVivo system permitted easy reorganisation and development of theme structure without loss of subthemes or their associated data. As Andrew Hutchison and colleagues noted, 'qualitative data analysis software [QSR-NVivo] can be used to encourage good quality grounded theory research by facilitating many of the key processes and characteristics associated with this approach' (Hutchison et al., 2010, p. 283). Once I had completed the interview process I began using the data to develop an understanding of how and why digital engagement was experienced differently by participants, including why individuals reached different levels of engagement. In the following sections I discuss how the repeated process of organisation, analysis and regrouping of relevant data finally led to the development of a framework for understanding the process of digital engagement.

Before proceeding, it is important to explain what I mean when using the term 'success' or 'successful digital engagement' in what follows. Throughout this thesis discussion, references or inferences related to 'a value judgment' or 'successful digital engagement' are gauged according to the *individual's* parameters of success. My appraisal of an individual's 'successful digital engagement' considers whether their engagement with digital technology aids the successful attainment of their own unique goals. 'Successful digital engagement' is not intended to be or used as a value judgment of the individual or their particular goals.

[153] Source material was primarily the video recording of the interviews but also included notes and transcripts of the interviews.
[154] A node is a collection of references about a specific theme or area of interest. The references are gathered by 'coding' sources such as interviews, documents, articles or survey results.
See: http://help-nv10.qsrinternational.com/desktop/concepts/about_nodes.htm#MiniTOCBookMark2

There are many jobs or activities where a 'higher level' of digital engagement is not necessarily an advantage, or could even be a disadvantage especially where face-to-face exchange is important.

7.1.1 First Analysis: Ten-Themes - 128-nodes

My initial nVivo data coding resulted in 128 nodes. Each node was a collection of identified pieces of information that were extracted from the interviews, which were similar in concept. I grouped these 128 nodes into ten themes; Behaviour, Core concepts, Decision-making, Digital networked technology, Engagement, Feedback, Personality, Demographics, Physical environment and Tool use (see Appendix 1: Table 15 full list). The theme structure from this first analysis was useful for question development, but it soon became apparent that this arrangement of themes was not useful for developing an understanding of digital engagement itself. Some of the data within the themes Core concepts, Physical environment and Tool use did, however, lead me to question behavioural differences between the physical and digital environments. This enquiry led to my understanding of the duality of environments in which we now operate and the decision to consider digital networked technology as both a tool and an environment. In addition, extracts of data from the Engagement and Feedback themes began solidifying my idea that digital engagement would be better understood as a process. The following table shows the initial Ten-Theme analysis that required further investigation because it did not lend itself to examination of digital engagement relationships themselves. This led me to conclude that I needed to re-categorise my data into a new set of themes.

Table 15 Ten Themes Identified in First Digital Analysis

Model-1 Themes	What the information described…	Relevance to digital-engagement
Behaviour	Relates to technology/human interactive behaviours	Behaviours that can be observed
Core Concepts	Core concepts that are different in the digital environment	Not sure why it was important
Decision-making	Issues related to action in the digital environment	Not sure why it was important
Digital technology	All things related to relationship with the technology	Relationship behaviours
Engagement	Assorted awareness related to engaging with technology	Awareness is somehow important
Feedback	Indicators of a process	Feedback seemed important
Personality	One of the Big-Five Factor personality traits	Behaviours that can be observed
Demographics	Age, gender, education ...	Basic demographic data
Physical environ.	Specific to real world issues and examples	Environ. perceived differently
Tool Use	Use of digital technology as a tool	Different perception of use

In the course of this new analysis of interview data, which incorporated insights arising from participant discussions as well as secondary readings, such as the role of core concepts on behaviours within the two external environments, I came to realise that it was the relationship of the internal mechanism of the individual that was important. Below I will trace four themes (core concepts, value exchange, external expectations and internal expectations), as an illustrative example to detail the iterative process of organisation, analysis and re-categorisation that led to my Framework.

Table 16 Extract of Second Themes Identified in First Digital Analysis

level-1	level-2	level-3	Description
2-Core Concepts			Core concepts that are different in the DNE
	Identity		Issues related to online identity
	knowledge-base		Affects of information base on the individual
	representation of self		How does the individual represent themselves in DNT
	self-centred		DNT alters the locus of self in social environments
	Locus-self		Awareness of locus of self within digital environment
	Memory		Issues related to online memory
	Space		Issues related to online space
	Time		Issues related to online time
		endless - 24-7	Aware of endless or timeless time in digital environment
		engrossed	Lose time due to engrossed behaviour
		fragmented	Aware of fragmented time in digital environment
		instantaneous	Aware of instantaneous time in digital environment
		metronome	Use of metronome to link real world and digital time
		micro-rewards	Lose time due to micro-reward behaviour
		non-linear	Aware of non-liner or web time in digital environment
		time-awareness	Aware that time behaves differently online
	Value-exchange		Issues related to online value exchange
		Accountability	People have to be accountable for a successful value exchange
		expectations	Conditioned expectations of value exchange
		Extern. Expectation	Others will respond much like me- treating me fairly.
		Intern. Expectations	Approach is something to be gained and it will be a beneficial experience
		perception evolution	See value exchange as simply and evolutionary process
		tangible vs. abstract	Sees differenced in digital and real world value exchanges

7.1.2 Second Analysis: Twelve Themes –108-nodes

Having realised that the Ten-Theme analysis was not useful to me in describing or explaining what I was seeing as digital engagement I re-examined and regrouped all 128

nodes and their related data into a new structure containing 108 nodes. This resulted in twelve Level-1 themes.[155] (see Appendix 1: Table 16 for full list).

Table 17 Twelve Level-1 Themes

Twelve Theme Analyses – Level-1
Intensity
Embeddedness
Consciousness
Openness
Adaptability
Willingness
Rational Applications
Experiential Application
Implementation
Existential-Motivation
Fulfilment-Motivation
Gratification-Motivation

In addition to the twelve identified themes there were three nodes in this analysis that related to demographic information and five that were examples of personality behaviours. The content of these eight nodes did not contribute to advancing my understanding of digital engagement and were therefore not included in the theme structure. They are, however, referred to in the personality discussions within the thesis where they were relevant.

The following two tables are extracts from the Twelve-Theme structure (Appendix 1: Table 16) and I will use them to continue the illustration of my process of organisation, analysis, and regrouping of nodes. Table 18 below shows the nodes that I could not allocate and that required further investigation. After additional investigation I was able to reallocate the five nodes marked as 'moved'. The balance of the nodes (indicated with a question mark) were however persistently problematic and I could not comfortably reallocate them to any of the existing twelve themes.

[155] As this was a totally new analysis of data and structure, mapping the original Ten Theme analysis directly to the Twelve Theme analysis is not feasible. However, some data within a node was sufficiently similar and the entire node could be reallocated within the new structure. For example, in the first analysis the Level-2 node Adaptation-technology found under 1-Behaviour (Level-1) was renamed adaptability and allocated to the 5-Adaptability node in the second analysis. In other instances I had to break up a node and reallocate all the data to the appropriate node in new structure.

Table 18 Extract from the Second Digital Analysis: Unallocated nodes

Level-1	Level-2	Description
The following were important and require more investigation		
?	Accountability	People have to be accountable for a successful value exchange
?	External Expectation	Others will respond much like me- treating me fairly.
?	Identity	Issues related to online identity
?	Preference-Human	Preference is human as a solution
?	Solution Human	Primarily turn to humans for solutions / relationship building
?	Solution Technology	Primarily turn to technology for solutions / relationship building
?	Value-exchange	Issues related to online value exchange
Moved	Broadcast	See it as a tool for broadcasting
Moved	Comm. complex	understand that DN are complex - they are not simply a communication tool
Moved	Communication 121	Sees it as 1-to-1 communication
Moved	Communication 12m	Sees it as 1-to-many communication
Moved	Conven.-remote work	Uses are convenience or remote work

Table 19 below shows the Existential Motivation theme and its associated Level-2 nodes. In these two tables I have once again highlighted the three nodes External Expectations, Value-exchange and Internal Expectations. When this second analysis is compared to the previous analysis we see firstly, that all three nodes are now at Level-2 – they are now considered as equally important. The second point to note is that External Expectations, and Value-exchange could not have been allocated to one of the twelve identified themes. Thirdly, Internal Expectations has been moved from Core Concepts to Motivation. Finally, 'Core Concepts' is no longer a theme.

Table 19 Level-1: Existential Motivation Group of Nodes

Existential-Motivation		
	Basic functionality	Dependent on DN for basic functionality
	Existential	Are there important consequences for real world survival
	Had to Embrace	Did not embrace DNT voluntarily
	Internal Expectations	Approach it that something to be gained and that it will be a beneficial experience
	Unusual circum.	Unusual influences affect technology use

While this Twelve-Theme structure was better suited to describe digital engagement behaviours it still resulted in a fairly large number of themes that were difficult to explain coherently with regard to what I was observing in my participants. I therefore re-examined the twelve themes and the data-snippets that supported them from the perspective of *why* they related to digital-engagement. The following table shows how using this approach

revealed an association between the Level-1 themes Intensity, Embeddedness and Consciousness. All the data within these three nodes related to a behaviour that could be grouped under a meta theme 'Use of technology'. Similarly Openness, Adaptability and Willingness were related to 'processing of information' and the existential, fulfilment and gratification nodes all related to motivation.

Table 20 Analysis of Unallocated Nodes in Second Digital Analysis

108-Node Themes	Themes related to	Description of relationship
Intensity	Use of technology	Frequency if iterations with technology
Embeddedness	Use of technology	How seamlessly enmeshed technology is in users life
Consciousness	Use of technology	Users level of awareness of technology relationship
Openness	Information processing	How open are they to form relationship
Adaptability	Information processing	Are they prepared to adapt in relationships
Willingness	Information processing	How willing are they to actually form relationships
Rational Application	Decision-making	Do innate attributes aid action
Experiential Application	Decision-making	Does training aid action
Existential-Motivation	Motivation	Motivation is for some higher reason
Fulfilment-Motivation	Motivation	Motivation is caused by needs or wants
Gratification-Motivation	Motivation	Motivation is a result of gratification
Implementation	?	Do they use technology to build or consume
Accountability	?	Be accountable for a successful value exchange
External Expectation	?	Others will respond much like me- treating me fairly
Identity	?	Issues related to online identity
Preference-Human	?	Preference is human as a solution
Solution Human	?	Primarily humans for solutions / relationship building
Solution Technology	?	Use technology for solutions / relationship building
Value-exchange	?	Issues related to online value exchange

This left an important collection of nodes that could not readily be grouped together but were clearly vital to what was I was seeing in participant responses. A fresh analysis of this collection of nodes and their related data showed that they fell into two themes that I termed Value Exchange and Action. The first group related to the values that were being exchanged in the course of relationship identification, building or maintaining and the second group related to the actions taken as a result of the decision-making process. This insight led me to a third and final restructuring that resulted in my Digital Engagement Framework, which accommodates the identified behaviours observed in my participants.

7.1.3 Third Analysis: The Digital Engagement Framework

In developing the participants' statements into a framework, a number of reclassifications of the information were made, and the naming convention became important to keep track of these changes. The statements and insights from my participants were collected into 'nodes', which were groups of common meanings, organised by concept. These nodes were sorted into the more important, Level 1, and their dependent nodes, Level 2 groups. The Level 1 nodes consisted of a small number of coherent concepts, which were grouped into Themes. Eventually the nodes were collected into 5 Themes, which became the 5 Sectors of the framework. Each Sector was then given as many sub sectors as were applicable from the new analysis, which coincidentally were three per Sector. In the previous sections (7.1.1 and 7.1.2) I use the naming convention themes, under which the nodes were collected, in order to establish which themes were important. In this final analysis where the important themes and nodes have been identified I use the term Sectors in place of 'themes' and subsectors in place of 'nodes' as these are the terms that I use for my framework.

The first Level-1 node was **Tool Use**. This came from the previous analysis, which identified three nodes relating to 'use of technology' being *intensity*, *embeddedness* and (rather than the possibly confusing term consciousness) the third theme *awareness* because this term was more commonly used by participants. In my Digital Engagement Framework this becomes the Tool Use Sector and it explores the relationship between the individual and technology by examining the *intensity* and *embeddedness* of the users tool-use in daily activity as well as how conscious or *aware* they are of this process and relationship.

The second Theme referred to previously as 'information processing' was now called **Feedback**. This involved the Level-2 nodes *openness*, *adaptability* and *willingness*. Examination of these sub nodes revealed that I had not been identifying information processing as isolated events but rather I was examining them as a process involving multiple iterations of information processing that resulted in behaviour modification directed at a goal – in short, a *feedback loop*. I was identifying the individuals' openness to input, their willingness to take action to attain their desired outcome[156] and their capacity to make any

[156] Note that I was looking for the *individual's desired outcome* not any externally determined objective.

adjustments to their own behaviour in order to obtain their desired outcome. A second significance of this insight was the vital role that the individual's internal processing played in the development or deepening of their digital engagement. I was not simply observing the 'consumption of information' but rather I was examining a larger process of the effect of information processing on behaviour modification that resulted in what I was seeing as digital engagement.

Both the individual's internal environment and the environment external to the individual appeared to be important to the iterative process of digital engagement, but I needed to identify the link between the two and the second analysis had revealed a theme called 'decision making'. Examination of the data in these nodes, however, revealed that I was identifying a combination of decision-making style and more importantly, the individual's resulting actions. Indeed these actions were the manifestation of the internal decision making process. I therefore called the related third Level-1 node **Action.** I noticed that some actions were in part the result of *internal influencers* such as the individual's sense of duty to respond promptly to emails or their desire to be seen to be co-operative by contributing to discussion boards. Other actions were the result of *external influences* such as digital reminders, work requirements and social or peer pressures. For example the assumption of many individuals that if they post information on social media that others will automatically be informed. From my final analysis a third sub node emerged that related to Action in digital engagement and that was the individual's *ability* to take action that resulted from a decision being made.

I was now ready to re-examine the fourth Level-1 node, **Value Exchange**, which had been so difficult to identify because values permeated all themes as supporting or influencing factors. Most of the sub nodes in Value Exchange related to relationships in some way, but it was not the relationships themselves that were important, but rather the meaning that the relationships were given by the participant. As both Feedback and Action were identified as processes, I reassessed the data of the eight unallocated nodes by considering them as possibly also being part of a process. I found all data could be grouped into one of the following sub nodes *internal expectations, external expectations* and *reciprocity.* Internal

expectations related to the individuals' internal environment and included innate feelings that arose from an individuals' internal milieu. These led to some form of value exchange: for example, a shared sense of trust. External expectations were the individual's anticipated value exchanges of others – how will another person behave towards me? For example, the expectation that others would behave in a troll-like way or that digital information should be free. Reciprocity was the term that I used for the final sub node. It related to the overarching philosophy or perception developed by the individual as a result of their internal and external systems of value exchanges and how they had experienced previous iterations of value exchange. An understanding of reciprocity is necessary if the individual is to trust that they will be treated fairly and will derive the value they are seeking because without this there is a reluctance or resistance to engage with others.

At this point it is worth noting that all four Level-1 nodes discussed so far appeared to be behaving as a system where two components were being evaluated and the resulting outcome was evident in the third component. The third component served as an indicator of regulation of this interaction. In Tool Use, the individual's resulting awareness of technology's potential appeared to be a cause and a consequence of the individuals' intensity of use and how embedded it was in their daily functioning. In Feedback, the individual's resulting propensity to adapt to technology was both caused by, and was a consequence of, how open they were to its use and how willing they were to interact with it. The ability to take action was the result of the individual's evaluation of internal responses to external experiential stimuli. Similarly understanding value exchange resulted from an evaluation of internal and external expectations. In each of the four Level 1 nodes (Tool Use, Feedback, Action and Value Exchange) digital engagement was the result of multiple iterations and the individual's pro-active modification of their behaviour in order to gain a better outcome[157] on the next iteration. Therefore I determined that the outcome should also be considered important to digital-engagement. An outcome is, however, indicative of the presence of some type of controller or governor that aids adjustment. But a controller requires and objective, goal or motivation against which the stimuli and activity can be

[157] The 'better outcome' was unique to the individual.

evaluated. This provided the reason as to why motivation needed to be identified as important.

The fifth Level-1 node identified was thus **Motivation,** but unlike the other four nodes, which operate independently as subsystems as well as being part of the overall digital engagement system, Motivation was the controller of all the systems. Each individual appeared to display some behaviour of all three identified Motivation subnodes (existential, fulfilment and gratification). The first subnode, which I call *existential motivation*, generally aligns with Maslow's 'being needs' because it involves esteem and self-actualisation (Maslow, 1943). Examples of this type of motivation are seen in participants' comments related to the writing and sharing of poetry globally or the submission of code for free use (Sue, Tim and Roy). However, I also found that *existential motivation* could result from engaging with technology for the survival or well being of others as in Fay and Ivy who had serious health related issues with their children. The second subnode, called *fulfillment motivation*, aligned with Maslow's 'deficiency needs', these incorporated motivation to engage with technology as a result of work requirements or for the acquisition of goods. The final subnode, *gratification motivation*, was exemplified by the individual's desire to obtain immediate short-term pleasure rewards for an action taken. Examples of this would be surfing the net for fun, which gives micro rewards as each new piece of information is retrieved, or clicking the 'like' button.

My observation about the Motivation node with regard to digital engagement was that every individual was motivated to some degree by all three subnodes, but the impetus to take action on their motivation appeared to be dominated in most cases by only one of the subnodes. This was similar to what occurs with personality where an individual has attributes from all five factors but one will dominate and modify others. I also noted that the depth of digital engagement was associated with <u>personal</u> motivation rather than external motivators. An external motivation system such as a learning or gaming system did not necessarily result in deepening of digital engagement with the individuals who used it. Some individuals may have acquired advanced skills, but did not necessarily become engaged with the technology. Others, however, may have become deeply engaged with the system regardless

of their skill level. Where I encountered greater digital engagement in my participants there appeared to be strong personal motivation despite the diversity of the motivation involved. It was clear that motivation was indeed important; a conclusion that I concede is not in itself remarkable but is nonetheless vital to the process of digital engagement. Motivation had to be included in my model as it gave focus to the governing elements of the other four nodes.

The following table is a summary of my final analysis of all the nodes and subnodes. As I will now be discussing these themes in terms of my Digital Engagement Framework I will no longer use the terms nodes and themes and instead I will use the terms Sectors (as derived directly from the themes) and subsectors.

Table 21 Digital Engagement Model: Showing the 5 Sectors and their associated subsectors

Sector	Sub-sector	Description
1.- TOOL USE		**Explores the relationship between individual and technology**
	11 - Intensity	How intense is the individual's use of the technology? This does not necessarily mean how many times the individual uses digital technology in a specified timeframe but rather how in-depth the relationship is with the device/s they use.
	12 - Embeddedness	How integrated is digital networked technology in the individuals' physical environment interactions; cognitive processing, relationships, behaviours and self-management?
	13 - Awareness	How aware is the individual of their relationship with the technology. Are they aware of the relationship or in denial of it. Is their relationship with it more than one that they would have with a simple inanimate object?
2.- FEEDBACK ABILITY		**Explores the individuals relationship and use of incoming information**
	21 - Openness	Is the individual open to incoming information especially if it challenges their current mindset?
	22 - Willingness	Will the individual process incoming information against their internal knowledge base: Consider confirmation bias, self-disclosure, and self-reflection?
	23 - Adaptability	Does the individual use processed information for behaviour modification?
3.- ACTION POTENTIAL		**Explores individual's potential to act on processed information**
	31 - Internal Influencers	Is the individual responding to Internal influencing factors such as emotions and feelings, personality or background?
	32 - External Influencers	Is the individual responding to External influencing factors such as environment, people or devices?
	33 - Actionability	Once an individual has come to a conclusion will they actually do something about it?
4. - VALUE EXCHANGE		**The mechanism that the individual has developed to translate what they have to offer into what they want.**
	41 - Internal Expectations	Explores the individual's internal understanding and self-awareness of values that they have and how they feel about the risks and rewards in potential interactions. These are the in-skin systems that are modified by the autobiographical self and internal milieu.
	42 - External Expectation	Explores the individual's expectations of external exchanges within the digital networked environment. These tend to be modified by external environmental experiences and conditions such as troll-aggression.

43 - Reciprocity	Explores the individual's overarching philosophy and expectation of how social interactions or behaviours play out.
5. - MOTIVATION	**The drive to get personal benefit**
51 – Existential and Meaning Motivation	The individual's motivation is driven by abstract meaning, purpose and attitudes that shape how they see the world and has significant physical environment consequences for themselves and others close to them.
52 – Needs Fulfilment-Motivation	There is a tangible or acquisitive element to the individual's motivation that exists beyond the immediate engagement and relates to more practical issues of survival and prospering.
53 - Gratification-Motivation	The individual's motivation provides temporary benefits or pleasures - its consequences are transient.

To conclude this section the following table illustrates the progression of my thinking using the node example 'value exchange'. The following table demonstrates how the core themes were identified at the start but by using a grounded theory approach to analyse the data I was able to identify the five key themes related to digital engagement.

Table 22 Progression of Illustration Nodes Through The Three Digital Analysis Phases

Ten-Themes	Twelve-Themes Plus	Five-Themes – Framework
1 - Behaviour	1 - Intensity	1.- Tool Use
2 - Core Concepts	2 - Embeddedness	11-Intensity
21- Identity	3 - Consciousness	12-Embeddedness
22-Locus-self	4 - Openness	13-Awareness
23-Memory	5 - Adaptability	2.- Feedback Ability
24-Space	6 - Willingness	21-Openness
25-Time	7 - Rational Application	22-Willingness
26-Value-exchange	8 - Experiential Application	23-Adaptability
261-accountability	9 - Existential-Motivation	3.- Action Potential
261-expectations	10 - Fulfilment-Motivation	31-Internal Influencers
263-External Expectation	101-Basic functionality	32-External Influencers
264-Internal Expectations	102-Existential	33-Actionability
3 - Decision-Making	102-Had to Embrace	4. - Value Exchange
4 - Digital Networked Technology	104-Internal Expectations	41-Internal Expectations
5 - Engagement	105-Unusual circumstances	42-External Expectation
6 - Feedback	11 - Gratification-Motivation	43-Reciprocity
7 - Personality	12 - Implementation	5. - Motivation
8 - Demographics	?_Accountability	51-Existential-Motiv.
9 - Physical Environment	?_External Expectation	52-Fulfilment-Motiv.
10 - Tool Use	?_Identity	53-Gratification-Motiv.
	?_Preference-Human	
	?_Solution Human	
	?_Solution Technology	
	?_Value-Exchange	

Once I was satisfied that these five Themes did indeed represent what I was observing as digital engagement behaviours I was able to examine them in terms of the overall process of digital engagement. This led to the development of my Digital Engagement Framework, which describes the process of digital engagement.

7.2 Digital Engagement Framework: The Five Sectors as a Process

Through repeated analysis I came to a conclusion that when the five identified Sectors of Tool Use, Feedback, Action, Value Exchange and Motivation were taken together as a system or process they represented a way to think about the factors that would influence the kind of engagement participants had with digital technology. I therefore turned to system thinkers for insights into how and why these five Sectors might function as a system.

The area of study loosely termed *learning systems*, which focuses on the way individuals learn and the systems within which they learn, was useful in providing insights into digital engagement with regard to the necessity for accounting for both the internal and external environments. Kurt Lewin, a learning systems theorist, suggested that neither the innate nature of the individual nor the learned experiences resulting from their interaction with the environment were solely responsible for individuals' observable behaviors or personality. Lewin argued these behaviours were a combination of both innate nature and the environment expressed in the form of an equation as $B = f(P, E)$[158] (K. Lewin, 1947a, 1947b). In this regard Lewin's ideas certainly supported my observation that the observable behaviors of digital engagement involved both the internal environment of the individual and the external digital networked environment. Lewin's framework for explaining factors that influence situations by supporting or hindering motivation was also useful and influenced my thinking with regard to the Motivation Sector: I realised that an individual's dominant motivation sub-sector could potentially hinder or support digital engagement. My understanding of the role of learning within the Feedback Sector was also influenced by Lewin's action research. Lewin's research explored the conditions that led to social action, which he suggested is the result of a spiral of steps made up of planning, action, and fact-

[158] Where β is behaviour, P is the person and E the environment.

finding about the result of an action (K. Lewin, 1943).[159] In terms of my research this related to and described the feedback process that I was witnessing at a number of levels within my identified Sectors and subsectors. Despite the influence that Lewin and other learning systems researchers had on the formulation of my conceptual understanding of certain behaviours within a system, none of them provided sufficient theoretical support to fully substantiate my Digital Engagement Framework.

I also examined complex system theories, which focus on self-organisation,[160] emergence [161] and nonlinearity.[162] In essence, complex system theories definitely supported my observation that digital engagement involved multiple related systems. I therefore examined a variety of complexity theorists to source an appropriate theory or framework to contextualise my research. For example, I drew on Per Bak, who examined stable systems in order to identify the critical state where a system breaks down and reconfigures into a new system (R. Lewin, 1993, p. 60). I considered these ideas in the context of attractor centers in social media such as the 'like' button: Why did it work? When did it not work? Who did it work on? I was also struck by the work of Patricia Churchland, an analytical philosopher, who wrote that 'when you think about brain activity it's correct to think about emergent properties at higher levels that depend on lower-level phenomena in the system' (R. Lewin, 1993, p. photo caption 26). Churchland's comment influenced my ideas about nested systems and the internal systems of the individual, which led to my research into Antonio Damasio's theories on the evolving of consciousness. I also considered the work of many other theorists, such as Tom Ray's early digital evolution simulations (R. Lewin, 1993, pp. 84-105), Stuart Kauffman's basic ideas related to the concept of complexity and his more specific views on network attractor centers (Kauffman, 1996, pp. 71-112; R. Lewin, 1993, pp. 23-32) and Richard Dawkins explorations into genetics (Dawkins, 1976, 1987). While all these theories influenced my thinking to some degree, in many ways I found they were too specific to the theorists' own discipline or interests and adapting their theories to my

[159] This process of spiraled steps is sometimes referred to as the Lewinian spiral.
[160] Self-organization describes a process where some form of overall order or coordination arises out of the local interactions between smaller component parts of an initially disordered system.
[161] Emergence is a process whereby larger entities, patterns, and regularities arise through interactions among smaller or simpler entities that themselves do not exhibit such properties.
[162] A nonlinear relationships the wider range of possible dependencies as opposed to a linear relationship, which simply considers two quantities that are proportional to each other.

research was impractical. I therefore focused on examining theorists who had influenced complexity and learning systems theory more directly in the hope that they would provide a foundational theory on which I could build. This led me to cybernetics and second order cybernetics, which I introduced in chapter 2 as being the theories that I have found most useful to support my research. The following discussion of my Digital Engagement Framework makes explicit the ways in which the Sectors of my Framework can be thought of in terms of a second order cybernetic system.

7.2.1 The Digital Engagement Framework Explained by Second Order Cybernetics.

Of the five identified sectors of the Digital Engagement Framework, the three Sectors of Tool Use, Value Exchange and Feedback, function as the core system that can lead to digital engagement. The first component of digital engagement is the digital networked environment, which is accessed through technology. As such the Sector Tool Use provides a good summation of the skills, behaviours and awareness of the individual's technology use that enables access to and operation within the digital environment. I found that my least engaged participants used technology sporadically, were reluctant to embed it into their lives and compared with others were generally unaware of its potential to enhance or extend their capabilities and objectives.[163] The more digitally engaged individuals were very conscious of their frequent interactions with technology, were generally aware of its potential and how they had embedded it in their lives.[164] The *fully* engaged also frequently used technology and had totally embedded it in their lives but, counter intuitively, their awareness of engaging with the technology was not as conscious. Engagement with technology had become second nature to them and was now instinctive.[165]

The second component of digital engagement was, as discussed in chapter 4, the individual's behaviours and mental constructs that form consciousness, resulting from a complex and complicated system driven by the internal milieu of the individual and their response to stimuli.[166] The second core Sector of my Digital Engagement Model is Value

[163] Exemplified by Kate and Ann.
[164] Exemplified by Tim, Roy and Joe.
[165] Exemplified by Fay.
[166] See Damasio, Antonio. (2000). *The Feeling of What Happens: body, emotion and the making of consciousness*. London: Vintage.

Exchange. This Sector explores the underlying values that are exchanged to develop and moderate relationships associated with digital-engagement. This Sector provided a useful summation of the individual's attitudes and opinions on value exchanges (internal expectations) and their expectation of the values of others (external expectations) and the mental construct that they form as a result of their learning experiences related to relationships (reciprocity).

The third core Sector is Feedback. This sector identifies how the individual is likely to use the two sectors, Tool Use and Value Exchange, as a system. The Feedback Sector examines how the individual is likely to process input from the two environments: internal and external. It also examines the outcome of the stimuli and the individuals' resulting adaptive behaviour. In general terms, Feedback examines the individual's overall ability to use the feedback process to attain their personal objectives. While the role of feedback is not specific to the process of digital environment, it becomes increasingly important when taken in conjunction with the subsectors of Tool Use where increased iterations and the convenience of embedded technology has the potential to amplify behavioural learning. When responses are successfully[167] repeated, mental constructs are formed that support the individual's awareness and behavioural learning, which contributes to the formation of the autobiographical self and the development of consciousness. For the purpose of understanding digital engagement I found that examining the feedback capabilities of the individual gave insights as to how they were likely to manage all systems in general. This is important because of the complex arrangement of underlying nested systems that lead to digital engagement. Tool Use provides insights into the external environment (digital environment), Value Exchange to the internal environment (individual) and Feedback shows how these sectors will work as the core system related to digital engagement. The problem is that feedback requires action to start the process: thus, this leads to a consideration of the Action Sector.

The Action Sector is central to digital engagement because if the individual takes no action to engage then digital engagement cannot occur. The Action Sector explores the

[167] Successful is not in terms of a value judgment but rather as the attainment of the individuals' desired outcomes e.g. survival, happiness or a specific object.

mechanisms in individuals that actually trigger and maintain the ongoing process of digital engagement. How the individual manages the Action Sector could explain why differences occur between an individual with advanced technology skills who does not become fully engaged and one who becomes fully engaged. In a fully engaged individual it appears there have been sufficient repeated actions for digital tool-use to become an instinctive behaviour, such that they are no longer conscious of their actions in using technology. Those who are not fully engaged seem to make conscious, and therefore fewer, decisions to engage, but in their case the triggers are insufficient to become intuitive. However, in many cases there are sufficient iterations to result in advanced skill levels without the individual becoming full engaged. This is discussed in more detail in chapter 8.3.

What I have described so far has been the three core Sectors that form the digital engagement framework (Tool Use, Value Exchange and Feedback), along with the trigger that can initiate the process (Action), but the process needs to be sustained for the individual to become fully engaged. This is where the final Sector, Motivation, plays a part in the process of digital engagement. The role of the attributes described by the Motivation Sector is to provide incentive to sustain action within the system. The Motivation Sector does not have subsectors that behave as a process as in the other four Sectors. Motivation is more like personality where an individual will have aspects of all the personality traits, which behaves as a continuum, but one trait will tend to dominate and will commonly be perceived as the individual's personality. Similarly in the Motivation Sector the three subsectors: existential, fulfilment and gratification behave as a continuum. Each individual has all three types of motivation but one will tend to dominate and this dominance is important because their motivation will influence how the feedback process of the system is governed.

From this we see that each of the five identified Sectors describes the principles of regulation and communication within a system that constitutes digital engagement. Each Sector plays a vital role in the process that I witnessed in my participants as digital engagement. The following table (Table 23) summarises the subsectors of Tool Use, Value Exchange, Action and Feedback which form four separate cybernetic systems under the influence of Motivation which is not a cybernetic system. The two sources of input (internally

and externally driven input) are evaluated against the individual's motivation and the outcome shows that some form of regulation or governance (being a governor driven by motivation) has taken place to move the system closer to meeting the objectives of the motivation.

Table 23 How subsectors form four Sector Cybernetic Systems.

Motivation	Internally driven input	Externally driven input	Governor driven by
Tool Use subsectors	Intensity	Embeddedness	Awareness
Feedback subsectors	Openness	Willingness	Adaptability
Action subsectors	Internal Influencers	External Influencers	Actionability
Value Exchange subsectors	Internal Expectations	External Expectation	Reciprocity

At the higher Sector level (Table below) the two sources of input are Value Exchange (internal input) and Tool Use (external input). These two inputs are again evaluated against the individual's motivation resulting in Action creating nested cybernetic systems.

Table 24 How four Sectors form one overall Cybernetic System.

Internally driven input	Externally driven input	Governor driven by **Motivation**
Value Exchange	**Tool Use**	**Action**

When viewing these systems the Feedback Sector could not be accommodated directly in this structure. Feedback had however emerged as being important to digital engagement. It was therefore essential that I understood the role of the Feedback Sector. All the data that led to the identification of the Feedback subsectors involved some form of self-reflection, of a certain level of consciousness, an awareness of the participants' internal systems as well as an awareness of themselves within the environment and the environment itself. The data indicated that individuals who were more engaged were functioning not merely in a cybernetic relationship with technology, but rather they were operating as a second order cybernetic system. They were being both observers of and participants in the system. They were aware of the mechanism of value exchanges in both environments, as well as their use of technology and were thus able to maximise their exchanges by taking action. They were prepared, and able, to adapt to the outcome of each feedback cycle. It appeared that the

distinction between levels of digital engagement lay in awareness, that is, whether or not the individual was operating at a cybernetic or second order cybernetic level. There was, however, one other feature that was extremely relevant, and that was whether the Feedback Sector was functioning as a positive or negative feedback process. A positive feedback process would amplify the system without limit, whereas a negative one would attempt to maintain homeostasis. The Feedback Sector was therefore very important within the system.

