School of Psychology

Internet Gaming Disorder:

Associated Cognitions, Measures and Clinical Utility.

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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.

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 2018. The proposed research study received human research ethics approval from the Curtin University Research Ethics, Approval Number RDHS-09-15-01.

Signature: …….

Date: 6/12/2019

Internet Gaming Disorder: Associated Cognitions, Measures and Clinical Utility.

Internet gaming disorder (IGD) was listed as a condition for further study in the Diagnostic and Statistical Manual for Mental Disorders (5th Edition; DSM-5; American Psychiatric Association, 2013). A similar disorder, gaming disorder, has since gained recognition as a listed disorder in the International Classification of Diseases (11th Edition; WHO, 2018). Measures of IGD developed before the release of the DSM-5 do not adequately address the new criteria or meet the reliability and validity requirements to be used as diagnostic measures of IGD. The main aim of my research program was to create a reliable and valid measure of the DSM-5 criteria for IGD, including a self-report and clinician-administered version. The second aim was to explore cognitions associated with IGD, and whether IGD explains unique variance in distress and or disability after accounting for symptoms of commonly co-occurring disorders.

Two studies were conducted to address these aims. The first study used a cross-sectional correlational design to develop and validate a self-report measure of IGD that assesses the DSM-5 criteria (Chapter 3), explore comorbidities (Chapter 4), and investigate cognitions associated with IGD (Chapter 5). A student sample (n =119) and a community sample (n = 285), sourced through a variety of online gaming forums, completed the online survey comprising the new measure, existing measures of internet gaming disorder, and a range of health and demographic questions. The second study (Chapter 6) aimed to compare the clinical utility of the self-administered version of the measure developed in the first study with a clinician-administered version of the measure. The second study used a within-groups design, comparing respondents' scores on a clinician-administered structured interview to scores on the self-report measure. The findings from the second study are reported in Chapter 6.

Chapter 3 and Chapter 4 present the initial development and validation of a new self-report measure derived from the proposed DSM-5 criteria for IGD, the Personal Internet Gaming Disorder Evaluation (PIE-9). The scale's reliability and validity were found to be acceptable using conventional testing methods. The PIE-9 was found to be unidimensional with high internal consistency (α =.89), and test-retest reliability (*ICC* =.77). Predictive validity was demonstrated by establishing those who met the criteria for IGD using the PIE-9 demonstrated significantly higher levels of distress and disability compared to those who did not. Similar gaming measures were used to demonstrate acceptable convergent validity. Preliminary testing of the PIE-9 demonstrated that it is an efficient and straightforward measure for use in further research of IGD. This chapter has been published in *Cyberpsychology, Behavior and Social Networking*.

Chapter 4 addresses the second aim of my research program, to assess whether IGD accounts for unique variance in distress and disability after controlling for commonly co-occurring mental health symptoms, such as anxiety and depressive symptoms, and disorders including attention deficit hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD). Participants who met IGD criteria using the PIE-9 showed higher comorbidities with other mental health disorders, compared to participants who did not meet IGD criteria. Anxiety and ADHD symptoms accounted for a smaller proportion of unique variance in disability than IGD, and depression accounted for a similar proportion to IGD. IGD explained a significant, but relatively small proportion of unique variance in distress compared to symptoms of comorbid disorders. The findings provide some evidence to support the inclusion of IGD as a separable disorder in future versions of the DSM-5, as IGD was associated with comparable levels of distress and disability as existing mental health disorders. This chapter has been published in *Cyberpsychology, Behavior and Social Networking*.

Chapter 5 addresses the research aim related to cognitions associated with IGD, to gain insight into the underlying cognitive mechanisms of the disorder. The study used bifactor modelling to investigate the relationship between gaming-related cognitions and IGD symptoms. The PIE-9 was used as a measure of IGD symptoms, and a modified, shorter version of the Problematic Gaming Cognitions Scale (PGCS) was used as a measure of gaming-related cognitions. Bifactor modelling indicated a general gaming cognitions factor was the strongest statistical predictor of IGD symptoms. Findings suggest that the frequency of gaming-related thoughts is a stronger statistical predictor of IGD symptoms than specific cognitions assessed by the PGCS. These findings are consistent with the DSM-5 IGD criterion of preoccupation with gaming.

Chapter 6 provides a comparison of the self-report version of the PIE-9 to a clinician-administered version of the PIE-9, named the Personal Internet Gaming Disorder Evaluation Interview (PIE-Interview). The interview version of the scale demonstrated similar scores to the self-report scale for each participant. The interview version demonstrated good specificity, which is useful for ensuring a very low false-positive rate, avoiding overdiagnosis. The PIE-Interview shows promise as a clinician-administered tool to assist in the diagnosis of IGD, using the current DSM-5 criteria.

In summary, this research program into internet gaming disorder has attempted to improve our understanding of IGD in several areas. I developed reliable and valid assessment tools (PIE-9 and PIE-Interview) that can be further developed and utilised in research and clinical settings. I demonstrated that after controlling for existing mental health conditions, IGD uniquely contributed to distress and disability. My novel application of bifactor modelling to analysing the relationship between cognitions associated with gaming and IGD symptoms supports the current preoccupation criterion in the DSM-5. In combination, my

research has demonstrated substantial evidence that IGD should be considered as a mental disorder.

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My lovely wife, Leah, thank you for supporting and putting up with me throughout the course of my PhD. You're the best, around! Nothing's gonna ever keep you down!

To my Dad, thank you for substituting 'hello' for 'have you finished your PhD yet?' every time we caught up over the past few years, the reminders were helpful, and probably kept me on track. You can stop asking me now.

To all my family and friends, thank you for your patience while I pressed pause on many aspects of my life while completing my PhD. I'm glad you're all still around to celebrate on the other side. Thank you for the good times along the way that helped cheer me on as I worked on something I wasn't sure was possible.

Dedication

To Mum, we miss you, and wish you were here.

Publications included as part of the thesis

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Pearcy, B.T.D., McEvoy, P.M., and Roberts, L.D. (2017). Internet Gaming Disorder Explains Unique Variance in Psychological Distress and Disability After Controlling for Comorbid Depression, OCD, ADHD, and Anxiety. *Cyberpsychology, Behavior, and Social Networking*, 20. doi: 10.1089/cyber.2016.0304

Statement of author contribution

All authors have validated the nature and extent of the intellectual input by the candidate and co-authors, and each of the signed below acknowledges that Benjamin T. D. Pearcy was primarily responsible for the work included in this thesis. Associate Professor Lynne D. Roberts and Professor Peter M. McEvoy provided supervision and editorial support under their roles as co-supervisors of Mr Pearcy's PhD.

Benjamin T.D. Pearcy	Lynne D. Roberts	Peter M. McEvoy
(Candidate)	(Supervisor)	(Co-Supervisor)

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Chapter 1: Literature review on the development of IGD, and an outline of this research program.

Videogames have been an enduring pastime for many over the past few decades, with indications that their popularity is only increasing over time (Brand, Todhunter, & Jervis, 2018). For many, videogames are an enjoyable hobby, that is part of everyday life (McQuade, Gentry, & Colt, 2012). However, for the few, videogames may be the cause of problems in other areas of life. The earliest known instance of a video game related death was recorded in 1982, where a young man died shortly after achieving a high score in an arcade game (Kiesling, 1982). The video game was not the cause in this case, however, it has piqued interest over the years about whether video games could be harmful. Every so often, a media article grabs our attention about how video games have caused someone to die from playing games excessively (Hunt, & Ng, 2015). In recognition of these extreme cases, and developing evidence of potential harmful effects of video games, the Diagnostic and Statistical Manual for Mental Disorders (5th Edition; American Psychiatric Association, 2013) has proposed internet gaming disorder (IGD; APA, 2013) may be a mental health disorder. This raises the question, is IGD a concern or are we pathologising a common pastime? I was curious about the answer to this question, which resulted in the design and implementation of the current research program.

This chapter provides a literature review of the topic of this thesis, IGD (APA, 2013). To understand IGD, one first needs to understand the context in which the proposed disorder has evolved. First, I provide a brief introduction to video games, noting the increasing evidence that, for specific individuals, internet gaming may be problematic and harm their health and well-being. The development of evidence that video games may cause harm has led to the proposed introduction of IGD in the DSM-5 (APA, 2013). Second, an explanation, history and evolution of the definition of addiction, behavioural additions including gambling

disorder, and internet addiction are discussed. Third, I provide a detailed description and explanation of IGD, including the proposed symptoms, to establish what our understanding of the disorder was at the inception of this research program. Finally, the objectives and scope of the current research program are described, followed by an overview of the chapters in the thesis.

A brief introduction to video games

Video games are a common pastime, whether that be on computers, mobile phones, or dedicated gaming consoles (McQuade, Gentry, & Colt, 2012). Sixty-seven percent of Australians report that they play video games regularly, with an average gameplay time of 89 minutes per day across all ages (Brand, Todhunter, & Jervis, 2018). Video games are interactive digital programs that involve reacting to stimuli on a screen using an input device such as a keyboard, mouse, touch screen, or dedicated gaming controller, often with the aim of the game to win through skill or chance (Bartle, 2004; Esposito, 2005; King, & Delfabbro, 2018; Salen, & Zimmerman, 2004). Video games may be an individual pursuit, or something played with others, often involving an online component. King, Delfabbro, and Griffiths (2010) provide a useful summary of the structural characteristics of video games, categorising features into social features, manipulation and control features, narrative and identity features, reward and punishment features, and presentation features. For example, a popular online computer game may allow players to communicate with other players through voice or text chat (social features). The player may control their in-game avatar through keyboard and mouse, or game controller input (control features). The player may have different quests or objectives which guide the player through the story of the game (narrative features). Players may also win or lose these quests as they progress, changing their avatar by either increasing in-game abilities or progress or retracting progress (reward or punishment features). All the above noted features are presented to the player through their monitor that

displays the online world with visual landscapes and music or other audio cues to rewards or punishment presented through speakers or their headset (presentation features). There are a variety of video games available to play. For example, Steam (Valve Corporation, 2019), a standalone PC software client through which you purchase and play games, has a huge library of over 33,690 games available for purchase (As of December 2019; Galyonkin, 2019). Seven thousand six hundred and fifty-nine (7659) of those games have been released on the Steam store in 2019 (Valve Corporation, 2019), according to analysis (Galyonkin, 2015-2019).

There are also a variety of types of video games, which include Massive Multiplayer Online Role-Playing Games (MMORPGs), First Person Shooters (FPS), Multiplayer Online Battle Arena (MOBA), and Real-Time Strategy (RTS) games, to name the most common types of games. As an example of a game type, MMORPGs involve controlling an avatar and moving around in a simulated world. The objective is often to complete different quests or objectives that involve exploring the world to earn experience points to further improve the skills and or level of the players' avatar. MMORPGs often have a long gameplay cycle that may vary from five minutes to hours, depending on the quest or objective of the content. FPS games involve the player taking on the view of an individual, where the aim of the game is usually to shoot computer-controlled or other human players using weaponry aligned to the theme of the game (e.g. science fiction, modern era, western) to gain points, usually against a similarly matched opposing team. FPS games tend to be fast-paced with short gameplay cycles of five to ten minutes.

Video games are a popular pastime, and may be played in order to have fun, pass the time, and to relax (Brand, Todhunter, & Jervis, 2018). However, there is increasing evidence that for certain individuals, it may be problematic (APA, 2013). In recognition of increasing evidence, internet gaming disorder (IGD) has been included in section three (areas for further

study) of the DSM-5 (APA, 2013). It would be helpful to chronologically discuss how our understanding of addictions, and more specifically behavioural addictions, developed and informed our current understanding of IGD.

Addiction – A review beyond substance-related disorders

Addiction has historically been associated with substance use disorders. The DSM-5 (APA, 2013) classifies substance use disorders by the type of substance to which an individual may become addicted (for example alcohol use disorder, or opioid use disorder). However, there are common overarching criteria related to substance use disorders. For an individual to be diagnosed with a substance use disorder, they need to meet two or more of the following eleven criteria within a twelve-month period:

> "(1) The individual may express a persistent desire to cut down or regulate substance use and may report multiple unsuccessful efforts to decrease or discontinue use.
>
> (2) The individual may spend a great deal of time obtaining the substance, use the substance, or recovering from its effects.
>
> (3) In some instances of more severe substance use disorders, virtually all the individual's daily activities revolve around the substance.
>
> (4) Craving. Is manifested by an intense desire or urge for the drug that may occur at any time but is more likely when in an environment where the drug previously was obtained or used.
>
> (5) Recurrent substance use may result in a failure to fulfil major role obligations at work, school, or home.
>
> (6) The individual may continue substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance.

(7) Important social, occupational, or recreational activities may be given up or reduced because of substance use.

(8) Recurrent substance use where it is physically hazardous.

(9) The individual may continue substance use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance.