It must be remembered that digital engagement is the result of nested systems and not all Sectors, subsectors or even the lower level systems that feed the subsectors, function equally and simultaneously. The whole system is dynamic and in a constant state of change. However, it appears that the more awareness the individual has of the controllers within the system, the more likely the total system becomes a positive feedback system. I observed that when a positive feedback system occurred the individual was more likely to become fully engaged, such that they were no longer as consciously aware of their functioning with digital networked technology as a system. Their relationship to, with and through technology presented as a seamless extension of the self within the environment.[168]

Individuals who had some awareness of the controllers, but not within all Sectors or subsectors, were found to be at different levels of digital engagement.[169] This is a possible explanation for the variety of stresses and frustrations expressed by participants. Some parts of the system were uncontrolled as a result of the positive feedback systems while others were more stable homeostatic systems. This would also explain why some participants became highly skilled in digital networked technology but were still not fully engaged.[170] Full digital engagement appeared to require system awareness that led to positive feedback within the identified Sectors and subsectors.

As these nested systems are complex, complicated and constantly changing, I required a level of abstraction in order to gain meaningful insights. The personality measure is a useful proxy to describe the internal environment of the individual. The Digital Engagement Framework provided a start for the abstraction of how humans relate to technology: the

[168] Exemplified by Fay, Joe and Roy.
[169] Exemplified by Dan, Max and Ivy.
[170] Exemplified by Ben, Tom and Con.

external digital environment. Below, I outline how I developed a prototype instrument to quantify an individual's relationship to digital technology based on my Digital Engagement Framework. This measure could then be correlated to the individual's personality thereby providing a measure of how personality relates to the individual's digital engagement.

7.3 Manual Analysis Leads to Digital Engagement Measure

In chapter 4.3, I discussed how words evolve in order to describe commonly occurring things and how a lexical analysis of words relating to observable behaviors by Allport and Odbert led to the development of personality evaluation instruments and categorisation. Since I was trying to establish a similar type of instrument for digital engagement I did a manual analysis of my interviews where I identified the meaning from the communication (as opposed to words)[171] that related to different levels of digital engagement. The fully and least engaged levels of engagement could be classified with a reasonable level of confidence but other levels could not be grouped in any meaningful way due to the small sample. I therefore elected simply to use three levels of digital engagement that my research could confidently support: fully engaged, least engaged and those who were neither.

The manual analysis entailed extracting meaningful concepts from all interviews that indicated different levels of engagement and assigning them to the subsectors of my Digital Engagement Framework. For example, the following is a participant's statement that was identified as being related to the subsector 'adaptability' in the Feedback Sector:

> Fay i1q1: "Six months to a year ago I would have said [my primary use is] through a PC … a desktop computer…[She then continues describing her son's Autism] I didn't know what was wrong with him but I knew there was a communication barrier … [she then realizes] that the best ways of interacting and engaging with him was the use of the Apple iPad] … We had a lot of positive feedback with that. Not only for him but I found that when he would finally let go of it and go to sleep. I was using it to read books to do more research to answer questions …[about his autism] … and I also found that I could do, to a limited extent, some of the work that I needed to do [for clients on the iPad while watching him]."

[171] Developing an instrument, even a proto type instrument, based on word use alone would require a more specific and larger data set than was available from my interviews. It would also have been a full research project in its own right and was therefore not possible or practical. I did however find that I could develop a proto type instrument using snippets of text that conveyed recurring concepts or views that participants were expressing. The development of a digital engagement instrument that was valid and reliable would require a large sample and numerous iterations of testing the instrument items before it would be acceptable as a valid research instrument and was not within the scope of this thesis.

Concepts extracted from all participants' statements such as the example of Fay above resulted in an extensive list of concept statements. The following table shows concepts that related to the adaptability subsector (See Appendix 1: Table 20 for full list).

Table 25 Identified Concepts for The Feedback subsector adaptability

Concepts demonstrating Fully engaged
Will apply new or different approaches and methods and recognizes that in themselves.
Can read a situation and extract lessons for behavior modification.
Will embrace and utilize the technology to enhance their capacity and capability.
Easily recognizes that the technology is altering them in many ways
Will adapt technology in a creative way.
Concepts demonstrating Least engaged
Technology is shaping behaviours.
Will rely on the technology to make up for any deficit in capacity.
The balance
Will use crowd sourcing in a creative way
Applies new or different approaches but not consciously.
Need practical verification.
Recognized that technology has altered them in some areas of life.

Once I had extracted all concepts I compiled them into single question-statements for each subsector that typified the fully, partial and least engaged participant (Appendix Table 18). I then reviewed each participant in the light of these statements and allocated them a score for each of the fifteen subsectors. The score was derived by considering how the individual was likely to respond, based on my understanding of them from their interviews and discussions with me. This led to a numeric score ranging from one to five: with five being most likely that the individual would have agreed with the statement. While this score was essentially subjective, the structured approach was intended to increase objectivity.

Table 26 Subjective Score of Participants as per Digital Engagement Model Statements.

Subject ID	Intensity	Embeddedness	Awareness	Tool-Use	Openness	Willingness	Adaptability	Feedback Ability	Internal Infl	External Influences	Action Ability	Action Potential	Internal Expectations	External Expectations	Reciprocity	Value Exchange	Existential	Fulfilment	Gratification	Motivation	Average
Fay	5	5	5	**15**	5	4.5	5	**14.5**	4.5	5	5	**14.5**	5	5	5	**15**	5	5	5	**15**	**4.9**
Joe	5	4.5	5	**14.5**	5	5	5	**15**	5	5	4.5	**14.5**	5	5	5	**15**	5	4.5	5	**14.5**	**4.9**
Roy	5	4	5	**14**	4.5	4.5	4	**13**	3	3.5	3.5	**10**	4.5	4.5	5	**14**	4.5	5	5	**14.5**	**4.4**
Tim	4	4.5	5	**13.5**	4.5	4.5	4	**13**	3	3	3.5	**9.5**	5	4.5	5	**14.5**	4.5	5	5	**14.5**	**4.3**
Sue	4	4	4	**12**	4	4	3.5	**11.5**	4	3	4	**11**	4	3.5	3.5	**11**	3.5	4	3.5	**11**	**3.8**
Sam	4.5	5	3.5	**13**	3.5	3.5	3.5	**10.5**	4	4	4	**12**	3.5	4	3.5	**11**	4	3	3	**10**	**3.8**
Ivy	4	4	4	**12**	4	4	3.5	**11.5**	3	4	4	**11**	4	3	3.5	**10.5**	3.5	3.5	3	**10**	**3.7**
Max	3.5	5	3.5	**12**	4	3.5	3.5	**11**	2.5	2.5	3	**8**	3	5	3.5	**11.5**	3.5	3	3.5	**10**	**3.5**
Con	3.5	3.5	3.5	**10.5**	3.5	3	3.5	**10**	3	2.5	3.5	**9**	3.5	3.5	3.5	**10.5**	3	3	3	**9**	**3.3**
Dan	3.5	3	3	**9.5**	3	3	3.5	**9.5**	4	3	3.5	**10.5**	3	3.5	3	**9.5**	3	3	3	**9**	**3.2**
Eva	3.5	4	3.5	**11**	3.5	3.5	3	**10**	2	3.5	2.5	**8**	3	3	3	**9**	1.5	3	1.5	**6**	**2.9**
Tom	3	3	3	**9**	3	2.5	2.5	**8**	3.5	2.5	3.5	**9.5**	3	2.5	3	**8.5**	3	2	3	**8**	**2.9**
Ben	3	3.5	3	**9.5**	2.5	2.5	2.5	**7.5**	4	2.5	4	**10.5**	2	2.5	1.5	**6**	3	3	1.5	**7.5**	**2.7**
Ann	2	2	2	**6**	3	2.5	3	**8.5**	4	2	4.5	**10.5**	2	2	1.5	**5.5**	1.5	2	1	**4.5**	**2.3**
Bob	1	2	2	**5**	2	2	2.5	**6.5**	3	3	2.5	**8.5**	2	2.5	2	**6.5**	2	2	1	**5**	**2.1**
Kat	1	1	1	**3**	1	1	1	**3**	2	3	2	**7**	1	1	1	**3**	1	1	1	**3**	**1.3**

All participants' subsector scores were averaged for the Sector and again for the overall, resulting in the right hand column in the table above. These final averaged Digital Engagement Framework scores were then examined against the average of my *Impression* score, to ensure that my two methods for estimating engagement scores were at least coherent.

The recording of my Impression score was to ensure that I did not lose my intuitive evaluation of participants' digital-engagement levels. To do this I recorded my subjective engagement score for each participant's digital engagement at the end of their interview without reference to any previous score. The evaluation was in the forms of a score of 1 to 5: One being the least engaged to 5 as the most engaged.

Table 27 Subjective Impression score allocated at the end of each interview.

Subject ID	Interview 1	Interview 2	Interview 3	Ave
Fay	5	5	5	**5.0**
Joe	5	5	5	**5.0**
Roy	4	4	5	**4.3**
Tim	3	5	4	**4.0**
Sue	3	4	4	**3.7**
Sam	3	3	3	**3.0**
Ivy	4	4	4	**4.0**
Max	2	4	3	**3.0**
Con	4	4	3	**3.7**
Dan	3	3	4	**3.3**
Eva	3	3	4	**3.3**
Tom	2	4	2	**2.7**
Ben	2	2	2	**2.0**
Ann	2	3	2	**2.3**
Bob	1	2	3	**2.0**
Kat	1	1	1	**1.0**

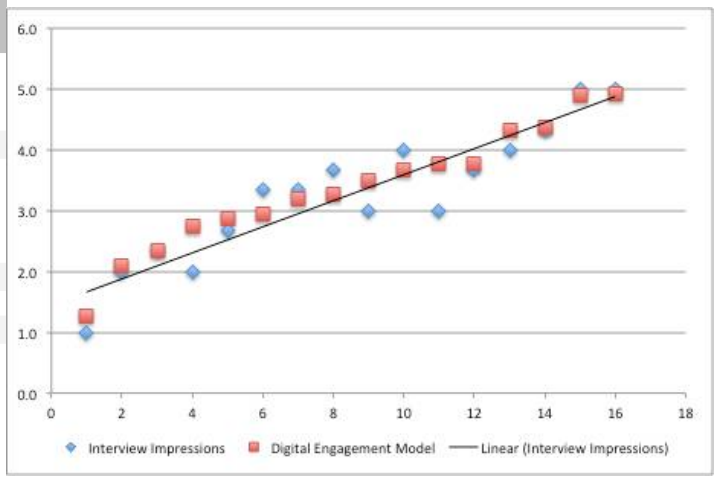
I based these scores on participants' verbal answers or indicators of their opinion seen in hand gestures, facial expressions, silences, omitted answers or evasions. Confounding factors such as the education level of the participant and their ability to express themselves verbally was also taken into account. This series of subjective scores was used to crosscheck with the participant's digital engagement score (derived from the Digital Engagement Framework) before proceeding to correlate the engagement and personality scores: All discrepancies had to be understood and accounted for.

7.3.1 Comparing Impression to Digital Engagement Score

For most participants their *Impression* and *digital engagement* scores were sufficiently similar for me to consider using the digital engagement score as representative of the participant's digital engagement level: Divergent scores were considered as being less than 0.5. There were, however, three participants that required further investigation and understanding before I was confident to proceed with my digital engagement score: Sam with a divergence of 0.8, Max with 0.5 and Ben with 0.7

Table 28 Comparing Impression Score to Digital Engagement Model Score.

Subject ID	Interview Impressions	Digital Engagement Model
Kate	1.0	1.3
Bob	2.0	2.1
Ann	2.3	2.3
Ben	2.0	2.7
Tom	2.7	2.9
Eva	3.3	2.9
Dan	3.3	3.2
Con	3.7	3.3
Max	3.0	3.5
Ivy	4.0	3.7
Sam	3.0	3.8
Sue	3.7	3.8
Tim	4.0	4.3
Roy	4.3	4.4
Joe	5.0	4.9
Fay	5.0	4.9



In Max's first interview he presented as disliking digital networked technology and indicated that he only used it because of peer pressure.

> Max i1q1: "I know that I don't really like them [digital networked technology] but its like the only way that I can contact people keep in touch with people now days because everyone else does use it, you can't avoid it."

Then as part of his answer to the next question he says:

> Max i1q2: "I'm never offline. If I'm not on my computer it's on my phone, which is always signed in. I never sign out of Facebook."

These contradicting comments continued throughout his first interview, indicating someone who was not digital engaged, but simply tolerated it because of social convention. As a result, my initial *impression* score was quite low. On reviewing Max, I believe I incorrectly scored him at a two for the first interview where it should possibly have been a three. His responses had been similar to Ann, who was highly skilled in digital networked technology, but displayed a distinct dislike of or frustration with technology. Unlike Ann, however, in the second interview Max revealed enhanced awareness of the complexities of digital engagement such as different value exchanges. Max's level of awareness was high, and similar to that of Fay, who had consistently displayed fully engaged behaviours. When discussing digital value exchanges most participants tended to be more comfortable relating to commodities whereas like Fay, Max easily discussed social value exchanges:

> Max i2q3: "Online discussion goes a lot faster I find. You jump from thing to thing very quickly, so the value behind what is said is less … you might have back and forth exchange, it is there but it is not ... [Interviewer: It's disjointed?] Yes but its more light hearted… . In the real world things take longer to happen."

Overall, I found that Max's perception and awareness level was more like that of a fully engaged individual, which resulted in his second interview score being a much higher score (4) than the one I gave after the first interview. As the final interview was a mix of questions, probing both practical and abstract philosophical aspects of digital-engagement, Max's impression score dropped back to a 3. Max had the propensity for full engagement but appeared to be resisting aspects of digital engagement.

The reason for Max's inconsistency became clear in a follow-up discussion after the interviews had been completed. When Max graduated he resigned from the company and followed a different career path. Despite having an affinity and skill-set for the digital environment Max's *motivation* lay in the non-digital environment. To Max, digital networked technology was intrusive and potentially harmful to what he valued most and therefore he believed it required aggressive management. Max did, however, see the value and potential of technology, especially when managed properly, but he believed that this was seldom the case. Max typifies the significance of *Motivation* in the Digital Engagement Model. Having come to an understanding of the divergence between Max's two scores I was happy to proceed with his Digital Engagement Model score as it was a better overall reflection of Max.

The reason for the divergence in Sam's scores has already been discussed in The Conscientiousness Subscales. Sam showed no innate propensity for digital engagement until he acquired his smartphone. The combination of his personality traits (high Extraversion) and the engaging nature of the technology resulted in Sam displaying fully engaged behaviours, without the perception and awareness normally associated with full engagement. In addition to this, Sam's engagement with digital networked technology was limited to a narrow range of technology. From the understanding that I developed regarding the role of Sam's personality subscales, I was happy to use the Digital Engagement Model score (3.8) as it provided a refined measure of particular aspects of digital engagement. Sam's personality subscale explanation also clarified the consistently moderate score that I

had allocated during the *impression* ratings: revealing to me that I was having difficulty reading Sam's conflicting signals.

Ben was the final divergent score that needed explaining before I could proceed. Analysis of Ben's interviews consistently presented answers that were challenges to my statements, and it was only when I identified the role of his feedback ability in relation to his value exchanges, which affected the process of relationship building, that I understood why I had such a divergence in my subjective impression (2) and Digital Engagement Framework (2.7) scores. It was well known within the company that Ben was resistant to feedback and not very empathetic.[172] For example he had little to no understanding, tolerance or empathy for the difficulties or challenges that others encountered with value exchange relationships in regard to clients. Ben is, however, an extremely moral person who always 'plays by the rules'. As a result I received conflicting signals. On the one hand, Ben behaved in an almost fully engaged way through his use of apps, social media and discussion boards. However, there was little to no evidence of the more subtle indicators of the fully engaged individual, such as unconditional altruistic value exchanges or relationship development. Ben's participation, contribution, or empathy was externally prescribed and determined by his need to 'play by the rules'. I now felt comfortable using my digital engagement score (2.7) for Ben as opposed to the subjective score (2).

Having addressed all three anomalies and finding in each case the initial subjective score was inferior to the digital engagement score I now felt confident in using my digital engagement scores for the correlation to my participants' personality scores. The purpose of correlating these two measures was to aid understanding, or confirm observations, relating to the relationship between the individual and digital networked technology.

[172] Due to confidentiality issues I have chosen not to quote from the interviews to illustrate this point.

8 What Do the Numbers Tell Us

The course of my research thus far had led me to a solid understanding of the components and processes involved in digital engagement, which was core to my research question. However, I felt that examining this understanding through the rigors of searching for relationships between the data I had collected in relation to personality, and my observations and analyses of the participants' levels of digital engagement, was a necessary step. I wanted to see if my observations about digital engagement consistently lined up with what I had discovered in terms of the impact of personality on digital engagement. If aspects of the two elements (digital engagement and personality) were in a causative relationship, i.e. correlated with each other, then I would expect to find that the more there was of one, the more (or less) I would find of the other. It should be noted that finding a correlation simply indicates that there is a relationship of some sort, but the meaning of the relationship still has to be exposed. In this chapter I therefore compare the two data sets to see if and where there are relationships and discuss the findings to extract the meaning of the correlations.

The digital engagement data set was my subjective score of each individual based on my prototype instrument for measuring digital engagement. This data set is discussed at both the Sector and the subsector level. The personality data set was sourced from the two surveys and included the Big-Five Factors, the REI subscales and the NEO-PR-I subscales. Two of the additional subscales were accounted for in the NEO-PR-I subscales and the other two were not included in this discussion because there were no meaningful correlations. While all participants were considered in this analysis, the Threshold Hypothesis, which is discussed below, was applied and participants were considered as being part of Group A – those who were more digitally engaged or as Group B – those who were less digitally engaged.

The division of participants into Group A or Group B was initially subjective. Just as one can observe a group of people and conclude that some members are shy, active or lazy without having to perform complex personality or activity measurements, I considered my participants and identified those individuals who clearly presented as being what I perceived

to be more digitally engaged. Their sorting into Group A was confirmed later when I checked these participants against the data. This is discussed in more detail below on pages 203-204.

I begin the chapter by discussing why I used the Threshold Hypothesis. The chapter then identifies and considers important personality Factors and digital engagement Sectors as well as subsectors. The significance of rational or intuitive decision making is then explored through the REI correlations. Finally, I discuss the notable NEO-PR-I personality subscales correlations.

To correlate participants' personality and digital engagement scores I used the Microsoft Excel's Pearson correlation coefficient. In the Excel formula[173] below, the 'x' symbol represents the sample means AVERAGE of array1, which would be one of the following depending on what was being compared, the Big-Five Factor results, the REI results or the NOE-PR-I results. The 'y' symbol represents the sample means AVERAGE of array2, which is the digital engagement measure. In short x is correlated to y using the following formula.

$$r = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

Pearson correlation formula used in Microsoft Excel

I also sought third party research involving *large* sample groups that would substantiate or contradict the correlations found in my research, which involved a small sample size. It should be noted that at the time of collecting my data I could not find supporting research but the lack of associated research appears to be changing. Research that corroborates my findings is now emerging and is referred to below, although it is in different areas of research.

[173] See the Microsoft support page at https://support.office.com/en-us/article/PEARSON-function-0c3e30fc-e5af-49c4-808a-3ef66e034c18.

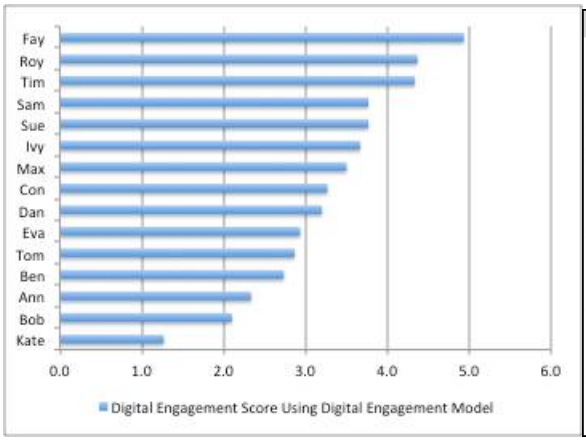
8.1 Does Anything Correlate?

My first attempt at correlating the data used *all participants as one single group* and correlated their subjective digital engagement score to the Big-Five Factors, the four REI subscales as well as the additional selected subscales believed to be related to digital engagement. These results were abysmal and there appeared to be no correlation at all. I therefore sought an alternate way of examining my data. J P Guilford, in his research into the correlation between intelligence and creativity found there was a positive relationship in the lower range of his sample group, those who had an average IQ range, but there was no correlation at above-average levels of IQ (Guilford, 1967). There appeared to be some variable factor that affected the sample correlations in different ranges of the sample; in Guilford's case the Average IQ and above average IQ range behaved differently in the correlations. For Guilford the nature of the variable factors was not fully understood but its existence was clearly evident when the average IQ participants showed a positive correlation between IQ and creativity but the above average IQ participants did not. At some undetermined point, the participant's IQ became relevant to the correlation between intelligence and creativity. Exactly what the threshold is, is still being debated but its existence has become more accepted as research projects examine and substantiate this anomaly (Jauk, Benedek, Dunst, & Neubauer, 2013). Use of the threshold hypothesis has been applied to many other areas of research such the relationship between cyst development and levels of function protein (Ong & Harris, 2015, p. 699) to politics (Gasper, 2015, p. 4) and literacy (Brase & Hill, 2015; Cummins, 2000).

I therefore decided to apply this approach of examining my data set as two distinct ranges to see if it too produced outcomes that were more meaningful. I split my sample into Group A – Those who presented as more fully engaged with technology, and Group B – those who were less engaged. This split was based on the results of assessing participants' digital engagement scores as discussed in the previous chapter. In the following graph we see that Fay, Roy and Tim clearly present as Group A and Kate, Bob and Ann as Group B. The remaining participants were then examined to decide where the threshold should be and this was ultimately determined by my observation of the participant's level of awareness of their

digital engagement and understanding of value exchanges within the digital environment.[174] Ben, Tom, and Eva displayed lower levels of one or both of these variables and the overall impression was that they definitely tended towards Group B. Dan, Con and Max presented more extreme variables making a clear decision difficult. I decided to err on the side of caution and allocate them to Group B. This left Ivy and Sue with higher digital engagement scores and levels of awareness so they were allocated to Group A. Sam was a problem, because his score was higher than Ivy's, but his awareness was notably lower. I therefore allocated him to group B.

Graph 14 Engagement Scores and Group Allocation



Participant	Score	Group
Fay	4.9	A
Roy	4.4	A
Tim	4.3	A
Sue	3.8	A
Sam	3.8	B
Ivy	3.7	A
Max	3.5	B
Con	3.3	B
Dan	3.2	B
Eva	2.9	B
Tom	2.9	B
Ben	2.7	B
Ann	2.3	B
Bob	2.1	B
Kate	1.3	B

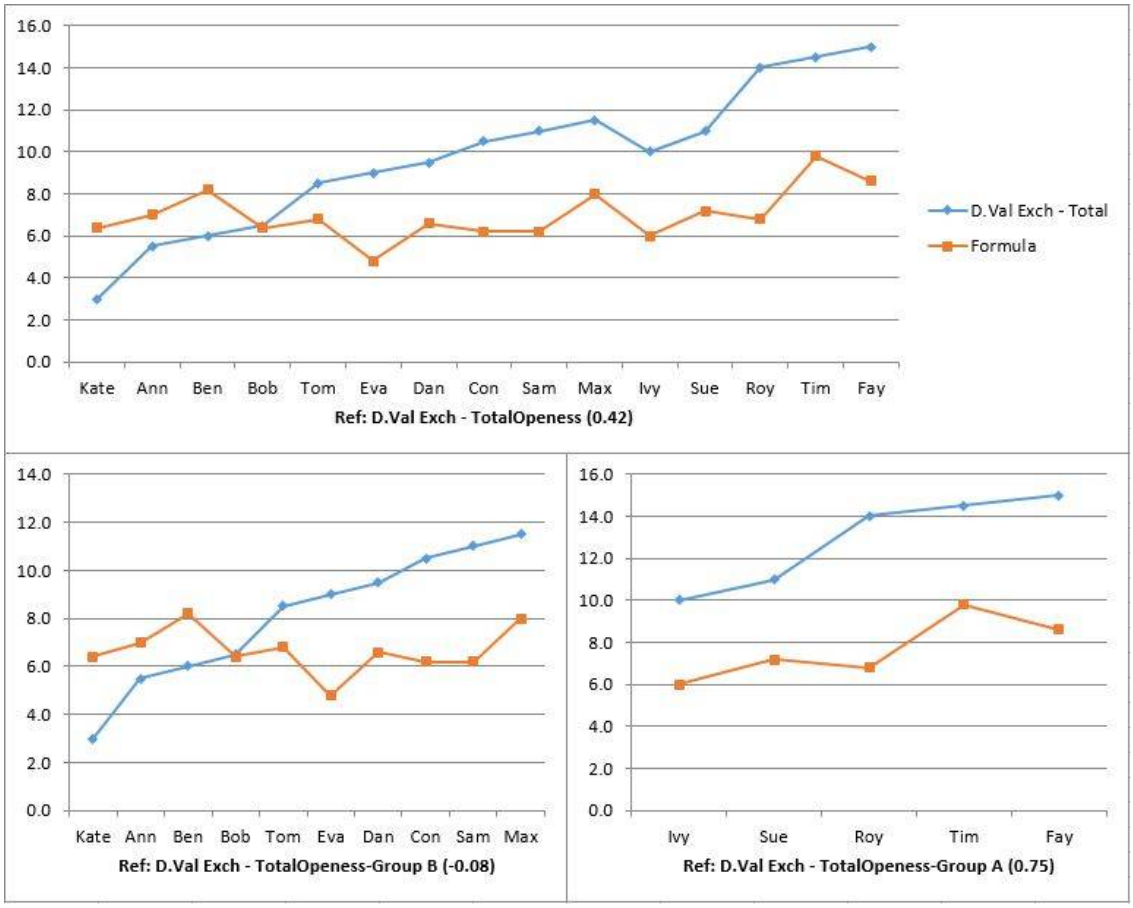
I then examined variables in pairs, one from personality and one from digital engagement, in the following three ways. 1) A correlation of *all participants* 2) The correlation of *Group A* participants 3) The correlation of *Group B* participants. The object was to see if splitting the sample into Groups A and B did indeed show any correlations or at the very least provide more meaningful information. The following graphs are a sample of my results showing the

[174] While this distinction was subjective it was a necessary step to progress the discussion. The development of an appropriate instrument to determine this distinction would be possible in future research.

correlation between the personality variable Openness and the Digital engagement variable Value Exchange.

In Graph 2 below the top graph shows all participants (both Group A and B) with a moderate-weak positive correlation (0.42), the bottom left graph shows the less digital-engaged (Group B) with no correlation at (-0.08) and the bottom right graph shows *more* fully engaged (Group A) with a strong positive correlation of (0.75).

Graph 15 Correlation - Personality variable Openness to Digital engagement variable Value Exchange.



In the first graph where I used all participants the weak correlation (0.42) would be considered an insignificant correlation. The graph of Group B showed no correlation between Openness and Value Exchange (-0.08). However Group A, participants who

presented as more engaged in the interviews now showed a strong correlation between the two variables (0,75). The strength of the correlations varied depending on which variables had been selected but overall, when the sample was divided into the two groups, there was a distinct improvement in the number of correlations present. When considering all participants as a single group, Group B masks the correlations of the fully engaged participants. Therefore the threshold hypothesis[175] as used by Guilford proved to be a viable method for interpreting my data. I therefore proceeded with the 'split group' method.

In correlations it is not the value of the score that is significant it is the relationship between the two variables. To illustrate this, in Graph 15 (All Participants) note that the value of Max's score is not only the highest score in Group B but it is actually higher than Ivy, who is the lowest scorer in Group A. However when we consider the relationship between the two variables there is a coherent correlation in Group A (0.75) that is not seen in Group B (-0.08). When taken together Group B would mask Group A's result.

The following table shows the correlation of my participants' average personality scores[176] with their average Digital Engagement Framework scores by Group A and Group B.

Table 29 Correlation: Average Personality to Average Digital Engagement in Both Group A and B.

Factors	AVE. SECTORS Group (A)	AVE. SECTORS Group (B)
Openness	0.52	0.10
Conscientiousness	0.04	-0.02
Extraversion	-0.63	0.44
Agreeableness	0.59	0.21
Neuroticism	-0.34	-0.02

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7
Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

[175] The Threshold Hypothesis, is commonly used in evaluation of divergent thinking, general intelligence, IQ and creativity. (Runco, 2010, p. 425)
[176] This did not include the NEO-PR-I scores, which is discussed later.

These results show that in the more fully engaged group, Group A, there is a moderate-positive correlation to digital engagement for the personality traits Agreeableness and Openness. There is also a moderate-negative correlation in the Extraversion trait for Group A. This moderate-negative correlation is in contrast to Group B, the less digitally engaged, which shows a moderate-positive correlation. The other correlations for Group B are all insignificant as is Group A's Conscientiousness. Group A's Neuroticism does show a very weak positive correlation. Overall this level of analysis suggests that the personality traits Openness and Agreeableness are positively correlated to digital engagement while Extraversion is negatively correlated. In other words these results indicate that higher Agreeableness and Openness and lower Extraversion may be related to digital engagement. This evidence of correlations indicated that there were indeed meaningful relationships that would help support and explain the connections I had already observed in the interviews.

8.2 Correlations of the Big-Five Factor to Digital Engagement.

The following tables show the five Sectors of my Digital Engagement Framework across the top, and the Personality Big-Five Factors down the side. The first table is Group A - the more engaged, and the second table is Group B - the less engaged.

Table 30 Personality Factor to Digital Engagement Framework Sectors by Group.

Group A: More Engaged

Factors	Average: Tool Use (A)	Average: Feedback (A)	Average: Action (A)	Average: Value Exchange (A)	Average: Motivation (A)
Openness	0.53	0.58	0.08	0.75	0.68
Conscientiousness	0.15	0.02	0.15	-0.09	-0.01
Extraversion	-0.61	-0.70	-0.55	-0.66	-0.63
Agreeableness	0.56	0.72	0.68	0.49	0.48
Neuroticism	-0.25	-0.39	-0.34	-0.40	-0.33

Group B: Less Engaged

Factors	Average: Tool Use (B)	Average: Feedback (B)	Average: Action (B)	Average: Value Exchange (B)	Average: Motivation (B)
Openness	0.00	-0.04	0.20	-0.08	0.31
Conscientiousness	-0.19	-0.28	0.39	-0.26	-0.05
Extraversion	0.53	0.63	0.62	0.41	0.37
Agreeableness	0.33	0.22	0.01	0.24	0.26
Neuroticism	-0.12	-0.20	0.37	-0.18	0.13

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7

Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

As seen in Table 30 there is a significant difference in the correlations of Group B and Group A. The less-engaged group, Group B, showed significantly fewer correlations with the Exception of Extraversion. The following discussion is therefore focused on the results of Group A and Group B's positive Extraversion results will be discussed in contrast to Group A's negative Extraversion results.

8.2.1 Correlations of digital-engagement to Openness

At the Sector level (Table 30 above) we see that in Openness there is a strong correlation for Value Exchange (0.75) and a strong-moderate correlation for Motivation (0.68). Tool Use (0.53) and Feedback (0.58) show moderate correlations while the Action Sector has no correlation (0.08). These results indicate that unlike Group B, the more engaged participants who are higher in Openness have a good understanding of the Value Exchanges within the digital environment, which is necessary for relationship development and maintenance. Additionally these high Openness participants show strong-positive motivation to be involved in digital relationships. The higher moderate-positive Feedback correlation suggest that high Openness participants in Group A are predisposed to incoming information, which because of the nature of the feedback process will tend to affect their behaviours in the other Sectors. The lower moderate Tool Use score indicates that the actual use of technology is not as important to higher scoring individuals in Group A as is the relationship aspect of their digital engagement. This is better explained using Table 31 below, which provides more detail of the engagement model.

Table 31 Group A Digital Engagement Framework Subsectors for Openness.

	Tool Use			Feedback			Action			Value Exchange			Motivation		
Factors	Intensity (A)	Embededness (A)	Awareness (A)	Open To. (A)	Willingness (A)	Adaptability (A)	Internal Influencers (A)	External Influencers (A)	Action Ability (A)	Internal Expectations (A)	External Expectations (A)	Reciprocity (A)	Existential (A)	Fulfillment (A)	Gratification (A)
Openness	0.01	0.73	0.65	0.61	0.61	0.54	0.21	-0.06	0.08	0.87	0.70	0.65	0.64	0.70	0.69

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7

Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

Motivation: In the context of this research Motivation is the drive that initiates digital engagement. In Group A motivation is fairly evenly correlated across all three motivation Sectors (0.64, 0.70 and 0.69). This range of correlations indicates that with higher Openness, the Motivation trigger for engaging with digital networked technology could come from any of the three sources but that *fulfillment* is a marginally stronger trigger -- for example, in seeking employment.

Value Exchange: In the context of this research Value Exchange is the collection of behaviors and attitudes related to relationship development, reward mechanism and the reinforcement of digital engagement. In the Value Exchange subsectors the internal characteristics that drive the value exchanges have an exceptionally strong-positive correlation (0.87) followed by a strong-positive correlation of the *external influences* that affect value exchange (0.70) and the last subsector has high-strong correlation to *reciprocity* (0.65). This suggest that the more fully engaged individual who is higher in Openness derives a greater appreciation and understanding of the potential benefits of value exchanges and are better able to conduct reciprocal relationships. This suggests that those individuals who score higher on the Openness personality trait are likely to have a better understanding of the internal mechanisms that drive their external value exchanges within the digital environment and they have an expectation of reciprocity (For a discussion on reciprocal alrtuism see Winston, 2002, pp. 206-208; Wright, 1995, pp. 189-209).

Feedback: Feedback is the next Sector in Group A that shows important correlations. These are high-moderate to moderate positive correlations (0.61, 0.61, 0.54). From these correlations it appears that individuals in Group A, who are higher in Openness are more developed in the process of data assimilation, evaluation and response. To understand this it is necessary to examine the Tool Use correlations.

Tool Use: The Tool Use correlations for Group A shows no correlation for how intensely Group A uses technology (0.01). This result was initially surprising but quite understandable once it was considered in the context of the other scores of this Sector. *Awareness* of tool-use correlates at a moderate-high positive (0.65) and the *embeddedness* of digital technology at a high positive correlation of (0.73). This implied that those

individuals who were more fully engaged and higher in Openness did not simply use the technology '*a lot'* (quantitatively) but rather they were aware of what they required for their relationship building needs (Value Exchange, Motivation and Feedback) and they seamlessly incorporated selected technology that 'worked for them' (qualitatively) into their lives: They embedded appropriate technology for their specific requirements.

Action: As expected from Table 31 (Group A) the Action Sector did not reveal any significant positive or negative correlations at the detailed sub-sector level. Based on my research I suggest the reason for this is that the Action Sector relates to the *act and execution of decision-making,* which ends an iteration cycle whereas the trait Openness describes *behaviors of exploration, assimilation and evaluation of information or input*, which are ongoing iteration cycles. The high Openness individual would unknowingly be reluctant to take any action because it would cease opportunities for their preferred behaviors. Those high in Openness appears to have no correlation to action. Decision-making is discussed in 8.3 below.

8.2.2 Correlations of digital-engagement to Openness and Agreeableness

In Table 29 above (Group A) we saw that the average score of Agreeableness (0.59) was higher than the average score of Openness (0.52) making Agreeableness appear to be the more significant Factor of the two in this sample. Both will now discussed in relation to the digital engagement subsectors.

Table 32 Group A Digital Engagement Framework Subsectors for Agreeableness and Openness

	Tool Use			Feedback			Action			Value Exchange			Motivation		
Factors	Intensity (A)	Embededness (A)	Awareness (A)	Open To. (A)	Willingness (A)	Adaptability (A)	Internal Influencers (A)	External Influencers (A)	Action Ability (A)	Internal Expectations (A)	External Expectations (A)	Reciprocity (A)	Existential (A)	Fulfillment (A)	Gratification (A)
Openness	0.01	0.73	0.65	0.61	0.61	0.54	0.21	-0.06	0.08	0.87	0.70	0.65	0.64	0.70	0.69
Agreeableness	0.17	0.94	0.40	0.69	0.69	0.76	0.50	0.66	0.70	0.56	0.50	0.40	0.59	0.33	0.35

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7
Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

Motivation: Unlike Openness, which had motivation spread across all three subsectors, the Motivation correlation to Agreeableness is only in the *existential* subsector (0.59). This suggests that the triggers for digital engagement in individuals with higher Agreeableness are less motivated by acquisitive or 'deficiency needs' but are more motivated by 'being needs', for example self-actualization or esteem (Maslow, 1943).

Value Exchanges: Value Exchange for Agreeableness shows a moderate positive correlation across all three subsectors indicating that all three subsectors are important with regard to Value Exchanges. These results are similar to Openness but the actual Openness correlation scores were lower. This suggests that an individual who is higher in Agreeableness places more importance on value exchanges. This is not surprising considering the large number of Agreeableness subscales that relate to relationship building and maintenance.

Action: Agreeableness had positive correlations for all subsectors of the Action Sector whereas Openness had no significant correlations for Action. The highest positive correlation in Agreeableness was the ability to take *action* (0.70) followed by external (0.66) and internal (0.50) influences to take action. These correlations indicate that individuals scoring higher in Agreeableness are more likely to be proactive in sourcing and using digital technologies as part of their daily functioning. Interview data suggests this is because digital networked technology is compatible with the higher scoring Agreeableness individuals' values as discussed above in Value Exchange. While the relationship between action and agreeableness is not initially obvious, the connection becomes clearer when the role of value exchange is factored in as the intermediary for relationship development.

Feedback: In Agreeableness the feedback correlations are significantly high with *open-to* and *adaptability* at (0.69), just shy of a high-positive correlation, and *willingness* a high-positive correlation (0.76). These correlations indicate that individuals who are higher in Agreeableness are significantly more receptive to digital engagement feedback. Higher correlations in Agreeableness compared to the Openness correlations for Feedback indicate that the Openness trait is slightly less important than Agreeableness for digital engagement

feedback. Agreeable people tend to moderate their behavior to suit their situation so this finding is not surprising.

The low scores in the Action Sector for Openness may be influencing feedback because the feedback process requires an action and, as seen in Table 32, high Openness scorers have low Action correlations.

The explanation may be that Openness individuals derive pleasure from sourcing or seeking incoming input and this ceases once action is taken. This finding requires further research that is not within the scope of this thesis. Further possible explanations are discussed in the REI results, which examines decision-making style.

Tool Use: The extremely high-positive correlation for the subsector *embeddedness* (0.94) to the trait Agreeableness is very significant particularly when taken in conjunction with the low-moderate-positive correlation to *awareness* (0.40). These results suggest that the more fully engaged participant who is higher in Agreeableness is likely to have digital networked technology *significantly* embedded in their lives and the more embedded technology becomes, the less the individual is consciously aware of its role in their functioning. An explanation for this may be that Agreeableness behaviors are not deliberately and calculatingly developed but rather is a byproduct of relationship development. Therefore it is not surprising that an awareness of the exchanges is less important. This is unlike the higher-scoring Openness individual who is adept at embedding technology in their life and is also consciously aware of the process. The very low *intensity* correlation also suggests that it is not the frequency of use that matters in digital engagement but rather the embedding of relevant technology.

8.2.3 Correlations of digital-engagement to Extraversion

At the top level of correlation analysis (Table 29) the third significant correlation of digital engagement to personality was Extraversion. In Table 29 we saw that Extraversion had a moderate-*negative* correlation (-0.63) for Group A. This suggests that within Group A those individuals, who are *lower* in Extraversion, were more digitally engaged. This result is contra

to the moderate-*positive* correlation (0.44) in Group B, where individuals who were higher in extraversion were *more* digitally engaged.

These correlations supported the understanding that I had developed during the interview process regarding Extraversion behaviours. I had found that behavioural traits seen in Extraversion initially aided digital engagement but these same behaviours become counterproductive as digital engagement increased. This shift can be explained by considering the individual's perception of self in relation to their environment. Generally speaking a high scoring Extravert is someone who is comfortable and confident in his or her knowledge, understanding, and interpretation of their primary environment, the physical environment, and they can extract benefit from it. At the lower levels of digital engagement the Extravert is advantaged because of their confidence that is rooted in physical environment knowledge but as they transition to the unknown elements of the digital environment with its different framework of first principle concepts the Extravert begins to lose their initial advantage and this may act as a disincentive. These results indicate that fully engaged individuals tend to score low in Extraversion. The following table provides more insights.

Table 33 Group A and B Digital Engagement Framework Subsectors for Extraversion Including Average for each Sector.

	Factors	Intensity (A)	Embededness (A)	Awareness (A)	**Average: Tool Use (A)**	Open To. (A)	Willingness (A)	Adaptability (A)	**Average: Feedback (A)**	Internal Influencers (A)	External Influencers (A)	Action Ability (A)	**Average: Action (A)**	Internal Expectation (A)	External Expectations (A)	Reciprocity (A)	**Average: Value Exchange (A)**	Existential (A)	Fulfillment (A)	Gratification (A)	**Average: Motivation (A)**
Group A	Extraversion	-0.32	-0.78	-0.48	**-0.61**	-0.68	-0.68	-0.72	**-0.70**	-0.78	-0.24	-0.54	**-0.55**	-0.77	-0.72	-0.48	**-0.66**	-0.62	-0.62	-0.58	**-0.63**
Group B	Extraversion	0.54	0.57	0.40	**0.53**	0.57	0.66	0.60	**0.63**	0.39	0.37	0.53	**0.62**	0.40	0.45	0.30	**0.41**	0.31	0.57	0.14	**0.37**

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7

Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

Feedback: The most striking correlation is the high-negative correlation for the average of the Feedback Sector (-0.70) for Group A. This strong negative correlation in Group A suggests that those fully engaged individuals who are high in Extraversion are significantly *less* amenable to digital engagement feedback. The high scoring Extravert is less likely to

respond to digital feedback. Group B on the other hand showed a reasonably high-moderate *positive* correlation of 0.63 suggesting that Extraversion is a benefit to digital feedback in those who are less engaged. It appears that some extraversion helps in the early stages of digital engagement formation but not in deeper digital engagement. Interview data indicated that the reason for this lay in the individuals' comfort level within the physical environment. This pair of correlations of Group A and Group B in Extraversion is significant because behavior modification is learned through the feedback process (Mazur, 2006, pp. 39-42 and 310-321). If the individual's preference is for physical environment feedback they will tolerate some digital feedback but will not be as open to the ongoing persistent digital feedback relationship and will therefore not experience the amplifying affect of digital engagement feedback that is seen in the high Agreeableness individual.

Tool Use: Individuals in Group A showed a very high-negative correlation of Extraversion to *embeddedness* (-0.78) and a moderate negative correlation to awareness of their technology use (-0.48). Group B on the other hand showed moderate positive correlations for both (0.57 and 0.40). This indicates that in Group B which are the less engaged, Extraversion assists the individual in attaining a moderate level of awareness, embedding and intensity of digital networked technology use. However at some point Extraversion becomes counterproductive to increased digital engagement. The *intensity* subsector once again does not appear to be significant in the fully engaged group.

Action: In this Sector for Group B the moderate-positive correlation to Action Ability compared to Group A's moderate-negative correlation is interesting. The correlation suggests that Extraversion in the less engaged helps them to take action but in the more engaged it is counterproductive. In Group A the high negative correlation for Internal Influences (-0.78) is consistent with expected behaviours of the higher scoring Extravert who tends to be more responsive to external environment stimuli rather than quiet internal reflection.

Motivation: In Group A Motivation shows moderate negative correlations in all three subsectors indicating that in the digital environment Extraverts who are less engaged do not source their digital engagement motivation in the same way that the fully engaged do. These

correlations should be viewed in contrast to Group B, the less engaged, where the only significant correlation was *fulfillment* (0.57), which is an acquisitive motivator. This indicated that in the less engaged participants Extraverts were more likely to be motivated by needs fulfillment when engaging with technology.

Value Exchanges: In both Group A and B the Value Exchange correlations showed a weighting to the *internal* (-0.77 and 0.40) and *external* (-0.72 and 0.45) source of value exchange rather than the activity of exchanges - *reciprocity* (-0.48 and 0.30). The Value Exchange correlations once again indicate that in the initial stages of digital engagement Extraversion can be moderately advantageous but as engagement deepens Extravert behaviors become counterproductive.

8.2.4 Significant subsectors of the Digital Engagement Framework in Relation to the Big-Five Factor

Earlier in this section I focused on how each personality Factor affected my Digital Engagement Framework at the *Sector* level. I now change my focus and examine correlations of personality Factors to the *subsectors* of my Digital Engagement Framework. The value of deeper level investigation gained in Chapter 5 motivated this investigation. I wanted to see which, if any, subsectors were more significant to a specific personality type. As the following discussions will show this proved to be a worthwhile exercise, particularly with regard to how the subsectors function as systems and how some personality traits correlate strongly to certain subsectors. For example Conscientiousness correlates positively to intensity.

Table 34 Group A Digital Engagement Framework Correlation of Subsectors for all Personality Factors.

	Tool Use			Feedback			Action			Value Exchange			Motivation		
Factors	Intensity (A)	Embededness (A)	Awareness (A)	Open To. (A)	Willingness (A)	Adaptability (A)	Internal Influencers (A)	External Influencers (A)	Action Ability (A)	Internal Expectations (A)	External Expectations (A)	Reciprocity (A)	Existential (A)	Fulfillment (A)	Gratification (A)
Openness	0.01	0.73	0.65	0.61	0.61	0.54	0.21	-0.06	0.08	0.87	0.70	0.65	0.64	0.70	0.69
Conscientiousness	0.66	-0.36	-0.01	0.02	0.02	0.03	0.03	0.29	0.06	-0.29	-0.01	-0.01	0.01	-0.03	-0.02
Extraversion	-0.32	-0.78	-0.48	-0.68	-0.68	-0.72	-0.78	-0.24	-0.54	-0.77	-0.72	-0.48	-0.62	-0.62	-0.58
Agreeableness	0.17	0.94	0.40	0.69	0.69	0.76	0.50	0.66	0.70	0.56	0.50	0.40	0.59	0.33	0.35
Neuroticism	0.14	-0.65	-0.21	-0.37	-0.37	-0.41	-0.64	0.03	-0.38	-0.60	-0.42	-0.21	-0.32	-0.36	-0.32

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7
Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

Tool Use: The strong correlations in *embedding* of technology, and to a lesser degree *awareness*, are significant to digital engagement. Personality types most likely to be embedded and be aware are those high in Agreeableness (0.94 and 0.40) and Openness (0.73 and 0.65). High scoring Extraverts appear to avoid embedding technology (-0.78 and -0.48) and Neuroticism appears to have similar negative correlations to Extraversion but with slightly weaker correlations (-0.65). With regard to digital engagement, *intensity* only appears significant to those high in Conscientiousness, this finding substantiates my proposition in Chapter 6 regarding the effect of subscales on Sam's Extraversion trait. This indicates that the interaction between Conscientiousness and the subsector *intensity* is significant.

Feedback: A *willingness* and *openness-to* Feedback also appears to be important to digital engagement. Those high in both Openness (0.61, 0.61) and Agreeableness (0.69, 0.69) appear most likely to be in this category. Extraverts on the other hand appear to be considerably unwilling to take feedback and Neurotics slightly less so. The most interesting aspect of this Sector was however *adaptability*, i.e. what the individual actually did with their feedback in terms of applying lesson learned through the feedback. Individuals high in Agreeableness appear to be very adaptable (0.76). In contrast, the Extravert appears to be particularly unwilling to adapt to feedback (-0.72). A similar but weaker contrast can be seen between the Openness (positive) and Neuroticism (negative) pair. This is discussed below in section 8.2.5.

Action: The *ability* to take action is a significant indicator of digital engagement because taking action initiates and sustains the iterative process. A strong correlation was found in individuals who scored higher on Agreeableness (0.70). On the other hand Extraverts appear to actively resist *internal influencers* that could help them to take action to engage with technology (-0.78). For example the extrovert will favor face-to-face interactions as opposed to digital interactions. In the less engaged they will be content with either forms of contact but the deeper the engagement the more likely the extrovert will struggle with the intrusion of digital technology in their physical interactions. Action is discussed in greater detail below in section 8.3.

Value Exchange: Individuals who are high in Openness (0.87 and 0.70) and, to a lesser degree, higher in Agreeableness (0.56 and 0.50), are likely to be positively affected by *internal* and *external* Value Exchange *expectations*. These correlations show that Individuals who are higher in Openness are significantly more attuned to Value Exchange mechanisms in the digital environment with high Agreeable individuals less so. Previously in this chapter I noted Agreeableness was related to both Value Exchange and Action through a willingness to modify behaviour in order to improve Value Exchanges. That Openness correlates with a particularly high score could be explained by the individual being sensitive to the stimulation and nuances of a wide variety of relationships. High Openness individuals seem to derive pleasure from the activity of exploring exchanges rather than the exchange itself as would be expected in the highly Agreeable individual. The opposite appears true with high scoring Extraverts who will resist or struggle with digital engagement because of the *internal* and *external* Value Exchange *expectations* (-0.77 and -0.72).

Motivation: In individuals who score higher in Openness, the *fulfillment* and *gratification* motivators (0.70 and 0.69) are strong indicators of digital engagement although *existential* motivation is only slightly less significant (0.64). This suggests that high scorers of Openness are motivated on multiple levels to engage with technology. This multi-faceted motivation may be playing a part in their digital engagement. High scoring Agreeable individuals are existentially motivated but only moderately so. I propose that explanations for this can be

found in the compatibility of some of the Agreeableness subscales to the nature of the digital environment: for example altruism and cooperation.

8.2.5 Additional points of interest

There were two personality traits that did not provide any notable correlations.

Neuroticism: In the fully engaged, Group A, Neuroticism generally followed the trend of the Extraversion results but with less dramatic scores. For every *strong* negative score in Extraversion there was also a *moderate* negative score for Neuroticism: For example in the subsector *embedding* where the Extraversion score was negative -0.78 the corresponding Neuroticism score was negative -0.65.

Conscientiousness: The second personality trait that did not provide correlations of note was Conscientiousness. In the physical environment Conscientiousness is often taken as a significant indicator of success potential so its lack of correlation was surprising. With the exception of the subsector *intensity* in the Tool Use Sector all other scores showed weak or no correlations. This result was also extremely significant because Conscientiousness was the *only* personality trait to score in the subsector *intensity* of the Sector Tool Use. Conscientiousness appears to only relate to Intensity of use. The implication of this was that Conscientiousness is either predictive of the *intensity* of Tool Use or causative of Tool Use as in the case of Sam. (See Chapters 5-6)

8.3 Correlations of Decision Making Style to Digital Engagement

The correlation between digital engagement and decision-making style is important because it led to my understanding of the underlying mechanisms required for taking action to engage with technology. The correlations in this section provided insights into the Action Sector of my Digital Engagement Framework, which when taken together with the and Value Exchange Sectors form the core cybernetic system that results in digital engagement. The premise is that decision making affects subsequent behaviours and outcomes.

As with personality, the meta-level analysis of decision-making style showed that Group B had no significant correlations compared to Group A. These results indicate that the way

more fully engaged individuals make decisions is significantly different to the less engaged individuals. In the table 35 below (Group A) there is a significant positive weighting towards intuition and ability and that intuitive iterations are more significant than rational iterations.

Table 35 Correlation: Decision Making Style to Digital Engagement Framework Average

Factors	AVE. SECTORS Group (A)	AVE. SECTORS Group (B)
Intuitive Ability	0.71	0.02
Intuitive Iteration	0.56	0.07
Rational Ability	0.56	0.28
Rational Iterations	0.33	0.29

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7
Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

Earlier in Chapter 5 decision-making style was mentioned as being a *possible* reason for differences between participants Max and Dan who scored conscientiousness as their lowest score. At that level of analysis there were no significant trends but these correlation results do provide interesting indicators regarding the relationship between decision-making style and digital engagement. It appears that when the use of technology requires a rational decision for each iteration then the process is slower and digital engagement is less likely to occur. This behaviour was seen in the example of Ben (See Chapter 6). Seymour Epstein described the rational thinking style as being 'an inferential system that operates according to a person's understanding of the rules of reasoning and of evidence, which are mainly culturally transmitted' (Epstein, 2003, p. 161). Ben, whose behaviours generally tended to indicate being less engaged, displayed Rational Iteration behaviours in his Facebook and Linkedin participation.

> Beni1q1: I don't like the invasiveness of a lot of it [digital networked technology]. Particularly things like Facebook. … I've got a Facebook page for the company but I hardly do anything with it. I would never do anything private or personal on Facebook. … I am on Linkedin but that is a professional network. … you need to be careful, I need to manage them [Facebook and Linkedin] I waste an enormous amount of time and waste is the operative word. I waste massive amounts of time messing around with sites like that.'

Ben was making decisions to engaging with social media technology at a rational level not as an intuitive response resulting from his interaction with the social media. These observations are substantiated by Ben's scores, which showed his two Rational scores as being higher (ability 45, iterations 36) than his Intuitive scores (ability 34, iterations 33).

This leads to the examination of correlation results by Sector in order to develop an understanding of the relationship between digital networked technology and the two types of decision making styles: Rational and Intuitive. Once again I primarily focus my discussion on Group A where there are more correlations compared to Group B as per Table 36 below.

Table 36 Correlation: Decision Making Style to Digital Engagement Framework Average by Sector – Group A and Group B.

Group A: More Engaged

Factors	Total: Tool Use (A)	Total: Feedback (A)	Total: Action (A)	Total: Value Exchange (A)	Total: Motivation (A)
Intuitive Ability	0.75	0.81	0.88	0.53	0.57
Intuitive Iteration	0.60	0.63	0.79	0.36	0.41
Rational Ability	0.66	0.68	0.60	0.39	0.46
Rational Iterations	0.42	0.34	-0.44	0.68	0.63
		doing		conditions to do	

Group B: Less Engaged

Factors	Total: Tool Use (B)	Total: Feedback (B)	Total: Action (B)	Total: Value Exchange (B)	Total: Motivation (B)
Intuitive Ability	-0.16	0.00	0.45	-0.16	-0.07
Intuitive Iteration	-0.05	0.12	0.15	0.10	0.11
Rational Ability	0.14	0.22	0.40	0.17	0.35
Rational Iterations	0.12	0.47	0.23	0.27	0.21
		doing		conditions to do	

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7

Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

With regard to decision making these five Sectors are considered in two groups. The groups perform different functions; the 'doing' group, which involves Tool Use, Feedback and Action and 'conditions to do', which are Value Exchange and Motivation. In Table 36 above the 'Conditions to do' group have correlations that do not appear to be as significant as the 'doing' group. Of interest in 'conditions to do' is the concentration of scores in Intuitive Ability (0.53 & 0.57) and Rational Iterations (0.68 & 0.63). These results suggest that individuals who score higher on Rational Iteration and who are more digitally engaged (Group A) are consciously deciding to use technology on the assumption that it aligns with what they want to achieve whereas the more fully engaged individuals have developed their intuitive ability to attain what they want using technology.

In the 'doing' group for both Intuitive results[177] there is a high number of strong-positive correlations (Action 0.88, 0.79, Feedback 0.81 and Tool Use 0.75) with the balance showing moderate-positive correlations (0.63 and 0.60). The Rational results[178] on the other hand show mostly moderate-positive correlations (Tool Use 0.66, 0.42, Feedback 0.68 and Action 0.60) with one weak-positive (0.34) and one moderate-negative (-0.44). These results indicate that the Intuitive thinking style is more significantly correlated to digital engagement than a Rational thinking style.

In Table 36 above Group A showed three strong-positive correlations for Intuitive Ability in the Sectors Action (0.88), followed by Feedback (0.81) and then Tool Use (0.75) indicating significance. Similarly Intuitive Iterations showed a strong-positive correlation for the Action Sector (0.79), followed by a moderate positive Feedback (0.63) and Tool Use (0.60) score.

At the averaged level as seen in Table 35 above both Intuitive Iterations and Rational Ability had shown a moderate-positive correlation of (0.56) indicating that they were similar, but examination at the Sector level provided additional insights into the relationship between decision making style and digital engagement. This is best illustrated by examining the weighting of Rational and Intuitive Iterations across the three Sectors (Table 36 above). Where Intuitive Iterations had showed the weighting order of the sectors to be Action (0.79), Feedback (0.63) and Tool Use (0.60), Rational Iterations showed the reverse rank order: Tool Use score (0.42), Feedback score (0.34) and Action score at a negative (-0.44). This suggested the relationship between these three Sectors might be significant and is discussed below at the subsector level.

The extreme range in the Action Sector scores (-0.44, 0.60, 0.79, and 0.88) suggests that Action may be a key indicator of digital engagement. Overall the Action correlations increase from the rational to the intuitive and then within each group (Rational and Intuitive) there are two stages firstly *iterations* followed by *ability*. It suggests that ability to take action is acquired through iterations of technology use. This is in itself not particularly surprising as there is a substantial body of research related to improved human (and animal) abilities

[177] The Intuitive group includes - Intuitive Ability and Intuitive Iterations
[178] The Rational group includes - Rational Ability and Rational Iterations

acquired through repetitive learning or training of intuitive responses that result from learned experience (Rosenzweig, 1996). These correlations become useful when they are considered in conjunction with the other two Sectors; Tool Use and Feedback.

My broad interpretation of these decision making results is that the more fully engaged appear to have developed an Intuitive decision making style, which assists their ability to take Action to use technology (Tool Use) and their capacity to process Feedback. If the feedback loop is positive[179] then the number of iterations is likely to increase and individuals' behaviours are likely to amplify.

On the other hand, those who have higher Rational Iteration will use technology (0.42 correlation) but the feedback they extract from it may only have a *weak* positive influence as indicated by a correlation of 0.34. Overall, Rational Iterative decision-makers appear to have a moderate-*negative* tendency to actively embrace the technology. This indicates that individuals who rely on deliberate rational decision making are less likely to become digitally engaged. In Rational Ability, the ability of the individual to rationally evaluate Feedback (0.68 correlation) is also a moderate positive for Tool Use (0.66 correlation) and the slower rate of rational processing compared to Intuitive Ability seems to impact on the individual's decision making or *action* as reflected in the lower action correlation of 0.60 (For examples and discussion on intuitive and rational thinking that illustrates the speed of processing see: Bechara et al., 2005; Lehrer, 2009). In the Rational pair (rational ability and rational iterations) we see that the Sectors of Feedback (0.68 and 0.34) and Tool Use (0.66 and 0.42) are more closely related to each other than to Action (0.60 and -0.44). From these results I propose that rational decisions to use digital networked technology result in reduced iterations with the technology and therefore less engagement because rational decisions generally take longer to process than intuitive ones. This process will reduce the overall number of iterations the individual experiences, which will in turn affect the process of repetitive learning through technology-use in the rational thinker. Relying on a conscious

[179] In this thesis the 'positive' with regard to feedback in not a value judgement, it refers to a process of open-ended feedback loops as opposed to negative feedback loops that regulate the system processes to maintain homeostasis.

decision making approach may serve as a barrier to embedding technology which is most effective if done seamlessly.

I propose that in a Cybernetic system where both the individual and the technology are actively engaging, the action style of the individual becomes increasingly significant: This is best revealed by examining the average correlations scores for each Sector of Intuition and Rational thinking style (Table 37 below).

Table 37 Group A Average of Intuitive and Rational Decision-Making Style by Digital Engagement Framework Subsectors.

	Tool Use			Feedback			Action			Value Exchange			Motivation		
Factors	Intensity (A)	Embededness (A)	Awareness (A)	Open To. (A)	Willingness (A)	Adaptability (A)	Internal Influencers (A)	External Influencers (A)	Action Ability (A)	Internal Expectations (A)	External Expectations (A)	Reciprocity (A)	Existential (A)	Fulfillment (A)	Gratification (A)
Ave. Intuition	0.81	0.56	0.34	0.68	0.68	0.77	0.79	0.72	0.77	0.38	0.57	0.34	0.56	0.40	0.38
Ave. Rationality	0.34	0.43	0.59	0.53	0.53	0.46	-0.15	0.29	0.03	0.47	0.49	0.59	0.58	0.48	0.52

Strong Positive: > or equal tp 0..7
Moderate Positive: Between 0.4 and 0.7

Strong Negative: > or equal to -0.7
Moderate Negative: - 0.4 and -0.7

At this level of analysis the most significant correlations are for intuitive thinkers. The high correlations in the three Action subsectors (0.79, 0.72 and 0.77), feedback *adaptability* (0.77) and the *intensity* of technology-use (0.81) all indicate that Intuitive thinkers are more likely to engage with technology. This is in direct contrast to Rational thinkers where significant correlations are noticeably absent in four of these five areas.. As discussed in Chapter 7, the three core sectors Value Exchange, Tool Use and Action behave as a cybernetic system that is governed by the Motivation Sector. I also discussed how the Feedback Sector related to the individuals' level of awareness of the process and that in a positive feedback system the individual becomes increasingly less aware of the process as they become more fully engaged. The results of these correlations for intuitive thinking are made clearer when approached from the perspective of second order cybernetics.

When examined as a system, the correlations of the subsectors of Tool Use reflect what I expected from the behaviours of Intuitive thinkers. As the frequency of technology use

increases (*intensity* 0.81) the individual will embed the relevant technology into their daily functioning (*embeddedness* 0.56) and the synthesis of technology within the individual's daily functioning tends to reduce awareness of the process (0.34). At the Sector level Tool Use is the external input to the core cybernetic system and it is dominated by the frequency of technology use (intensity). Value Exchange shows external expectations (0.57) as the only significant subsector. Again this is consistent with my expectations of Intuitive thinkers behaviour, especially when taken in context of the dominant Tool Use subsector *intensity*. The intuitive thinker has developed 'short-cut' processing of internal value exchanges that have resulted in reduced internal Value Exchange awareness (*internal expectations* 0.38) and *reciprocity* (0.34). It is only with regard to the *external influencers* that the intuitive thinker still has to maintain awareness of processing because this input is unpredictable and constantly changing. This leads to the Action Sector, the final core Sector. Here the difference between intuitive and rational thinking style is dramatic but not surprising. Correlations of all three Action subsectors are high in the intuitive thinker who, with reduced awareness, has the capability to evaluate (*internal influencers* 0.79 and *external influencers 0.72*) and respond to input (*action ability 0.77*). It appears that these three Sectors are functioning as a positive feedback system where behaviours are being amplified as iterations increase. This is supported by the high Feedback Sector correlations *open-to* (0.68), *willingness* (0.68) and particularly *adaptability* (0.77). The intuitive thinker is open and willing to adapt to input that comes from digital engagement.

Rational thinkers do not have the same positive feedback process as found in the Intuitive thinkers particularly in the key areas of *intensity* (0.34) and the Action subscales (-0.15, 0.2 and 0.03). Digital engagement in the rational thinker relies on the rational processing of Motivation and Value Exchange which is slower to produce results and thus affects behavioural learning (Kahneman, 2013).

8.4 Significant Subscales of the Big-Five Factor

I now examine personality subscales for indicators that may distinguish the more engaged, Group A, from the less engaged Group B in order to see if any specific subscales could be key indicators of digital engagement. A cursory glance of Group A and B subscale

correlations (Table 38 below) visually illustrates just how different the more and less-engaged groups are. On average Group A shows more positive correlations to digital engagement (more green than red), whereas Group B has more negative correlations (more red than green). While I had anticipated a result similar to this, I did not expect it to be quite so dramatic because all the participants were after all ICT professionals. The most striking difference revealed in this overview is the substantial number of strong positives in Group A for Agreeableness that contrast to Group B's similar number of strong negative correlations. This substantiates earlier observations that the higher an individual scores on Agreeableness the more likely they were to be digitally engaged. That these strong differences are so dramatically carried through to the subscale level suggests the possibility that agreeableness could serve as the prime indicator of digital engagement.

Table 38 Correlations of NEO-PR-I subscales to Digital Engagement Framework subsectors for both Group A and B.