(10) Tolerance is signalled by requiring a markedly increased dose of the substance to achieve the desired effect or a markedly reduced effect when the usual dose is consumed.

(11) Withdrawal is a syndrome that occurs when blood or tissue concentrations of the substance decline in an individual who had maintained prolonged heavy use of the substance."

(APA, 2013, p483-84)

The number of the above criteria endorsed determines the severity of the substance use disorder. For example, if two to three criteria are met the substance use disorder would likely be considered mild, for four to five criteria moderate, and six or more criteria would be considered severe (APA, 2013).

Researchers have noted similarities between excessive behaviours and substance-based addictions (Griffiths, 2005; Marsh, Dale, & O'Toole, 2013). Researchers argued that substance use disorders and behavioural addictions (for example, pathological gambling and sex addiction) share an underlying biopsychological process (Davis, 2001; Goodman, 2008; Griffiths, 2005; Potenza, 2006). This process may include behavioural, psychological and social components similar to substance additions, including withdrawal symptoms (including affect dysregulation), behavioural inhibition, salience or preoccupation, decreasing tolerance and therefore an increasing need to engage in the target activity, increased conflict and

relapse (Goodman, 2008; Griffiths, 2000; Griffiths, 2005; Marks, 1990; Young, 1996a). In response to developing literature at the time, the American Society of Addiction Medicine released a public policy statement on the 15th of August 2011, revising the definition of addiction to include behavioural addiction. The short definition has been provided below:

> Addiction is a primary, chronic disease of brain reward, motivation, memory and related circuitry. Dysfunction in these circuits leads to characteristic biological, psychological, social and spiritual manifestations. This is reflected in an individual pathologically pursuing reward and/or relief by substance use and other behaviours.
>
> Addiction is characterised by the inability to consistently abstain, impairment in behavioural control, craving, diminished recognition of significant problems with one's behaviours and interpersonal relationships, and a dysfunctional emotional response. Like other chronic diseases, addiction often involves cycles of relapse and remission. Without treatment or engagement in recovery activities, addiction is progressive and can result in disability or premature death. (American Society of Addiction Medicine, 2011, p.1)

Consistent with this, the American Psychiatric Association (APA, 2013) stated in the latest release of the DSM-5 that some behavioural addictions, such as gambling disorder, activate reward systems and behavioural symptoms similar to substance-related addictions, supporting research demonstrating that behavioural addictions may elicit similar biological responses to substance-related addictions through reward-seeking behaviour (Holden, 2001; Lejoyeux, McLoughlin, & Adès, 2000; Potenza et al., 2003; Reuter et al., 2005). Other behavioural addictions, such as internet gaming disorder, have been recognised by the APA as conditions for further study. Behavioural addictions noted by the APA such as sex addiction, exercise addiction and shopping addiction have been excluded from the DSM-5

due to a lack of peer-reviewed research to confirm diagnostic criteria and course descriptions to identify these addictions as mental disorders. The change in definition and inclusiveness of behavioural addictions can better be explained through discussing the development of an established behavioural addiction, gambling disorder.

Gambling disorder – An example of our understanding of behavioural addictions developing over time

Gambling disorder was first recognised in the 3rd edition of the DSM (APA, 1980) based on Dr Robert Custer's work on problematic gambling (Reilly, & Smith, 2013). The diagnostic criteria of pathological gambling included progressive loss of control, damage to personal and occupational aspects of the individual's life, and money related issues. Pathological Gambling was initially introduced to the DSM-III as an 'Impulse control disorder not elsewhere specified' (Albrecht, Kirschner, & Grüsser, 2007). Impulse control disorders often involve engagement in problematic behaviours despite the consequences (e.g. stealing in regard to kleptomania), diminished control over the problematic behaviour, and appetite or urge or craving for engaging in the problematic behaviour, and a hedonic quality experience during the performance of the problematic behaviour (Grant, & Potenza, 2004; Schreiber, Odlaug, & Grant, 2011)

The 4th edition of the DSM updated the criteria of gambling disorder to include criteria similar to substance use disorder, such as the second criterion "Repeated, unsuccessful efforts to control, cut back or stop gambling" and third criterion "A need to gamble with increasing amounts of money in order to achieve the desired level of excitement" (APA, 2000). Shaffer and Korn (2002) argued that gambling disorder presented differently to impulse control disorders such as kleptomania and pyromania in that pathological gamblers enjoy their gambling experiences and only feel distressed after the fact, whereas people with impulse control disorders feel relief after committing the impulsive act. Therefore, the rationale for

gambling disorder to be included as an addiction, rather than an impulse control disorder otherwise unspecified, strengthened with a diversion from impulse control disorders and an increasing likeness to addictions as research in the area developed (Holden, 2010).

The increasing recognition that gambling disorder is more similar to addictions, rather than impulse control disorders, leads us to the most recently published DSM-5 and the current state of gambling disorder. Petry et al. (2014a) provide a summary of the changes made in the DSM-5 and the rationale as to why the changes were made. In previous editions of the DSM, gambling disorder was referred to as pathological gambling. In the DSM-5, pathological gambling has been renamed gambling disorder as the term 'pathological' has since become out-dated and negative (Petry et al., 2014a). Gambling disorder has been moved from the impulse control disorders not elsewhere specified section of the DSM to the Substance-Related and Addictive Disorders section given increasing similarity between gambling disorder and substance-related disorders, including underlying genetic vulnerabilities (Black, Monahan, Temkit, & Shaw, 2006; Blanco, Myers, & Kendler, 2012) and similar biological markers (Blanco et al., 2012; Potenza et al., 2003; Reuter et al., 2005). In addition, the treatment approach for gambling disorder is more closely aligned to substance-related addictions than other psychological conditions (Marsh et al., 2013). The 'illegal acts' criterion has been removed in the DSM-5 due to this only occurring in extreme cases of the disorder, in conjunction with other criteria (Petry et al., 2014a). Removing the 'illegal acts' criterion improved the internal consistency of the single factor structure of gambling disorder (Petry, Blanco, Stinchfield, & Volberg, 2012) and lessened the assessment burden. The last change to gambling disorder involved a reduction in the number of required criteria to be met for a diagnosis. The criterion for a diagnosis has been reduced to four out of nine, instead of the previous five, to provide a more consistent diagnosis (Petry et al., 2012).

Internet addiction – A recent history in recognising a new behavioural addiction

It is essential to discuss research in internet addiction (also sometimes referred to as problematic internet use in the literature) over the past two decades to gain a better understanding of IGD. Kimberly Young (1996a) was a seminal researcher in defining and developing research on internet addiction, publishing client case studies and proposing diagnostic criteria. Young (1996a) proposed the following criteria, drawing from the pathological gambling criteria and her research at the time: withdrawal, tolerance, preoccupation, increased usage, loss of interest in other activities, and disregard for the consequences of continued excessive use of the internet.

Young developed two measures of internet addiction, the Diagnostic Questionnaire of Internet addiction and a 20-item Internet Addiction Test (IAT), each adapted from pathological gambling criteria (Young, 1996b, 1998). Young's work in the late 1990s demonstrates that the conceptualisation of internet addiction as a disorder began by utilising existing criteria associated with recognised behavioural addictions, such as pathological gambling.

Internet addiction has not been consistently defined in the literature (Kuss, Griffiths, Karila, & Billieux, 2013), with multiple authors describing characteristics similar to an impulse control disorder (as pathological gambling was previously classified) such as withdrawal symptoms (anger, tension or depression), excessive use, a lack of tolerance (need for better software and hardware) and negative repercussions (social isolation, lying, fatigue) (Block, 2008; Ko et al., 2009; Young, 1996b). The dimensions used to identify internet addiction are also inconsistent across measures. Some researchers draw on substance use disorder criteria, gambling disorder criteria, or impulse control disorder criteria (Aboujaoude, 2010). Researchers continue to devote attention to clarify inconsistencies in the evolving criteria for internet addiction, given the increasingly significant role the internet plays in society globally (Aboujaoude, 2010; Kuss et al., 2013; Shaw & Black, 2008).

Internet addiction literature details three key subtypes: excessive video gaming, sexual preoccupation, and e-mail or text messaging (Block, 2008). Of these subtypes, excessive video gaming has shown similarities to gambling disorder. For example, video games apply principles used in gambling to elicit continued play, such as the use of minimal rewards to train someone to continue with the given process. This process is known by behavioural psychologists as shaping, a type of reinforcement, initially developed by B.F. Skinner (McQuade, Gentry, & Colt, 2012). The use of minimal rewards to maintain play in gambling includes the use of the 'maximum bet' button in poker machines, amongst other strategies to maintain the players' engagement and excitement.

Games have evolved to include more complex reward or punishment features to maintain player engagement. Reward features may include in-game rewards for completing objectives within a specific time, meta-rewards such as achievement points on the console for completing difficult in-game tasks, rewards for remaining in the game by completing objectives that are only available at particular times of the day (in real-time), intermittent rewards or 'quick wins' to provide the player with a sense of achievement, near-miss mechanics to induce the player into continuing to play as they 'nearly won' (Griffiths, 1990), and some achievements or rewards for simply logging in to the game on a daily basis (King, Delfabbro, & Griffiths, 2010). In each case, rewards in video games are often immediate and allow the player to 'reinvest' their rewards back into the in-game systems immediately, perpetuating gameplay, similar to slot machine mechanics (Delfabbro, & Winefield, 1999). Punishment features may include the loss of in-game items, character levels or experience, and in-game progress towards a quest or game completion, or missing out on unique rewards for not participating in games on a particular day or time (King, Delfabbro, & Griffiths, 2010). Each of these mechanisms, including reward and punishment, typically encourage increased playing time in the games, which can then lead to other problems in life (McQuade,

Gentry, & Colt, 2012). McQuade et al. (2012) discuss the prevalence of deaths caused by internet gaming addiction, citing several individual cases in Hong Kong, Bangkok, and South Korea where death has occurred from extremely long hours of gameplay without regard for basic health needs such as hydration, drawing cause for concern.

Increasing literature on internet gaming, and parallels observed with gambling disorder symptoms, have resulted in internet gaming disorder (IGD) being included in the DSM-5 as an area warranting further study (O'Brien, 2010). The defining features and proposed diagnostic criteria for IGD have been defined in the section below. The inclusion of IGD contrasts with other sub-types of internet addiction (sexual pre-occupation and messaging), which have not been included in the DSM-5 due to insufficient peer-reviewed research (APA, 2013).

The terms used in the research area of IGD vary considerably and include gaming or internet use disorder, gaming or internet addiction, gaming or internet dependence and pathological or problematic gaming (Petry & O'Brien, 2013). For this dissertation, the term 'internet gaming disorder' (IGD) will be used as this is the term used in the DSM-5 (APA, 2013).

Internet gaming disorder – Recognising a new behavioural addiction

IGD is in the early stages of recognition as a disorder. The Substance Use Disorder Workgroup was tasked by the American Psychiatric Association to assess the data to determine whether IGD should be included in the DSM-5 as a condition for further study (Petry & O'Brien, 2013). While there has not been unanimous agreement towards the proposed definition and criteria of IGD (Griffiths, van Rooij, Kardefelt-Winther, et a., 2014), the definition has provided a clear set of criteria to debate and test for studies conducted after the DSM-5's release. Indeed, a problem with research investigating IGD before the DSM-5's release was that inconsistent criteria were used across different studies (King, Haagsma,

Delfabbro, Gradisar, & Griffiths, 2013), making comparisons between studies complicated, and potentially stifling progress in our understanding of the proposed disorder.

The seminal article used to develop the existing diagnostic criteria for IGD (Tao et al., 2009) proposed the following criteria: preoccupation, withdrawal (manifest as anxiety, irritability or boredom), tolerance, difficulty to control use, disregard for harmful consequences of excessive use, loss of social communications, alleviation of negative emotions and use of deception to hide usage. Tao et al. (2009) interviewed patients (n = 110, M = 17.9 age in years, initially then in a follow-up sample n = 408, M = 17.6 age in years) admitted to the Addiction Medicine Centre, General Hospital of Beijing against the proposed diagnostic criteria for internet addiction disorder. Tao et al. (2009) suggested a 2 + 1 diagnostic approach, where individuals who met the first two criteria, preoccupation and withdrawal, plus one of the other criteria, could be considered to have IGD. Tao et al. (2009) noted limitations to their study, in that the focus was predominantly on Chinese youth and that online gaming was socially acceptable and easily accessible in China. However, Tao et al. (2009) provided a strong foundation for further development of diagnostic criteria due to the rigorous approach to developing their criteria and results, stating high diagnostic accuracy (99.26%), specificity (100%) and positive predictive value (100%). However, Tao et al. (2009) acknowledged the weaknesses of their study, such as leniency on their cut-off scores by test administrators, resulting in potential over-representation of confirmed diagnoses and relying on psychiatrists' general clinical impressions of whether patients met the criteria proposed. Despite the shortcomings of Tao and colleagues' research, it gained the attention of the DSM-5 workgroup responsible for evaluating IGD research.