		Group A															Group B													
		Tool Use			Feedback			Action			Value Exchange			Motivation			Tool Use			Feedback			Action			Value Exchange			Motivation		
Factors	Subscales	Intensity (A)	Embeddedness. (A)	Awareness (A)	Open To. (A)	Willingness (A)	Adaptability (A)	Internal Influencers (A)	External Influencers (A)	Action Ability (A)	Internal Expectations (A)	External Expectations (A)	Reciprocity (A)	Existential (A)	Fulfillment (A)	Gratification (A)	Intensity (B)	Embeddedness (B)	Awareness (B)	Open To (B)	Willingness (B)	Adaptability (B)	Internal Influencers (B)	External Influencers (B)	Action Ability (B)	Internal Expectations (B)	External Expectations. (B)	Reciprocity (B)	Existential (B)	Fulfillment (B)	Gratification (B)
Openness	*imagination*	0.23	0.84	0.65	0.73	0.71	0.73	0.52	0.14	0.35	0.90	0.79	0.65	0.72	0.74	0.72	-0.32	-0.29	-0.42	-0.18	-0.09	-0.22	0.67	-0.40	0.63	-0.45	-0.35	-0.59	-0.09	-0.15	-0.48
	artistic interests	-0.01	0.31	-0.40	0.03	0.22	0.03	0.91	0.36	0.78	-0.10	-0.08	-0.40	-0.15	-0.27	-0.31	-0.32	-0.37	-0.35	0.10	0.06	-0.03	-0.13	-0.17	0.04	-0.10	-0.25	-0.09	-0.57	-0.39	-0.35
	emotionality	0.22	0.83	0.11	0.55	0.71	0.55	0.87	0.72	0.94	0.35	0.36	0.11	0.39	0.13	0.12	-0.17	-0.20	-0.10	0.05	-0.09	0.03	-0.82	0.22	-0.66	0.08	-0.12	0.21	-0.62	-0.30	-0.14
	adventurousness	0.02	0.28	0.74	0.40	0.21	0.40	-0.48	-0.33	-0.51	0.69	0.55	0.74	0.55	0.70	0.71	-0.42	-0.44	-0.58	-0.64	-0.48	-0.68	0.30	-0.20	0.12	-0.48	-0.38	-0.46	0.16	-0.56	0.00
	intellect	0.33	0.89	0.82	0.85	0.80	0.85	0.30	0.28	0.28	0.95	0.86	0.82	0.86	0.81	0.82	0.65	0.62	0.73	0.75	0.82	0.67	0.73	-0.27	0.82	0.63	0.68	0.46	0.70	0.75	0.52
	liberalism	-0.23	-0.11	-0.77	-0.38	-0.18	-0.38	0.41	0.45	0.59	-0.69	-0.62	-0.77	-0.55	-0.80	-0.80	-0.65	-0.68	-0.82	-0.54	-0.47	-0.61	-0.04	-0.11	-0.09	-0.55	-0.59	-0.49	-0.45	-0.82	-0.39
Conscientiousness	*self efficacy*	0.81	-0.08	0.54	0.40	0.30	0.40	-0.26	0.27	-0.15	0.18	0.42	0.54	0.47	0.46	0.48	0.60	0.60	0.58	0.27	0.37	0.32	0.51	0.11	0.40	0.43	0.58	0.37	0.88	0.58	0.67
	orderliness	0.02	-0.90	-0.33	-0.58	-0.65	-0.58	-0.48	-0.47	-0.60	-0.57	-0.45	-0.33	-0.50	-0.30	-0.31	-0.11	-0.21	-0.30	-0.16	-0.02	-0.27	0.14	0.04	0.10	0.05	0.03	0.12	0.21	-0.50	0.41
	dutifulness	0.89	0.41	0.35	0.62	0.70	0.62	0.67	0.69	0.66	0.30	0.53	0.35	0.53	0.38	0.37	-0.58	-0.66	-0.59	-0.56	-0.49	-0.69	-0.38	-0.29	-0.40	-0.36	-0.45	-0.24	-0.30	-0.82	0.00
	achievement-striving	0.54	0.15	-0.21	0.19	0.35	0.19	0.66	0.74	0.76	-0.24	-0.01	-0.21	0.03	-0.20	-0.21	0.08	-0.03	-0.07	0.02	0.20	-0.11	0.40	-0.11	0.36	0.21	0.22	0.22	0.48	-0.25	0.58
	self-discipline	0.38	-0.50	-0.26	-0.23	-0.19	-0.23	-0.22	0.31	0.00	-0.59	-0.34	-0.26	-0.25	-0.36	-0.33	-0.52	-0.56	-0.70	-0.70	-0.59	-0.73	-0.12	0.01	-0.27	-0.47	-0.46	-0.36	-0.12	-0.79	-0.03
	cautiousness	0.94	0.23	0.38	0.55	0.59	0.55	0.40	0.65	0.46	0.20	0.47	0.38	0.50	0.36	0.37	0.03	0.06	0.13	-0.32	-0.35	-0.21	-0.42	0.15	-0.54	-0.06	-0.02	0.02	0.13	0.06	0.16
Extraversion	*friendliness*	0.39	0.27	0.72	0.51	0.37	0.51	0.11	-0.33	-0.25	0.79	0.76	0.72	0.61	0.86	0.83	0.58	0.59	0.45	0.61	0.67	0.61	0.86	0.11	0.86	0.43	0.55	0.28	0.61	0.61	0.29
	gregariousness	0.89	0.10	0.61	0.55	0.47	0.55	-0.13	0.44	0.02	0.28	0.52	0.61	0.59	0.52	0.55	0.35	0.29	0.23	0.53	0.65	0.42	0.84	-0.18	0.90	0.38	0.42	0.24	0.47	0.27	0.33
	assertiveness	-0.64	0.39	-0.20	-0.07	0.00	-0.07	0.33	-0.15	0.23	0.17	-0.08	-0.20	-0.12	-0.13	-0.15	0.71	0.68	0.72	0.88	0.93	0.81	0.74	-0.09	0.85	0.71	0.74	0.54	0.62	0.76	0.48
	activity level	0.62	-0.27	-0.10	0.02	0.08	0.02	0.33	0.26	0.23	-0.24	0.02	-0.10	-0.03	-0.03	-0.05	-0.65	-0.72	-0.77	-0.68	-0.56	-0.72	-0.10	-0.26	-0.19	-0.53	-0.55	-0.44	-0.25	-0.88	-0.13
	excitement seeking	0.29	-0.46	0.27	-0.06	-0.20	-0.06	-0.26	-0.57	-0.61	0.15	0.22	0.27	0.07	0.40	0.36	0.51	0.48	0.38	0.53	0.66	0.48	0.95	-0.08	0.95	0.42	0.53	0.27	0.71	0.47	0.43
	cheerfulness	0.33	0.99	0.50	0.80	0.87	0.80	0.61	0.69	0.75	0.67	0.64	0.50	0.70	0.47	0.48	0.55	0.57	0.55	0.68	0.72	0.66	0.83	-0.14	0.89	0.43	0.52	0.24	0.51	0.72	0.19
Agreeableness	*trust*	0.60	0.92	0.75	0.94	0.94	0.94	0.36	0.73	0.58	0.75	0.79	0.75	0.89	0.66	0.69	-0.36	-0.45	-0.48	-0.29	-0.11	-0.46	0.34	-0.39	0.31	-0.21	-0.22	-0.20	0.08	-0.59	0.14
	morality	0.43	0.95	0.72	0.88	0.88	0.88	0.57	0.41	0.51	0.91	0.87	0.72	0.85	0.76	0.76	-0.79	-0.72	-0.68	-0.86	-0.92	-0.80	-0.59	-0.23	-0.67	-0.84	-0.85	-0.77	-0.71	-0.60	-0.74
	altruism	0.78	0.60	0.97	0.89	0.78	0.89	0.15	0.25	0.09	0.90	0.97	0.97	0.95	0.91	0.98	-0.7[illegible]	-0.75	-0.70	-0.72	-0.68	-0.80	-0.55	-0.21	-0.59	-0.51	-0.60	-0.37	-0.47	-0.88	-0.18
	cooperation	0.31	0.51	0.91	0.67	0.51	0.67	-0.22	-0.09	-0.26	0.88	0.80	0.91	0.79	0.[illegible]	0.90	-0.[illegible]	-0.74	-0.63	-0.71	-0.75	-0.75	-0.78	-0.20	-0.80	-0.55	-0.67	-0.41	-0.66	-0.78	-0.36
	modesty	0.81	0.64	0.46	0.76	0.83	0.76	0.81	0.65	0.73	0.54	0.70	0.46	0.66	0.54	0.52	-0.[illegible]9	-0.83	-0.85	-0.92	-0.98	-0.89	-0.58	-0.19	-0.67	-0.91	-0.93	-0.82	-0.79	-0.77	-0.79
	sympathy	0.94	0.33	0.40	0.62	0.66	0.62	0.42	0.75	0.54	0.23	0.49	0.40	0.55	0.36	0.38	-0.61	-0.67	-0.51	-0.26	-0.32	-0.40	-0.66	-0.31	-0.50	-0.30	-0.51	-0.20	-0.81	-0.69	-0.40
Neurotic	*anxiety*	-0.56	0.50	-0.20	0.02	0.11	0.02	0.39	0.07	0.40	0.14	-0.07	-0.20	-0.07	-0.17	0.18	-0.09	-0.01	0.11	0.42	0.38	0.28	-0.34	0.05	-0.13	0.43	0.22	0.50	-0.22	-0.16	0.26
	anger	0.01	0.06	-0.61	-0.16	0.05	-0.16	0.70	0.52	0.76	-0.47	-0.37	-0.61	-0.35	-0.57	-0.59	0.21	0.10	0.23	0.62	0.68	0.41	0.35	-0.34	0.56	0.48	0.36	0.40	0.11	0.08	0.31
	depression	-0.17	-0.01	0.48	0.10	-0.08	0.10	-0.36	-0.72	-0.66	0.55	0.38	0.48	0.26	0.57	0.15	-0.79	-0.81	-0.71	-0.68	-0.73	-0.74	-0.79	-0.23	-0.77	-0.59	-0.73	-0.45	-0.80	-0.85	-0.48
	self-consciousness	0.22	0.61	-0.10	0.36	0.54	0.36	0.98	0.58	0.92	0.18	0.22	-0.10	0.19	0.00	-0.[illegible]	-0.61	-0.65	-0.56	-0.63	-0.65	-0.68	-0.77	-0.09	-0.78	-0.42	-0.54	-0.25	-0.55	-0.77	-0.18
	immoderation	-0.31	0.31	0.41	0.20	0.09	0.20	-0.04	-0.53	-0.32	0.64	0.41	0.41	0.29	0.51	0.4[illegible]	0.37	0.35	0.46	0.76	0.71	0.68	0.32	-0.18	0.53	0.45	0.38	0.32	0.00	0.51	-0.01
	vulnerability	-0.76	0.01	-0.61	-0.44	-0.33	-0.44	0.37	-0.28	0.19	-0.24	-0.44	-0.61	-0.52	-0.49	-0.53	0.28	0.19	0.35	0.68	0.65	0.53	-0.08	-0.09	0.17	0.59	0.41	0.58	-0.06	0.14	0.31

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

The correlation average for subscales in Table 39 below revealed that *trust* (0.81), *altruism* (0.79), *morality* (0.78) and *modesty* (0.71) from the Agreeableness Factor and *Intellect* from the Openness Factor all had strong positive correlations. This suggests that higher scores in these subscales are likely to be indicative of digital engagement. In the following table I have averaged the subscale correlations for Group A to identify the significance of each subscale.

Table 39 below shows the averages of the subscales in descending order. Colour coding for correlation strength has been added to aid interpretation.

Table 39 Correlation Averages of Subscales for Group A

Factors	Subscales	Average of Sectors (A)	
Agreeableness	*trust*	0.81	Strong correlation
Agreeableness	*altruism*	0.79	Strong correlation
Agreeableness	*morality*	0.78	Strong correlation
Openness	*intellect*	0.74	Strong correlation
Agreeableness	*modesty*	0.71	Strong correlation
Extraversion	*cheerfulness*	0.70	Moderate correlation
Openness	*imagination*	0.65	Moderate correlation
Conscientiousness	*dutifulness*	0.59	Moderate correlation
Agreeableness	*cooperation*	0.57	Moderate correlation
Agreeableness	*sympathy*	0.57	Moderate correlation
Conscientiousness	*cautiousness*	0.52	Moderate correlation
Openness	*emotionality*	0.50	Moderate correlation
Extraversion	*gregariousness*	0.48	Moderate correlation
Extraversion	*friendliness*	0.47	Moderate correlation
Neuroticism	*self-consciousness*	0.36	Moderate correlation
Conscientiousness	*self efficacy*	0.35	Moderate correlation
Openness	*adventurousness*	0.31	No significant correlation
Conscientiousness	*achievement-striving*	0.20	No significant correlation
Neuroticism	*immoderation*	0.17	No significant correlation
Neuroticism	*depression*	0.08	No significant correlation
Openness	*artistic interests*	0.07	No significant correlation
Extraversion	*activity level*	0.07	No significant correlation
Neuroticism	*anxiety*	0.00	No significant correlation
Extraversion	*excitement seeking*	-0.02	No significant correlation
Extraversion	*assertiveness*	-0.06	No significant correlation
Neuroticism	*anger*	-0.11	No significant correlation
Conscientiousness	*self-discipline*	-0.19	No significant correlation
Openness	*liberalism*	-0.32	No significant correlation
Neuroticism	*vulnerability*	-0.37	No significant correlation
Conscientiousness	*orderliness*	-0.50	Moderate negative correlation

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

Finding this level of analysis useful, in table 40 I grouped the subscales by Factor for Both Group A and Group B as per their correlation strength denoted by the colour code used in table 39.

Table 40 Subscales Grouped by Factor for Both Group A and Group B

Group A: More Engaged

Agreeableness (A)		Openness (A)		Extraversion (A)		Conscientiousness (A)		Neuroticisms (A)	
trust		*intellect*		*friendliness*		*self efficacy*		*self-consciousness*	*(v)*
morality		*imagination*	*(i)*	*gregariousness*		*dutifulness*	*(v)*	*anxiety*	
altruism		*emotionality*	*(i)*	*cheerfulness*		*cautiousness*		*anger*	
modesty		*artistic interests*	*(iii)*	*assertiveness*		*achievement-striving*		*depression*	*(v)*
sympathy	*(i)*	*adventurousness*	*(iii)*	*activity level*		*self-discipline*		*immoderation*	
cooperation	*(ii)*	*liberalism*	*(iii)*	*excitement seeking*		*orderliness*		*vulnerability*	

Group B: Less Engaged

Agreeableness (B)		Openness (B)		Extraversion (B)		Conscientiousness (B)		Neuroticisms (B)	
trust		*intellect*		*assertiveness*	*(iv)*	*self efficacy*		*immoderation*	
altruism		*imagination*		*friendliness*		*cautiousness*		*anxiety*	
sympathy		*emotionality*		*gregariousness*		*achievement-striving*		*anger*	
morality		*artistic interests*		*cheerfulness*		*orderliness*		*vulnerability*	
modesty		*adventurousness*		*excitement seeking*		*dutifulness*	*(v)*	*self-consciousness*	*(v)*
cooperation	*(ii)*	*liberalism*		*activity level*	*(iv)*	*self-discipline*		*depression*	*(v)*

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

In previous discussions Agreeableness and Openness were significantly related to digital engagement therefore the moderate correlations in *sympathy*, *imagination* and *emotionality* (See i) are taken to be important. The lack of correlation in Group A's *cooperation* should not be dismissed but rather it should be taken in relation to the strong negative correlation found in Group B (See ii). The additional three subscales of Openness with no correlations (see iii) may simply be the result of item questions not being suited to examining the digital environment behaviours or they may not relate to digital engagement. Further research would be required to confirm this.

In the Extraversion subscales we see that there are moderate positive correlations for *friendliness*, *gregariousness* and *cheerfulness* in both Group A and B. As a result these subscales are less useful as indicators for determining digital engagement. In Group B however the moderate negative correlation for *activity level* and the strong positive correlation for *assertiveness* (see iv) may serve as better indicators of digital engagement in a higher scoring Extravert. It is possible the divergence between these two subscales is important and an individual who scored high in the subscale *assertiveness* and low on *activity level* would likely have a propensity to lower digital engagement.

The correlation results for the subscales of Conscientiousness and Neuroticism do not clearly indicate which subscales are indicators of digital engagement or the specific role that they play in the digital engagement process. Insights into these subscales came from the interviews and were discussed at length in Chapter 6, for example Sam's high *achievement-striving* and *immoderation*. The correlations do suggest that the three subscales *dutifulness*, *self-consciousness* and possibly *depression* (see items marked v in the table above) behave in a similar way to the Extraversion Factor where Group B has negative correlations and Group A has positive correlations for the same subscale, or visa versa. In the less digitally engaged these subscales are a negative influence (shown as negative correlations) however as the individual becomes more engaged these subscales become a positive influence. Overall I propose that the correlations of the subscales Conscientiousness and Neuroticism support my earlier insights that these two Factors behave as moderating or confounding influences on the digital engagement process. They therefore have to be considered in conjunction with other subscales in order to understand their influence. It should be noted that this does not reduce the significance of some of these subscales because they may have the capacity to initiate a positive feedback loop that will amplify the individual's behaviours.

8.5 External Validation of Findings

At the start of my thesis there was little research into the direct relationship between personality and the use of digital networked technology. This situation has improved in the last few years with an increasing number of large sample research projects that are investigating associated aspects of digital technology use and application. The results of some of these projects coincidently support my observations and findings.

An investigation by Osatuyi into the relationship between personality and privacy issues on social media platforms using a sample group of 298 undergraduate students found that individuals who scored higher on Agreeableness were more concerned about privacy in the digital environment (Osatuyi, 2015). This is consistent with my findings and is typified by my participant Fay who was fully engaged and scored high on agreeableness. I found that those participants who were more engaged and high in Agreeableness were more aware of the

nature of the digital environment. While Osatuyi does not provide an explanation I suggest the cause may be that highly agreeable people tend to be more fully engaged and thus more aware of digital privacy issues. Osatuyi also found a relationship to Conscientiousness that is consistent with my findings as typified by Sam whose extreme engagement with one aspect of digital engagement could be explained by the interplay of subscales with his high levels of Conscientiousness.

In a study using a sample of 400 students regarding the impact of social networking immersion on their academic performance, results showed that extraverted students tended to underperform on their studies (Rouis, Limayem, & Salehi-Sangari, 2015). The results were taken to indicate that extroversion was related to poor academic performance. This finding is certainly consistent with my results, but the explanation may be more complex. I suggest that the relationship between Extraversion and digital technology use is far more complex due to its positive correlation in early engagement but transition to negative correlation with increased engagement.

Finding that the role of personality in relation to the use of technology had remained largely unexplored Tim Barnett and associates decided to test the direct relationships between Big-Five Factor and technology use in the context of a web-based classroom technological system, utilizing measures of perceived and actual use of technology on a sample of 382 undergraduate students (Barnett et al., 2015). They found Conscientiousness showed a positive association with both perceived and actual use while Neuroticism showed a negative association. These findings are again consistent with my findings where high Conscientiousness had a confounding affect that resulted in an amplification of technology use (e.g. Sam) and Neuroticism acted as a moderator of other traits as discussed in Chapters 4 and 5. Barnett also found Extraversion had a significant negative association with the actual use of technology. This was an unanticipated result for them but can be explained by my research.

A study in 2014 to determine the slower rate of technology adoption in senior members of society using a sample of 300 non-computer-using adults between the ages 64 and 98 (Mitzner et al., 2014). The study examined a number of variables such as perceived

usefulness, perceived ease of use, technology experience, cognitive abilities and personality. Their results found that Openness had the strongest relationship to technology use and Agreeableness was positively correlated. Neuroticism (their equivalent term 'emotional stability') was partially positively correlated. Extroversion and Conscientiousness showed no significant correlation to technology use. All Mitzner's findings are consistent with my research.

Research specifically related to differences between rational and intuitive decision making with regard to personality and digital networked technology has been difficult to source.[180] Juanchich and associates did however find that a marginal increase in extroversion was associated with a slight decrease in decision outcome and an small increase in conscientiousness was associated with a minor increase in decision outcome (Juanchich, Dewberry, Sirota, & Narendran, 2015).[181] Juanchich's conclusions are only partially relevant to my findings and do not necessarily contradict them.

8.6 Conclusions of Correlation

This chapter has examined the correlation between observable behaviours, as measured by personality instruments, and digital engagement as measured using my Digital Engagement Framework. When the data is self-evident I have kept correlation explanations based on interviews to a minimum and have only used discussion when I felt that prima facie interpretation was inadequate.

At the Factor level I found that high scores in Agreeableness and Openness or lower scores in Extraversion were indicative of digital engagement. High scores in Conscientiousness tended to have a confounding effect on other Factors and subscales and would need to be considered in conjunction with the full behavioural profile of an individual. High Neuroticism scores tended to moderate other Factors and subscales and should also be considered in conjunction with the full behavioural profile. With regard to the effects of decision-making

[180] Decision-making tends to be explored in relation to rational thinking and only occasionally includes personality. Where digital networked technology is examined in relation to personality, the focus is on marketing decisions and not on differences between intuitive and rational thinking styles. As a result finding third party research related to my decision making subscales has not been successful.

[181] This research was unfortunately not specifically related to digital networked technology but was nevertheless useful in supporting a relationship between personality and decision making.

style on digital engagement, this research found that an intuitive thinking style is significantly related to digital engagement.

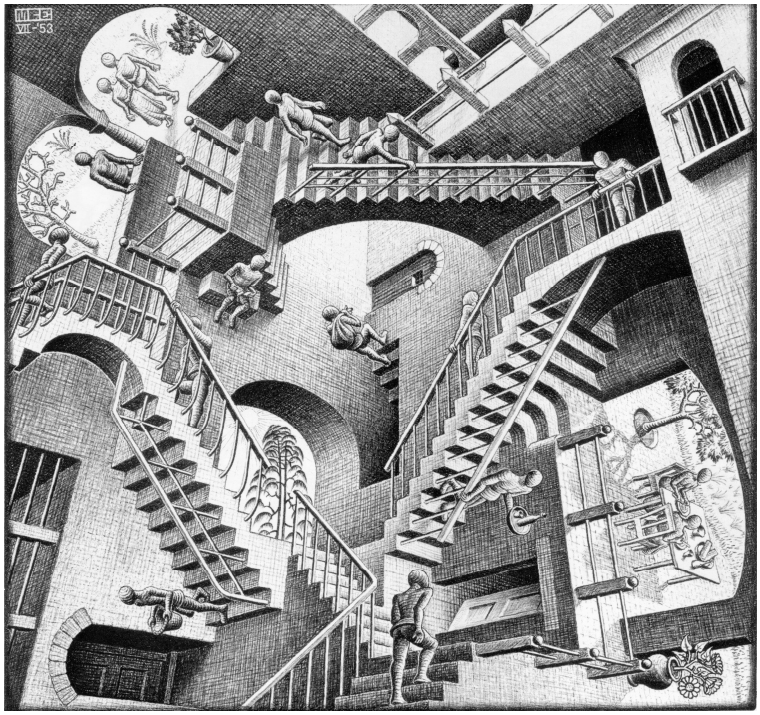
At the subscale level high *altruism* from Agreeableness and *intellect* from Openness are significant and strong positive indicators of digital engagement. High *imagination* and *emotionality* from Openness are moderate positive indicators of digital engagement but should also be considered important. *Modesty* from Agreeableness and *friendliness* from Extraversion are also strong indicators of digital engagement but these subscales tend to modify the behaviours of other Factors or subscales and should therefore be considered in relation to the other subscales when evaluating their impact. High *excitement-seeking* from the Extraversion Factor is a strong negative indicator of digital engagement.

Immoderation and *anxiety* from Neuroticism are also significant strong indicators of digital engagement but in this case the subscales have a confounding effect. They will tend to amplify or diminish the individuals' other subscale behaviours and must therefore be examined in the context of the other subscales. They result in complex relationships. Other confounding subscales that are moderately indicative of digital engagement are *cooperation* from Agreeableness and *dutifulness* from Conscientiousness.

The modifying subscales that are moderately indicative of digital engagement are *morality* from Agreeableness, *self-discipline* from Conscientiousness and Extraversion's *cheerfulness* and *activity level.* These subscales will tend to modify behaviours from the other Factors or subscales and therefore should also be considered in relation to the individual's other subscales when evaluating the strength of the said subscale. These too are complex relationships. Having established that there are indeed correlations between aspects of the internal environment (personality) and the external environment (digital engagement), I now consider the whole process as a coherent system.

9 Conclusion

As I have progressed through this thesis I have had to examine specific aspects of digital engagement in great depth and detail. At times these investigations may have appeared tangential or unrelated to the question of digital engagement as a whole, such as my examination of personality and instrument limitations, or how biochemistry affects the individual. Any one of these aspects could in themselves have been a full research project, but in relation to digital engagement, they were simply parts of the whole. While trying to consolidate all the diverse aspects I have discussed into one logical hierarchical structure, I have found myself simultaneously experiencing extreme clarity and overwhelming confusion. My examination of digital engagement has at times felt similar to looking at Maurits Escher's *Relativity* lithograph; every focal point can be seen to have internal consistency and appears coherent but is linked to other focal points in incoherent ways. When the focal points are considered together the overall result appears confusing.[182]



'Relativity' - lithograph print by M. C. Escher, December 1953

[182] Relativity is a lithograph print by the Dutch artist M. C. Escher, first printed in December 1953. See Appendix 1.

Considering Escher's *Relativity* as an analogy for digital engagement I came to appreciate that hierarchal or linear representation of my findings would likely mask the value of this research. For example, tool use and awareness are not in a linear relationship. I felt that understanding digital engagement required a more Deleuzian approach, where there is no beginning or end, only 'a middle (milieu)', and the strength or value of a milieu-node would vary depending on its relationships at any given point in time (see chapter 3.2). When using this approach to understand digital engagement, all systems and subsystems could be considered as having similar value even though, at times they vary their relative importance over time. For example, the 'Tool Use' Sector is not in a fixed relationship to the subsector *Internal Influencers* (from the 'Action' Sector), because both could vary at times and alter an individual's overall level of engagement. One acts at a biochemical level (e.g. dopamine rewards when seeking information) and the other acts as a result of the iterative and pervasive nature of the technology (e.g. the ubiquitous convenience of mobile devices).

In addition to this, the systems, especially digital engagement as a whole, are in a constant state of flux depending on which system first attracted the observer's attention, and the position of the observer in relation to the system being observed: are they observing the system as a whole or are they observing it from the perspective of being part of a specific system within the system? With Escher's lithograph the relevance of relationships between parts of the image also depends on where the viewer's attention lies. If they are intent on observing the image as a whole, the relationship-links become the stairs and the viewer's eye will move around the three dominant sets of stairs taking in the whole image. However, if the viewer is first attracted to the top left 'gravity well'[183] for example, then the feet, gaze of the couple, curved tree and railing of the first landing will create a visual circularity that the viewer will only leave once they are attracted to the gaze of the body on the landing who looks out and creates a relationship to the next 'gravity well' via the stairs. Thus, what you focus on becomes what is coherent at that time. It appears from my research that digital engagement behaves in a similar way. I found that the more engaged a participant was, the more able they were to manage simultaneously exploration of the parts that make up digital

[183] A gravity well is a conceptual model of the gravitational field surrounding a body. In space in Escher's lithograph it is an area/focus of interest such as the couple walking away in the top left which is in contrast to the man on the balcony – the discordance leads the eye down the steps to the next area of interest – the next gravitational well.

engagement (identified in my framework) and the whole (their relationship to themselves and technology as a system) as well as to cope with the contradictions of the whole.

The analogy of Escher's *Relativity* leads to three significant observations about factors important to digital engagement.[184] First is the concept of awareness, or to be more specific, self-awareness, which is essential for full digital engagement. Without sufficient levels of awareness the individual tends to simply move through the human/technology system, drawn forward by areas of interest that attract and direct their focus. This leads to undirected behavior, stress or even disorientation, as demonstrated by Ivy, Eva, and Kate when pursuing information.[185] Another observation concerning digital engagement that is powerfully illustrated in Escher's lithograph is related to second order cybernetics. In Escher's lithograph a viewer can simultaneously explore and appreciate the line, form and function of the contradictions of this image as a whole, as well as dip into the 'gravity wells' for deeper investigation. A similar situation occurs in digital engagement. The individual is simultaneously aware of their digital engagement with the overarching system that is also dependent on the seamless function of related subsystems, many of which will be delegated to subliminal processing. Finally, a further observation revealed by Escher's *Relativity* that creates an understanding of digital engagement relates to the image's apparent 'folding in on itself'. In the lithograph, no matter where a viewer enters the image their eye is inevitably drawn to following a 'gravity well' and from there to another, then another. There is no beginning and no end: the eye continues to move through the image as encompassing the system that is Escher's *Relativity*. This is significant because in this type of system all parts are continuously affecting other parts. Understanding and managing any one subsystem has the potential to affect others and ultimately leads to the development of skills and capacity for management of the whole system.

It was this final observation that clarified why I was having difficulty pulling divergent aspects of digital engagement into a hierarchal structure for presentation of my findings. I was trying to prioritise the significant findings in this research, but as it is a second order cybernetic

[184] All three observations are equally significant and their order of discussion is purely for convenience.
[185] There is increasing amount of research into lack of focus related to digital networked technology for example (Rouis et al., 2015).

system this is not a straightforward task. It was similar to Escher's lithograph where all 'gravity wells' are equally important to the whole. In the same way, each aspect of digital engagement has to be simultaneously considered independently of the others and also as being part of the whole. By doing this an individual can explore and understand all the parts and the whole in much the same way that one would examine and appreciate a collage.

My objective in this research was to examine the relationship between the individual and digital networked technology so that I could understand the nature of this intersection and why it is effecting individuals in such distinct ways. Of necessity my research has drawn from a variety of disciplines exploring aspects as diverse as cultural theory and neuroscience. However, the outcomes of this research do not simply provide a theoretical contribution to the body of knowledge, they offer a more practical description of our current understanding as a basis for future research that could aid industries such as human resources, education and training.

I began this research by examining both the individual and digital networked technology on a complex ecological level, rather than at the level of human tool use or in the broader sense of cultural practices. This has led me to understand both the individual and digital networked technology as being independent complex environments driven by nested systems that are cybernetic in nature, and, when taken together, form a further cybernetic system. However, as I have explained, digital engagement is better described as being a second order cybernetic system, because an important feature of any form of engagement is that the individual is cognisant of their role as both participant and observer of the system. Second order cybernetics recognises the significant and distinct role of awareness in this type of relationship. My understanding of digital engagement as being a second order cybernetic system resulted from the development of my Digital Engagement Framework, which highlighted the vital role of awareness within the process of digital engagement at its many levels.

Taking a multidisciplinary approach meant that a range of disciplines were foregrounded at different points in my research, depending on the particular focus at the time. It was the development of my Digital Engagement Framework that clarified why finding a suitable

theoretical underpinning for this research had been so difficult. Each of the sectors and subsectors of my framework were often influenced by different disciplines, theories or philosophies. While these may have been individually suited to specific aspects of digital engagement, when they were individually considered as an overall theory to underpin this research I found them to be inadequate. For example, phenomenology favoured the second order cybernetic aspect of digital engagement, ontology the abstract constructs of the individual, epistemology and logic the feedback Sector, and ethics the Action and Value Exchange Sectors. However when each of these were applied to other sectors of the Digital Engagement Framework they were lacking in some way. On the one hand, Heidegger and Ihde, for example, offer interesting and suitable phenomenological insights related to consciousness, which can be used to explain some aspects of digital engagement but not all. On the other hand, Damasio's neurobiologically based proposition regarding the making of consciousness could be used to explain all aspects of consciousness related to the digital engagement framework, but unfortunately was not applicable to all aspects of the system as a whole. In contrast, cybernetics, and more specifically second order cybernetics, was able to provide an overarching theory that successfully accommodated all my findings as described in the Digital Engagement Framework and the theories that supported aspects of it.

In developing my Digital Engagement Framework I came to a theoretical understanding of digital engagement, which enabled me to identify and explain the key sectors and subsectors that seem most important to the process of engaging with digital networked technology. This built a comprehensive picture of the behaviours necessary for digital engagement to occur. I also used the framework to develop a prototype instrument for measuring digital engagement, which was correlated to personality in order to examine the relationship between the two. Development of this prototype instrument was necessary because at the time there were no other suitable instruments for measuring digital engagement. This prototype instrument not only advanced my research but it may be useful to other researchers working in the field of human-technology relationships.

A recurring feature of my research into digital engagement has been the apparent incoherence of behaviours related to technology-use and the differences in individuals' awareness of their relationship with, to, and through the technology. This incoherence was often displayed as simple dichotomies such as a 'love-hate' relationship that participants had with the utility and invasiveness of technology such as mobile phones. I found this apparent incoherence could be understood by viewing digital engagement as a type of fractal system where similar cybernetic systems function at different scales. For example at the more fundamental level of the individual there are the biochemical systems, then at another level there are the systems that result in the autobiographical self, and at yet another level there are the systems identified in my framework that led to digital engagement.[186] Each system is in essence repeating simple governance processes in ongoing feedback loops but they also interact. In this thesis I describe these multiple governed-feedback-processes as nested cybernetic systems because they are governed processes that have control mechanisms for achieving an outcome. The Motivation Sector is an exception but in order to understand this exception I need to consider the ways in which the nested cybernetic systems work.

At the start of this chapter I used Escher's *Relativity* lithograph to illustrate how each independent part of the whole can be understood in isolation, but when the disparate parts are put together the discord appears overwhelming as the viewer tries to make a singular sense of the apparent chaos. Similarly in digital engagement the apparent incoherence and discord of the multiple subsystems can appear overwhelming, but this can be resolved by considering the whole process as being the sum of multiple nested systems of governance, where the internal logic of each system can be considered independently as well as being a part of a whole overriding control system. In negotiating this reality the individual using the technology needs the mental capacity, in the sense of subtlety and astuteness, to be at least somewhat aware of the systems in play. As my analysis demonstrated, it is the individual's *capacity for* and *exercise of* awareness that tends to determine an individual's level of digital engagement. This is because an increased system awareness enables the individual to productively align their behaviours for improved outcomes in any given situation involving digital engagement.

[186] Similar fractal type systems can be found in digital networked technology.

This was demonstrated at the individual level, when I found that the greater an individual's level of awareness the more likely it was that they would become fully engaged, since they were better able to grasp and manage the *governance* of the multiple subsystems to their advantage. This was exemplified by Fay, for whom many behaviours had become intuitive responses that were aligned to maximise her personal objectives (see 8.3). An individual's level of awareness is therefore important to digital engagement but it is a confounding factor that is often not understood or even acknowledged by the individual. This can be seen in people who successfully engage with technology, but do not become fully engaged. These individuals are generally not consciously aware of the complexities of digital engagement relationships and do not fully understand the subconscious causes of their behaviours. In these cases of reduced levels of awareness it is often unproductive simply to ask how or why they are using technology in a particular way because their answers will tend to be confusing. This was often the case in my interviews. Added to this, external parties such as people observing digital engagement, can also find it difficult to identify awareness-behaviours because awareness is subtle and permeates many aspects of the digital engagement process. This led to my realisation that not being aware of the process was itself a major source of the apparent chaos of digital engagement behaviours. As with Escher's 'gravity wells' in *Relativity* I found that each system or subsystem of digital engagement was distinct, but was also intrinsically woven into a single larger unit, such that full engagement required being simultaneously cognisant of multiple subsystems while retaining awareness of the system as a whole. *Digital engagement was thus to some degree contingent on system awareness.* This was the case even when this awareness reached the stage that it was intuitive.

In this thesis I also proposed that the physical and digital networked environments should be considered as distinctive, due to people's differing perceptions within them of first principle concepts such as time, space and memory: fundamental concepts that affect human behaviours and thus digital engagement. The discussion in my thesis was not designed to *prove* that the two environments were indeed different, but rather to present a reasonable explanation for the differences that I had observed in participant behaviours. This approach proved valuable to my understanding of digital engagement. While in many ways the

physical and digital environments increasingly seem to be intertwined and overlapping I suggest that given our current level of understanding of the digital environment, further investigation and acknowledgment of the distinctiveness of each environment remains beneficial to developing our understanding of how and why we engage with technology.

Identifying and acknowledging differences in the environments might also suggest the potential for individuals to modify their behaviour to suit the environment in which they are currently operating. Introducing individuals to environmental differences may be a way to reveal the possibilities of changing or modifying internal responses to digital technology For example, I found that Fay, a fully-engaged participant, was notably aware of value exchange differences within each of the two environments, and she was therefore subconsciously modifying her behaviours to maximise her outcomes within each of the environments even though she did not completely understand the distinctions. In the physical environment Fay would tend to be a very reserved and private person, but in the digital environment she would freely share personal experiences and opinions because she found this form of value exchange would initiate and foster relationships. She subconsciously understood that value exchanges were different in each environment. In contrast, I found that those who were less aware of the differences would misuse the digital environment value exchanges. This behaviour was typified by Ben who, when asked about sharing online, said “[there are] no rules. If I want to be a consumer of information then I will be. I don't feel compelled to reciprocate” (Ben: i2q2). When asked if he was more inclined to share in the physical environment he replied “Probably but then in the real world it is more personal.” Ben was only aware of ‘physical environment resource control’ as a means of value exchange and he was applying these learned behaviours to the digital environment. Differences between the two environments were particularly apparent when existing personality instruments were used to evaluate observable behaviours within the digital environment and found to be inadequate.

Because personality is perceived as being a consequence of biological makeup and environmental interaction, and because an individual is – generally speaking – the same

being[187] in both the physical and the digital environments, it appears reasonable to assume that the individual's overarching behaviours and personality would remain consistent across those environments. However, as my thesis discussions have shown, this is not necessarily the case. Personality instruments developed for the physical environment were not necessarily suitable for measuring the same personality trait in the digital environment. Assuming that there is no difference between the environments may thus potentially be affecting many areas of society, such as Human Resources, where inadequate instruments are used to evaluate and place employees, particularly those interacting with technology such as ICT professionals. This is especially the case when measuring Extraversion and Openness and subscales like *gregariousness* and *artistic interests*.

Approaching the digital networked environment from the perspective of it being a 'unique environment' as opposed to being 'a continuum of' the physical environment resulted in explanations of numerous stress points experienced by my participants and led to my understanding of the significance of the individuals' system awareness. Those individuals who demonstrated recognition of differences in first principle concepts within the two environments were better able to embrace the duality of environments and appeared better able to govern their own unique digital engagement systems as described in the Digital Engagement Framework. This resulted in their ability to transition seamlessly between the two environments and optimise their outcomes within each environment by adapting to the parameters of the environment.

My approach to understanding the digital environment seems to differ from other research in this area. Other research tends to focus on the transition across the environments, in order to understand them as a whole, or consider them as being totally separate spaces. Both these approaches contribute in some way to our understanding of the digital environment, but I feel they cannot adequately explain the behavioural differences increasingly evident in society. My consideration of the continuum as being 'between the individual and environments' rather than being 'between the digital and physical environments' has revealed interesting environmental differences related to first principle behavioural

[187] Here I am referring to the basic physicality of the individual not any esoteric discussions regarding virtual presences, avatars or consciousness all of which are valid within other contexts.

responses. Differences and similarities between environments may benefit from further research in this direction.

Following this line of thinking, some unanticipated insights for hardware and software development may be revealed if the perception of the interface between environments moves from the physical screen of the device as the permeable interface between the physical and digital to 'something different'. For example consider the individuals' skin as a permeable interface, as shown in the Iowa Gambling experiment, which monitored cognitive response by skin reaction.[188] In some ways technology advances are moving in this direction with wearable technology that monitors internal systems. However, simply using technology does not necessarily result in a conscious continuum between the individual and digital networked technology as described in my Digital Engagement Framework. Without system awareness the individual may be managed by the technology rather than managing it to advantage their outcomes, as seen in love/hate relationships with mobile phones. Further research in areas such as neuroscience, cognitive science, and behavioural psychology may provide interesting approaches to addressing the concept of some identified aspects of the individual and will aid our understanding of the environments involved in digital engagement.

Whether or not the physical and digital environments are accepted as being different, separate or a continuum, I suggest that there is a need for instruments to measure behaviours reliably within the digital environment just as tools like NodeXL[189] and Sentinel Visualizer[190] have been developed to examine and measure relationships reliably within the digital environment. The development of more appropriate and consistent personality instruments would certainly be of use to all industry sectors that use human behavioural measures such as education and human resources. Taking a position that there is only one environment may well lead people to miss the vital nuances that could provide insights needed to explain and understand the digital engagement phenomenon that is shaping individuals and society. There is no doubt that just as humans developed an understanding of first principle concepts, such as friction and weightlessness for water vs. a gaseous

[188] See (Bechara et al., 2005)
[189] http://nodexl.codeplex.com/
[190] http://www.fmsasg.com/fmsasg/products/sentinelvisualizer/

environment (referring back to the scenario of the climber and scuba diver on a ledge), they will ultimately evolve and develop an understanding of different perceptions for the digital environment. However, the potential for behavioural amplification as a result of a positive second order cybernetic feedback system could result in notable social consequences as some individuals more readily adapt, while others struggle to understand their divergent emotional responses and behaviours.

In chapter 4, I explained personality as a manifestation of the sum of complex internal systems that make up the individual. Despite the limitations discussed above, and the fact that I only had a small sample, my research did indicate that there is a relationship between personality and a propensity to engage with technology. High Openness and Agreeableness or low Extraversion appears to be more suited to the digital environment. I also found that understanding personality and explaining anomalies in relation to the digital environment required deeper investigation and an understanding of the interplay between subscales that make up the Big-Five Factors. A notable finding of this research was the identification of subscales that were specifically related to digital engagement.

The following table summarises the personality subscales that consistently correlated to high digital engagement across all four methods of investigation[191] used in this research as well as in the observed behaviours of participants during the interviews. This suggests that these subscales are notable to digital engagement.

Table 41 Minimum Subscale list for Digital engagement Evaluation

Agreeableness	*altruism*	*modesty*	*cooperation*	*morality*
Openness	*intellect*	*imagination*	*emotionality*	
Extraversion	*excitement-seek*	*friendliness*	*cheerfulness*	*activity level*
Conscientiousness	*self-discipline*	*dutifulness*		
Neuroticism	*immoderation*	*anxiety*		
Decision Style	*intuitive iterations.*	*intuitive ability*	*rational iterations*	*rational ability*

[191] Four ways the relationship between personality and digital engagement were investigated. 1) The range analysis of each Factor and subscale as indicated by participants. (see Chapters 5-6). 2) The Excel correlations of participants' personality to digital engagement scores. (see Chapter 7-8). 3) The Statistical software package analysis. Results and discussion the can be found in Appendix 2. 4) Third party projects that have a bearing on my research. The results of these four approaches have been consolidated into Table 19 in Appendix 1.

As these findings were based on a small sample they cannot be considered conclusive but when this research is taken in conjunction with third party research that is now emerging, my findings do appear to be valid. This suggests interesting opportunities for further investigations, which could focus on the identified subscales using larger samples. Hopefully the framework developed in this thesis will serve as a useful basis for the development of valid and reliable instruments that will provide more suitable evaluation of behaviours within the digital environment. This could lead to research that will aid education about and management of digital engagement for the benefit of both the individual and society.

Another area for further research suggested by my work is the potential use of technology in behavioural training and education through development of a positive second order cybernetic system. I found that when digital engagement is understood as a second order cybernetic system, and *system awareness* is developed, digital networked technology has the potential to initiate a positive feedback cycle that can alter behaviours in fundamental ways. This was illustrated in Sam's behaviour when, despite being high in Extraversion,[192] his engagement with technology resulted in increasingly high levels of engagement. Sam, however, did not become fully engaged as might have been expected because of his persistant lack of awareness. In contrast, Fay not only became fully engaged, but her high level of system awareness resulted in governance of both her internal and external systems that resulted in increasing levels of intuitive response involving technology and the outsourcing of cognitive processing to technology. Fay's relationship to digital networked technology demonstrated a positive second order cybernetic feedback system where she was governing and managing her relationship with technology to adapt and adjust both her behaviour and that of her son. A superficial interpretation would be that Fay was simply using the tool effectively, but my observation of both Sam and Fay over the course of this research suggests that this was not the case and that something more profound was occurring involving individual awareness and responsiveness to feedback'.[193]

[192] Extraversion was shown to be contra indicated for digital engagement see chapters 5 and 6.
[193] Other participants (Tim, Ivy, Sue and Joe) displayed similar examples of this behaviour but it was not as clear.

This research becomes important when considering the potential of digital networked technology to amplify human behaviour on a mass scale, as increased iterations[194] with digital technology facilitate behavior modification through learning from feedback processes (Mazur, 2006, pp. 39-42 and 310-321). Further research in this area using larger sample groups would be beneficial to determine the threshold at which learning behaviours using technology become intuitive and thus self-perpetuating. My research indicated that rational decision making, which is a more conscious process, reduced the overall number of iterations that the individual experienced. This affected the process of repetitive learning through technology use in the rational thinker, suggesting that relying on a conscious decision making approach may serve as a *barrier* to embedding technology which is most effective if done seamlessly. The impact of technological iterations on the neuroplasticity of the individual could, on a larger scale, also lead to social changes due to its affect on individuals' biochemical responses, which affect the development of the autobiographical self and ultimately individuals' behaviours. Understanding the mechanism of digital engagement has the potential to aid individual participants, researchers and stakeholders to manage digital engagement in a socially responsible way.

When considering the benefits of positive feedback loops, the pervasiveness and utility of technology can easily provide 'in the skin' stimuli that effect the autobiographical self and the development of abstract constructs that can in turn influence behavioural learning. If this learning process is taken in conjunction with how an individual understands each system, the way systems are nested in the whole, and the powerful role of system governance and awareness, then directed digital engagement might be able to alter behaviours profoundly. From this perspective, understanding digital engagement as second order cybernetics becomes important and worthy of further research.

My research turned out to be one of macro and micro exploration that involved both the specificity of numbers and generalisations, the examination of hardware, software, wetware and the ephemeral nature of consciousness. But in order to obtain the necessary depth of knowledge my research was limited to a small number of participants. Further research

[194] Iterations here describes repeated interactive processes with technology.

using larger samples could build on and expand this research thereby providing insights as to how individuals and society can best manage digital networked technology in a constructive way. As noted, another rich research avenue is the development of instruments more suitable for measuring personality in the digital environment. Similarly, another extension of my research would be the development of my prototype into a tested instrument for measuring of digital engagement. Exploring the significance of the identified subscales of the NEO-PR-I to see if they form a Factor structure that is different from the Big-Five Factor structure; Examining the distinctions between the digital and physical environment in order to better understand human behaviours within the digital environment; Developing a method of imparting identified environmental differences to aid internal change management; Developing a method of teaching system awareness to aid management of technology use; and Conducting a longitudinal study of learning behaviours resulting from technology iterations based on personality profile and decision making style.

The aim of this research was to examine a sample of ICT professionals to develop an understanding of digital engagement. While this research has produced many nuanced findings and observations, in concluding I feel it is appropriate to consolidate my thoughts into a succinct answer. I would therefore say that digital engagement, as the relationship between an individual and digital networked technology, is best understood as a Second Order Cybernetic system, which involves a complex arrangement of governed interacting nested cybernetic systems and the individual's awareness that they are both a 'participant in' and 'an observer of'' a positive feedback process between themself and the technology. In addition to this, digital engagement is directly influenced by the individuals' level of system-awareness, which enables them to govern and manage their unique set of cybernetic feedback processes, both internal and external, in conjunction with their personal motivation. The exciting possibility of this is that some future research will reveal how raising awareness of this relationship will produce massive personal and social benefits.

This research has been a journey of interwoven extremes that demanded my letting go of preconceived ideas and conditioning in order to allow the exquisite complexity of digital engagement to emerge. I have come to realise that digital engagement is not about the

devices we touch, or how often we go online to gather information, nor is it about convenience or mobility, although these are in part contributing factors. Conceptually, digital engagement is about how we use the digital networked environment as an empowering abstract ‘exoskeleton’ to enhance our potential. The power and potential of digital engagement thus lies within the individual who, if they know and understand themselves as a system, can then harness the ‘exoskeleton’ to their advantage. There is little doubt that human engagement with digital networked technology is altering how we experience the world. It is my hope that this thesis may contribute to understanding it better, while also prompting further research.

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11 APPENDIX 1

1. Glossary

Ability ϕ	Ones capacity to do something.
Achievement-Striving *	Individuals who score high on this scale strive hard to achieve excellence. Their drive to be recognized as successful keeps them focused on their goals. They tend to have a strong sense of direction in life. Extremely high scores may be single-minded and obsessed with their work. Low scorers may be content to get by with a minimal amount of work, and might be considered as being lazy.
Acquisitive ^	In this thesis acquisitive refers to individuals who show a tendency to seek, acquire, and maintain possession of concrete or abstract properties acquired in or through the digital environment. In the digital environment acquisitive individuals pleasure is obtained from possession not creation.
Activities ^	In this thesis activities refers to something done in the digital networked environment by individuals, entities or collectives. Entities and collectives may be human or non-human.
Activity-Level *	Individuals high in activity-level lead fast-paced, busy lives. They move about quickly, energetically, and vigorously, and are involved in many activities. Individuals who score low on this scale follow a slower and more leisurely, relaxed pace.
Adventurousness *	High scorers in adventurousness are eager to try new activities, travel to foreign lands, and experience different things. They find familiarity and routine boring, and they will try new things just because it is different. Low scorers tend to feel uncomfortable with change and prefer familiar routines.
Agreeableness *	Individual who score high on Agreeableness tend to have an optimistic view of human nature. They value relationships and are willing to compromise.
Altruism *	Altruistic people find helping other people genuinely rewarding. Consequently, they are generally willing to assist those who are in need. Altruistic people find that doing things for others is a form of self-fulfilment rather than self-sacrifice.
Anger *	Individuals who score high in anger feel enraged when things do not go their way. They are sensitive about being treated fairly and feel resentful and bitter when they feel they are being cheated. This subscale measures the *tendency* to feel angry; whether or not the person expresses annoyance and hostility depends on the individual's level on Agreeableness. Low scorers do not get angry often or easily.
Anxiety *	People who are high in anxiety often feel like something dangerous is about to happen. Their "fight-or-flight" system of the brain is too easily and too often engaged. They may be afraid of specific situations or be just generally fearful. They feel tense, jittery, and nervous. Persons low in Anxiety are generally calm and fearless

Applications ϕ	Applications are small often cheep or free software programs used in the digital environment. More commonly referred to as APPs.
Artistic Interests *	High scorers on this subscale love beauty, both in art and in nature. They become easily involved and absorbed in artistic and natural events. They are not necessarily artistically trained or talented, although many will be. The defining features of this scale are interest in, and appreciation of natural and artificial beauty. Low scorers lack aesthetic sensitivity and interest in the arts.
Assertiveness *	High scorers in assertiveness like to speak out, take charge, and direct the activities of others. They tend to be leaders in groups. Low scorers tend not to talk much and let others control the activities of groups
Autobiographical Self ∞	This is a term coined by Antonio Damasio and refers to the traditional notion of self, which he describes as being 'linked to the idea of identity and corresponds to a nontransient collection of unique facts and ways of being which characterize a person.' It 'depends on systemized memories of situations in which core consciousness was involved in the knowing of the most invarient characteristics of an organism's life'. Damasio, Antonio. (2000). The Feeling of What Happens: body, emotion and the making of consciousness. London: Vintage. Page 17.
Builder ^	The term builder is used in this thesis to describe an individual who contributes in some form within the digital environment that benefits the system. Pleasure is obtained from creation not possession.
Cautiousness *	Cautiousness describes an individuals' disposition to think through possibilities before acting. High scorers on the Cautiousness scale take their time when making decisions. Low scorers often say or do first thing that comes to mind without deliberating alternatives and the probable consequences of those alternatives.
CEST ∞	CEST refers to Seymor Epstein's Cognitive-Experiential Self-Theory. It is a broadly integrative theory of personality that is compatible with a variety of other theories. Epstein, Seymor. (2003). Cognitive-experiential self-theory of personality. In T. Millon, M. J. Lerner & I. B. Weiner (Eds.), Handbook of Psychology, Personality and Social Psychology.
Cheerfulness *	The cheerfulness scale measures positive mood and feelings, not negative emotions (which are a part of the Neuroticism domain). Individuals' who score high on this scale typically experience a range of positive feelings, including happiness, enthusiasm, optimism, and joy. Low scorers are not as prone to such energetic, high spirits.
Component ^	In this thesis a component is used to describe one independent part of a whole. Due to the interdisciplinary nature of this thesis the terms organisms, elements, nodes or components should be considered as being interchangeable. In this thesis the term is usually used to describe a concrete or mechanical part of the whole.
Conscientiousness *	Individuals who score high on Conscientiousness tend to be reliable. Their planning, persistence and tenacity generally lead to successful achievement of goals. Their considered behaviour is often perceived as intelligence.
Consumer ^	The term consumer in this thesis describes someone who uses the resources of the digital environment without contributing to it.

Cooperation *	Individuals who score high on this scale dislike confrontations. They are perfectly willing to compromise or to deny their own needs in order to get along with others. Those who score low on this scale are more likely to intimidate others to get their way
Core Self ∞	A term coined by Antonio Damasio to describe ones sense of self which emerges in core consciousness. The core self is a transient entity, ceaselessly re-created for each and every object with which the brain interacts. Damasio, Antonio. (2000). The Feeling of What Happens: body, emotion and the making of consciousness. London: Vintage. Page 17.
Core self-evaluations *	This is a psychology term e.g. Neuroticism has been included as one of the four dimensions that comprise core self-evaluations, one's fundamental appraisal of oneself, along with locus of control, self-efficacy, and self-esteem. Judge, T A, Locke, E A, & Durham, C C. (1997). The dispositional causes of job satisfaction: A core evaluations approach. Research in Organizational Behavior, 19, 151–188.
Crowd sourcing ϕ	Crowdsourcing is using collective intelligence gathered from the wider public.
Cybernetics ^	A generalized description of cybernetics is that it is the examination of design and application of principles of regulation and communication within a system. The focus of cybernetics is in the *behaviour* of the objet rather than on the object itself.
Depression *	The depression scale measures the tendency to feel sad, dejected, and discouraged. High scorers lack energy and have difficult initiating activities. Low scorers tend to be free from these depressive feelings
Digital Network ^	For this research digital networks should be considered as hardware is that it is made up by the devices that interface with a network (routers, computers, mobile phones, iPads, Wi-Fi devices etc.) and the network which connects the devices (high speed backbones, typically fibre optic trunk line, and more recently radio band width in the case of wireless networks as well as the software used on these systems. It is a collection of nested cybernetic systems.
Digital Network as a Tool ^	Digital networks can be considered a tool used by humans because they are manipulable objects which alter the environment in order to achieve a goal however once the human engages with digital networks, they can no longer simply be considered a tool in the traditional sense because they also become an environment.
Digital Network tools ^	Digital network tools can be hard or software entities that utilize digital principles and can be manipulated to alter the environment in order to achieve a goal.
Digital networked environment ^	The digital networked environment is a digitally created environment in which and through which human and non-human entities operate and should be considered as in contrast to the physical world in which humans have evolved.
Digital engagement ^	Digital-engagement is the relationship between an individual and digital networked technology and is best understood as a Second Order Cybernetic system, which involves a complex arrangement of interacting nested cybernetic systems and the individual's awareness that they are both a 'participant in' and 'an observer of' a positive feedback process between themself and the technology. The level of an individuals' digital-engagement is directly influenced by the individuals' level of system-awareness, which

	enables them to govern/manage their unique set of cybernetic feedback process, both internal and external, in conjunction with their personal motivation.
Dutifulness *	The dutifulness scale reflects the strength of a person's sense of duty and obligation. Those individuals who score high on this scale have a strong sense of moral obligation. Low scorers find contracts, rules, and regulations overly confining. They are likely to be seen as unreliable or even irresponsible.
Element ^	In this thesis an element is one independent part of a whole. Due to the interdisciplinary nature of this research the use of the terms organisms, elements, nodes or components should be considered interchangeable. The term element will usually used to describe sub sections of ephemeral and biological entities.
Emotionality *	Persons high on emotionality have good access to and awareness of their own feelings. Low scorers are less aware of their feelings and tend not to express their emotions openly.
Engagement ^, ∞	In this thesis engagement describes the enmeshing process of an individual with technology. Seymor Epstien however uses it in the context of 'frequency in use' in his REI test.
Excitement-Seeking *	High scoring individuals on excitement-seeking are easily bored without high levels of stimulation. They love bright lights and hustle and bustle. They are likely to take risks and seek thrills. Low scorers are overwhelmed by noise and commotion and are averse to thrill-seeking.
Experiential ∞	A term used by Seymor Epstein to describe the more commonly used term intuition. It is a subconscious response developed by repeated successful iterations.
Extraversion *	Individual who score high on Extraversion actively interact with other humans. They draw energy from this interaction and will nurture it through their energy and positive behaviours.
Facet ^	Term used to describe the sub-sections of personality Factors. Other terms that could be used interchangeably are subscale, or subfactor.
Flexibility ϕ	The ability to adapt to change.
Friendliness *	Individuals scoring high on friendliness are people who genuinely like other people and openly demonstrate positive feelings toward others. They make friends quickly and it is easy for them to form close, intimate relationships. Low scorers on Friendliness are not necessarily cold and hostile, but they do not reach out to others and are perceived as distant and reserved.
Gregariousness *	Gregarious individuals find the company of others pleasantly stimulating and rewarding. They enjoy the excitement of crowds. Low scorers tend to feel overwhelmed by, and therefore actively avoid, large crowds. They do not necessarily dislike being with people sometimes, but their need for privacy and time to themselves is much greater than for individuals who score high on this scale.
Heuristics ϕ	Strategies using readily accessible, though loosely applicable, information to control problem solving in human beings and machines.
Imagination *	Individuals who are high in imagination find the real world is often too plain and ordinary and may use fantasy as a way of creating a

richer, more interesting world. Low scorers are on this scale are more oriented to facts than fantasy.

Immoderation *	Immoderate individuals feel strong cravings and urges that they have difficulty resisting. They tend to be oriented toward short-term pleasures and rewards rather than long-term consequences. Low scorers do not experience strong, irresistible cravings and consequently do not find themselves tempted to overindulge
Internal environment ^	This term is used as a catch-all phrase to describe the multiple subsystems of the individual from the neurological, biochemical, and physiological systems, to systems that result in the making of consciousness and the resulting autobiographical self and its related behaviors.
Inquisitive ^	The term inquisitive is used in this to describe the behaviour given to inquiry, research, or asking of questions; eagerness for knowledge or intellectual curiosity. For this individual pleasure is obtained in the *pursuit* of information.
Intellect *	Intellect and artistic interests are the two most important, central aspects of the Openness factor. High scorers on intellect love to play with ideas. They are open-minded to new and unusual ideas, and like to debate intellectual issues. They enjoy riddles, puzzles, and brainteasers. Low scorers on intellect prefer dealing with people or things rather than ideas. They regard intellectual exercises as a waste of time. Intellect should not be equated with intelligence. Intellect is an intellectual *style*, *not* an intellectual *ability*, although high scorers on Intellect score slightly higher than low-Intellect individuals on standardized intelligence tests.
Intuitive ^	The term intuitive in this thesis refers to the power or faculty of gaining direct knowledge or cognition without evident rational thought and inference. The response is generally associated with an emotion.
Iterations ^	In this thesis the term iterations refers to a process of repeated actions that yields results successively closer to a desired result or until a condition is met. It also relates to the frequency-of-use in digital networked technology.
Liberalism *	Liberalism in behavioural psychology refers to a readiness to challenge authority, convention, and traditional values. In its most extreme form, it can even represent hostility toward rules, sympathy for law-breakers, and a love of ambiguity, chaos, and disorder. Low scorers of liberalism prefer the security and stability brought by conformity to tradition. Psychological liberalism and conservatism is not the same as a political affiliation, but is indicative of political tendencies.
Locus of the self ^	In this thesis locus of self refers to how the individual sees themselves in relation to the environment in which they are operating.
Long tail ϕ	The origin of the term 'long tail' is from statistical distributions such as the Pareto distribution, named after Vilfredo Pareto a civil engineer and economist who observed a power law probability distribution that is now used in descriptions of social, scientific and many other types of observable phenomena. Generally speaking the graph of such a distribution will start high and quickly drops off as a concave curved line, approaching zero along the X-axis. Events at the far ends of the axis have an increasingly low probability of occurrence. The Pareto principle applies in many cases, which gave rise to the 80/20 rule: 80% are accounted for by

	the first 20% of items in the distribution. It should be noted that the Pareto distribution is not strictly 80/20 and it may vary.
Modesty *	High scorers on modesty do not like to claim that they are better than other people. In some cases this attitude may derive from low self-confidence or self-esteem. Individuals with high self-esteem find immodesty unseemly. Individuals low in modesty tend to describe themselves as superior are seen as disagreeably arrogant by other people
Morality *	High scorers on morality see no need for pretence or manipulation when dealing with others and are therefore candid, frank, and sincere. Low scorers believe that a certain amount of deception may be necessary usually in social relationships. The straightforwardness of high scorers makes them relatively easy to relate to, compared to the low-scorers on this scale. Note that low scorers are not unprincipled or immoral, they are simply more guarded and less willing to openly reveal the whole truth.
Neuroticism *	Individuals who score high on Neuroticism tend to be emotionally reactive. Their struggle with emotional regulation can inhibit their action potential and moods.
Node ^	A node is one independent part of a whole. Due to the interdisciplinary application of ecology this use of the terms organisms, elements, nodes or components should be considered interchangeable. In this thesis the term is usually used to describe sub sections of digital entities. A node in relation to the software nVivo refers to a collection of references about a specific theme or area of interest. The references are gathered by 'coding' sources such as interviews, documents, articles or survey results.
Openness *	Individuals who score high on Openness tend to be intellectually curious and have the cognitive capacity for abstraction. They enjoy complexities and tend to be more aware of their feeling.
Orderliness *	Persons with high scores on orderliness are well organized. They like to live according to routines and schedules. They keep lists and make plans. Low scorers tend to be disorganized and scattered.
Organism ^	In this thesis an organism describes one independent part of a whole. Due to the interdisciplinary application of ecology the use of the terms organisms, elements, nodes or components should be considered interchangeable. In this thesis the term organism is generally used to describe a biological subsystem. It should be noted that the subsystem may however a system within its own right.
Rational ϕ	A logical or deductive processes.
Sector ^	A term used to describe the major groups of the Digital Engagement Model developed in this thesis. There are five of these in the model.
Self ^	I use the term self in this thesis to describe the unique state of consciousness that an individual develops from being both observer and participant of their internal environment and the external environment in which they operate: It is the individuals' state of awareness at the interface between the internal and external environments.
Self-consciousness *	Self-conscious individuals are sensitive about what others think of them. Their concern about rejection and ridicule cause them to feel

	shy and uncomfortable around others. They are easily embarrassed and often feel ashamed. Their fears that others will criticize or make fun of them are exaggerated and unrealistic, but their awkwardness and discomfort may make these fears a self-fulfilling prophecy. Low scorers, in contrast, do not suffer from the mistaken impression that everyone is watching and judging them and do not feel nervous in social situations.
Self-discipline *	The self-discipline subscale is generally referred to as will-power. It refers to the ability to persist at difficult or unpleasant tasks until they are completed. People who possess high self-discipline are able to overcome reluctance to begin tasks and stay on track despite distractions. Those with low self-discipline procrastinate and show poor follow-through, often failing to complete tasks-even tasks they want very much to complete.
Self-disclosure *	High scorers in self-disclosure will readily give over information about themselves to other individuals which tends to increase rapport and trust.
Self-efficacy *	Self-efficacy describes an individuals' confidence in their own ability to accomplish things. High scorers believe they have the intelligence (common sense), drive, and self-control necessary for achieving success. Low scorers do not feel effective, and may have a sense that they are not in control of their lives.
Self-esteem *	This psychology term describes an individuals' ability to reflect the overall emotional evaluation of their own worth. It is a judgment of oneself as well as an attitude toward 'the self'.
Snippet ^	The term snippet is used in this thesis to describe a small piece of information extracted from the interviews.
Software ϕ	These are larger more substantial software programs than apps used in the digital environment.
Subfactor ^	Term used to describe the sub-sections of the personality Factors. Other terms that could be used interchangeably are facet, or subscale.
Subscale ^	Term used to describe the sub-sections of personality Factors. Other terms that could be used interchangeably are facet, or subfactor.
Subsector ^	Term used to describe the sub-sections of Sectors of the Digital Engagement Model developed in this thesis. There are fifteen of these in the model.
Sympathy *	People who score high on sympathy are tender-hearted and compassionate. They feel the pain of others vicariously and are easily moved to pity. Low scorers are not affected strongly by human suffering. They pride themselves on making objective judgments based on reason. They tend to be more concerned with truth and impartial justice than with mercy.
Tool ^	A tool is a manipulable objects/entity that can be used to alter the environment in order to achieve a goal.
Tool ecology ϕ	The science of the relationships between organisms, their tools and their environments.
Trust *	An individual who scores high in trust assumes that most people are fair, honest, and have good intentions. Low scoring individuals of the trust subscale may see others as selfish, devious, and potentially dangerous.

Use-enabler ϕ	A generic term for any protocols, software or system that enables the use of digital networked technology
Uses ^	Different ways in which digital networked technology can be used. Either in a new and creative way or as the technology was originally intended to be used.
Vulnerability *	High scorers of the vulnerability subscale experience panic, confusion, and helplessness when under pressure or stress. Low scorers feel more poised, confidant, and clear thinking when stressed.

*** = Definition sourced from the field of psychology. ^ Defined for this thesis.**
ϕ = Generic understanding of term applies. ∞ = Term sourced from another author.

2. Demographic Items - Not Part Of IPIP

Question	Options
Name	_____
Gender	M / F
In what year were you born?	_ _ _ _
Role in this company	_____
What is the highest educational qualification that you have?	
	Year 10
	Year 12
	College / TAFE
	University Graduate
	University Post Graduate
If you are currently studying is the objective to complete…	
	Not applicable
	Year 10
	Year 12
	College course, certification or diploma
	TAFE course, certification or diploma
	University Graduate
	University Post Graduate
In approximately what year did you begin using the internet?	_ _ _ _
What year did you begin working in IT?	_ _ _ _
How long have you worked for this company	_ _ years
Do you have mobile Internet connection?	Yes / No

3. The Big Five Factor Personality Test

Openness	http://ipip.ori.org/newBigFive5broadKey.htm	*10-item scale (Alpha = .84)*
+ keyed	Have a rich vocabulary.	
+ keyed	Have a vivid imagination.	
+ keyed	Have excellent ideas.	
+ keyed	Am quick to understand things.	
+ keyed	Use difficult words.	
+ keyed	Spend time reflecting on things.	
+ keyed	Am full of ideas.	
– keyed	Have difficulty understanding abstract ideas.	
– keyed	Am not interested in abstract ideas.	
– keyed	Do not have a good imagination.	

Conscientiousness	http://ipip.ori.org/newBigFive5broadKey.htm	*10-item scale (Alpha = .79)*
+ keyed	Am always prepared.	
+ keyed	Pay attention to details.	
+ keyed	Get chores done right away.	
+ keyed	Like order.	
+ keyed	Follow a schedule.	
+ keyed	Am exacting in my work.	
– keyed	Leave my belongings around.	
– keyed	Make a mess of things.	
– keyed	Often forget to put things back in their proper place.	
– keyed	Shirk my duties.	

Extraversion	http://ipip.ori.org/newBigFive5broadKey.htm	*10-item scale (Alpha = .87)*
+ keyed	Am the life of the party.	
+ keyed	Feel comfortable around people.	
+ keyed	Start conversations.	
+ keyed	Talk to a lot of different people at parties.	
+ keyed	Don't mind being the centre of attention.	

– keyed	Don't talk a lot.	
– keyed	Keep in the background.	
– keyed	Have little to say.	
– keyed	Don't like to draw attention to myself.	
– keyed	Am quiet around strangers.	
Agreeableness	**http://ipip.ori.org/newBigFive5broadKey.htm**	***10-item scale (Alpha = .82)***
+ keyed	Am interested in people.	
+ keyed	Sympathize with others' feelings.	
+ keyed	Have a soft heart.	
+ keyed	Take time out for others.	
+ keyed	Feel others' emotions.	
+ keyed	Make people feel at ease.	
– keyed	Am not really interested in others.	
– keyed	Insult people.	
– keyed	Am not interested in other people's problems.	
– keyed	Feel little concern for others.	
Neuroticism	**http://ipip.ori.org/newBigFive5broadKey.htm**	**10-item scale (Alpha = .86)**
+ keyed	Am relaxed most of the time.	
+ keyed	Seldom feel blue.	
– keyed	Get stressed out easily.	
– keyed	Worry about things.	
– keyed	Am easily disturbed.	
– keyed	Get upset easily.	
– keyed	Change my mood a lot.	
– keyed	Have frequent mood swings.	
– keyed	Get irritated easily.	
– keyed	Often feel blue.	

4. The REI Test For Decision Making Style

Experiential Ability	doi:10.1037/0022-3514.76.6.972	*Cronbach alpha ranging from 0.74 to 0.91
+ keyed	Using my "gut feelings" usually works well for me in figuring out problems in my life.	
+ keyed	I believe in trusting my hunches.	
+ keyed	I trust my initial feelings about people.	
+ keyed	When it comes to trusting people, I can usually rely on my gut feelings.	
+ keyed	I hardly ever go wrong when I listen to my deepest "gut feelings" to find an answer.	
+ keyed	I can usually feel when a person is right or wrong, even if I can't explain how I know.	
– keyed	I don't have a very good sense of intuition.	
– keyed	If I were to rely on my gut feelings, I would often make mistakes.	
– keyed	I suspect my hunches are inaccurate as often as they are accurate.	
– keyed	My snap judgments are probably not as good as most people's.	