Commentary by O'Brien (2010) stated that Tao et al. (2009) provided a strong case for IGD to be included within the same section of the DSM-5 as gambling disorder, Substance-Related and Addictive Disorders. However, O'Brien (2010) noted that the level of evidence to

include a new diagnosis in the DSM is very high and that further research similar to Tao et al.'s (2009) study would be required before this would occur.

A unified approach to the definition and assessment of internet gaming disorder (IGD) had been called for by members of the DSM-5 Substance Use Disorder Workgroup and leading researchers in the area (Griffiths, King, & Demetrovics, 2014; King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Petry & O'Brien, 2013). Consensus on definition and assessment is crucial for IGD to be included in the substance use area of the DSM in future editions. The proposed definition and diagnostic criteria of IGD, as noted in the DSM-5, is as follows:

> Persistent and recurrent use of the internet to engage in games, often with other players, leading to clinically significant impairment or distress as indicated by five (or more) of the following in 12 months:
>
> 1. Preoccupation with internet games.
> 2. Withdrawal symptoms when internet gaming is taken away.
> 3. Tolerance – the need to spend increasing amounts of time engaged in internet games.
> 4. Unsuccessful attempts to control the participation in internet games.
> 5. Loss of interests in previous hobbies and entertainment as a result of, and with the exception of, internet games.
> 6. Continued excessive use of internet games despite knowledge of psychosocial problems.
> 7. Has deceived family members, therapists, or others regarding the amount of internet gaming.
> 8. Use of internet games to escape or relieve a negative mood.

9. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in internet games.

(APA, 2013, p. 795)

The diagnostic criteria proposed in the DSM-5 show some similarities to other behaviour-based addictions such as gambling disorder. Table 1.1 illustrates that several of the IGD criteria are similar to gambling disorder Criterion A, with only two criteria from gambling disorder not having a direct comparison (DSM-5).

Table 1.1. Internet gaming disorder criteria and compared to gambling disorder criteria group A

IGD Criteria	Gambling Disorder Criteria A
1. Preoccupation with internet games.	4. Is often preoccupied with gambling (e.g., having persistent thoughts of reliving past gambling experiences, handicapping or planning the next venture, thinking of ways to get money with which to gamble).
2. Withdrawal symptoms when internet gaming is taken away.	2. Is restless or irritable when attempting to cut down or stop gambling.
3. Tolerance – the need to spend increasing amounts of time engaged in internet games.	1. Needs to gamble with increasing amounts of money in order to achieve the desired excitement.
4. Unsuccessful attempts to control the participation in internet games.	3. Has made repeated unsuccessful efforts to control, cut back, or stop gambling.
5. Loss of interests in previous hobbies and entertainment as a result of, and with the exception of, internet games.	
6. Continued excessive use of internet games despite knowledge of psychosocial problems.	6. After losing money gambling, often returns another day to get even ("chasing" one's losses).
7. Has deceived family members, therapists, or others regarding the amount of internet gaming.	7. Lies to conceal the extent of involvement with gambling.
8. Use of internet games to escape or relieve a negative mood.	5. Often gambles when feeling distressed (e.g., helpless, guilty, anxious, depressed).
9. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in internet games.	8. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling.
-	9. Relies on others to provide money to relieve desperate financial situations caused by gambling.

Note. IGD = internet gaming disorder. Criteria B of gambling disorder = "The gambling behaviour is not better explained by a manic episode". (APA, 2013, p585).

While developing the DSM-5 diagnostic criteria for IGD, the workgroup stated "Despite an extensive literature, the workgroup concluded readily that no standard diagnostic criteria were applied across studies. Some used those similar to substance use disorder (SUD), pathological gambling and other criteria completely." (Petry & O'Brien, 2013, p. 1). The inclusion of the definition of IGD in the DSM-5 is welcomed, as it provides a consistent foundation for future research (King & Delfabbro, 2014).

It is important to demonstrate that IGD is separable from other clinical problems. In particular, the DSM-5 notes that IGD may be associated with major depressive disorder, attention deficit hyperactivity disorder (ADHD) and obsessive-compulsive disorder (OCD). Therefore, future research into IGD should consider including items that may indicate symptomology of ADHD, OCD and depression in order to consider differential diagnosis (King et al., 2013).

More recently, after the development of the current research project, the International Classification of Diseases (11th Edition; ICD-11; World Health Organization, 2018) included gaming disorder as part of their classification system. The ICD-11 defined gaming disorder as

> "…as a pattern of gaming behavior ("digital-gaming" or "video-gaming") characterized by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences. For gaming disorder to be diagnosed, the behaviour pattern must be of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning and would normally have been evident for at least 12 months." (Retrieved from: http://id.who.int/icd/entity/1448597234)

The inclusion of gaming disorder in the ICD-11 helps provide further recognition of the disruptive impact problematic gaming may have; however, there are fewer criteria in its definition compared to the proposed definition in the DSM-5 (APA, 2013). Further discussion and comparison between the DSM-5 and ICD-11 versions are provided in Chapter 7 General Discussion.

Measuring internet gaming disorder

King et al. (2013) conducted a systematic review of existing measures of 'pathological video gaming' and their ability to measure the then proposed criteria for IGD. They found that existing measures were brief, easy to score, and had good psychometric properties (including convergent validity and internal consistency), which will aid the development of standardised norms for adolescent populations. However, none of the existing measures covered all the proposed IGD criteria, in addition to other shortcoming described below.

One of the significant shortcomings across existing measures is the inconsistency of criteria measured. The Substance Use Disorder Workgroup determined that there were no standard diagnostic criteria applied across studies. Studies varied in the origin of their diagnostic criteria from pathological gambling, substance use disorder (SUD), or other criteria (Petry & O'Brien, 2013). Conceptually, most instruments were developed on established addiction criteria. However, very few demonstrated this in practice (Griffiths et al., 2014). A systematic review across 18 different measures found that no two measures provided the same conceptualisation of internet gaming or mapping of the diagnostic criteria for IGD (King et al., 2013). King et al.'s (2013) systematic review identified only two existing measures appearing to address the majority of the diagnostic criteria for the DSM-5 defined IGD: the Problematic Videogame Playing scale (PVP; Salguero & Moran, 2002) and the Gaming Addiction Scale (GAS; Lemmens, Valkenburg, & Peter 2009). An evaluation of each of these measures is provided below.

The PVP is a nine-item scale designed to measure the problems associated with addictive use of video games (Salguero & Moran, 2002). Despite appearing to cover the diagnostic criteria of IGD through each of its items, the PVP has several limitations. The response scale is limited to 'yes' or 'no', providing dichotomous data only, limiting the range of response for each question. The psychometric properties of the PVP have been inconsistent across studies. Internal consistency for the PVP was marginal ($\alpha = 0.69$) in the original development study by Salguero and Moran (2002), although a number of follow up studies report improved Cronbach's alpha scores ranging from .74 to .91 without modifying the response scale (King et al., 2013), providing evidence of acceptable internal consistency for research purposes (above .70; DeVellis, 2003), but below the standard required for clinical use (above .90; DeVellis, 2003). Salguero and Moran (2002) reported the scale as unidimensional based on a principal components analysis with a first factor explaining 39.1% of variance, below the 40% recommended level of variance (Carmines & Zeller, 1979), although the 40% cut-off is also debated due to a variety of analytical approaches (Hattie, 1985). Construct validity was tested by comparing the PVP with measures of excessive video gameplay. In the scale development study, the PVP total score was positively correlated with the frequency ($r_s = 0.64$) and duration ($r_s = 0.52$) of video gameplay (Salguero & Moran, 2002), although this has not been replicated in later studies (Hart et al., 2009).

Research has indicated that the duration of video gameplay does not distinguish between problematic and non-problematic video gameplay (Lemmens et al., 2009). PVP cut-off scores for differentiating recreational gaming from problematic gaming behaviour have varied between authors. Hart et al. (2009) proposed a cut-off score of four or more endorsed items as being indicative of problematic gaming behaviour, while Sun, Ma, Bao, Chen, and Zhang (2008) and Collins, Freeman, and Chamarro-Premuzic (2012) proposed a cut-off of five or more endorsed items. The variation in proposed cut-off scores and variable internal

consistency limits the clinical utility of the PVP, despite items appearing to address the DSM-5 criteria for IGD.

The Gaming Addiction Scale (GAS) was developed by Lemmens et al. (2009) to measure computer and video game addiction. The GAS is available in two versions, 21-item and 7-item. Both versions have acceptable internal consistency with Cronbach's alphas ranging between .92 - .94 and .81 - .86, respectively, across two student samples in the Netherlands (Lemmens et al., 2009). Lemmens et al. (2009) demonstrated acceptable model fit for a single higher-order factor, accounting for the majority of variance in the seven first-order factors of gaming addiction: salience, tolerance, mood modification, relapse, withdrawal, conflict, and problems. Concurrent validity was established through comparing the 21-item and 7-item GAS scores respectively with time spent gaming (r = .583, r = .576), life satisfaction (r = -.308, r = -.290), loneliness (r = .337, r = .314), social competence (r = -.194, r = -.176), and aggression (r = .257, r = .265) (Lemmens et al., 2009). The GAS has been tested primarily in student samples including high school students in the Netherlands (Lemmens et al., 2009), and university students in the United Kingdom (Mehroof & Griffiths, 2010). However, the GAS is limited as a measure of IGD as it does not address all of the IGD criteria, missing the criteria related to deception, and loss of interest in other activities (Criterion 5, and 7, APA, 2013, see Table 1.1).

There are several other shortcomings of existing measures related to their validity and factor structure. A lack of evidence using clinical samples was an apparent shortcoming in establishing the validity of existing measures (King et al., 2013), and cut-off scores to indicate clinical severity were inconsistent (Griffiths et al., 2014; Petry & O'Brien, 2013). King et al. (2013) further commented that the dimensionality of measures overall was either untested or inconsistent and that there were inadequate data on predictive validity and inter-rater reliability.

Another shortcoming of existing measures is the limited questions regarding gaming-related cognitions. Whether gaming behaviour is problematic or not may be influenced by the cognitions associated with gaming behaviour (King & Delfabbro, 2014). Only one of the diagnostic criteria for IGD considers the cognitions associated with gaming, the preoccupation criterion. King and Delfabbro (2014) suggest that this criterion needs to be expanded, as preoccupation does not distinguish between problematic and non-problematic behaviour associated with internet gaming. To gain further insight into internet-gaming-specific cognitions, King and Delfabbro (2014) conducted a systematic review of the literature. As an outcome of this review, four key categories of cognitions associated with online gaming were identified: beliefs about in-game rewards, maladaptive and inflexible rules about gaming, gaming-based self-esteem, and gaming as a means of gaining social acceptance. Several illustrative client statements were provided to demonstrate examples of each of these categories. Future measures of IGD would benefit from integrating or specifically measuring gaming-based cognitions to help differentiate between problematic and non-problematic gaming behaviour, and to inform treatment planning.

The variation in measures and classifications in the area increase the difficulty of providing reliable information associated with the prevalence, course, biomarkers, and treatment associated with IGD (Petry and O'Brien, 2013). A meta-analysis of prevalence rates for pathological gaming across 33 studies revealed an overall prevalence rate of 6% (Ferguson, Coulson, & Barnett, 2011). However, it was acknowledged that this figure might be inflated due to a lack of consistency in measuring pathological gaming across studies.

The focus of my research

In summary, with the inclusion of IGD in section III of the DSM-5, researchers at the time had called for consistency in future research, enabled using the proposed DSM-5 diagnostic criteria (APA, 2013; King et al., 2013; Petry & O'Brien, 2013). At the time of the

inception of this research program (2014), shortly after the release of the DSM-5, there was a lack of consistency in diagnostic criteria across existing IGD measures. Further, many of these problematic gaming measures had had not been evaluated in clinical samples (King et al., 2013). Neither of the two best measures identified by King et al. (2013; PVP and GAS) were suitable for use as a self-report measure of IGD as defined by the DSM-5. Future research needed to avoid the limitations of the PVP and GAS by developing a new measure using the DSM-5 definition and testing reliability and validity using more widely accepted methods. Both the CONSORT guidelines (Plint et al., 2006), and the COSMIN checklist (Mokkink et al., 2010), provide methods to test newly developed measures. Each of these guidelines provides the required information to assess whether a measure could be considered useful in clinical settings.

Importantly, in 2014 there was limited research into whether existing measures are appropriate for clinical use (King et al., 2013). The rationale for my PhD research was that our understanding of IGD would be significantly enhanced by the development of a new measure with self- and clinician-administered versions that directly assess the DSM-5 criteria, determining whether existing measures are assessing the same constructs, and determining whether IGD is distinct from depression, anxiety, ADHD, and OCD.

In addition, further exploration of the cognitions associated with problematic gaming would help further our understanding of the symptomology of IGD to assist practitioners in (a) differentiating problematic from non-problematic gaming behaviour and (b) treatment planning and outcome assessment. The proposed research project will use the illustrative client statements proposed by King & Delfabbro (2014) that represent gaming-related cognitions, to explore the relationship between the cognitions and the diagnostic criteria and evaluate whether they can provide further insight into problematic and non-problematic gaming behaviour.

In consideration for the above noted gaps in the existing literature on IGD, my research program aimed to address the following research objectives:

Research objectives

The specific objectives of my research are:

1. To develop and conduct preliminary psychometric testing on a new self-report measure for internet Gaming disorder, utilising using the existing DSM-5 criteria.
2. To compare the reliability and validity of existing self-report diagnostic measures to the newly developed diagnostic measures with respect to their ability to measure internet Gaming disorder, as defined by the DSM-5.
3. To compare the level of distress and disability between IGD symptoms and DSM-5 anxiety, depressive, and attention disorder symptoms.
4. To evaluate evidence that internet Gaming disorder is distinct from existing disorders and symptoms.
5. To use the illustrative client statements discussed by King and Delfabbro (2014) to create a measure of internet gaming cognitions that distinguishes between those with and without internet Gaming disorder.
6. Conduct a pilot study of a clinician-administered version of the PIE-9 developed in Study 1, continuing to adhere to the DSM-5 criteria.

The current research studies. Over the past five years, I have been investigating IGD to help improve our understanding of the disorder. More specifically, the two-study research program of my PhD has addressed important gaps in the IGD literature. The broad aim of the first study was to develop and validate a new measure (self-administered version) of IGD named the Problematic Internet Gaming Disorder Evaluation (PIE-9) that assessed all the proposed criteria of IGD as defined by the DSM-5 (APA, 2013). Additionally, the first study aimed to develop the Problematic Gaming Cognitions Scale (PGCS) using the cognitive

illustrative client statements (King & Delfabbro, 2014) and examine the measure's usefulness in distinguishing between those with or without problematic gaming behaviour. The broad aim of the second study was to develop a clinician-administered interview for IGD, using the established self-administered measure of IGD as the basis of development and comparison.

The thesis has been structured to include the current introductory chapter, a methodology chapter (Chapter 2), four chapters covering discrete objectives in the format of journal articles (Chapters 3 to 6), followed by an overall discussion chapter (Chapter 7). The following methodology chapter provides an outline and justification of the methodological decisions made across the research program. The next four chapters after the methodology chapter are written in the style of individual research articles, and detail the research conducted to address each of the objectives (Noted above, and in Table 1.2). Chapter 3 and 4 are published papers (Respectively; Pearcy, Roberts, & McEvoy, 2016; Pearcy, McEvoy, & Roberts, 2017), and the format follows a logical flow across the research program with each of the chapters structured in a similar format. An update on the literature since the inception of this research program, a summary of the objectives and how they were addressed, and the implications and future directions of the research program are discussed in the final chapter of this research program.

Table 1.2. Overview of each study, the chapters included in each study, and the objectives addressed by each chapter

Study	Chapter in this Thesis	Objective(s) addressed by the chapter
Study 1. Development and validation of a new measure of internet gaming disorder (PIE-9)	**Chapter 3**. Psychometric testing of the PIE-9: A new measure designed to assess internet gaming disorder	**Objective 1**. To develop and conduct preliminary psychometric testing on a new self-report measure for internet gaming disorder, using the existing DSM-5 criteria. **Objective 2**. To compare the reliability and validity of existing self-report diagnostic measures with respect to their ability to measure internet gaming disorder, as defined by the DSM-5. **Objective 3**. To compare the level of distress and disability between IGD symptoms and DSM-5 anxiety, depressive, and attention disorder symptoms.
	Chapter 4. Internet gaming disorder explains unique variance in psychological distress and disability after controlling for comorbid depression, OCD, ADHD and anxiety.	**Objective 4**. To evaluate evidence that internet gaming disorder is distinct from existing disorders and symptoms.
	Chapter 5. Internet gaming disorder Cognitions: A brief measure assessing thoughts associated with problematic gaming	**Objective 5**. To use the illustrative client statements discussed by King and Delfabbro (2014) to create a measure, of internet gaming cognitions that distinguishes between those with and without internet gaming disorder.
Study 2. Develop a clinician-administered interview for internet gaming disorder	**Chapter 6**. A Structured Interview for Assessing internet gaming disorder: The Personal internet gaming disorder Evaluation - Interview (PIE-Interview)	**Objective 6**. Conduct a pilot study of a clinician-administered version of the PIE-9 developed in Study 1, continuing to adhere to the DSM-5 criteria.

Chapter 2: Methodology

The following chapter details the rationale for the design of the two-study research program. A summary of the studies, papers associated with each study, and the research objectives related to each paper, was provided by Table 1.2. The chapter first details methodological decisions related to study 1, then study 2. The objectives are then used to describe and justify the methodological decisions made in designing each study.

Study 1: Development and validation of a new measure of internet gaming disorder (PIE-9)

Study 1 approach and sample selection decisions. An online survey was used as the method of data collection for Study 1 for several reasons. The use of an online survey removes transcription errors, allows for live monitoring of response rates, and is cost-effective at obtaining the required sample size given a limited research budget (Lee, Fielding, & Blank, 2008). Additionally, online surveys provide findings consistent with traditional survey research methods (Gosling, & Mason, 2015; Gosling, Vazire, Srivastava, & John, 2004) and are similar with respect to social desirability responding compared to paper copy surveys (Dodou, & Winter, 2014). The use of an online survey has also had ecological validity, given the topic of internet gaming. It makes intuitive sense to conduct the research online, as those engaged in gaming online are likely to access other activities online.

Two samples were obtained using convenience sampling: a student sample and a community sample. The student sample was recruited through the school of psychology research participation platform. Each semester, students are required to participate in research to gain course credits. The student sample was used as this cohort has a high rate of engagement with video games, with reportedly 82% of those aged 15-24 in Australia playing video games on a regular basis (Brand, Todhunter, & Jervis, 2018). Further, student samples are easy to access and completion rates for surveys using university participant pools are

high, due to the high motivation for course credits to compensate for their time. Student samples can be more homogenous compared to community samples in age (with average ages tending towards low 20's), and responses (Peterson, 2001), which is important to be aware of because it may limit the generalisability of this sample. However, the use of student samples is common across university research, and several studies have found that the use of student samples shows no systematic bias compared to community samples (Pernice, van der Veer, Ommundson, & Larsen, 2008; Peterson, 2001). Peterson (2001) conducted a second-order meta-analysis and found that while student responses tended to be slightly less variable than community samples, there were no systematic biases compared to community samples; for example, the decreased variability did not translate into larger effect sizes or statistical power to detect effects. The community sample was sought to enable the generalisation of the results, to account for any potential generalisability concerns with the student sample. Participants were sourced through social media (gaming forums, online survey sites, Reddit, and websites).

A number of considerations were made when calculating the required sample size for Study 1, including the necessary power, and anticipated effect sizes between measures across different statistical analyses. The DSM-5 (APA, 2013) did not provide any indications of the prevalence rates of comorbid disorders with IGD at the inception of this study, and epidemiological research was scarce in Western populations. Therefore, I hypothesised there would be a small effect between IGD and comorbid disorders when calculating the required sample size for study 1. A sample size of at least 193 participants were required to detect small correlations between measures (r = .20) with the power of 0.80 (α = .05 two-tailed; tested with G*Power; Faul, Erdfelder, Buchner, & Lang, 2009). The above sample size calculation was deemed sufficient when considering potential correlations between IGD measures. It was hypothesised that there would be a medium to large effect between

measures intending to measure the same construct. Therefore, a smaller sample would be needed, in comparison to the calculation between the IGD measure and comorbid disorder measures. Chapter 5 utilises exploratory and confirmatory factor analyses, which have differing requirements for sampling adequacy. When using the student and community samples in combination, the resulting total sample size of 404 participants is well above the recommended minimum of 5 cases per parameter (56; Kline, 1998), which would require 280 participants for confirmatory factor analysis. In conclusion, the obtained sample size was adequate for addressing all the objectives covered by study 1 (Objectives 1 to 5).

Objective 1: To develop and conduct preliminary psychometric testing on a new self-report measure for internet gaming disorder, using the existing DSM-5 criteria. A study was conducted to develop a new measure to assess the DSM-5 criteria of internet gaming disorder. The properties of the measure were assessed and reported to ensure adequate information was provided to assess the clinical utility of the measure, to comply with best practice guidelines, and for any potential future testing or meta-analyses. The COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) checklist (Mokkink, et al., 2010) for health measure development was used to guide the design of the measure and reporting of the study. In alignment with the COSMIN checklist, internal consistency, reliability, measurement error, content validity, internal validity, construct validity, responsiveness and interpretability were assessed and reported.

Reliability refers to the consistency of a measure (Field, 2018). Internal consistency or internal reliability is the degree to which each item in a test is measuring the same underlying construct (Allen, Bennett, & Heritage, 2014; Field, 2018), and was assessed using Cronbach's alpha. Test re-test reliability refers to the consistency of a test between two or more administrations and was assessed by comparing initial client responses and follow up responses two weeks later using intra-class correlations (ICC; Allen, Bennett, & Heritage,

2014). The two-week delay was chosen as the time between testing was long enough to ensure participants initial responses would not likely influence future responses, and provide enough time to have passed to demonstrate consistency while making considerations related to attrition, and practicality reasons. Social exchange theory states that ‘‘the respondent trusts that the expected rewards of responding will outweigh the anticipated costs” (Dillman, 2007, p. 27). The incentive for participation included the chance to win a $100AUD Amazon voucher for those who participated in both the initial and re-rest survey. The longer the delay between the initial survey, and the re-test survey, the higher the costs and the lower the perceived reward (Fan, & Yan, 2010). Therefore, the two-week delay was also chosen to account for social exchange theory considerations, in addition to concerns of attrition, and practicality, and reliability of responses.

Validity refers to whether a measure is accurately measuring what it is intended to be assessing (Field, 2018). Validity has multiple forms and requires assessing the empirical evidence and theoretical rationale for the measure (Field, 2018). Content validity assesses whether the measure’s items are consistent with the construct they intend to test (Field, 2018). Content validity required assessing whether the measure’s items covered each of the proposed criteria of IGD and was conducted by review of each of the items and whether they thematically addressed each criterion outlined by the DSM-5 (APA, 2013). Internal validity assesses whether the internal structure of the measure is free from flaws and can, therefore, represent the intended construct. Internal validity was assessed by Cronbach’s alpha, and factor analysis. Exploratory factor analysis is used to explore potential internal structures of a measure (Field, 2018). Confirmatory factor analysis is used to test hypotheses related to how the data might fit for a sample in a study (Field, 2018), including confirming a proposed internal structure for a measure. Convergent validity assesses whether the measure correlates with similar concepts (Field, 2018; Tabachnick, & Fidell, 2019). Convergent validity was

assessed by comparing the measure with other measures of similar constructs through correlation analysis (Tabachnick, & Fidell, 2019).

Objective 2: To compare the reliability and validity of existing self-report diagnostic measures with respect to their ability to measure internet gaming disorder, as defined by the DSM-5.

To address Objective 2, three existing measures of problematic gaming or IGD were chosen for comparison to the newly developed measure of IGD. Measures released before the DSM-5 (APA, 2013) had questionable reliability and validity due to weak or inconsistent internal consistencies between studies (King, Haagsma, Delfabbro, 2013; See Chapter 3 for further detail). Additionally, measures at the time did not cover all the proposed DSM-5 criteria. The Problematic Videogame Playing scale (PVP; Salguero. & Moran, 2002) and the Gaming Addiction Scale (GAS; Lemmens, Valkenburg, & Peter, 2009) covered the most criteria. However, as described in Chapter 1, each measure had its weaknesses. The PVP demonstrated variability in its internal validity across studies and used a dichotomous rating scale. Dichotomous rating scales reduce the statistical power to detect effects or differences between variables compared to continuous or categorical scales, and may also underestimate the variation between groups, and increase Type I error (increase in false positives; Altman, & Royston, 2006). The GAS only assessed seven of the nine proposed IGD criteria.

The IGD-20 test was released shortly before study one and assessed the nine proposed IGD criteria across 20 items (Pontes, Kiraly, Demetrovics, & Griffiths, 2014). These items loaded onto six factors, representing Griffiths' (2005) components model of addiction (see Chapter 1 for more detail). Griffiths (2005) proposed six components of addiction (substance or behavioural) as salience, mood modification, tolerance, withdrawal, conflict, and relapse. Three of the six factors had internal consistency values (Cronbach's alpha) below the conventional cut-off of greater than .70. The overall model fit of the measure from a

confirmatory factor analysis was good (*RMSEA* = .04 [*C.I.* .04 - .05], *CFI* = .93 *TLI* = .92, *SRMR* = .04; Pontes et al., 2014). Criterion-related validity was determined by correlating the measure with hours of gameplay (which we now know is only weakly associated with IGD symptoms, see Chapter 1), rather than other measures of IGD symptoms that existed, such as the GAS or PVP. Aside from potential internal consistency discrepancies of the underlying six-factor model, the IGD-20 test was a useful measure against which to compare the newly developed PIE-9. Therefore, to assess criterion-related validity, the PVP, GAS and IGD-20 test were used to compare to the measure developed (PIE-9).