Experiential Engagement	doi:10.1037/0022-3514.76.6.972	*Cronbach alpha ranging from 0.74 to 0.91
+ keyed	I like to rely on my intuitive impressions.	
+ keyed	Intuition can be a very useful way to solve problems.	
+ keyed	I often go by my instincts when deciding on a course of action.	
+ keyed	I tend to use my heart as a guide for my actions.	
+ keyed	I think there are times when one should rely on one's intuition.	
– keyed	I don't think it is a good idea to rely on one's intuition for important decisions.	
– keyed	I don't like situations in which I have to rely on intuition.	
– keyed	I think it is foolish to make important decisions based on feelings.	
– keyed	I generally don't depend on my feelings to help me make decisions.	
– keyed	I would not want to depend on anyone who described himself or herself as intuitive.	

Rational Ability	doi:10.1037/0022-3514.76.6.972	*Cronbach alpha ranging from 0.74 to 0.91
+ keyed	I have a logical mind.	
+ keyed	I am much better at figuring things out logically than most people.	
+ keyed	I have no problem in thinking things through clearly.	
+ keyed	I usually have clear, explainable reasons for my decisions.	
+ keyed	Using logic usually works well for me in figuring out problems in my life.	
– keyed	I am not very good at solving problems that require careful logical analysis.	
– keyed	I'm not that good at figuring out complicated problems.	
– keyed	Reasoning things out carefully is not one of my strong points.	
– keyed	I am not a very analytical thinker.	
– keyed	I don't reason well under pressure.	

Rational Engagement	doi:10.1037/0022-3514.76.6.972	*Cronbach alpha ranging from 0.74 to 0.91
+ keyed	I enjoy solving problems that require hard thinking.	
+ keyed	I enjoy intellectual challenges.	
+ keyed	I prefer complex to simple problems.	
+ keyed	I enjoy thinking in abstract terms.	
+ keyed	Learning new ways to think would be very appealing to me.	
– keyed	I don't like to have to do a lot of thinking.	
– keyed	I try to avoid situations that require thinking in depth about something.	
– keyed	Thinking hard and for a long time about something gives me little satisfaction.	
– keyed	Knowing the answer without having to understand the reasoning behind it is good enough for me.	
– keyed	Thinking is not my idea of an enjoyable activity.	

***Cronbach Alpha Reference:** McLaughlin, Jacqueline E., Cox, Wendy C., Williams, Charlene R., & Shepherd, Greene. (2014). Rational and Experiential Decision-Making Preferences of Third-Year Student Pharmacists. *American Journal of Pharmaceutical Education, 78*(6), 120. doi: 10.5688/ajpe786120

5. Four Additional Factors Selected From The International Personality Item Pool Thought To Be Relevant To Digital-Engagement

Trust	**http://ipip.ori.org/newNEOKey.htm#Trust**	***10-item scale (Alpha = .82)***
+ keyed	**Trust others.**	
+ keyed	**Believe that others have good intentions.**	
+ keyed	**Trust what people say.**	
+ keyed	**Believe that people are basically moral.**	
+ keyed	**Believe in human goodness.**	
+ keyed	**Think that all will be well.**	
– keyed	**Distrust people.**	
– keyed	**Suspect hidden motives in others.**	
– keyed	**Am wary of others.**	
– keyed	**Believe that people are essentially evil.**	

Flexibility	http://ipip.ori.org/newHEXACO_PI_key.htm#Flexibility	***10-item scale (Alpha = .73)***
+ keyed	**Adjust easily.**	
+ keyed	**Am good at taking advice.**	
- keyed	**When interacting with a group of people, am often bothered by at least one of them.**	
– keyed	**React strongly to criticism.**	
– keyed	**Get upset if others change the way that I have arranged things.**	
– keyed	**Am hard to convince.**	
– keyed	**Am annoyed by others' mistakes.**	
– keyed	**Can't stand being contradicted.**	
– keyed	**Am hard to satisfy.**	
– keyed	**Am hard to reason with.**	

Private Self-Consciousness	**http://ipip.ori.org/newPASKey.htm#Public-Self-Consciousness**	***10-item scale (Alpha = .81)***
+ keyed	**Am constantly reflecting about myself.**	
+ keyed	**Examine my motives constantly.**	
+ keyed	**Look for hidden meaning in things.**	
+ keyed	**Try to examine myself objectively.**	
+ keyed	**Spend time reflecting on things.**	
+ keyed	**Like to get lost in thought.**	
– keyed	**Don't try to figure myself out.**	
– keyed	**Rarely look for a deeper meaning in things.**	
– keyed	**Seldom daydream.**	
– keyed	**Seldom get lost in thought.**	

Self-Disclosure	**http://ipip.ori.org/newTCIKey.htm#Self-Disclosure**	***10-item scale (Alpha = .86)***
+ keyed	**Am open about my feelings.**	
+ keyed	**Am open about myself to others.**	
+ keyed	**Disclose my intimate thoughts.**	
+ keyed	**Show my feelings.**	
+ keyed	**Talk about my worries.**	
– keyed	**Don't talk a lot.**	
– keyed	**Reveal little about myself.**	
– keyed	**Bottle up my feelings.**	
– keyed	**Have little to say.**	
– keyed	**Say little.**	

6. NEO-PR-I test: 30 subscales of the Big Five Factors - total of 300 items

Factor	Subscale	Question (http://ipip.ori.org/newNEOKey.htm#Trust)	Key
Agreeableness	altruism	Have a good word for everyone.	+
Agreeableness	altruism	Make people feel welcome.	+
Agreeableness	altruism	Anticipate the needs of others.	+
Agreeableness	altruism	Love to help others.	+
Agreeableness	altruism	Am concerned about others.	+
Agreeableness	altruism	Look down on others.	–
Agreeableness	altruism	Am indifferent to the feelings of others.	–
Agreeableness	altruism	Make people feel uncomfortable.	–
Agreeableness	altruism	Turn my back on others.	–
Agreeableness	altruism	Take no time for others.	–
Agreeableness	cooperation	Am easy to satisfy.	+
Agreeableness	cooperation	Can't stand confrontations.	+
Agreeableness	cooperation	Hate to seem pushy.	+
Agreeableness	cooperation	Get back at others.	–
Agreeableness	cooperation	Have a sharp tongue.	–
Agreeableness	cooperation	Contradict others.	–
Agreeableness	cooperation	Love a good fight.	–
Agreeableness	cooperation	Yell at people.	–
Agreeableness	cooperation	Insult people.	–
Agreeableness	cooperation	Hold a grudge.	–
Agreeableness	modesty	Dislike being the centre of attention.	+
Agreeableness	modesty	Dislike talking about myself.	+
Agreeableness	modesty	Consider myself an average person.	+
Agreeableness	modesty	Seldom toot my own horn.	+
Agreeableness	modesty	Believe that I am better than others.	–
Agreeableness	modesty	Think highly of myself.	–
Agreeableness	modesty	Have a high opinion of myself.	–
Agreeableness	modesty	Know the answers to many questions.	–
Agreeableness	modesty	Boast about my virtues.	–
Agreeableness	modesty	Make myself the centre of attention.	–
Agreeableness	morality	Would never cheat on my taxes.	+
Agreeableness	morality	Stick to the rules.	+
Agreeableness	morality	Use flattery to get ahead.	–
Agreeableness	morality	Use others for my own ends.	–
Agreeableness	morality	Know how to get around the rules.	–
Agreeableness	morality	Cheat to get ahead.	–
Agreeableness	morality	Put people under pressure.	–
Agreeableness	morality	Pretend to be concerned for others.	–
Agreeableness	morality	Take advantage of others.	–
Agreeableness	morality	Obstruct others' plans.	–
Agreeableness	sympathy	Sympathize with the homeless.	+
Agreeableness	sympathy	Feel sympathy for those who are worse off than myself.	+
Agreeableness	sympathy	Value cooperation over competition.	+
Agreeableness	sympathy	Suffer from others' sorrows.	+
Agreeableness	sympathy	Am not interested in other people's problems.	–
Agreeableness	sympathy	Tend to dislike soft-hearted people.	–
Agreeableness	sympathy	Believe in an eye for an eye.	–
Agreeableness	sympathy	Try not to think about the needy.	–

Factor	Subscale	Question (http://ipip.ori.org/newNEOKey.htm#Trust)	Key
Agreeableness	sympathy	Believe people should fend for themselves	–
Agreeableness	sympathy	Can't stand weak people.	–
Agreeableness	trust	Trust others.	+

Agreeableness	trust	Believe that others have good intentions.	+
Agreeableness	trust	Trust what people say.	+
Agreeableness	trust	Believe that people are basically moral.	+
Agreeableness	trust	Believe in human goodness.	+
Agreeableness	trust	Think that all will be well.	+
Agreeableness	trust	Suspect hidden motives in others.	–
Agreeableness	trust	Distrust people.	–
Agreeableness	trust	Am wary of others.	–
Agreeableness	trust	Believe that people are essentially evil.	–
Conscientiousness	achievement-striving	Go straight for the goal.	+
Conscientiousness	achievement-striving	Work hard.	+
Conscientiousness	achievement-striving	Turn plans into actions.	+
Conscientiousness	achievement-striving	Plunge into tasks with all my heart.	+
Conscientiousness	achievement-striving	Do more than what's expected of me.	+
Conscientiousness	achievement-striving	Set high standards for myself and others.	+
Conscientiousness	achievement-striving	Demand quality.	+
Conscientiousness	achievement-striving	Do just enough work to get by.	–
Conscientiousness	achievement-striving	Am not highly motivated to succeed.	–
Conscientiousness	achievement-striving	Put little time and effort into my work.	–
Conscientiousness	cautiousness	Avoid mistakes.	+
Conscientiousness	cautiousness	Choose my words with care.	+
Conscientiousness	cautiousness	Stick to my chosen path.	+
Conscientiousness	cautiousness	Jump into things without thinking.	–
Conscientiousness	cautiousness	Make rash decisions.	–
Conscientiousness	cautiousness	Like to act on a whim.	–
Conscientiousness	cautiousness	Rush into things.	–
Conscientiousness	cautiousness	Do crazy things.	–
Conscientiousness	cautiousness	Act without thinking.	–
Conscientiousness	cautiousness	Often make last-minute plans.	–
Conscientiousness	dutifulness	Try to follow the rules.	+
Conscientiousness	dutifulness	Keep my promises.	+
Conscientiousness	dutifulness	Pay my bills on time.	+
Conscientiousness	dutifulness	Tell the truth.	+
Conscientiousness	dutifulness	Listen to my conscience.	+
Conscientiousness	dutifulness	Break rules.	–
Conscientiousness	dutifulness	Break my promises.	–
Conscientiousness	dutifulness	Get others to do my duties.	–
Conscientiousness	dutifulness	Do the opposite of what is asked.	–
Conscientiousness	dutifulness	Misrepresent the facts.	–
Conscientiousness	orderliness	Like order.	+
Conscientiousness	orderliness	Like to tidy up.	+
Conscientiousness	orderliness	Want everything to be "just right."	+
Conscientiousness	orderliness	Love order and regularity.	+
Conscientiousness	orderliness	Do things according to a plan.	+
Conscientiousness	orderliness	Often forget to put things back in their proper place.	–
Conscientiousness	orderliness	Leave a mess in my room.	–
Conscientiousness	orderliness	Leave my belongings around.	–
Conscientiousness	orderliness	Am not bothered by messy people.	–

Factor	Subscale	Question (http://ipip.ori.org/newNEOKey.htm#Trust)	Key
Conscientiousness	orderliness	Am not bothered by disorder.	–
Conscientiousness	self-discipline	Get chores done right away.	+
Conscientiousness	self-discipline	Am always prepared.	+
Conscientiousness	self-discipline	Carry out my plans.	+
Conscientiousness	self-discipline	Start tasks right away.	+
Conscientiousness	self-discipline	Get to work at once.	+
Conscientiousness	self-discipline	Find it difficult to get down to work.	–
Conscientiousness	self-discipline	Waste my time.	–

Conscientiousness	self-discipline	Need a push to get started.	–
Conscientiousness	self-discipline	Have difficulty starting tasks.	–
Conscientiousness	self-discipline	Postpone decisions.	–
Conscientiousness	self-efficacy	Complete tasks successfully.	+
Conscientiousness	self-efficacy	Excel in what I do.	+
Conscientiousness	self-efficacy	Handle tasks smoothly.	+
Conscientiousness	self-efficacy	Am sure of my ground.	+
Conscientiousness	self-efficacy	Come up with good solutions.	+
Conscientiousness	self-efficacy	Know how to get things done.	+
Conscientiousness	self-efficacy	Misjudge situations.	–
Conscientiousness	self-efficacy	Don't understand things.	–
Conscientiousness	self-efficacy	Have little to contribute.	–
Conscientiousness	self-efficacy	Don't see the consequences of things.	–
Extraversion	activity level	Am always busy.	+
Extraversion	activity level	Am always on the go.	+
Extraversion	activity level	Do a lot in my spare time.	+
Extraversion	activity level	Can manage many things at the same time.	+
Extraversion	activity level	React quickly.	+
Extraversion	activity level	Like to take it easy.	–
Extraversion	activity level	Like to take my time.	–
Extraversion	activity level	Like a leisurely lifestyle.	–
Extraversion	activity level	Let things proceed at their own pace.	–
Extraversion	activity level	React slowly.	–
Extraversion	assertiveness	Take charge.	+
Extraversion	assertiveness	Try to lead others.	+
Extraversion	assertiveness	Can talk others into doing things.	+
Extraversion	assertiveness	Seek to influence others.	+
Extraversion	assertiveness	Take control of things.	+
Extraversion	assertiveness	Keep in the background.	–
Extraversion	assertiveness	Have little to say.	–
Extraversion	assertiveness	Don't like to draw attention to myself.	–
Extraversion	assertiveness	Wait for others to lead the way.	–
Extraversion	assertiveness	Hold back my opinions.	–
Extraversion	cheerfulness	Radiate joy.	+
Extraversion	cheerfulness	Have a lot of fun.	+
Extraversion	cheerfulness	Express childlike joy.	+
Extraversion	cheerfulness	Laugh my way through life.	+
Extraversion	cheerfulness	Love life.	+
Extraversion	cheerfulness	Look at the bright side of life.	+
Extraversion	cheerfulness	Laugh aloud.	+
Extraversion	cheerfulness	Amuse my friends.	+
Extraversion	cheerfulness	Am not easily amused.	–
Extraversion	cheerfulness	Seldom joke around.	–

Factor	Subscale	Question (http://ipip.ori.org/newNEOKey.htm#Trust)	Key
Extraversion	excitement-seeking	Love excitement.	+
Extraversion	excitement-seeking	Seek adventure.	+
Extraversion	excitement-seeking	Love action.	+
Extraversion	excitement-seeking	Enjoy being part of a loud crowd.	+
Extraversion	excitement-seeking	Enjoy being reckless.	+
Extraversion	excitement-seeking	Act wild and crazy.	+
Extraversion	excitement-seeking	Willing to try anything once.	+
Extraversion	excitement-seeking	Seek danger.	+
Extraversion	excitement-seeking	Would never go hang gliding or bungee jumping.	–
Extraversion	excitement-seeking	Dislike loud music.	–
Extraversion	friendliness	Feel comfortable around people.	+
Extraversion	friendliness	Make friends easily.	+
Extraversion	friendliness	Warm up quickly to others.	+

Extraversion	friendliness	Act comfortably with others.	+
Extraversion	friendliness	Cheer people up.	+
Extraversion	friendliness	Am hard to get to know.	–
Extraversion	friendliness	Often feel uncomfortable around others.	–
Extraversion	friendliness	Avoid contacts with others.	–
Extraversion	friendliness	Am not really interested in others.	–
Extraversion	friendliness	Keep others at a distance.	–
Extraversion	gregariousness	Love large parties.	+
Extraversion	gregariousness	Talk to a lot of different people at parties.	+
Extraversion	gregariousness	Enjoy being part of a group.	+
Extraversion	gregariousness	Involve others in what I am doing.	+
Extraversion	gregariousness	Love surprise parties.	+
Extraversion	gregariousness	Prefer to be alone.	–
Extraversion	gregariousness	Want to be left alone.	–
Extraversion	gregariousness	Don't like crowded events.	–
Extraversion	gregariousness	Avoid crowds.	–
Extraversion	gregariousness	Seek quiet.	–
Neuroticism	anger	Get angry easily.	+
Neuroticism	anger	Get irritated easily.	+
Neuroticism	anger	Get upset easily.	+
Neuroticism	anger	Am often in a bad mood.	+
Neuroticism	anger	Lose my temper.	+
Neuroticism	anger	Rarely get irritated.	–
Neuroticism	anger	Seldom get mad.	–
Neuroticism	anger	Am not easily annoyed.	–
Neuroticism	anger	Keep my cool.	–
Neuroticism	anger	Rarely complain.	–
Neuroticism	anxiety	Worry about things.	+
Neuroticism	anxiety	Fear for the worst.	+
Neuroticism	anxiety	Am afraid of many things.	+
Neuroticism	anxiety	Get stressed out easily.	+
Neuroticism	anxiety	Get caught up in my problems.	+
Neuroticism	anxiety	Am not easily bothered by things.	–
Neuroticism	anxiety	Am relaxed most of the time.	–
Neuroticism	anxiety	Am not easily disturbed by events.	–
Neuroticism	anxiety	Don't worry about things that have already happened.	–
Neuroticism	anxiety	Adapt easily to new situations.	–
Neuroticism	depression	Dislike myself.	+

Factor	Subscale	Question (http://ipip.ori.org/newNEOKey.htm#Trust)	Key
Neuroticism	depression	Am often down in the dumps.	+
Neuroticism	depression	Have frequent mood swings.	+
Neuroticism	depression	Often feel blue.	+
Neuroticism	depression	Have a low opinion of myself.	+
Neuroticism	depression	Feel desperate.	+
Neuroticism	depression	Feel that my life lacks direction.	+
Neuroticism	depression	Feel comfortable with myself.	–
Neuroticism	depression	Am very pleased with myself.	–
Neuroticism	depression	Seldom feel blue.	–
Neuroticism	immoderation	Often eat too much.	+
Neuroticism	immoderation	Don't know why I do some of the things I do.	+
Neuroticism	immoderation	Do things I later regret.	+
Neuroticism	immoderation	Go on binges.	+
Neuroticism	immoderation	Love to eat.	+
Neuroticism	immoderation	Rarely overindulge.	–
Neuroticism	immoderation	Easily resist temptations.	–
Neuroticism	immoderation	Am able to control my cravings.	–
Neuroticism	immoderation	Never spend more than I can afford.	–

Neuroticism	immoderation	Never splurge.	–
Neuroticism	self-consciousness	Am easily intimidated.	+
Neuroticism	self-consciousness	Am afraid that I will do the wrong thing.	+
Neuroticism	self-consciousness	Find it difficult to approach others.	+
Neuroticism	self-consciousness	Am afraid to draw attention to myself.	+
Neuroticism	self-consciousness	Only feel comfortable with friends.	+
Neuroticism	self-consciousness	Stumble over my words.	+
Neuroticism	self-consciousness	Am not embarrassed easily.	–
Neuroticism	self-consciousness	Am comfortable in unfamiliar situations.	–
Neuroticism	self-consciousness	Am not bothered by difficult social situations.	–
Neuroticism	self-consciousness	Am able to stand up for myself.	–
Neuroticism	vulnerability	Panic easily.	+
Neuroticism	vulnerability	Become overwhelmed by events.	+
Neuroticism	vulnerability	Feel that I'm unable to deal with things.	+
Neuroticism	vulnerability	Can't make up my mind.	+
Neuroticism	vulnerability	Get overwhelmed by emotions.	+
Neuroticism	vulnerability	Remain calm under pressure.	–
Neuroticism	vulnerability	Can handle complex problems.	–
Neuroticism	vulnerability	Know how to cope.	–
Neuroticism	vulnerability	Readily overcome setbacks.	–
Neuroticism	vulnerability	Am calm even in tense situations.	–
Openness	adventurousness	Prefer variety to routine.	+
Openness	adventurousness	Like to visit new places.	+
Openness	adventurousness	Interested in many things.	+
Openness	adventurousness	Like to begin new things.	+
Openness	adventurousness	Prefer to stick with things that I know.	–
Openness	adventurousness	Dislike changes.	–
Openness	adventurousness	Don't like the idea of change.	–
Openness	adventurousness	Am a creature of habit.	–
Openness	adventurousness	Dislike new foods.	–
Openness	adventurousness	Am attached to conventional ways.	–
Openness	artistic interests	Believe in the importance of art.	+
Openness	artistic interests	Like music.	+

Factor	Subscale	Question (http://ipip.ori.org/newNEOKey.htm#Trust)	Key
Openness	artistic interests	See beauty in things that others might not notice.	+
Openness	artistic interests	Love flowers.	+
Openness	artistic interests	Enjoy the beauty of nature.	+
Openness	artistic interests	Do not like art.	–
Openness	artistic interests	Do not enjoy going to art museums.	–
Openness	artistic interests	Do not like poetry.	–
Openness	artistic interests	Do not like concerts.	–
Openness	artistic interests	Do not enjoy watching dance performances.	–
Openness	emotionality	Experience my emotions intensely.	+
Openness	emotionality	Feel others' emotions.	+
Openness	emotionality	Am passionate about causes.	+
Openness	emotionality	Enjoy examining myself and my life.	+
Openness	emotionality	Try to understand myself.	+
Openness	emotionality	Seldom get emotional.	–
Openness	emotionality	Am not easily affected by my emotions.	–
Openness	emotionality	Rarely notice my emotional reactions.	–
Openness	emotionality	Experience very few emotional highs and lows.	–
Openness	emotionality	Don't understand people who get emotional.	–
Openness	imagination	Have a vivid imagination.	+
Openness	imagination	Enjoy wild flights of fantasy.	+
Openness	imagination	Love to daydream.	+
Openness	imagination	Like to get lost in thought.	+
Openness	imagination	Indulge in my fantasies.	+

Openness	imagination	Spend time reflecting on things.	+
Openness	imagination	Seldom daydream.	–
Openness	imagination	Do not have a good imagination.	–
Openness	imagination	Seldom get lost in thought.	–
Openness	imagination	Have difficulty imagining things.	–
Openness	intellect	Like to solve complex problems.	+
Openness	intellect	Love to read challenging material.	+
Openness	intellect	Have a rich vocabulary.	+
Openness	intellect	Can handle a lot of information.	+
Openness	intellect	Enjoy thinking about things.	+
Openness	intellect	Am not interested in abstract ideas.	–
Openness	intellect	Avoid philosophical discussions.	–
Openness	intellect	Have difficulty understanding abstract ideas.	–
Openness	intellect	Am not interested in theoretical discussions.	–
Openness	intellect	Avoid difficult reading material.	–
Openness	liberalism	Tend to vote for less conservative political candidates.	+
Openness	liberalism	Believe that there is no absolute right or wrong.	+
Openness	liberalism	Believe that criminals should receive help rather than punishment.	+
Openness	liberalism	Tend to vote for conservative political candidates.	–
Openness	liberalism	Believe in one true religion.	–
Openness	liberalism	Believe that too much tax money goes to support artists.	–
Openness	liberalism	Believe laws should be strictly enforced.	–
Openness	liberalism	Believe that we coddle criminals too much.	–
Openness	liberalism	Believe that we should be tough on crime.	–
Openness	liberalism	Like to stand during the national anthem.	–

7. Survey 1 Raw Score Results For Participants

Name	Five Factor Model					Additional Factors				Decision Making			
	O	C	E	A	N	t	f	sc	sd	ea (ia)	ra (ra)	ee (ii)	re (ri)
Tim	49	25	21	44	23	31	38	49	27	24	37	23	47
Fay	43	35	19	47	23	42	32	50	41	47	48	46	39
Ben	41	38	30	39	38	41	32	33	31	34	45	33	36
Max	40	29	34	46	33	42	34	32	36	33	38	39	41
Sue	36	34	21	40	24	31	35	38	30	30	31	35	36
Ann	35	40	40	42	32	41	30	28	46	40	39	40	45
Tom	34	38	24	43	34	28	33	34	19	29	48	26	40
Roy	34	43	23	39	36	36	38	37	25	33	42	37	41
Dan	33	27	32	40	32	35	28	39	29	34	44	38	39
Kate	32	39	22	43	31	36	36	33	23	35	27	37	28
Bob	32	37	27	33	42	23	31	18	24	34	46	35	38
Sam	31	45	46	43	40	36	38	33	40	38	36	38	32
Con	31	40	26	39	21	40	29	31	26	36	36	41	40
Ivy	30	35	25	42	36	35	34	31	33	25	43	27	37
Joe	30	26	28	30	21	28	26	33	29	30	33	32	33
Eva	24	27	36	40	27	33	34	37	38	30	36	28	34

Key: **O-Openness C-Conscientiousness E-Extraversion A-Agreeableness N-Neuroticism t-Trust f-Flexibility sc-Self-consciousness sd-Self-disclosure ea (ia)-Experiential Ability (Intuitive Ability) ra (ra)-Rational Ability (Rational Ability) ee (ii)-Experiential Engagement (Intuitive Iterations) re (ri)-Rational Engagement (Rational Iterations)**

Note: **ea, ra, ee, and re** are the acronyms used by Pucini and Epstein
ia, ra, ii, and ri are the acronyms used in this thesis

8. Comparison between the 30 facet scales in Costa and McCrae's NEO Personality Inventory (NEO-PI-R) and the corresponding Preliminary IPIP Scales Measuring Similar Constructs

SCALE NAMES		*Number of Items*		*Mean Item Intercorrelation*		*Coefficient Alpha*		*Correlation*
IPIP	NEO	IPIP	NEO	IPIP	NEO	IPIP	NEO	IPIP vs. NEO
Neuroticism		+ -	+ -					
ANXIETY	Anxiety (N1)	5+5=10	4+4=8	0.32	0.37	0.83	0.83	.75 [.90]
ANGER	Angry Hostility (N2)	5+5=10	5+3=8	0.42	0.34	0.88	0.80	.76 [.91]
DEPRESSION	Depression (N3)	7+3=10	6+2=8	0.43	0.41	0.88	0.85	.80 [.92]
SELF-CONSCIOUSNESS	Self-Consciousness (N4)	6+4=10	5+3=8	0.28	0.26	0.80	0.74	.72 [.94]
IMMODERATION	Impulsiveness (N5)	5+5=10	4+4=8	0.25	0.24	0.77	0.72	.73 [.98]
VULNERABILITY	Vulnerability (N6)	5+5=10	3+5=8	0.32	0.35	0.82	0.79	.77 [.96]
Extraversion								
FRIENDLINESS	Warmth (E1)	5+5=10	6+2=8	0.41	0.33	0.87	0.80	.76 [.91]
GREGARIOUSNESS	Gregariousness (E2)	5+5=10	4+4=8	0.28	0.34	0.79	0.80	.78 [.98]
ASSERTIVENESS	Assertiveness (E3)	5+5=10	4+4=8	0.34	0.33	0.84	0.80	.81 [.99]
ACTIVITY LEVEL	Activity (E4)	5+5=10	5+3=8	0.19	0.25	0.71	0.72	.70 [.98]
EXCITEMENT-SEEKING	Excitement-Seeking (E5)	8+2=10	6+2=8	0.28	0.19	0.78	0.64	.67 [.95]
CHEERFULNESS	Positive Emotions (E6)	8+2=10	4+4=8	0.30	0.36	0.81	0.81	.77 [.95]
Openness to Experience								
IMAGINATION	Fantasy (O1)	6+4=10	3+5=8	0.32	0.35	0.83	0.82	.74 [.90]
ARTISTIC INTERESTS	Aesthetics (O2)	5+5=10	5+3=8	0.36	0.40	0.84	0.84	.80 [.95]
EMOTIONALITY	Feelings (O3)	5+5=10	5+3=8	0.29	0.28	0.81	0.75	.70 [.90]
ADVENTUROUSNESS	Actions (O4)	4+6=10	3+5=8	0.24	0.18	0.77	0.64	.71 [.99]
INTELLECT	Ideas (O5)	5+5=10	5+3=8	0.38	0.38	0.86	0.82	.80 [.95]
LIBERALISM	Values (O6)	3+7=10	3+5=8	0.38	0.30	0.86	0.78	.70 [.86]
Agreeableness								
TRUST	Trust (A1)	6+4=10	5+3=8	0.32	0.42	0.82	0.84	.79 [.95]
MORALITY	Straightforwardness (A2)	2+8=10	3+5=8	0.25	0.26	0.75	0.74	.64 [.86]
ALTRUISM	Altruism (A3)	5+5=10	5+3=8	0.25	0.26	0.77	0.72	.67 [.90]
COOPERATION	Compliance (A4)	3+7=10	3+5=8	0.22	0.26	0.73	0.73	.71 [.97]
MODESTY	Modesty (A5)	4+6=10	4+4=8	0.25	0.27	0.77	0.75	.72 [.95]
SYMPATHY	Tender-Mindedness (A6)	4+6=10	6+2=8	0.23	0.17	0.75	0.61	.61 [.90]
Conscientiousness								
SELF-EFFICACY	Competence (C1)	6+4=10	5+3=8	0.27	0.25	0.78	0.70	.66 [.89]
ORDERLINESS	Order (C2)	5+5=10	3+5=8	0.33	0.28	0.82	0.74	.77 [.99]
DUTIFULNESS	Dutifulness (C3)	5+5=10	6+2=8	0.20	0.23	0.71	0.67	.60 [.87]
ACHIEVEMENT-STRIVING	Achievement Striving (C4)	7+3=10	5+3=8	0.27	0.21	0.78	0.67	.70 [.97]
SELF-DISCIPLINE	Self-Discipline (C5)	5+5=10	4+4=8	0.36	0.34	0.85	0.80	.76 [.92]
CAUTIOUSNESS	Deliberation (C6)	3+7=10	5+3=8	0.24	0.23	0.76	0.70	.69 [.95]
	Mean Item	**5+5=10**	**4+4=8**	**0.30**	**0.29**	**0.80**	0.75	**.73 [.94]**

Note. [Values in brackets are correlations corrected for unreliability.]

Note. The numbers under the "+ -" heading indicate the number of positively and negatively items in the scale. So, for example, "5+3=8" indicates that there are 5 positively keyed items and 3 negatively keyed items, for 8 total items.

See http://ipip.ori.org/newNEO_FacetsTable.htm for current updates.

Note 2 At the time surveys were conducted for this research the above equivalency NEO-PR-I instrument was available on the IPIP website together with the above comparison table. However at the time of submission the conversion table URL was no longer available and as an explanation the following notification was found on URL http://www.personal.psu.edu/%7Ej5j/IPIP/ipipneo300.htm.

"The IPIP-NEO is **not** equivalent to the commercial inventory on which it is based, the NEO PI-R™, authored by Paul T. Costa, Jr. and Robert R. McCrae. The genuine NEO PI-R™ (240 items) is considered by many psychologists to be the best inventory for measuring traits within the Five Factor Model (FFM) of personality. The NEO PI-R™ is copyrighted by Psychological Assessment Resources (PAR) in Florida, and can only be ordered by professionals and used by permission. You can contact PAR at: 1-800-331-TEST, or http://www.parinc.com."

9. Artistic Interest Item-Questions

Factor	Subscale	Item-question	Keyed
Openness	artistic Interest	Believe in the importance of art.	+
Openness	artistic Interest	Like music.	+
Openness	artistic Interest	See beauty in things that others might not notice.	+
Openness	artistic Interest	Love flowers.	+
Openness	artistic Interest	Enjoy the beauty of nature.	+
Openness	artistic Interest	Do not like art.	–
Openness	artistic Interest	Do not enjoy going to art museums.	–
Openness	artistic Interest	Do not like poetry.	–
Openness	artistic Interest	Do not like concerts.	–
Openness	artistic Interest	Do not enjoy watching dance performances.	–

10. Intellect Item-Questions

Factor	Subscale	Item-question	Keyed
Openness	intellect	Like to solve complex problems.	+
Openness	intellect	Love to read challenging material.	+
Openness	intellect	Have a rich vocabulary.	+
Openness	intellect	Can handle a lot of information.	+
Openness	intellect	Enjoy thinking about things.	+
Openness	intellect	Am not interested in abstract ideas.	–
Openness	intellect	Avoid philosophical discussions.	–
Openness	intellect	Have difficulty understanding abstract ideas.	–
Openness	intellect	Am not interested in theoretical discussions.	–
Openness	intellect	Avoid difficult reading material.	–

11. Liberalism Item-Questions

Factor	Subscale	Item-question	Keyed
Openness	liberalism	Tend to vote for less conservative political candidates.	+
Openness	liberalism	Tend to vote for conservative political candidates.	–
Openness	liberalism	Believe in one true religion.	–
Openness	liberalism	Believe that too much tax money goes to support artists.	–
Openness	liberalism	Like to stand during the national anthem.	–
Openness	liberalism	Believe that there is no absolute right or wrong.	+
Openness	liberalism	Believe that criminals should receive help rather than punishment.+	
Openness	liberalism	Believe laws should be strictly enforced.	–
Openness	liberalism	Believe that we coddle criminals too much.	–
Openness	liberalism	Believe that we should be tough on crime.	–

✗ Questions that participants found inappropriate or difficult to answer in relation to digital-engagement.

Additional information related to the origin and validity of the IPIP scales can be found on the IPIP website. http://ipip.ori.org/

Of particular interest is; http://ipip.ori.org/newRationale.htm , which provides a rationale for developing these instruments, http://ipip.ori.org/HistoryOfTheIPIP.htm, which provides a history of the IPIP project development, http://ipip.ori.org/ReliabilityValidity.htm gives an account of the validity and reliability of instruments and finally a 2016 report on the instruments http://ipip.ori.org/ESCS_TechnicalReport_January2016.pdf

12. Questions For The First Interview

1) Have you had any thoughts about digital networks … about how you use them …or how you think about them?
2) When did you first started using digital networks … is what you do and think now different to when you first started using them?
3) Think about all the reasons that you might use the Internet, or similar networks – can you tell me some of those reasons?
4) Can you explain in what way you integrate digital networks into your life?
5) With regard to digital networks, if you have questions, issues or need information … who or what do you turn to for solutions?
6) Most people view themselves differently to the way others view them. With regard to digital networks ... Would you regard yourself as very involved or not … and why do you think this?
7) You have indicated that === is now a part of your everyday functionality, explain how and why this is. [=== *is something related to digital networks that they have talked about e.g. iPhone or Goggle*]
8) I'd like you to think about the last few weeks … what sort of things have you read or done online?
9) Finally do you think digital networks have improved your life and why?

13. Questions For The Second Interview

1) We make big and small decisions every day of our life. What role do you feel digital network technology plays in how we make these decisions and why do you think we use them?
2) The value of things varies as a result of environments or individual's needs. For example time is more valuable to a terminally ill person than to a teenager or … Can you think of ways in which you value things differently in the digital networked environment?
3) Some people feel that using digital networks changes a person. How do you feel about this?
4) In the real-world we are governed by clock or chronological time. In other words time goes in one direction and we cannot go back. Some people feel that in the digital world time is somehow different, that we respond to time differently. What do you think and can you give me some examples.

5) Think about a source of information or solutions that you use fairly regularly like a person or online service… How did you develop this trust relationship and what would cause it to change. [*known physical person, database resource, an unknown online identity*]

14. Questions For The Third Interview

1. From the interviews it appeases that the way in which humans are involved with digital network falls into three different perception categories. Most people are involved with all three categories to different degrees. Today I'd like to discuss all three perceptions of digital network to get more of your insights and opinions. I will start by reading the perceptions one at a time. After each one I'd like you to tell me if for you it is 1. Definitely not true. 2. Moderately not true. 3. Neither true nor not true. 4. Moderately true, 5. Very true. After that we will go back to each one and discuss it to get your opinions, insights and examples.
    a. Digital network technology is about communication, social interaction and entertainment. It is how people interact.
    b. Digital network technology is a massive reservoir of information for you to access and use. It is like a huge yellow pages with extra information.
    c. Digital network technology is a pool of ideas, thoughts, opinions and experience that you can just tap into to cross check and balance against your own life. It is a mass of human consciousness.
2. Is technology making you ask more questions?
3. Has digital network made you more flexible in your ideas?
4. Do you think digital network are a passive entity or are they something more. What are they?
5. Do you feel we run the risk of loosing control if we are not aware of and accept that technology changes us as it changes?
6. How often do you refine your search, Do you use Boolean queries to refine your search?
7. If information or someone is being ambiguous Does ambiguity bother you? Do you generally try to get clarification?
8. Do you think the use and growth of digital networked technology is due to convenience is there another factor.
9. Consider a client in Wollengong. Excluding travel costs ...if you go to a client site and you work on a problem of theirs for 6 hours do you charge the full 6 hours? Even if you had to wait for the IT person to say set up or fix a permissions issue which took an hour, then later you needed vital information from someone who was in a meeting and you had to wait another hour to get the information and finally they has to reboot the server which delayed you a further hour? So in total you had been sitting around waiting for three hours.

    Now consider you are working remotely and you have the same set of circumstances... do you charge the full 6 hours? Why?

    Finally... You are working remotely and we have the same scenario only while you are waiting for client 1, a second client calls you with an urgent problem which you fix but you have to wait 3 hours for a validation process to be completed before you can sign off on the fix. Then two other clients call with urgent problems each of which take less than half an hour to fix and you were able to do this while waiting for the first client. In other words the work you have done is...Client 1 – 6 hours, Client 2 – 3 hours and client 3&4 and additional hour. In total you have worked 10 hours. Do you charge for the full 10 hours? Why?

10. Would you be searching for information if was not that readily available?

11. Do you think that humans will evolve a way of coping with the clarity of digital memory – the way the past can be recalled out of context.
12. Are you less defensive and protective of your self in digital network?
13. As a child/teenager were you involved in decision making in the family.
14. How does Facebook differ from email

15. First Digital Analysis: Ten Themes - 128 Nodes

Behaviour, Core Concepts, Decision Making, Digital networked technology, Engagement, Feedback, Personality and demographics, Physical environment and Tool Use.

Level-1	Level-2	Description
1-Behavior		Relates to technology/human interactive behaviour
	Adaptation-technology	Indication of adaptation to technology
	Amplify	Technology is amplifying behaviours
	Builder-consumer	Do they use technology to build or consume
	Curios as Child	Were they curious as a child
	Diminish	Indicators of technology diminishing capabilities
	Relationships to tech	Individual's relationship to others - Human to human through tech & Human
	Trusted source	Trusted source is more important than it being human or technology
	Solution Human	Primarily turn to humans for solutions / relationship building
	Solution Technology	Primarily turn to technology for solutions / relationship building
2-Core Concepts		Core concepts that are different in the DNE
	Identity	Issues related to online identity
	knowledge-base	Affects of information base on the individual
	representation of self	How does the individual represent themselves in DNT
	self-centred	DNT alters the locus of self in social environments
	Locus-self	Awareness of locus of self within digital environment
	Memory	Issues related to online memory
	Space	Issues related to online space
	Time	Issues related to online time
	endless - 24-7	Aware of endless or timeless time in digital environment
	engrossed	Lose time due to engrossed behaviour
	fragmented	Aware of fragmented time in digital environment
	instantaneous	Aware of instantaneous time in digital environment
	metronome	Use of metronome to correlate real world and digital time
	micro-rewards	Lose time due to micro-reward behaviour
	non-linear	Aware of non-liner or web time in digital environment
	time-awareness	Aware that time behaves differently online
	Value-exchange	Issues related to online value exchange
	Accountability	People have to be accountable for a successful value exchange
	expectations	Conditioned expectations of value exchange
	Extern. Expectation	Others will respond much like me- treating me fairly.
	Intern. Expectations	Is approach that there is something to be gained and that it will be a beneficial experience
	perception evolution	See value exchange as simply and evolutionary process
	tangible vs. abstract	Sees differenced in digital and real world value exchanges
3-Decision Making		Process related to potential to act
	DNT-altered	How DNT has altered their decision-making processes
	Experiential-ability	Intuition ability - what you are innately born with
	Experiential-engagement	Intuition reliance - or as a result of repeated experience
	Influence-convenience	Convenience of DNT influences DM
	Integrated	Technology is integrated in the DM process
	preference-Human	Preference is human as a solution

Preference-technology	Preference is technology as a solution
Rational-ability	Logic ability - what you are innately born with
Rational-engagement	Logic reliance - or as a result of repeated experience
Role of DNT in DM	Indicators of the role of DNT in DM
4-Digital Networked technology	All things related to relationship with DNT
Access	The access to technology affects engagement
Appropriate	Indicators of appropriating technology for a benefit
Back-ups	Aware that DNT is fallible
Dynamic	Aware that DNT is dynamic
Integrated - involved	Deeply integrated into personal and work
Iterative	indicators of iterative nature of DNT
Network not Device	It is the network not the device that is important
Passive-accept	Indicators of passively accepting influence of DNT
Pre-DNT	Aware of pre networked technology
Resist	Indicators of resisting technology to their advantage
Something more	Aware that DNT is something more than simply a tool
Ubiquitous	Aware of ubiquitous nature of DNT
5-Engagement	Assorted types of awareness related to engaging with technology
Aware-Bad	Are they unaware of their relationship to the technology
Aware-Denial	Aware of DNT but in denial of intensity of their relationship with it
Aware-Good	Indicators of awareness of their relationship to DNT
Digital-footprint	Aware of their digital footprint
Duality	Awareness of the duality of environments
Embedded	See the embeddedness of DNT
Emotional-attachment	Have developed and emotional attachment to the technology
Exposure to technology	Were they exposed to technology at an early age
Familiar	Aware of and comfortable using a variety of things
Improved -life	Has technology improved their life
Intensity	Intensity of technology use
Isolation overcoming isolation	Engagement leads to isolation from real world or DN as a means of
Rhizomic nature	awareness of the necessity to be an activist to maintain presence
Unusual circumstances	Unusual influences affect technology use
6-Feedback	Indicators of a process
Adaptability	Indicators of adaptability
Confirmation-bias	Indicators of confirmation-bias
Leverage	Indicators of leveraging for an advantage
Loop	Indicators of the feedback loop
Opinion-gathering	Indicators of crowd sourcing
Opinion-sharing	Indicators of information sharing
Perception-bias	Indicators of perception bias
Reality-check	Use DN to validate decision making
Willingness	Indicators of processing incoming data against internal insights
7-Motivators	Reasons for engaging with technology
Activity deepened engagement	Activity on DN deepens the engagement
Basic functionality	Dependent on DN for basic functionality
Consumer	Participant is a consumer of technology not a creator
Entertainment	Use DN for entertainment - Any form from blogging to reading.
Existential	Are there important consequences for real world survival
Experience	Expand experiences - exposure to ne ideas and concepts
Family-friends distance	Retaining contact with family and friends who are NOT local
Had to Embrace	Did not embrace DNT voluntarily
Information	Seeking general information NOT work or Academic
Interest group	Seeking general information NOT work or Academic
Meaningful relationships	Motivated to develop relationships
Micro-rewards	Participant is motivated by micro rewards

No access	Illustrations of individuals who do not have exposure
Peer or Brand pressure	Motivation related to peer or brand pressure
Purchase	On-line shopping - fast-food or groceries
Study-academic	Motivated by academic reasons
Tech-exposure	Exposure to technology affects motivation.
Work	It is their livelihood
8-Personality & Demographics	
Age	Age related indicators
Agreeableness	As per psychology definition
Ambiguity	Are they driven to clarify ambiguity
Conscientiousness	As per psychology definition
Extraversion	As per psychology definition
Flexibility aspects	the ability to adapt to change, it encompasses a number of different
Neurosis	As per psychology definition
Openness	As per psychology definition
Self-consciousness own nature	Capacity to exercise introspection - willingness to learn more about their
Self-disclosure herself to another	Process of communication through which one person reveals himself or
Trust party	A measure of belief in the honesty, fairness, or benevolence of another
consistency	How consistency builds trust
false-information	How false information breaks trust
9-Real World	Specific to real world issues and examples
Perception-changing	Examples of perception altering, conditioning or training
Perception-NOT-changing	Examples of perception NOT altering, despite conditioning or training
10 -Tool	Digital Networked Technology as a tool
Accessible to others	Makes them accessible to others
Awareness inanimate object	Are they aware or in denial of their relationship with tech- is it more than an
Broadcast	See it as a tool for broadcasting
Cognition	Extends their cognition
Communication complex	Understand that DN are complex they are not simply a communication tool
Communication 121	Sees it as 121 communication
Communication 12m	Sees it as 12 many communication
Convenience-remote work	Uses are convenience or remote work
Embeddedness cognitive processing	How integrated is the technology in their everyday interactions and
Extend-ability	Aware that DN extend their ability
Familiarity the individual	familiarity with DNT has reduced awareness of its role and relationship to
Information	DN are an information gathering tool
Intensity is their use.	Frequency of technology use. Not how many but how frequent and in depth
Marketing	Focus is on the marketing potential of the DN - it's a Marketing tool
New behaviours	Indicators of new behaviours resulting from DN
Perception-ability have been altered	DN have changed their perception of basic things - mundane behaviours
Scope-potential	awareness of the potential of the tool to extend their capability
Synthesized	How the participant has enmeshed with DN

16. Second Digital Analysis: Twelve Themes - 108 Nodes

Intensity, Embeddedness, Consciousness, Openness, Adaptability, Willingness, Rational Applications, Experiential Application, Implementation, Existential-Motivation, Fulfilment-Motivation, and Gratification-Motivation.

Level-1	Level-2	Description
1-Intensity		
	Emotional-attachment	Have developed and emotional attachment to the technology
	Intensity use	Intensity of technology use
	Intensity frequency use.	Frequency of technology use. Not how many but how frequent and in depth is their
	Iterative	indicators of iterative nature of DNT
	Marketing	Focus is on the marketing potential of the DN - it's a Marketing tool
2-Embeddedness		
	Access	The access to technology affects engagement
	Embedded	See the embeddedness of DNT
	Familiar	Aware of and comfortable using a variety of things
	Integrated	Technology is integrated in the DM process
	Integrated / involved	Deeply integrated into personal and work
	Ubiquitous	Aware of ubiquitous nature of DNT
3-Consciousness		
	Back-ups	Aware that DNT is fallible
	Dynamic	Aware that DNT is dynamic
	Embeddedness management	Real-world technology integration, cognitive processing, relationship behaviour and
	endless - 24-7	Aware of endless or timeless time in digital environment
	Improved -life	Has technology improved their life
	instantaneous	Aware of instantaneous time in digital environment
	Isolation isolation	Engagement leads to isolation from real-world or DN as a means of overcoming
	Locus-self	Awareness of locus of self within digital environment
	Memory	Issues related to online memory
	Network not Device	It is the network not the device that is important
	non-linear	Aware of non-liner or web time in digital environment
	Passive-accept	Indicators of passively accepting influence of DNT
	Rhizomic nature	awareness of the necessity to be an activist to maintain presence
	Something more	Aware that DNT is something more than simply a tool
	Space	Issues related to online space
	Time	Issues related to online time
	time-awareness	Aware that time behaves differently online
4-Openness		
	Accessible to others	Makes them accessible to others
	Aware-Bad	Are they unaware of their relationship to the technology
	Aware-Denial	Aware of DNT but in denial of intensity of their relationship with it
	Aware-Good	Indicators of awareness of their relationship to DNT
	Awareness object	Are they aware or in denial of their relationship with tech- is it more than an inanimate
	Digital-footprint	Aware of their digital footprint
	Duality	Awareness of the duality of environments
	Influence-convenient	Convenience of DNT influences DM
	knowledge-base	Affects of information base on the individual
	Self-consciousness 5-Adaptability	Capacity to exercise introspection - willingness to learn more about their own nature

Adaptability	Indicators of adaptability
Appropriate	Indicators of appropriating technology for a benefit
Cognition	Extends their cognition
consistency	How consistency builds trust
DNT-altered	How DNT has altered their decision-making processes
Extend-ability	Aware that DN extend their ability
false-information	How false information breaks trust
Familiarity individual	familiarity with DNT has reduced awareness of its role and relationship to the
Flexibility	the ability to adapt to change, it encompasses a number of different aspects
New behaviours	Indicators of new behaviours resulting from DN
Perception-ability altered	DN have changed their perception of basic things - mundane behaviours have been
Pre-DNT	Aware of pre networked technology
Preference-tech	Preference is technology as a solution
representation of self	How does the individual represent themselves in DNT
Resist	Indicators of resisting technology to their advantage
Role of DNT in DM	Indicators of the role of DNT in DM
Scope-potential	awareness of the potential of the tool to extend their capability
Self-disclosure another.	Process of communication through which one person reveals himself or herself to
Trust	A measure of belief in the honesty, fairness, or benevolence of another party
6-Willingness	
Adaptation-tech	Indication of adaptation to technology
Ambiguity	Are they driven to clarify ambiguity
Amplify	Technology is amplifying behaviours
engrossed	Lose time due to engrossed behaviour
fragmented	Aware of fragmented time in digital environment
metronome	Use of metronome to correlate real world and digital time
micro-rewards	Looe time due to micro-reward behaviour
Percept-NOT-change	Examples of perception NOT altering, despite conditioning or training
perception evolution	See value exchange as simply and evolutionary process
Perception-changing	Examples of perception altering , conditioning or training
self-centred	DNT alters the locus of self in social environments
Synthesized	How the participant has enmeshed with DN
tangible vs. abstract	Sees differenced in digital and real world value exchanges
Willingness	Indicators of processing incoming data against internal insights
7- Rational Applications	
Confirmation-bias	Indicators of confirmation-bias
Curios as Child	Were they curious as a child
Experiential-ability	Intuition ability - what you are innately born with
Experiential-engage	Intuition reliance - or as a result of repeated experience
Leverage	Indicators of leveraging for an advantage
Rational-ability	Logic ability - what you are innately born with
Rational-engagement	Logic reliance - or as a result of repeated experience
8-Experiential Application	
Diminish	Indicators of technology diminishing capabilities
Loop	Indicators of the feedback loop
Opinion-gathering	Indicators of crowd sourcing
Opinion-sharing	Indicators of information sharing
Perception-bias	Indicators of perception bias
Reality-check	Use DN to validate decision making
Trusted source	Trusted source is more important than it being human or technology

9-Implementation		
	Builder-consumer	Do they use technology to build or consume
	Information	DN is an information gathering tool
10-Existential-Motivation		
	Basic functionality	Dependent on DN for basic functionality
	Existential	Are there important consequences for real world survival
	Had to Embrace	Did not embrace DNT voluntarily
	Internal Expectations experience	Approach it that there is something to be gained and that it will be a beneficial
	Unusual circum.	Unusual influences affect technology use
11-Fulfillment-Motivation		
	Consumer	Participant is a consumer of technology not a creator
	expectations	Conditioned expectations of value exchange
	Experience	Expand experiences - exposure to new ideas and concepts
	Family-friends dist.	Retaining contact with family and friends who an NOT local
	Information	Seeking general information NOT work or Academic
	Interest group	Seeking general information NOT work or Academic
	Meaningful relations	Motivated to develop relationships
	Purchase	On-line shopping - fast-food or groceries
	Relationships Hum to tech	Individual's relationship to others - All relationships hum to hum through tech and
	Study-academic	Motivated by academic reasons
	Tech-exposure	Exposure to technology affects motivation.
	Work	It is their livelihood
12-Gratification-Motivation		
	Activity deepens eng.	Activity on DN deepens the engagement
	Entertainment	Use DN for entertainment - Any form from blogging to reading.
	Micro-rewards	Participant is motivated by micro rewards
	Peer/Brand pressure	Motivation related to peer or brand pressure
The following were important and require more investigation		
?	Accountability	People have to be accountable for a successful value exchange
?	External Expectation	Others will respond much like me- treating me fairly.
?	Identity	Issues related to online identity
?	Preference-Human	Preference is human as a solution
?	Solution Human	Primarily turn to humans for solutions / relationship building
?	Solution Technology	Primarily turn to technology for solutions / relationship building
?	Value-exchange	Issues related to online value exchange
Moved	Broadcast	See it as a tool for broadcasting
Moved	Comm. complex	understand that DN are complex - they are not simply a communication tool
Moved	Communication 121	Sees it as 121 communication
Moved	Communication 12m	Sees it as 12 many communication
Moved	Conven.-remote work	Uses are convenience or remote work
The following Nodes were not important to digital-engagement at this stage		
Demog	Age	Age related indicators
Demog	Exposure to technology	Were they exposed to technology at an early age
Demog	No access	Illustrations of individuals who do not have exposure
Personality		Agreeableness
Personality		Conscientiousness
Personality		Extraversion
Personality		Neurosis
Personality		Openness

17. Third Digital Analysis: Digital Engagement Framework Five Sectors: Fifteen subsectors

Sector	Sub-sector	Description
1-Tool Use		Explores the enmeshed relationship between individual and technology
	11-Intensity	How intense is the individual's use of the technology. This does not necessarily mean how many times the individual uses digital technology in a specified timeframe but rather how in-depth the relationship is with the device/s they use.
	12-Embeddedness	How integrated is digital networked technology in the individuals' physical world interactions; cognitive processing, relationships, behaviours and self management.
	13-Awareness	How aware is the individual of their relationship with the technology. Are they aware of the relationship or in denial of it. Is their relationship with it more than one that they would have with a simple inanimate object?
2-Feedback		Explores the individuals relationship and use of incoming information
	21-Openness	Is the individual open to incoming information especially if it challenges their current mindset?
	22-Willingness	Will the individual process incoming information against their internal knowledge base: Consider confirmation bias, self-disclosure, self-reflection?
	23-Adaptability	Will the individual use processed information for behaviour modification?
3-Action		Explores individual's potential to act on processed information
	31-Internal Influencers	Is the individual responding to Internal influencing factors such as emotions and feelings, personality or background?
	32-External Influencers	Is the individual responding to External influencing factors such as environment, people or devices?
	33-Actionability	Once an individual has come to a conclusion will they actually do something about it?
4-Value Exchange		Mechanism developed to translate what they have to offer into what they want
	41-Internal Expectations	Explores the individual's internal expectations of anticipated exchanges within the digital networked environment, which tends to be modified by the autobiographical self and internal milieu.
	42-External Expectation	Explores the individual' external expectations of exchanges within the digital networked environment. These tend to be modified by external environmental experiences and conditions such as troll-aggression.
	43-Reciprocity	Explores the individual's overarching philosophy and expectation of social interactions or behaviours.
5-Motivation		The drive to get a benefit
	51-Existential-Motivation	Is the individual's motivation is driven by factors that will have important consequences to themselves or others?
	52-Fulfillment-Motivation	Is there is a tangible or acquisitive element to the individual's motivation that exists beyond the immediate engagement?
	53-Gratification-Motivation	Is the individual's motivation to provide temporary benefits or pleasures - its consequences are transient?

18. Compiled Statements That Typified The Fully, Partial And Least Engaged Participant

1.- TOOL USE	Explores the relationship between individual and technology
11 – Intensity	
Fully Engaged	Digital network is frequently used as a first point of reference, recognized as having wider benefits of relationships, useful for managing 'whole of life'. Creatively use the technology in new or different ways - sees the affordance properties and gets pleasure and satisfaction from the multiple levels.
Partially Engaged	Intensity of use may be largely from external factors. Will not easily see affordances beyond immediate technology offerings - it may be referred to as 'just as a tool'. May appear to derive little pleasure or satisfaction from interacting.
Least Engaged	Their frequency of use will be driven by external factors such as work, specific short term needs and sustained by technology such as micro rewards
12 – Embeddedness	
Fully Engaged	Will readily use technology in many or all areas of life with little resistance - they are synthesized with the technology. They easily see the potential of embedding it in their lives and enthusiastically embrace it. Will proactively managed the embeddedness to remain in control and continually review its use to make sure it is to their advantage.
Partially Engaged	Individual may be cynical or overly cautious about digital technology's value and dubious about their ability to control its effect on their lives. Individual may embed the technology in narrow areas of life or only when driven to it by outside demands. They show resistance to embedding technology in some areas of their lives.
Least Engaged	The individual uses technology when they are told to use it, if it is required to interact with others or if it is a logical extension of physical world activities such as online banking. The individual may not recognize their actual level of technology embeddedness in their lives and they are likely to dismiss digital networked technology as merely a continuation of existing traditional methods of functionality and development.
13 – Awareness	
Fully Engaged	The individual easily recognizes that digital networked technology involves complex and new human, machines and relationships in society. These individuals can see the need to proactively manage technology to gain value and prevent technology managing them. They are aware of the risks and limitations of the technology but can compensate for these. These individuals tend to underestimate their own level of awareness because they have embraced their engagement with technology.
Partially Engaged	These individuals recognize that there are new and complex relationships resulting from digital networked technology. They may be overconfident about their level of awareness and their ability to manage their digital-engagement. The awareness of individuals in this group may be limited to only some aspects of digital-engagement like tool utility, personal skills, obvious affordance, practical usefulness, time and memory. The skill level and proficiency of digital networked technology is not necessarily accompanied with or commensurate with awareness.
Least Engaged	These individuals will show a preference for traditional physical world methods of engagement such as face to face interactions. They may be aware of the impact of digital networked technology on society but tend to dismiss their reliance on it, the consequences of technology on society, or underestimate it's effect on them personally. They tend to feel like they are in control of the technology. Their awareness may be most intense when related to personal opportunities or real world activities.

2.- FEEDBACK	Explores the individuals relationship to and use of incoming information
21 – Openness	
Fully Engaged	The individually correctly recognizes they are open to new ideas and inputs and readily sees technology as providing real value to improving their decision making process. They actively use technology to source a range of different viewpoints and counter arguments. These individuals are open to inputs of multiple types that will modify their behaviours and compensate for the fact that these inputs may be biased or filtered such as algorithms. These individuals will exploit the opportunities that the duality of environment creates and will tend to be more proficient in the digital environment rather than in the physical environment.
Partially Engaged	These individuals may say they are open to new ideas and inputs but they will tend to use incoming information to confirm their existing ideas. They are willing to use facts and information for decision-making but less willing to use it to modify their behaviours. The individual may be aware that information filtering may affect their decision-making and will tend to show greater sensitivity to negative online behaviour.
Least Engaged	Individuals in this group believe that they have most of the answers or have the correct opinions. They tend to use additional information or inputs to compliment existing knowledge rather than for modification. They believe most 'right thinking people' will see things the same way they do. Any inputs that they are open to are often circumscribed by immediate physical world needs.
22 – Willingness	

Fully Engaged	The individual shows a willingness to take input that they will compare to their internal knowledge base and take action accordingly. They are proactive in seeking counter arguments and information despite the possibly of incoming information leading to discomfort or the inconvenience of changing their behaviours. These individuals can easily extrapolate consequences of an input to wider frame of reference and applications. They recognize that a willingness to participate is an essential driver of digital networked technology.
Partially Engaged	The individual will readily take incoming data and inputs but they are limited to specific areas of interest. These individuals resist or ignore ideas that make them feel uncomfortable and have difficulty citing personal examples of willingness to process input that resulted in actionable outcomes. They may be proficient in using technology but prefers a human option. They proactively minimize incoming information that challenges their preconceptions and they show little inclination to adjust behaviours.
Least Engaged	These individuals will use digital networked technology to gather data when they have a strong reason to do so for example; work needs, a lack of knowledge or to compensate for social vulnerability. They show an unwillingness to widen their focus of interest to beyond their immediate needs. These individuals show a greater reliance on their own past experience or opinions.
23 – Adaptability	
Fully Engaged	The individual will readily use processed information for behaviour modification. They review their own behaviours regularly to ensure behaviours are optimized. These individuals can cite complex examples of where they have recently changed their own behaviour. The individual shows an awareness of their synthesis with technology and tend to show different levels of proactive management of the technology. They display a capacity for self-evaluation and for adaption and an awareness that not everyone can adapt to technology as they have done.
Partially Engaged	The individual may change behaviours when prompted or compelled to by need. They may be able to cite cases of their own behaviour modification and how technology is changing them but they are less aware of the underlying process. These individuals may show adaptability but it tends to be driven by external factors. When giving examples of changes they have made they tend to report experiences in terms of physical environment behaviour changes. These individuals show sensitivity to negative online behaviours and may demonstrate advanced strategies for managing perceived negative consequences of digital-engagement.
Least Engaged	Individuals in this group show little or no consciousness of the underlying process of adaptation to digital networked technology despite evidence of technology being integrated in their lives. They refer to digital networked technology as 'just a tool' or 'just a device'. They may however acknowledge that the world is being changed by digital networked technology but they struggle to cite examples of their own changes. These individuals dismiss adaptation to the technology as they see it as merely an extension of physical environment evolution. They tend to believe that adaptation to technology is skill driven.

3.- ACTION	Explores individual's potential to act on processed information
31 - Internal Influencers	
Fully Engaged	The individual shows an awareness that external enteritis will impact on them, their action potential and their social interactions. They are aware that iterative interactions are potentially advantageous and show self-confidence in ability to see affordances within digital networked technologies. These individuals tend to be aware of the role of personality as an influencing factor on behaviours or attitudes.
Partially Engaged	These individuals may display an awareness of the role that factors such as personality, technology, social interaction have on other individuals potential to act but tend to show limited awareness of how it applies to their own action potential. They may deny their own attitudes that inhibit their action potential such as social interactions, trust, self-confidence and assertiveness. When evaluating data they will tend to validate against a trusted source, mostly from the physical environment, but they are aware of possible risks if using unfiltered online data.
Least Engaged	The individual will tend to show an overestimation of their ability to gather data and take action. They may be unaware of trust and personality issues that could limit their social interaction, self-confidence or willingness to take action. These individual may be capable of action in some areas but not able to translate their behaviours to other areas.
32 - External Influencers	
Fully Engaged	This person shows a deep awareness of the vast potential and complexities of digital networked technology as a data provider for individual decision-making. They may have external drivers that compel action and can show frequent examples of implementation. This individual will respond rapidly to input and uses iterations to their advantage. Technology offers them opportunities for taking better action, which they exploit: E.g. lower risk, multiple input types, and crowd sourcing intelligence.
Partially Engaged	Action potential is inhibited due to the individuals' reliance on external inputs such as technology. They may be limited by a narrow focus of external possibilities and may be aware that they are limiting or enhancing the quality of inputs for their own action. These individuals are aware that they may have to compensate for input being filtered by external entities.
Least Engaged	These individuals have limited awareness of the process of getting inputs and implementing action. They do not see this as an issue and tend to be happy with their current levels of external input.

33 – Actionability

Fully Engaged	Once it is clear the benefit outweighs the cost these individuals will take action. They can readily think of examples where they have implemented or abandoned digital networked technology when their needs demanded it. They will take unconventional or unusual action even if against mainstream decisions and they show a common sense grasp of the potential and pitfalls of both the physical and digital environments. These individuals try to be deliberate in their decision making process.
Partially Engaged	The individual may show readiness to take action but only within their comfort zone. These actions may result from rational or intuitive processes and the individual can readily cite examples. They may have trust issues but these are not insurmountable and they tend to show preference for human validation before taking action. Once decided, they less likely to revisit decisions.
Least Engaged	These individuals show a reluctance or hesitation to act decisively. They will allow doubts and insecurities to block their actions and may place emphasis on risks to justify inaction. They tend to act on external approval, incentive or instruction.

4. - VALUE EXCHANGE The mechanism that the individual has decided will translate what they have to offer into what they want.

41 - Internal Expectations

Fully Engaged	The individual shows a confidence in their own ability to utilize skills within the digital networked environment, present themselves and manage relationships that are advantageous to them. They expects monetary value of online items to be different and understands the complexities of the an emerging value exchange system (modularization, licensing, economy of scale). They are aware of the need for relationship building and will provide value to others to achieve this.
Partially Engaged	The individual believes they have the skills necessary to engage in beneficial value exchanges in the digital environment but may show signs of hesitation and a lack of awareness of the process. They may be aware of need for skills and behaviours but they do not necessarily feel the drive to provide value to others. These individuals may show signs that negative experiences impair their participation and display a tendency for wanting tangible items when high value involved. Because digital environment exchanges are so convenient they may think their own contribution is worth less to others.
Least Engaged	These individuals display insecurity or a lack of awareness of skills and behaviours necessary for value exchange in the digital environment. They see little personal value in online exchanges apart from work and tend to show no need to contribute because they put little value on intangible exchanges. These individuals show clear signs that personality behaviours are affecting their evaluation of digital exchanges.

42 - External Expectation

Fully Engaged	These individuals can recognize that there are new opportunities for beneficial relationships but that these require effort and skill to locate and interact with. They are aware that these opportunities require personal adjustment before value can be derived. They show awareness that the external environment will impact on values that can be exchanged and are aware that the social fabric is altering because of these changing values. They may be prone to trusting and assuming others will probably behave ethically and in good faith.
Partially Engaged	The individual shows some of the skills needed to deal with others online to derive a benefit but they may not show an awareness of the complexities and requirements for deepening these relationships. They tend to have difficulty identifying new forms of digital value exchanges. They may however show some recognition that people have different behaviour paradigms to themselves. Some negative experiences may have inhibited their development of trust online.
Least Engaged	These individuals show a strong preference to physical world exchanges and little appreciation of subtleties and complexities for the online environment. They tend to struggle reading digital technology cues but believe that no special skills or techniques are required to participate. They show little to no recognition that people have different online behaviours to themselves.

43 – Reciprocity

Fully Engaged	These individuals show an awareness that value exchanges within the digital networked environment is different. They may be aware that that these exchanges may require; activism, different forms of currency, modified behaviours and varied time frames and formats. These individuals appreciate that reciprocity online is complex but workable if understood and may be aware that digital networked technology can amplify negative behaviour and they will adjust their behaviour accordingly.
Partially Engaged	The individual shows some skills and understanding of reciprocity in the digital environment but may fear the loss of intellectual property through a potential of unbalanced reciprocity. These individuals tend to show awareness of need for reciprocity but they are likely to with hold reciprocity due to risk aversion, personality or other reasons. They may show a higher sensitivity to personal data being compromised in online exchanges.
Least Engaged	These individuals do not see online reciprocity as being any different to the physical environment. They see no difference in behaviours and do not see a need to reciprocate in the digital environment in order to get better outcomes. They do however tend to see more negatives factors in online exchanges.

5. - MOTIVATION The drive to get a benefit

51 - Existential-Motivation

Fully Engaged	These individuals can readily list where engagement solves core life issues. They show an intuitive affinity with the technology and it is embraced for its own affordance possibilities beyond any employment needs. They are aware that any loss of their technology devices or data would have a serious impact on their functionality and have taken appropriate precautions.
Partially Engaged	This individual is aware the digital networked technology helps their core life issues but they may not be aware of the full extent. They may display a passion for the technology in addition to their work needs. Loss of technology, data or disruption to their digital environment is highly stressful to them.
Least Engaged	These individuals tend to display frustration and antipathy to technology but engage with it due to overwhelming compulsion. Use of it is often the result of external factors other than any affinity for technology.
52 - Fulfilment-Motivation	
Fully Engaged	The individual is aware of deriving important social benefits and status from technology use. They enjoy the possibilities provided by the affordance properties of digital networked technology such as creative expression, visionary ideals or inspiration. They may be aware of complex biochemical consequences of technology interaction but do not understand it.
Partially Engaged	These individuals enjoy the pleasures of using the technology but may not be aware of how it contributes to their social and status needs.
Least Engaged	Motivation for these individuals is driven by their physical environment needs and does not go much beyond fulfilling these needs.
53 - Gratification-Motivation	
Fully Engaged	These individuals are aware of the complex bio-chemical consequences of engaging with digital networked technology but may not understand it.
Partially Engaged	These individuals tend to struggle with managing the consequences of the micro-reward system of the digital environment.
Least Engaged	These individuals tend to be managed by the micro-reward system and unaware of the process.