Objective 3: To compare the level of distress and disability between IGD symptoms and DSM-5 anxiety, depressive, and attention disorder symptoms. The DSM-5 (APA, 2013) section on IGD specifically mentioned major depressive disorder, attention deficit hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD) as existing disorders potentially related to IGD, supported by studies investigating the comorbidity of problematic video-gaming and these disorders prior to the release of the DSM-5 (Chan, & Rabinowitz, 2006; Gentile, 2009; Mentzoni, et al., 2011; van Rooij, Schoenmakers, Vermulst, van den Eijnden, & van de Mheen, 2011; Wei, Chen, Huang, & Bai, 2012). Additionally, through their systematic review of existing pathological video-gaming instruments before the release of the DSM-5, King and colleagues (2013) identified ADHD (Including attention and impulsivity components), depression, anxiety, and OCD as the most common comorbid disorders used to assess the convergent validity of measures of IGD. For this reason, the convergent validity of the PIE-9 with measures of symptoms of these disorders was explored during measure development.

Several considerations guided the choice of measures of ADHD, depression, anxiety, and OCD symptoms. First, the measures needed to have reported good reliability and validity and be freely available. Second, if there was a choice between two comparable measures, the

shorter measure was chosen to reduce respondent burden and minimise dropout rates (Fan, & Yan, 2010). Third, preference was given to measures where the psychometric properties have been established with online administration. I searched for studies that had tested the measures online, or studies that had directly compared online and paper-copy use. The World Health Organization Disability Assessment Scale 2.0 (WHODAS 2.0; Axelsson, Lindsäter, Ljótsson, Andersson, & Hedman-Lagerlöf, 2017; Ustun, Chatterji, Kostanjsek, et al., 2010), and Generalized Anxiety Disorder scale (GAD-7; Donker, Van, Marks, & Cuijpers, 2011; Spitzer, Kroenke, Williams, et al., 2006) had been used online previously. I was unable to source research that had utilised the Kessler-10 (K-10; Kessler, Andrews, Colpe, 2002), Patient Health Questionaire 9 (PHQ-9; Kroenke, & Spitzer, 2002), adult ADHD self-report scale (ASRS; Kessler, Adler, Ames, et al., 2005) or Obsessive Compulsive Disorder Inventory – Revised (OCI-R; Foa, Huppert, Leiberg, et al., 2002) online directly. However, several studies have investigated whether there was a difference between online and paper-copy surveys in the areas of psychologist distress, depressive symptoms, and OCD, and reported either no difference (Coles, Cook, & Blake, 2007; Holländare, Andersson, & Engström, 2010; Storch et al., 2009; Truman et al., 2003; Williams, Turkheimer, Schmidt, & Oltmanns, 2005) or very small variations between modes of administration (Mangunkusumo, et al., 2005; McCabe, Boyd, Young, Crawford, &Pope, 2005). This is reassuring, in addition to evidence that there is no difference in social desirability responding between online and paper-copy data collection methods (Gosling, & Mason, 2015; Gosling, Vazire, Srivastava, & John, 2004), or between online surveys with community samples and undergraduate student samples (Briones, & Benham, 2017). Detailed information on the psychometric properties of each of the selected measures is provided in the following chapters.

Objective 4: To evaluate evidence that internet gaming disorder is distinct from existing disorders and symptoms.

One key piece of evidence to determine if IGD is a unique disorder, is to assess whether IGD provides a unique contribution of psychological distress and disability, after controlling for other disorders with overlapping features. As discussed in detail above regarding objective 3, the disorders and symptoms controlled for included comorbid OCD, and ADHD, and symptoms of depression and anxiety. These disorders and symptoms were included based on evidence at the time in the DSM-5 (APA, 2013) suggesting likely comorbidities with IGD.

Hierarchical multiple regression is often used to answer statistical prediction questions, such as the above objective. Hierarchical multiple regression is an effective method to estimate the linear relationship(s) between one dependent variable (for example, psychological distress), and one or more independent variables, and can provide measures of both shared and unique variance (Allen, Bennett, & Heritage, 2014; Field, 2013). Therefore, hierarchical multiple regression is well placed to help evaluate the unique contributions of the PIE-9 to the variance of measures of psychological distress and disability, after controlling for measures of existing disorders and symptoms. Therefore, this was the primary statistical method used to answer this objective, which is the focus of Chapter 4.

Objective 5: To use the illustrative client statements discussed by King and Delfabbro (2014) to create a measure of internet gaming cognitions that distinguishes between those with and without internet gaming disorder. Chapter 5 addresses this objective using different types of factor analysis. First, Confirmatory Factor Analysis was used to test the previously proposed theoretical model of gaming cognitions (King, & Delfabbro, 2014) with our dataset. CFA is used to examine the relationships between a set of observed and latent variables (Tabachnick, & Fidell, 2019). An initial test revealed the model fell below conventional cut-off values, so other modelling approaches were explored.

Second, exploratory factor analysis was used to explore other models that may fit to the data. Exploratory factor analysis (EFA) is a multivariate statistical approach that identifies

the number of underlying latent variables (factors) that may best explain the correlations between observed variables (factor indicators) (Field, 2013, Muthén, & Muthén, 2015). EFA is a useful approach to answer hypotheses related to understanding the potential relationships between latent and observed variables (Rietveld, & Van Hout 1993). An approach testing both conventional exploratory factor modelling (e.g. the items load onto X number of factors; from 1-6 in this case) and bifactor modelling was taken due to an absence of strong theory for the subtypes of cognitions, and due to past research having found extensive item cross-loadings (Forrest, King, & Delfabbro, 2016). Bifactor modelling allows the researcher to concurrently evaluate how much unique variance specific factors (latent variables) contribute to the model after accounting for the shared variance in the model, which is represented by the general factor (a latent variable on which all items of the measure load).

Study 2: Develop a clinician-administered interview for internet gaming disorder

Study 2 approach and sample selection decisions. A structured interview format was used as the method of data collection for Study 2 for several reasons. First, the use of a structured interview directly addresses the research objective to develop such a measure. Second, the use of a structured interview allows the participant to seek clarification on any questions they do not understand, resulting in more reliable and accurate information being obtained (Mihara, & Higuchi, 2017). Lastly, a clinician-administered interview would also help to guide clinicians who need to conduct a structured and comprehensive clinical assessment of IGD for case formulation, treatment planning, and outcome evaluation.

A single sample of students and community volunteers was used for study 2 ($N = 45$). Potential participants needed to report 20 or more hours of gaming per week to be included in the study. The decision to include this criterion was to increase the probability of identifying IGD cases. Further details relating to the sample selection, and sourcing of participants is provided in more detail in Chapter 6.

Objective 6: Conduct a pilot study of a clinician-administered version of the PIE-9 developed in Study 1, continuing to adhere to the DSM-5 criteria. Overreliance on self-report measures, and a lack of clinical research on IGD, had been identified as a shortfall of existing literature at the inception of this research program (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013), and remains an issue in recent years (Mihara, & Higuchi, 2017). Study 2 was designed to better enable future clinical research on IGD by providing a reliable and valid interview structure for clinicians assessing IGD. Previous research on IGD has commonly relied upon self-report measures (King et al., 2017; King, Delfabbro, Griffith, & Gradisarc, 2011). While self-report measures are cost-effective and can provide useful information, they rely on the individual to interpret and report their current symptoms, without a researcher or interviewer to clarify or probe for understanding. Additionally, individuals meeting IGD criteria often have co-occurring problems across several domains, including sleep, physical activity, dietary problems, psychological wellbeing, social areas, and academic or vocational performance issues (Koo, 2016). These issues could interfere with their ability to provide reliable information, which can be addressed by administering a structured or semi-structured interview by a trained practitioner (Mihara, & Higuchi, 2017).

When assessing the clinician-assisted interview for IGD developed, the COSMIN guidelines (Mokkink et al., 2010) on recommended reporting for evaluating dichotomous variables were reviewed. The COSMIN guidelines recommended reporting on the sensitivity and specificity of the scale, which was compared against the PIE-9 self-report measure. Additionally, we reported several other commonly reported statistics including likelihood ratios, accuracy, misclassification rate, diagnostic odds ratio, Youden's index, area under the curve, and Cramer's V to help provide the reader with the information needed to assess the usefulness of the measure. Each of these metrics will be explained and detailed in full in Chapter 6.

Summary

This chapter has outlined the methodology used across the two-study research program, including the rationale for decisions made about the research design. Further details are outlined in the following chapters related to each of the research objectives. Study 1 is presented across chapters 3 (Objective 1,2 & 3), 4 (Objective 4) and 5(Objective 5). Study 2 is discussed in chapter 6, which assesses Objective 6.

The following chapter has been published as a journal article in the journal *Cyberpsychology Behavior, and Social Networking*, as referenced below.

Pearcy B.T.D, Roberts L.D., and McEvoy P.M. (2016). Psychometric testing of the PIE-9: a new measure designed to assess internet gaming disorder. *Cyberpsychology, Behavior, and Social Networking*, 19, 335–341. doi: 10.1089/cyber.2015.0534

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Chapter 3: Psychometric testing of the PIE-9: A new measure designed to assess internet gaming disorder

Internet gaming disorder is in the early stages of recognition as a disorder, following its inclusion in the Diagnostic and Statistical Manual for Mental Disorders (DSM-5, American Psychiatric Association, 2013) as a condition for further study. Existing measures of internet gaming pathology are limited in their ability to measure internet gaming disorder as defined in the DSM-5. We present the initial development and validation of a new measure derived from the proposed DSM-5 criteria for internet gaming disorder, the Personal Internet Gaming Disorder Evaluation (PIE-9). A student sample (n=119) and a community sample (n=285), sourced through a variety of online gaming forums, completed an online survey comprising the new measure, existing measures of internet gaming disorder, and a range of health and demographic questions. Exploratory and confirmatory factor analysis supported a single factor structure for the 9-item PIE-9. Internal consistency (α=.89) and test re-test reliability (ICC=.77) were high. Convergent validity was demonstrated with similar gaming addiction measures. Predictive validity was established through significant differences in distress and disability between those who met the criteria for internet gaming disorder and those who did not. The distress and disability associated with meeting IGD criteria fell within the range of other common DSM-5 disorders. Preliminary testing of the PIE-9 has demonstrated that it is an efficient and straightforward measure for use in further research of internet gaming disorder, and as a potential screening measure in clinical practice.

Introduction

Internet gaming disorder (IGD) is in the early stages of recognition as a disorder. The Substance Use Disorder Workgroup was tasked by the American Psychiatric Association (APA) to define IGD for inclusion in the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; APA, 2013) as a condition for further study (Petry, & O'Brien, 2013). The Substance Use Disorder Workgroup noted that within extant research in the area, the diagnostic criteria were inconsistent and varied across authors (Petry, & O'Brien, 2013). These inconsistencies in diagnostic criteria have made it difficult to establish reliable and valid measures for diagnosis. By proposing diagnostic criteria, the DSM-5 has provided a foundation for future research into internet gaming disorder (King, & Debfabbro, 2014). The key feature of IGD is the persistent and recurrent use of the internet to engage in games, often with other players, leading to clinically significant impairment or distress over 12 months (see Table 3.1 for full diagnostic criteria). A standardised definition followed by a unified approach to assessment of IGD has been called for by members of the DSM-5 Substance Use Disorder Workgroup and leading researchers in the area (Griffiths, King, & Demetrovics, 2014; King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Petry, & O'Brien, 2013). Further research will then be required to refine the definition of IGD proposed in the DSM-5 (APA, 2013), and to establish the reliability and validity of the proposed diagnostic criteria. In this article, we first review existing measures of internet gaming pathology before presenting the development and initial validation of a new brief measure designed to assess IGD, as defined by the DSM-5 (APA, 2013).

Table 3.1. IGD Criteria And PIE-9 Items

IGD Criteria	PIE-9 item
1. Preoccupation with internet games.	1. I have been preoccupied with internet games.
2. Withdrawal symptoms when internet gaming is taken away.	2. I have experienced withdrawal symptoms when internet gaming is taken away (such as anger, frustration or sadness).
3. Tolerance – the need to spend increasing amounts of time engaged in internet games.	3. I find an increasing need to spend increasing amounts of time engaged in internet games.
4. Unsuccessful attempts to control the participation in internet games.	4. I have had unsuccessful attempts to control the participation in internet games.
5. Loss of interests in previous hobbies and entertainment as a result of, and with the exception of, internet games.	5. I have lost interest in previous hobbies and entertainment other than internet games.
6. Continued excessive use of internet games despite knowledge of psychosocial problems.	6. I continue excessive use of internet games despite knowledge of knowing it causes me problems.
7. Has deceived family members, therapists, or others regarding the amount of internet gaming.	7. I have deceived family members, therapists, or others regarding the amount of time I spend internet gaming.
8. Use of internet games to escape or relieve a negative mood.	8. I use internet games to escape or relieve a negative mood.
9. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in internet games.	9. I have jeopardized or lost significant relationships, jobs, or educational opportunities because of participation in internet games

Note. IGD = internet gaming disorder, PIE-9 = Personal Internet Gaming Disorder Evaluation-9.

Existing measures of internet gaming pathology

King and colleagues (2013) conducted a systematic review of measures designed to assess internet gaming addiction. They found that existing measures excelled in terms of brevity, ease of scoring, and psychometric properties. However, there are a number of shortcomings to existing measures, resulting in King and colleagues (2013) concluding that existing measures were limited in their ability to assess the newly proposed internet gaming disorder appropriately. First, the reliability and validity of existing measures were questionable due to weak or inconsistent internal consistencies and underlying structures between studies. Second, previous measures were produced prior to the release of the DSM-5 (APA, 2013) and therefore most do not cover all of the suggested criteria. New measures of IGD are needed to ensure these shortfalls are addressed.

King and colleagues' (2013) identified two existing measures of IGD that appeared to demonstrate adequate psychometric properties: The Problematic Video-game Playing scale (PVP; Salguero, & Moran, 2002) and the Gaming Addiction Scale (GAS; Lemmens, Valkenburg, & Peter, 2009). The PVP is a nine-item scale designed to measure problems associated with addictive use of video games (Salguero, & Moran, 2002) and appears to cover all of the criteria for IGD proposed in DSM-5 (APA, 2013; Salguero, & Moran, 2002). However, the PVP suffers from some limitations that may impact its clinical utility. First, the PVP uses a dichotomous response format, which does not provide any information on the frequency of symptoms over the past 12 months, as per the IGD criteria. Second, the PVP has demonstrated variable internal consistency across studies (range α = .69 - .91; Collins, Freeman, & Chamarro-Premuzic, 2012; Hart, Johonson, Stamm, Angers, Robinson, Lally, et al., 2009; Salguero, & Moran, 2002; Sun, Ma, Bao, Chen, & Zhang, 2008; Table 3.2). The Gaming Addiction Scale (GAS) was developed to measure video game addiction (Lemmens, Valkenburg, & Peter, 2009). The GAS demonstrated acceptable psychometric properties

(Table 3.2). However, it is limited as a measure of IGD as it only covers seven of the nine IGD criteria, excluding 'continued use despite knowledge of harm' and 'deception'.

In the period since King and colleagues review (2013), a new measure, The Internet Gaming Disorder 20 test (IGD-20 test; Pontes, Kiraly, Demetrovics, & Griffiths, 2014) has been published. The reliability and validity of the scale appear acceptable based on the original study (Pontes, Kiraly, Demetrovics, & Griffiths, 2014; Table 3.2). However, the IGD-20 test's items are mapped to six underlying factors of salience, mood modification, tolerance, withdrawal, conflict and relapse (Griffiths, 2005), rather than the nine IGD criteria directly, thereby limiting its utility as a screening tool for IGD. In summary, the existing measures of internet gaming pathology are limited in their ability to measure internet gaming disorder as defined in the DSM-5 (APA, 2013).

Table 3.2. Existing measures of internet gaming addiction symptoms

Measure name	Purpose	Number of items	Response format	Sample item	Factor structure	Reliability (α)
GAS	Gaming addiction	7	Never (1) – Very often (5)	Have you neglected other activities (e.g. school, work, sports) to play games?	1	.81 - .86*
IGD-20	Internet gaming disorder	20	Strongly disagree (1) – Strongly agree (5)	I often lose sleep because of long gaming sessions	6	.88**
PVP	Gaming addiction	9	Yes or No	When I can't use the video games, I get restless or irritable	1	.69 -.91***

Note. GAS = Gaming Addiction Scale (Lemmens, Valkenburg, & Peter, 2009), IGD-20 = Internet Gaming Disorder-20 test (Pontes, Kiraly, Demetrovics, & Griffiths, 2014), PVP = Problematic Video-game Playing scale (Salguero & Moran, 2002).

* Lemmens, Valkenburg, & Peter, 2009

** Pontes, Kiraly, Demetrovics, & Griffiths, 2014

*** Collins, Freeman, & Chamarro-Premuzic, 2012; Hart et al. 2009; King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Salguero, & Moran, 2002; Sun, Ma, Bao, Chen, & Zhang, 2008

The current study

This study reports on the initial development and validation of a new measure derived from the proposed DSM-5 criteria for internet gaming disorder, the Personal Internet Gaming Disorder Evaluation (PIE-9). The PIE-9 has been developed to produce a brief, reliable and valid measure for research purposes and to assist clinicians in identifying individuals who may present with IGD as defined by the DSM-5 (APA, 2013). Brief measures are more useful in practice than measures with 20 or more items that may take more than 10 minutes to administer (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013), provided they are reliable and valid.

The first hypothesis was that a single factor would be extracted from the PIE-9 items using exploratory factor analysis, and that the unitary factor structure would yield a good fit using confirmatory factor analysis in an independent sample. The second hypothesis was that the PIE-9 would demonstrate good internal consistency, with a Cronbach's alpha above .80 (DeVillis, 2003). The third hypothesis was that the PIE-9 would demonstrate good test-retest reliability over a 2-week period. The fourth hypothesis was that the PIE-9 would demonstrate convergent validity by correlating moderately with the PVP (Salguero, & Moran 2002), GAS (Lemmens, Valkenburg, & Peter, 2009), and IGD-20 test (Pontes, Kiraly, Demetrovics, & Griffiths, 2014). The fifth hypothesis was that participants who meet the cut off for IGD as defined by the DSM-5 (APA, 2013) would have significantly higher rates of disability and distress than participants who do not meet the cut-off.

Method

Participants. Two samples were used in this study: a university student sample (N=119, 57.1% males, 42.9% females), and a community sample (N=285, 75.4% males, 24.6% females), sourced through online gaming forums across the internet. To participate in the study, participants needed to be over 16 years of age and participate in at least one hour of

internet gaming per week. Demographic information collected for the two samples is provided in Table 3.3.

Table 3.3. Demographic characteristics of the two samples

	Community Sample (n = 285)		Student sample (n = 123)	
	Mean	*SD*	*Mean*	*SD*
Age (years)	25.08	7.87	20.72	3.82
Time spent playing games per week (hours)	19.82	15.99	10.34	9.72
	n	%	*n*	%
Gender				
Male	215	75%,	68	57%,
Female	70	25%	51	43%
Country				
Australia	101	35%	113	95%
United States	90	32%		
United Kingdom	30	11%		
Canada	7	2%		
Denmark	5	2%		
Malaysia			3	3%
Singapore			2	2%
Other	51	18%		
Employment status				
Full-time Employment	102	36%	3	3%
Full-time Education	94	33%	57	48%
Part-time Employment	14	5%	12	10%
Part-time Education	7	2%	4	4%
Full-time Training	1	0%		
Part-time Training	1	0%	1	
Combination of Education, Employment or Training	30	10%	41	35%
Not in Education, Employment or Training	36	13%	1	

Measures. The PIE-9. The PIE-9 is a new 9-item measure developed to assist in the diagnosis of the DSM-5's (APA, 2013) internet gaming disorder. A single item is used to assess each of the 9 IGD criteria. Items were developed by restructuring the DSM-5 IGD criteria into a first-person perspective, ensuring the creation of a brief and targeted measure for IGD in the general adult population (see Table 3.1). Participants respond using a 5-point Likert scale ranging from never (1) to very often (5) to measure the frequency of the symptoms over the past 12 months, in line with the DSM-5's proposed criteria (APA, 2013). If participants scored often (4) to very often (5) on five or more of the nine items, they were considered to have met the criteria for IGD.

The Problematic Videogame Playing scale. The PVP is a 9-item measure designed to assess gaming addiction (Salguero, & Moran, 2002). The PVP has a unitary factor structure and borderline-acceptable internal consistency (Collins, Freeman, & Chamarro-Premuzic, 2012; Hart, Johonson, Stamm, Angers, Robinson, Lally, et al., 2009; Salguero, & Moran, 2002; Sun, Ma, Bao, Chen, & Zhang, 2008; Table 3.2)

The Gaming Addiction Scale. The GAS is a 7-item measure of gaming addiction (Lemmens, Valkenburg, & Peter, 2009). The GAS has a unitary factor structure and has demonstrated acceptable reliability and internal consistency in previous studies (Table 3.2).

The Internet Gaming Disorder 20 test. The IGD-20 test is a 20-item measure designed to assess internet gaming disorder (Pontes, Kiraly, Demetrovics, & Griffiths, 2014; Table 3.2). The items load on six factors, with the internal consistency of each of the six factors ranging from $\alpha = .63$ to .80 (Pontes, Kiraly, Demetrovics, & Griffiths, 2014).

The Kessler 10 scale. The Kessler 10 (K10) is a 10-item scale designed as a brief measure of non-specific psychological distress (Kessler et al., 2002). The five-point response format ranges from none of the time (1) to all of the time (5), with a possible score range of 10 to 50. A sample question is 'In the past 30 days…how often did you feel nervous?'. The

K10 has demonstrated good internal consistency (α = .93; Andrew, & Slade, 2001; Kessler et al., 2002) and validity (Andrew, & Slade, 2001).

The World Health Organization Disability Assessment Schedule 2.0. The World Health Organization Disability Assessment Schedule 2.0 (WHODAS) is a reliable and valid 12-item measure of disability, designed to provide a standardised method for measuring health and disability across cultures (Üstün et al., 2010). The WHODAS has a response scale from none (0) to extreme or cannot do (5) in response to questions including 'standing for long periods, such as 30 minutes?'. The WHODAS is a widely accepted measure and has demonstrated good internal consistency (α = .94 - .98; Üstün et al., 2010) and validity (Andrews, Sunderland, von Korff, & Üstün, 2009; Üstün et al., 2010).

Validity Items. King and colleagues (2013) proposed that future measures should consider adding items that assess whether the individual and significant others believe that his/her video-gaming behaviour is problematic as a validity check. The following two items were therefore included as validity checks: "I personally believe that my internet game playing behaviour is problematic" and "Significant others in my life would consider my internet game playing as problematic". Participants were provided with a 4-point Likert scale from strongly disagree (1) to strongly agree (4) to avoid neutral or misleading responses.

Procedure. After obtaining approval from the institution's Human Research Ethics Committee (Approval No. RDHS-09-15), two online surveys (one for students and one for the general public) were hosted on Qualtrics.com. Students were recruited through a university student participation pool and internal marketing. Community participants were recruited through snowballing on social media and through posting on online gaming or social interest forums. Upon providing informed consent, participants completed the online survey. The order of internet gaming pathology measures was randomised. The survey took approximately 20 minutes to complete. Consenting participants were e-mailed a link to the

re-test survey (comprising the PIE-9) 14 days later. Data were downloaded from Qualtrics.com into SPSS. Only completed surveys were used for analysis.

Results

Factor analyses and reliability. Principal axis factoring was used to explore the factor structure of the PIE-9 items using a randomly selected portion of the community sample (n=80). The remaining sample (n=205) was saved for a confirmatory factor analysis. Sampling adequacy (KMO = .88) and sphericity ($\chi^2(36) = 595.36$, $p < .001$) indicated the data were appropriate for factor analysis. Minor violations of normality and linearity were not considered problematic due to the robust nature of factor analysis. The PIE-9 items loaded on a single factor (eigenvalue greater than one) explaining 62.6% of the variance (range of loadings = .43 to .84, Table 3.4). A confirmatory factor analysis on the second dataset were then conducted using EQS v6.1 (see Figure 3.1). The model provided acceptable model fit (Hu, & Bentler, 1998; 1999) across multiple fit indices, (see Table 3.5).