19. Summary of Correlation Results Using Four Different Methods of Examination

	Factors	Subscales	Spread	Excel	SPSS	External	Relationship Type	Classification of Confidence in Results
Big-Five Factor	Agreeableness		↑	↑	↑	↑	Strong Pos Indicator	Strong Confident and External Verification
	Openness		⇧	↑	↑	↑	Strong Pos Indicator	Strong Confident and External Verification
	Extraversion		↓	↓	↓	↓	Strong Neg Indicator	Strong Confident and External Verification
	Conscientiousness		⇧		↓	≈	Confounder	Confident and External Verification
	Neuroticism				⇧	≈	Moderator	Confident and External Verification
Decision Making	Intuitive Iterations		≈	↑			Pos Indicator	Confident No External Verification Requires More Research
	Intuitive Ability		≈	⇧	⇧		Moderate Pos Indicator	Confident No External Verification Requires More Research
	Rational Iterations			⇧			Moderator	Requires more research
	Rational Ability						Moderator	Requires more research
NOE-PR-I	Agreeableness	*altruism*	↑	↑	↑		Strong Pos Indicator	Confident
	Openness	*intellect*	↑	↑	↑		Strong Pos Indicator	Confident
	Extraversion	*excitement seeking*	↓	↓	↓		Neg Indicator	Confident
	Openness	*emotionality*	⇧	⇧	⇧		Pos Indicator	Confident
	Openness	*imagination*	⇧	⇧	↑		Pos Indicator	Confident
	Agreeableness	*modesty*	↓	↑	↑		Significant Moderator	Confident but requires associated information
	Extraversion	*friendliness*	↑	⇧	↓		Significant Moderator	Confident but requires associated information
	Neuroticism	*immoderation*	⇧	↑	↓		Significant Confounder	Confident but requires associated information
	Neuroticism	*anxiety*	↑	↓	⇧		Significant Confounder	Confident but requires associated information
	Conscientiousness	*dutifulness*	↑	⇧			Confounder	Moderately Confident but requires associated information
	Agreeableness	*cooperation*		⇧	↑		Confounder	Moderately Confident but requires associated information
	Agreeableness	*morality*	↑	↑			Moderator	Moderately Confident but requires associated information
	Conscientiousness	*self-discipline*	↓		↓		Moderator	Moderately Confident but requires associated information
	Extraversion	*cheerfulness*		⇧			Moderator	Moderately Confident but requires associated information
	Extraversion	*activity level*			↓		Moderator	Moderately Confident but requires associated information
	Conscientiousness	*cautiousness*		⇧	↑		Moderator	Not Confident requires more research
	Agreeableness	*sympathy*		⇧	⇧		Moderator	Not Confident requires more research
	Conscientiousness	*self efficacy*		⇧	⇧		Moderator	Not Confident requires more research
	Neuroticism	*self-consciousness*	⇧	⇧			Moderator	Not Confident requires more research
	Openness	*artistic interests*	⇧		⇧		Moderator	Not Confident requires more research
	Neuroticism	*vulnerability*	↓				Moderator	Not Confident requires more research
	Agreeableness	*trust*		↑			Confounder	Not Confident requires more research
	Neuroticism	*depression*		⇧			Confounder	Not Confident requires more research
	Neuroticism	*anger*			↓		Moderator	Not Confident requires more research
	Conscientiousness	*orderliness*			↓		Moderator	Not Confident requires more research
	Conscientiousness	*achievement-striving*					Confounder	Not Confident requires more research
	Extraversion	*assertiveness*			↓		Moderator	More related to physical environment
	Openness	*adventurousness*		⇧	↑		Confounder	More related to physical environment
	Extraversion	*gregariousness*		⇧	↓		Confounder	More related to physical environment
	Openness	*liberalism*	✕		⇧		n/a	Instrument inadequate

↑ Strong Positive Correlation ⇧ Moderate Positive Correlation ✕ Not included in Discussion
↓ Strong Negative Correlation ≈ Related to

Note: Sourcing third party studies that supported or challenged my research was successful only where the Big-Five Factors were involved. As a result the decision making and subscale sections in the table and discussion only show findings from within this research.

20. Full List of Concepts Extracted From the Interviews

Within each subsector the statements start with those that are more indicative of the fully engaged individual and ends with those that represent the least engaged. All statements have been extrapolated from comments made in the interviews. It was from these statements that the compiled statements in table 18 were made.

Tool Use

Intensity	
Fully Engaged	
	At an intense time when the person really needs an answer they will primarily turn to DN, it is their first option

	Aware that the new ways of interacting creates a depth and breadth of relationship that they can no longer do without – becomes essential to their behaviours.
	Easily see beyond the tool - object and recognise potential benefit that the tool affords.
	Their investment in the technology is not the device/brand but rather in the affordance.
	Aware it is used in multiple ways so is part of life management coping mechanism - entertainment, diversion, pressure release, human interaction, gaining information, validation and escape.
	Leave out moved to another area
	Know that they interact in the DE a number of times a day….in a number of ways.
	Intensely enjoys and explores numerous aspects of DT.
	Digital networked technology is used for most daily queries
	Can see benefit and limitations that the tool affords
	Know they interact with DN frequently but in limited ways e.g. just social media
	Enjoys and explores a range of DT at a deep level
	Used technology to sustain relationship - emotionally rewarding
	Tends to see as 'just a tool'
	I know what I like and don't like and what I am comfortable with
	Even though skilled and active has little enthusiasm - it's a tool to meet my needs
	Digital networked technology is simply a work tool - brings little pleasure
	Can see some uses like communication but not the whole breadth
	Has an intense dependency relationship with limited aspect of digital networked technology
	Interacts intensely that has resulted in a deep trust of digital networked technology but is to how this happened or to possible pitfalls.
	Used only if required usually for work or for entertainment-to relieve boredom
	Intensity if micro reward driven
Least Engaged	

Embeddedness

Fully Engaged	
	Will easily and comfortably reach out to DE when faced with a new challenge, with little resistance.
	Will reach out to the technology of DE to solve pressing life problems as first reaction.
	The use of DE is in many or most areas of life and enthusiastically embraced.
	Will very easily see the affordance in a device and what it offers.
	Embraces the connectedness and 'always on' as a positive to manage their lives.
	May be aware that at different times and in different areas of life they are more or less immersed.
	While deeply embedded, still exercises control and goes off line deliberately to gain other values.
	Shows willingness to integrate into routine family and personal tasks.
	DN is often the first choice of finding answers - often before turning to people.
	Uses it in different ways so that it has become integral to their daily activities
	I am so integrated with digital networked technology that I feel I cannot think clearly if the Internet is down
	Open to the use of DN in many areas of their life but has an antithesis to some
	Aware that they should exercise control to gain other values or reduce vulnerability
	Uses it in a number of ways in their daily activities
	May be embedded in many areas but sees little beyond the utility
	Is cynical about affordances but persuaded by social or peer pressure.
	Embrace connectedness and 'always on line' as long as it is mobile technology. ##Limited to smartphone and possibly iPad##
	Very aware that they are enmeshed with digital networked technology
	Can't go offline its social suicide
	May use DE but the solution is in the human being communicated with
	Very narrow areas of life
	Sometimes have problems seeing the affordance
	Reluctantly always connected - peer pressure
	Apart from its convenience and mobility, its not that special, its just another tool
	Reaches out to digital networked technology but as an add-on to real-world activities.
Least Engaged	

Awareness	
Fully Engaged	
	Aware that it is more than humans only,
	Awareness that the devices are more than simply communication - it is a complex
	Aware that this is giving humans a new or different concept or experience of the world.
	Aware that the media modifies the message - so same info by different media could give different experience.
	Aware that you manage technology and not be managed by it. Can place you more in control if used right.
	Aware if may be inferior communication but it is better than no communication.
	Awareness of digital footprint and how it can cause you harm if not managed
	May not be aware of their own level of engagement - self-evaluation may be unreliable.
	Aware of fragility of devices and taken steps to ensure they can be recovered.
	Aware of dichotomy of vision and reality and how it unfolds in society
	Awareness that the tool affords complex opportunities and efficiency means utilising the affordances.
	Aware that the tool needs a relationship with the human to increase it's affordance properties
	Aware that engagement is complex and not confined to skill, use, device or personality
	It is a medium through which complex human activity can take place
	Aware of the DN gives to users different values that they can exploit
	Although based on 0's and 's software tools are complex and may not easily translate/be useable in different cultures or languages
	Use or skill level of digital networked technology does not equate to understanding its potential and pitfalls
	Aware that DN is affecting human experience of Time and memory
	Aware but not concerned
	Understands competing interests in technology and the need to reconcile them
	You can‘t just use it off the shelf
	Use or skill level of digital networked technology does not equate to understanding its potential and pitfalls or duality of concepts
	Technology is not an end in itself but must serve my purposes.
	Initial awareness is that it is just a communication tool but may be a bit more sophisticated than previous forms
	Aware that the dynamic nature of DN creates new opportunities for them e.g. careers
	Real-world time constraints determine perception of web-time
	Use digital networked technology to enhance real-world circumstances
	It is difficult to communicate properly in the digital environment
	DN has not really change life much - we are all doing much the same thing
	It’s better face-to-face
	Blind to their relance on digital networked technology
Least Engaged	

Feedback

Openness	
Fully Engaged	
	Recognise in themselves that they are open to new uses, behaviours
	If aware of DN as Collective Human Consciousness, then change/lowers their resistance to ideas coming in from it
	Enjoys or is aware of the fact that the DN provides alternate ideas and opinions that you would not think of on your own.
	Recognises that being open to other inputs is strengthening their decision making process.
	Digital networked technology provides a range of information so I feel I am not thinking clearly if the Internet is down

	Aware that digital filtering could potentially reduce accessibility to information Open to the idea that concepts -time space memory value exchanges - are different in the digital networked environment and that this is impacting on their or societies behaviour.
	Can read negatives in digital networked technology but not that easily in humans
	Input incorporates but is not limited to crowd sourcing, data gathering and expert opinion.
	Recognises that technology is changing them but that they are not in control
	Aware of the critical role of filtering in the decision making process.
	Importantly affected by negative experiences
	Sourced information is used to confirm my ideas are correct.
	Relies of Google queries to source information
	Expect I already have most of the answers to things.
	Believe most people see things the same way I do
	Digital technology use is very driven by real-world inputs
Least Engaged	

Willingness	
Fully Engaged	
	Prepared to take incoming information and compare it to own needs and take action
	They see the value of using the collective consciousness as a useful measure against their internal knowledgebase/ value system
	Will actively seek out the counter arguments to my opinion as a way to strengthen my own decision-making.
	Once evaluated input and come to a conclusion will extrapolate possibilities for the wider community
	Intellectually aware of the process of taking information in for evaluation and actionable outcome but no strong indicators that they are actively doing that in their own life.
	Understands that it is a willingness to contribute that drives the digital environment.
	Prepared to take incoming information and test against other sources
	Willing to use technology even extensively but also wants a human option
	Prepared to take incoming information and test against other trusted sources - prefer human where possible
	Knows what they are looking for and uses limited sources
	Use their own experience or opinion as the measure
	Will seek information to counteract inadequacies
Least Engaged	

Adaptability	
Fully Engaged	
	Will apply new or different approaches and methods and recognises that in themselves.
	Can read a situation and extract lessons for behaviour modification
	Will creatively embrace and utilise the technology to enhance their capacity and capability.
	Easily recognises that the technology is altering them in many ways
	Will adapt technology in a creative way
	Those good at real-world interactions are usually not good in the DE because they are unaware of differences in the DE
	Negative experiences outweigh potential learning for behaviour modification
	Will actively utilise existing technology, sites or apps to enhance their capacity and capability.
	Recognises that technology is altering them but management of the technology is the solution. It's just a tool for human use.
	Will use crowd sourcing in a creative way
	Projects through digital networked technology for real-world interaction - it's a tool
	Sees more complex adaptation of humans to digital networked technology but will not easily relate it to self.
	Applies new or different approaches but not consciously.
	Needs practical verification
	Will use real-world solutions to monitor digital behaviour - metronome for time management
	Recognized that technology has altered them in some areas of life
	Will adapt technology in a creative way for a real world benefit - document trail
	Have importantly adapted and undergone major behavioural changes albeit unconscious
	Believes skills can be taught and that people do adapt.

	Technology is shaping behaviours
	Will rely on the technology to make up for any deficit in capacity
	Skills can be taught but not understanding
	Believes there is no difference between real-world and digital networked environment - it's just a matter of training
	Cannot read digital cues - can only read real-world cues
Least Engaged	

Action

Internal Influencers	
Fully Engaged	
	Shows an ability to recognize their own and others needs for checks and cross checks. +++solutions and define and clarify them+++
	Shows an ability to recognize the affordance offered by tools and to turn them into solutions for problems.
	Uses technology for societal and self reflection Personality factors unexpectedly have no impact on engagement
	Aware of the role and affect of digital networked technology on decision making or trust processes and how it impacts behaviours.
	Personality factors hinder self-evaluation in digital networked environment. e.g. online billing
	Will use digital networked technology to source info for DM and also validate against trusted sources
	Recognizes that they are susceptible to digital networked technology actively engaging with humans.
	Aware of the role and affect of digital networked technology on decision-making or trust processes but reluctant to relate it to self.
	Technology reduces emotional investment making it easier to deal with rather than real world
	Not readily aware of how much they use digital networked technology in their DM process
	May uses technology for self-reflection
	Personality factors impact on engagement
	Highly skilled at using digital networked technology to source information required for making informed decisions - may cross check against a variety of sources or other trusted people.
	Treats others the way as one wishes to be treated -reciprocity
	Believes they have sufficient knowledge for their needs
	No awareness
Least Engaged	

External Influencers	
Fully Engaged	
	Has exhibited external drivers that are so compelling or important that internal resistance such as personality are overcome.
	Technology has placed the pressure on you to get answers immediately so take action is everyday occurrence
	The immediacy of communication makes it more likely that action gets taken on the most recent input
	Technology is a safe environment for seeking answers
	The iterative nature of DT becomes an integral part of the DM for trust process.
	The media is not a single resource its range of information, opinions and diverse formats that provides a depth and breadth of knowledge for a comprehensive decision making process.
	The nature of DT provides opportunities for unique and often very specific opportunities for knowledge sourcing and sharing that is generally not possible in the real world due to time and space constraints.
	Digital networked technology is more than just providing information:, technology filters and re-contextualized the information on which we base our decisions
	Technology can easily end up managing human action and must therefor be actively managed
	Internal consistence from people and external consistency from technology builds trust
	It is the textual nature of digital networked technology that has resulted in a form of trust - the email becomes binding because it is a document. (This is another insight into how technology is used/appreciated)

	External drivers such as work technology structures are so fundamental that they cannot make decisions or function if technology is not operating. Uses specific technology for crowd sourcing in limited areas of their life
	Technology is quick and convenient in providing answers
	If not getting satisfaction from digital networked technology it is because the correct input has not been given.
	Believes technology has had no impact
	Only uses technology when prompted to do so by others
Least Engaged	

Action Ability	
Fully Engaged	
	Once it is clear the benefit outweighs the cost they will take action.
	Can think of examples where they have actually gone out and implemented a DN use to achieve some benefit
	Can think of examples where they have abandoned technology or made unconventional decisions because it meets their needs.
	Easily takes action once input has been processed and evaluated against internal values. Input incorporates but is not limited to crowd sourcing, data gathering and expert opinion.(see Openness)
	Aware that actionable outcomes are influenced by environment beit real world or digital.
	Use of digital networked technology always has a purpose - It is not done mindlessly.
	Once trust has been built through iterations...albeit simple... then it is given unquestioningly.
	Can think of examples where managing digital networked technology results in beneficial outcomes
	Understands trust processes online but has a preference for a human option as well - work through the technology not in it.
	Will readily take action once input is processed often based on intuition but supported by technology.
	Will readily trust socially validated institutions
	Can think of examples where technology is problematic to action
Least Engaged	

Value Exchange

Internal Expectations	
Fully Engaged	
	Understand that I have enough social skill in this media to let me reach out and connect with people.
	Awareness that sustaining relationships online needs certain behaviours and activism from yourself.
	I know that I can turn my DN experience into useful/valuable information and better decisions - so it is high value to me.
	What DN offers is more than just information; it is the dynamic contributions of other people with useful experiences.
	I have technical skills that I can use to provide value to others
	Expect commodities to be cheaper due to intangibility, lower overheads, subscription or modularization. It is a different environment with different rules.
	Aware that activist behaviour online can have real-world consequences
	Recognises that there is value to be had in crowd sourcing
	Personal convenience will affect evaluation of self worth in the DIGITAL ENGAGEMENT
	Negative experiences are hampering their synthesis with digital networked technology. They are aware of its potential but reticent.
	Awareness that sustaining relationships online needs certain behaviours and skills if rust is to be built.
	Despite having technical skill and knowledge there is no drive or compulsion to provide value to others
	Cost of commodity is not the issue it is its value to me. Will take digital for convenience but if valuable will choose tangible.
	Sees no need for technology in their life apart from work
	There is no need to contribute because the DE is free
	I have technical skills to get what I want
	I have the skills to get what I need and that is enough

	Personality or character is hampering their openness to value exchanges
	I can not relate…
Least Engaged	

External Expectations	
Fully Engaged	
	Aware that there are others who will constructively exchange with you but they need to be found - the connection must make some sense/ protocols need to be established.
	I can identify engagement levels of other people and interpret their behaviours to aligning with mine or not.
	Embraced that there are new opportunities for social interactions that have different rules, costs, punishments and benefits.
	Online it is far easier to find my peers and when interacting with them they can deliver great value. In the real world this is very hard.
	Other people will see a variety of affordances with the same devices as me, and this is to be expected and worked with
	External environments beit society or technology will impact of values exchanged
	DE is affecting the value of communication and that in turn affects society.
	Don't re-invent the wheel - someone has done this before - just search
	In their nature to be very trusting assumes others will behave ethically and reciprocate.
	Aware that despite an apparent understanding of the digital environment many people have limited understanding of different rules, costs, punishments and benefits.
	Can see a few value exchanges that digital networked technology has changed
	Has developed a sound understanding of trust in the digital environment despite negative personality or background experiences.
	It is real-world value exchanges that matter - not really aware that there could be others.
	I will participate but only on my terms and when it is to my advantage
	Does not understand subtleties of digital VE
	Cannot read or accept basic DT protocols such as smiley face
	I think everyone would be happy if social media just vanished
	I do it because everyone else does it I assume everyone uses it the same way I do
	I assume everyone is under the same pressure to conform to technology use that I am under.
Least Engaged	

Reciprocity	
Fully Engaged	
	Although social bonds are very tenuous, they are still workable and can yield results.
	If you are not working your node it will wither and die - activism.
	Doing things to annoy or irritate other people may have bad consequences, even if you can appear to 'get away with it'.
	Value exchanges are different in the digital networked environment
	Aware that someone has probably solved your problem and you just need to find them to get an answer (is this intensity?)
	Digital networked technology amplifies negative behaviours
	Will happily contribute if has something to share and that often you get more than you give
	Value exchanges are different working onsite or remotely - work onsite to solve dilemma
	Convenience and low cost of using digital networked technology aids reciprocity e.g. illness or crisis
	Understands that reciprocity does not mean loosing intellectual property.
	Loss of trust in DN is only if personal data abused
	Is a consumer of technology not a builder-contributor?
	There are bad people online
	Aware that reciprocity drives social interactions but reluctant to conform - its not them
	Can only see problems with DT - it is changing our values
	Self-control in DE is driven by REAL-WORLD values
	Will not readily contribute - believes there is no need for reciprocity
	Working remotely should be charged the same as onsite - there is no difference
Least Engaged	

Motivation

Existential	
Fully Engaged	
	Can easily think of a number of benefits from DN that touch core life issues - family, career, social, health etc.
	Have an affinity and enjoy digital networked technology that is independent of compulsion to engage.
	Work requires it and it is deployed usefully to great benefit
	Have created such a unique environment that the loss is stressful
	Work requirements of digital technology have encouraged and amplified use of technology
	Aware that digital networked technology has been extremely beneficial to core life issues
	Engagement has enhanced passion for use of technology
	Not necessarily aware that digital environment is compensating for important existential shortcomings
	Unaware that motivation was to maintain external relationship or approval
	Has antipathy and experience frustration but engages because of overwhelming compulsion.
	Fell into area and stayed there
Least Engaged	

Fulfilment	
Fully Engaged	
	Passion or interest in early years led to beneficial status, social or career outcomes
	Enjoys the creative, visionary, inspiring affordance provided
	Aware of the complex bio-chemical consequences of engaging with digital networked technology
	Explores the toys and entertainment potential of new devices early when they get them.
	If I require human contact then I will happily use the technology.
	Use it to enhance real-world circumstances
Least Engaged	

Gratification	
Fully Engaged	
	Aware of the complex bio-chemical consequences of engaging with digital networked technology
	Get a sense of satisfaction from information sourcing
	Gets drawn in by micro rewards
Least Engaged	

12 APPENDIX 2: SPSS Correlations

I decided that including an SPSS in my analysis process would be worthwhile because could possibly provide additional support of my results using Excel. Despite finding that this analysis did to some extent support my findings some differences in the two methods of analysis made it difficult to merge the findings. As the Excel analysis was done first and was more in depth that was retained in the body of the thesis and the SPSS has been included here as further support. The unanticipated problems that I encountered were firstly that the SPSS program is better suited to larger sample sizes and even using all my participants as one sample was considered as being too small for reliable results using the SPSS program. This also meant that I could not factor in the threshold hypothesis and split the group into even smaller groups as I did in chapter 8.1. As a result most of the correlations that were revealed in chapter 8 using Excel were masked in the SPSS results. To compensate for this instead of setting r > +/- 0.7 as a strong correlation, r > +/- 0.5 as a moderate correlation and r > +/- 0.3 as a weak correlation as I had in Excel, SPSS was set as r > +/- 0.5 was regarded as a strong correlation, r > +/- 0.3 as a moderate correlation and r > +/- 0.1 as a weak correlation. This allowed me to identify some consistent results between the two methods of analysis but made it confusing when displaying the two methods side by side. The final issue was that the SPSS program presented the first variable as the digital engagement variable and the second as the personality. In Excel this was reversed again making it confusing when displaying the two methods side by side in the body of the research.

12.1.1 Data Sets used in the SPSS Analysis

The same data sets discussed in the Excel correlation was used for the SPSS Statistical Analysis software. See chapter 8. An r > +/- 0.5 was regarded as a strong correlation, r > +/- 0.3 as a moderate correlation and r > +/- 0.1 as a weak correlation. The following is a summary of the results.

Variable Set 1 Engagement was the independent variable of this study and consisted of results obtained by evaluating participant's interviews according to my Digital Engagement Model. Results were presented as interval variables and broken down into five Sectors,

which together formed an overall engagement score. **Variable Set 2** was the dependent variable taken from the standardised Big-Five Factor Personality Assessments, which evaluated the Factors of: Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. **Variable Set 3** was from the Rational Experiential Inventory. (REI) **Variable Set 4** was the standardised NEO-PR-I Personality Inventory, which examined the Big-Five Factor at the subscale level.

12.1.2 Discussion of SPSS Factor Correlations

The table below shows the SPSS correlation summary of the digital engagement score to the Big-Five Factor, REI and four additional scales. It must be emphasized that the use of the SPSS analysis was simply to confirm or challenge *correlation trends discussed in chapter 8.* The actual correlation scores below cannot be directly compared to correlation scores discussed in chapter 8 but the strength of the correlation can. Further research using larger samples would be necessary to establish definitive correlations.

Summary: SPSS Correlations of Digital Engagement to Big-Five Factor and REI (Decision Making).

	Correlation	Factor	Interpretation
Big-Five Factor	0.304	Openness	Moderate Postive Correlation To Engagement
	0.12	Agreeableness	Weak Positive Correlation To Engagement
	-0.205	Extraversion	Weak Negative Correlation To Engagement
	-0.293	Conscientiousness	Weak Negative Correlation To Engagement
	-0.448	Neuroticism	Moderate Negative Correlation To Engagement
Decision Making	0.248	Rational Iterations	Weak Positive Correlation To Engagement
	0.123	Intuitive Iteration	Weak Positive Correlation To Engagement
	0.008	Rational Ability	No correlation
	-0.41	Intuitive Ability	Moderate Negative Correlation To Engagement

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

The fact that some correlations were found at all was very encouraging. In the Big-Five Factor the positive correlations (Openness and Agreeableness) and negative correlations (Extraversion and Neuroticism) were consistent with my earlier findings. The negative correlation in Conscientiousness was not anticipated but could be explained by the influence of Group B as discussed in chapter 8, which showed negative correlation in the Excel correlation analysis.

There were also correlations in the decision-making section but the addition of Group B to the analysis appeared to confound the results. For example Intuitive ability produced a strong positive in the Excel correlations for Group A (0.71) whereas the SPSS correlations using all participants produced a moderate negative correlation (-0.410).[195] What is important however is that there are some correlations. Further research using larger sample groups would provide more conclusive correlations.

Comparison of Excel Correlations to SPSS Correlations of Decision-Making.

Factors	Excel Correlations Group (A)	Excel Correlations Group (B)	SPSS Correlations Groups A & B
Intuitive Ability	0.71	0.02	-0.410
Intuitive Iteration	0.56	0.07	0.123
Rational Ability	0.56	0.28	0.008
Rational Iterations	0.33	0.29	0.248

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

Table 15 shows how the SPSS results make coherent sense with the Group A and B results.

12.1.3 Discussion of SPSS Subscale Correlations

As discussed in chapter 8 only 12 participants were available to completed the standardised NEO-PR-I Personality Inventory: Variable Set 4. The following is a summary of results.

[195] The actual value of the correlations from the two sources cannot be compared due to differences in the instruments used for analysis

Summary: SPSS Correlations of Digital Engagement to NEO-PR-I.

	Correlation	Factor	Subscale	Interpretation
(i)	.609	Openness	*intellect*	Strong Positive Correlation To Engagement
	.514	Neuroticism	*self-consciousness*	Strong Positive Correlation To Engagement
	.457	Openness	*adventurousness*	Strong Positive Correlation To Engagement
	.429	Openness	*imagination*	Strong Positive Correlation To Engagement
	.372	Conscientiousness	*cautiousness*	Strong Positive Correlation To Engagement
	.372	Agreeableness	*modesty*	Strong Positive Correlation To Engagement
	.354	Agreeableness	*cooperation*	Strong Positive Correlation To Engagement
	.342	Agreeableness	*altruism*	Strong Positive Correlation To Engagement
	.275	Openness	*emotionality*	Weak Positive Correlation To Engagement
	.257	Neuroticism	*anxiety*	Weak Positive Correlation To Engagement
	.240	Openness	*liberalism*	Weak Positive Correlation To Engagement
	.238	Agreeableness	*sympathy*	Weak Positive Correlation To Engagement
	.229	Conscientiousness	*self-efficacy*	Weak Positive Correlation To Engagement
	.174	Openness	*artistic interests*	Weak Positive Correlation To Engagement
	.105	Neuroticism	*depression*	No Correlation
	.048	Agreeableness	*trust*	No Correlation
	-.012	Agreeableness	*morality*	No Correlation
	-.038	Neuroticism	*vulnerability*	No Correlation
	-.099	Conscientiousness	*achievement-striving*	No Correlation
	-.143	Extraversion	*cheerfulness*	Weak Negative Correlation To Engagement
	-.169	Conscientiousness	*dutifulness*	Weak Negative Correlation To Engagement
(ii)	-.330	Extraversion	*activity level*	Strong Negative Correlation To Engagement
	-.341	Neuroticism	*anger*	Strong Negative Correlation To Engagement
	-.358	Extraversion	*excitement-seeking*	Strong Negative Correlation To Engagement
	-.429	Conscientiousness	*self-discipline*	Strong Negative Correlation To Engagement
	-.499	Neuroticism	*immoderation*	Strong Negative Correlation To Engagement
	-.567	Extraversion	*gregariousness*	Strong Negative Correlation To Engagement
	-.595	Conscientiousness	*orderliness*	Strong Negative Correlation To Engagement
	-.726	Extraversion	*friendliness*	Strong Negative Correlation To Engagement
	-.749	Extraversion	*assertiveness*	Strong Negative Correlation To Engagement

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

In this table the SPSS correlations show that *intellect, self-consciousness, adventurousness, imagination, cautiousness, modesty, cooperation* and *altruism* (see i) have a important positive correlation to digital-engagement. On the other hand *assertiveness, friendliness, orderliness, gregariousness, immoderation, self-discipline, excitement seeking, anger* and *activity level* (see ii) show a important negative correlation. This indicates that in the combined sample higher scores in subscales marked (i) and lower scores in those marked (ii) may show a propensity to digital engagement. The subscales indicated as having a weak positive or negative correlation are likely to be confounding or moderating personality traits with regard to digital engagement, they may serve to amplify or reduce digital-engagement behaviours. Table 16 below examining the SPSS correlations subscales by Factor provides more information.

SPSS Correlations of Subscales by Factor with Colour Coding

Openness	Agreeableness	Extraversion	Conscientiousness	Neuroticism
intellect	*modesty*	*cheerfulness*	*cautiousness*	*self-consciousness*
adventurousness	*cooperation*	*activity level*	*self-efficacy*	*anxiety*
imagination	*altruism*	*excitement-seeking*	*achievement-striving*	*depression*
emotionality	*sympathy*	*gregariousness*	*dutifulness*	*vulnerability*
liberalism	*trust*	*friendliness*	*self-discipline*	*anger*
artistic interests	*morality*	*assertiveness*	*orderliness*	*immoderation*

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

At this subscale level Openness was confirmed as being important having three strong and three moderate positive subscales. The strength of correlation shown at this level for Agreeableness and Extraversion was not evident in Table 13 above. The significance of Neuroticism at the Factor level appears to be overstated and Conscientiousness understated. I would argue that the relationship between personality and digital-engagement is best revealed at the subscale level. I also suggest that when using a diverse sample the Factor level can only provide a very broad propensity to digital-engagement, as the interplay of the individual's specific subscale profile will influence the complex relationship of digital-engagement. The Factor level could however still provide a useful *broad* classification of propensity to engage with digital networked technology.

12.1.4 Examining SPSS Correlations of Sectors

The following two tables show a comparison of the SPSS and Excel Correlation. It is evident in both tables that Openness, Neuroticism and Rational Ability and Iterations correlate to the Digital Engagement Model despite the masking influence of Group B in the excel correlations. Other correlations are not as clear although close examination of trends in the score[196] indicate that there are similarities.

[196] Actual scores cannot be compared due to differences in analysis methods.

Comparing SPSS Correlations to Excel Correlations at the Sector Level

	Excel Analysis Group A & B					SPSS Analysis				
Factors	Tool Use (A&B)	Feedback (A&B)	Action (A&B)	Value Exchange (A&B)	Motivation (A&B)	Tool Use (SPSS)	Feedback (SPSS)	Action (SPSS)	Value Exchange (SPSS)	Motivation (SPSS)
Openness	0.33	0.38	0.31	0.42	0.56	0.25	0.24	0.15	0.29	**0.43**
Conscientiousness	-0.18	-0.24	0.20	-0.24	-0.12	-0.27	-0.36	-0.05	-0.35	-0.27
Extraversion	-0.10	-0.16	-0.03	-0.26	-0.34	-0.10	-0.14	-0.03	-0.25	-0.36
Agreeableness	0.41	0.38	0.32	0.37	0.37	0.10	-0.02	-0.15	0.02	0.04
Neuroticism	-0.31	-0.40	-0.09	-0.40	-0.27	**-0.39**	**-0.49**	-0.27	-0.48	-0.43
Intuitive Ability	-0.06	0.03	0.46	-0.03	-0.02	-0.10	-0.07	-0.30	-0.10	-0.09
Intuitive Iteration	-0.02	0.07	0.33	0.04	0.03	-0.06	0.00	0.22	-0.02	-0.02
Rational Ability	0.19	0.25	0.44	0.20	0.29	0.10	0.10	0.21	0.09	0.12
Rational Iterations	0.29	0.49	0.14	0.45	0.41	0.19	**0.32**	-0.03	0.30	0.29

Strong Poitive *Moderate Poitive* *Moderate Negative* *Strong Negative*

In the SPSS table the Sector Motivation shows importantly strong correlations (0.43, -0.36 and -0.43). Feedback (-0.36 and -0.49) and Value Exchange (-0.35 and -0.48) also have strong correlations with Tool Use showing only one strong correlation (-0.39) and three moderate ones (0.25, -0.27 and -0.10). The fact that some reasonably strong correlations are evident in the SPSS analysis indicates that the Digital Engagement Model is effective in revealing a relationship between personality and engagement with the technology. The decision-making correlations in both tables also show similar trends. Action is positively correlated in both tables, as is Rational Iterations.

12.1.5 Conclusions of the SPSS Analysis

The purpose of the SPSS analysis was to simply see if any correlations could be found using both Groups A and B. Considering the masking affect of Group B that I had previously encountered my expectations at the outset were rather low. I was however pleasantly surprised with these results which showed not simply a few correlations but a important number of strong correlations. It must be restated I did not infer too much from actual scores. This analysis did however serve its purpose, which was to show that there are certainly correlations worthy of further investigation using larger random sample groups that would be more suited to SPSS software analysis.