Table 3.4. Principal axis factoring loadings of the nine item PIE-9

Item	Factor loadings
6. I continue excessive use of internet games despite knowledge of knowing it causes me problems.	.84
9. I have jeopardised or lost significant relationships, jobs, or educational opportunities because of participation in internet games	.69
2. I have experienced withdrawal symptoms when internet gaming is taken away (such as anger, frustration or sadness).	.65
3. I find an increasing need to spend increasing amounts of time engaged in internet games.	.63
5. I have lost of interest in previous hobbies and entertainment other than internet games.	.63
4. I have had unsuccessful attempts to control participation in internet games.	.62
1. I have been preoccupied with internet games.	.59
7. I have deceived family members, therapists, or others regarding the amount of time I spend internet gaming.	.54
8. I use internet games to escape or relieve a negative mood.	.43
Percentage of Variance:	62.60%

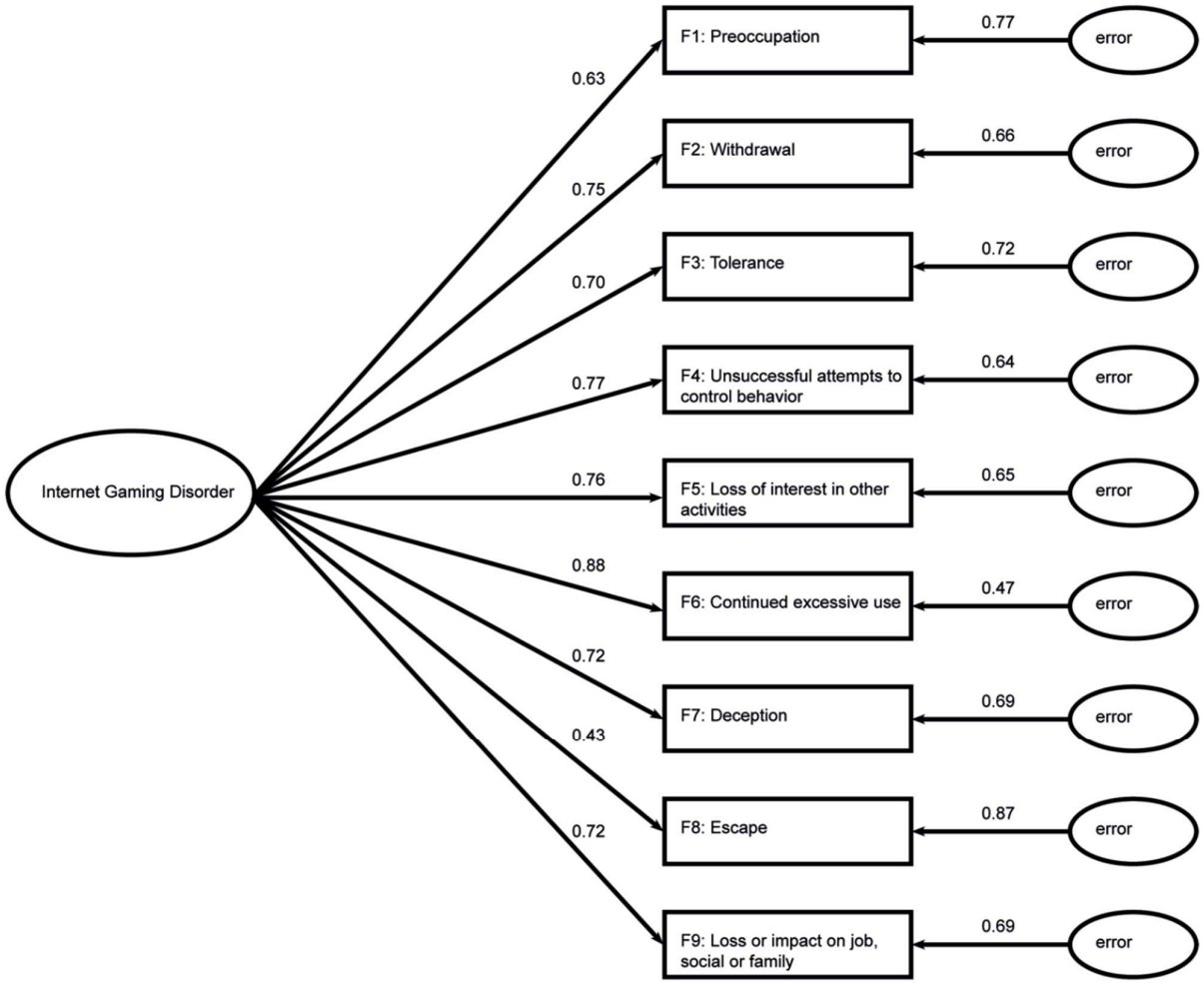
Note. PIE-9 = Personal Internet Gaming Disorder Evaluation-9

Table 3.5. Goodness of fit indices for the confirmatory factor analysis of the PIE-9

Goodness of fit indices	Fit indices score	Desired cut-off score for acceptable fit.
NFI	.94	≥.95
TLI	.94	≥.95
CFI	.96	≥.95
SRMR	.04	≤.08
RMSEA	.08	≤.06

Note: desired cut-off scores were derived from Hu and Bentler's (1998,1999) recommendations. PIE-9 = Personal Internet Gaming Disorder Evaluation-9, NFI = Normed Fit Index, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, SRMR = Square Root Mean Residual, RMSEA = Root Mean Square Error of Approximation.

Figure 3.1. Standardised model of the confirmatory factor analysis of the PIE-9



Note. All items significantly loaded on the latent factor.

Internal consistency and test re-test reliability. Internal consistency of the PIE-9 in the community (α =.89) and student samples (α =.86) was high and comparable to the IGD-20 test and GAS (Table 3.6). The PVP yielded poor internal consistency. The PIE-9 demonstrated acceptable test-retest reliability (community; *ICC* =.77, *n* =78; students *ICC* =.84, *n* =71) over a two-week period.

Criterion-related and concurrent validity. Table 3.6 presents Spearman rho correlations of the PVP, GAS and IGD-20 test with the PIE-9. The strong positive correlations between the PIE-9 and other measures of problematic internet gaming provide support for the PIE-9's concurrent validity.

Participants were classified as meeting the criteria for IGD if they answered 'sometimes' to 'very often' for 5 or more of the 9 questions in the PIE-9. Table 3.7 summarises responses to the validity questions between those who were or were not identified as meeting the criteria for IGD. Compared to participants who did not meet IGD criteria, a significantly higher proportion of participants who met criteria endorsed the personal validity question in both the community, $\chi^2(1, N = 263) = 54.15$, $p < .001$, and student samples, $\chi^2(1, N = 107) = 6.57$, $p = .01$, and endorsed the significant others validity question in the community sample, $\chi^2(1, N = 263) = 26.76$, $p < .001$. There was no significant difference in the student sample for the significant others validity question, $\chi^2(1, N = 107) = 1.29$, $p = .25$.

Distress and disability. Independent samples t-tests were used to compare mean scores of those who did and did not meet the criteria for IGD on measures of distress (K10) and disability (WHODAS) (Table 3.8). Participants who met the cut off for the IGD criteria scored significantly higher on both distress and disability compared to participants who did not meet criteria. The effect sizes were large (Cohen, 1988) across both samples.

Table 3.6. Internal consistency (α) and Spearman's Rho correlations (r_s) between gaming measures

	Community sample (n = 285)		Student sample (n = 119)	
	Correlation with PIE-9	Internal consistency	Correlation with PIE-9	Internal consistency
PIE-9	-	.89	-	.86
IGD-20	.64*	.89	.49*	.89
GAS	.57*	.84	.69*	.82
PVP	.43*	.66	.45*	.68

Note. GAS = Gaming Addiction Scale (Lemmens, Valkenburg, & Peter, 2009), IGD-20 = Internet Gaming Disorder-20 test (Pontes, Kiraly, Demetrovics, & Griffiths, 2014), PVP = Problematic Video-game Playing scale (Salguero & Moran, 2002).

*p<.001, two tailed.

Table 3.7. Concordance of the PIE-9 with validity questions

	Community sample				Student sample			
	IGD group		Non-IGD group		IGD group		Non-IGD group	
	n	%	n	%	n	%	n	%
PIE-9 IGD criteria met	22		263		12		107	
Personal Validity question*	15	68%	27	10%	5	42%	14	13%
Significant others validity question**	18	82%	74	28%	5	42%	28	26%

Note. PIE=9 = Personal Internet Gaming Disorder Evaluation (PIE-9), IGD = Internet gaming disorder.

* "I personally believe that my internet game playing behaviour is problematic."

** "Significant others in my life would consider my internet game playing as problematic."

Table 3.8. Independent Samples T-Tests Between The PIE-9 And Distress and Disability Measures

Community sample		n	Mean	SD	t	df	p	Effect Size (*d*)
Kessler-10	IGD	22	30.14	10.35	4.96	283	<.001	1.10
	Non-IGD	263	20.47	8.64				
WHODAS 2.0	IGD	22	18.23	15.35	6.62*	21.72	.002	1.47
	Non-IGD	263	6.66	6.93				
Student sample		n	Mean	SD	t	df	p	Effect Size (*d*)
Kessler-10	IGD	12	27.5	7.73	3.56	117	<.001	2.96
	Non-IGD	107	19.42	7.42				
WHODAS 2.0	IGD	12	13.42	7.18	2.99	117	.003	2.42
	Non-IGD	107	6.96	7.07				

Note. Kessler-10 = Kessler 10 scale (Kessler et al. 2002), WHODAS 2.0 = World Health Organization Disability Assessment Schedule 2.0 12 item version (Üstün et al.2010)

*Equal variances not assumed

Discussion

The overall aim of this study was to conduct preliminary psychometric testing of a new measure of IGD, the PIE-9. It was hypothesised that the PIE-9 would have a unitary structure, high internal consistency and test-retest reliability, and that it would demonstrate criterion-related and concurrent validity. These hypotheses were supported. The PIE-9 items loaded on a single factor and met criteria for good model fit. The PIE-9 demonstrated good internal consistency and test-retest reliability. Moderate to strong positive correlations between the IGD and existing measures of internet gaming pathology supported the PIE-9's convergent validity. Furthermore, participants who met the cut-off for IGD as defined by the DSM-5 (APA, 2013) had significantly higher levels of distress and disability compared to those who did not.

Factor structure. The unidimentionality of the PIE-9 scale supports the notion that IGD symptoms reflect a single underlying factor. King and colleagues (2014) systematic review reported that five of the 11 pathological gaming measures with factor structure information available were also unidimensional. This is in alignment with a recent study by Lemmens, Valkenburg and Gentile (2015) who confirmed a single factor structure for their IGD measure during preliminary testing. Lemmens and colleagues' (2015) measure is yet to be compared to existing IGD measures for convergent validity and may be a useful comparative measure for future research.

Distress and disability. One of the most critical considerations before IGD is included in future editions of the DSM is whether those who present with symptoms of IGD experience similar levels of distress and disability compared to existing mental disorders. Comparisons in the current study found that those who met IGD criteria showed significantly higher levels of distress and disability compared to those who did not meet the IGD criteria. Andrews and Slade (2001) conducted a normative study for the Kessler-10 scale in Australia

and identified scores for individuals likely to be well (<20), and scores for individuals likely to have mild (20-24), moderate (25-29), and severe (30+) mental disorders. The mean Kessler-10 score for community sample participants who met criteria for IGD in the current study was in the severe range, whereas the mean of the non-IGD group fell in the mild range. The student sample yielded similar results, with the mean of the IGD group falling in the moderate range and the mean of the non-IGD group falling in the well range. These findings provide evidence that individuals identified by the PIE-9 as meeting the criteria for IGD experience similar levels of distress as individuals with other DSM mental disorders.

Participants who met the IGD criteria in both the community and student samples also reported significantly higher levels of disability than the non-IGD groups. Comparisons between participants in this study who met criteria for IGD and Australian total population norms for the WHODAS (Andrews et al., 2009) suggest that the mean of the IGD group in the student sample was equivalent to the 95th percentile, and the mean for the IGD group in the community sample was above the 95th percentile. The means for the non-IGD groups for both samples were equivalent to the 85th percentile of the total population norm scores. These comparisons provide evidence that IGD is a significant mental health concern associated with high levels of distress and disability.

Limitations. The dropout rate was 38% for the community sample online survey. Administration of a number of similar measures may have appeared repetitive, which may have deterred participants from completing the full questionnaire battery. The majority of participants completed the internet gaming measures (n = 352 in the community sample) and appeared to drop out once they had completed this section. We acknowledge that the disparity between sample sizes has the potential to increase Type I error. As an additional check, the data were reanalysed using Mann-Whitney U tests, resulting in similar findings. This strengthens our confidence in the results.

Future research direction. We recommend further research focusing on two areas. First, a lack of clinical testing is a known weakness of existing internet gaming pathology measures (King, et al., 2013). Administering the PIE-9 as part of a structured interview would provide an assessment of the clinical utility of the measure and help further our understanding of the underlying constructs and clinical impacts of the condition. Second, exploring the relationship between IGD and other mental disorders seems warranted as a result of the distress and disability scores examined in the current study. It will also be important to identify pathways to comorbidity, whereby IGD may be a consequence of other mental disorders (e.g., functional avoidance secondary to social anxiety or depression), other mental disorders may be a consequence of IGD (e.g., depression may ensue due to IGD), IGD and other disorders may be manifestations of common underlying vulnerabilities to psychopathology, or IGD may develop independently of other disorders. Third, we recommend discriminant validity testing of the PIE-9 in future studies, to further the conceptualisation of IGD by comparing the PIE-9 with existing measures of internet addiction.

Conclusions. Preliminary testing of the PIE-9 has demonstrated that it is an efficient and straightforward measure for use in further research of IGD, and as a potential screening measure in clinical practice. Internal consistency and test-retest reliability were high and evidence for convergent and concurrent validity was found. The study has provided advances in our knowledge of the association between IGD and distress and disability.

The following chapter has been published as a journal article in the journal *Cyberpsychology Behavior, and Social Networking*, as referenced below.

Pearcy, B.T.D., McEvoy, P.M., and Roberts, L.D. (2017). Internet Gaming Disorder Explains Unique Variance in Psychological Distress and Disability After Controlling for Comorbid Depression, OCD, ADHD, and Anxiety. *Cyberpsychology, Behavior, and Social Networking*, 20. doi: 10.1089/cyber.2016.0304

The final publication is available from Mary Ann Liebert, Inc., publishers http://dx.doi.org/10.1089/cyber.2016.0304

Chapter 4: Internet gaming disorder explains unique variance in psychological distress and disability after controlling for comorbid depression, OCD, ADHD and anxiety.

This study extends knowledge about the relationship of internet gaming disorder (IGD) to other established mental disorders by exploring comorbidities with anxiety, depression, attention deficit hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD), and assessing whether IGD accounts for unique variance in distress and disability. An online survey was completed by a convenience sample that engages in internet gaming ($N = 404$). Participants meeting criteria for IGD based on the Personal Internet Gaming Disorder Evaluation – 9 (PIE-9) reported higher comorbidity with depression, OCD, ADHD and anxiety compared to those who did not meet the IGD criteria. IGD explained a small proportion of unique variance in distress (1%) and disability (3%). IGD accounted for a larger proportion of unique variance in disability than anxiety and ADHD, and a similar proportion to depression. Replications with clinical samples using longitudinal designs and structured diagnostic interviews are required.

Internet gaming disorder (IGD) was included in section III of the Diagnostic and Statistical Manual of Mental Disorders (5th Ed., DSM-5; APA, 2013) as an emerging diagnosis for further study. The aim of providing a set of proposed diagnostic criteria was to improve consistency in future research (Petry, & O'Brien, 2013) and to provide a framework from which further refinements could be investigated (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). The debate around IGD and its underlying structure remain contentious (Griffiths, King, & Demetrovics, 2014; Griffiths et al., 2014; Petry et al., 2014b; Petry et al., 2015), so further research into the validity of measures assessing the proposed criteria is required. The Personal Internet Gaming Disorder Evaluation (PIE-9; Pearcy, Roberts, & McEvoy, 2016) was recently developed to directly assess the proposed DSM-5 criteria, which will allow for further evaluations of the IGD construct.

One of the key questions to be addressed in further research of IGD is whether the proposed disorder is related to elevated levels of distress and disability compared to those who do not have the disorder. This question was examined as part of an initial development study of the PIE-9 (Pearcy, Roberts, & McEvoy, 2016), which found that individuals who met IGD criteria according to the PIE-9 had significantly higher rates of distress and disability compared to those who did not meet the criteria (Pearcy, Roberts, & McEvoy, 2016). However, the DSM-5 notes that IGD may be comorbid with other mental disorders, mentioning specifically major depressive disorder, attention deficit hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD; APA, 2013). Generalized anxiety disorder (GAD) is also highly comorbid with other mental disorders (McEvoy, Grove, & Slade, 2007), and one of the proposed DSM-5 criteria suggests an explicit functional link between internet-gaming and emotions such as anxiety, whereby internet gaming may be used as an emotion regulation strategy (Criterion 8: use of internet games to escape or relieve a negative mood, such as helplessness, guilt, anxiety or depression; Petry et al., 2014b).

Therefore, it is unclear whether the higher distress and disability reported by Pearcy and colleagues (2016) in their IGD group were attributable to IGD per se, or rather comorbid disorders. Research must demonstrate that IGD is uniquely associated with problematic levels of distress and disability. Additionally, since the release of the DSM-5 criteria for IGD (APA, 2013), there has been limited research examining comorbidities with IGD. To date, three studies have investigated specific relationships with IGD. The first study reported that the IGD and ADHD were comorbid, with 39.08% of individuals who met IGD criteria also meeting ADHD criteria (Yen, Liu, Wang, Chen, Yen, & Ko, 2016). The second study reported that individuals with IGD were more likely to have symptoms of depression compared to the control group and that comorbid depression symptoms were associated with poorer emotion regulation in participants with IGD (Lee, Lee, Chun, Cho, Kim, & Jung, 2015). The third study reported that in a sample of 14-17-year-olds, IGD was associated with a range of comorbid psychosocial and psychological symptoms, including anxiety, depression, and attention problems (Müller et al., 2015). However, no previous studies have explored all of the proposed comorbidities in the DSM-5.

The first aim of the current study was to investigate the prevalence of major depressive disorder, ADHD, OCD and generalized anxiety disorder (GAD) symptoms in individuals who did and did not meet criteria for IGD. The second aim was to investigate whether IGD explains unique variance in distress and disability after accounting for symptoms of comorbid depression, OCD, ADHD, and GAD. The first hypothesis was that participants with IGD based on the PIE-9 would display higher rates of comorbid symptoms compared to those who did not meet the IGD criteria. The second hypothesis was that IGD would explain unique variance in distress and disability after accounting for symptoms of comorbid disorders.

Method

Participants. Convenience samples of adult community members ($N = 285$) and university students ($N = 119$) who reported engaging in internet gaming participated in this research. The sample included 70% males ($N = 282$) and 30% females ($N = 121$), with an age distribution between 16 and 60 ($M = 23.8$ years, $SD = 7.2$). Please see Pearcy et al. (2016) for further demographic characteristics.

Measures. The Personal Internet Gaming Disorder Evaluation (PIE-9; Pearcy, Roberts, & McEvoy, 2016) is a 9-item scale developed as a self-report measure of the proposed IGD criteria (APA, 2013). Participants rate the frequency of symptoms over the past 12 months using a 5-point Likert scale ranging from never (1) to very often (5). Pearcy and colleagues (2016) reported a single factor structure, and high internal consistency ($\alpha = 0.89$) and test-retest reliability ($ICC = 0.77$). Convergent validity was assessed with the internet Gaming Disorder test (IGD-20 test; Pontes, Kiraly, Demetrovics, & Griffiths, 2014) ($r = .64$), Gaming Addiction Scale ($r = .57$; Lemmens, Valkenburg, & Peter, 2015) and the Problematic Video-game Playing scale (PVP; Salguero, & Moran, 2002) ($r = .43$). The psychometric properties and suggested caseness cut off scores for the mental disorder measures used in this research are summarised in Table 4.1.

Table 4.1. Summary of existing disorder measures

Measure name	Purpose	Number of items	Response format	Sample item	Factor structure	Internal Consistency (α)	Caseness criteria
GAD-7	Generalised anxiety disorder	7	4 point Likert, not at all (0) to nearly every day (3)	Not being able to stop or control worrying	1	.92	>10[a]
PHQ-9	Major depressive disorder	9	4-point Likert, not at all (0) to nearly every day (3)	Little interest or pleasure in doing things	1	.89	>10[b]
ASRS	Adult ADHD	18	5 point Likert from never (0) to very often (4)	How often are you distracted by activity or noise around you?	2	.88	>17[c]
OCI-R	Obsessive-compulsive disorder	18	5 point Likert, not at all (0) to extremely (4)	I collect things I don't need	6	.83 - .90	≥21[d]
K10	Non-specific psychological distress	10	5-point Likert, none of the time (1) to all of the time (5)	During the last 30 days, how often did you feel that everything was an effort?	1	.93	
WHODAS 2.0	Disability	12	5-point Likert, none to extreme or cannot do.	In the past 30 days, how much difficulty have you had in standing for long periods, such as 30 minutes?	1	.94 - .98	

Note. a = Spitzer, Kroenke, Williams, & Löwe, 2006, b = Kroenke, & Spitzer, 2002, c = Kessler et al., 2005, d = Foa et al., 2002, GAD-7 = Generalized Anxiety Disorder 7 scale, PHQ-9 = Patient Health Questionnaire 9; Kroenke, & Spitzer, 2002, ASRS = World Health Organization Adult Attention Deficit Hyperactivity Disorder self-report scale; Kessler et al., 2005, OCI-R = The Obsessive-Compulsive Inventory – Revised, Foa et al., 2002. Kessler-10 = Kessler 10 scale; Andrews, & Slade, 2001; Kessler et al., 2002, WHODAS 2.0 = World Health Organization Disability Assessment Schedule 2.0 12 item version; Andrews, Kemp, Sunderland, Von Korff, & Üstün, 2009; Üstün et al., 2010; Üstün, Kostanjsek, Chatterji, & Rehm, 2010. α = Cronbach's alpha for the current sample.

The following established measures were utilised to assess related symptoms or disorders, and each scale has demonstrated adequate reliability and validity for research purposes. The Kessler-10 scale (Andrews, & Slade, 2001; Kessler et al., 2002) is an established 10-item measure of non-specific psychological distress. The World Health Organization Disability Assessment Schedule 2.0 (WHODAS) self-report (Andrews, Kemp, Sunderland, Von Korff, & Üstün, 2009; Üstün et al., 2010; Üstün, Kostanjsek, Chatterji, & Rehm, 2010) is a 12-item measure intended for use as a measure of general disability, applicable across cultures. The Adult Self-Report Scale is an adult measure of ADHD, developed by the World Health Organization (Kessler et al., 2005). The Generalised Anxiety Disorder-7 (GAD-7) scale is a brief measure to assess generalised anxiety disorder (Spitzer, Kroenke, Williams, & Löwe, 2006). The Obsessive-Compulsive Inventory – Revised (OCI-R; Foa et al., 2002) is a brief measure designed to assess obsessive-compulsive disorder (OCD). The Personal Health Questionnaire 9 (PHQ-9; Kroenke, & Spitzer, 2002) is a brief measure designed to assess depressive symptoms.

Procedure. Following approval from the University's Human Research Ethics Committee (Approval No. RDHS-09-15), two online surveys were hosted on Qualitrics.com, one survey for students and one for the general public. Questionnaire data were downloaded into SPSS v22 for analysis.

Results

Descriptive information for each of the scale measures by the sample is reported in Table 4.2. Twenty-two participants in the community sample and 12 participants in the student sample met the criteria for internet gaming disorder based on their PIE-9 scores. Table 4.3 provides the number of participants who met the diagnostic criteria for each of the mental disorder measures by internet gaming disorder status. Table 4.3 also provides the results of chi-square tests in a combined sample between IGD and non-IGD groups. The chi-

square tests demonstrated that participants with IGD were more likely to meet criteria for each of the mental disorders than participants in the non-IGD group.

Table 4.2. Mean, standard deviation and range of mental health disorder, distress and disability scales by sample

Measure	Community sample (n = 285)				Student sample (n = 119)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
GAD-7 (total score)	5.28	5.37	0	21	4.66	4.86	0	21
PHQ-9 (total score)	7.49	6.47	0	27	6.18	5.92	0	25
ASRS (total score)	23.27	13.12	0	72	25.8	12.38	0	53
OCI-R (total score)	11.85	12.65	0	72	15.12	13.39	0	52
K10 (total score)	21.21	9.14	10	50	20.24	9.14	10	41
WHODAS (total as a percentage)	15.73	17.59	0	100	15.86	15.25	0	56

Note. PIE-9 Mean data has been reported by Pearcy, Roberts, & McEvoy, 2016, Kessler-10 = Kessler 10 scale, WHODAS 2.0 = World Health Organization Disability Assessment Schedule 2.0 12 item version, GAD-7 = Generalized Anxiety Disorder 7 scale, PHQ-9 = Patient Health Questionnaire 9, ASRS = World Health Organization adult Attention Deficit Hyperactivity Disorder self-report scale , OCI-R = Obsessive Compulsive Inventory - Revised.

Table 4.3. Number and percentage of cases who did or did not meet cut-off criteria for GAD, depression, ADHD and OCD by internet gaming disorder classification

	Community sample (n=285)				Student sample (n=119)				Combined sample (n=404)				
	IGD group		Non-IGD group		IGD group		Non-IGD group		IGD group		Non-IGD group		
	n	%	n	%	n	%	n	%	n	%	n	%	χ^2
GAD-7													18.87*
criteria met	12	54.5	44	16.7	4	33.3	17	15.9	16	47.1	61	16.5	
criteria not met	10	45.5	219	83.3	8	66.7	90	84.1	18	52.9	309	83.5	
PHQ-9													15.08*
criteria met	13	59.1	80	30.4	7	58.3	20	18.7	20	58.8	100	27.0	
criteria not met	9	40.9	183	69.6	5	41.7	87	81.3	14	41.2	270	73.0	
ASRS													8.5**
criteria met	19	86.4	170	64.6	12	100.0	78	72.9	31	91.2	248	67.0	
criteria not met	3	13.6	93	35.4	0	0.0	29	27.1	3	8.8	122	33.0	
OCI-R													16.43*
criteria met	10	45.5	36	13.7	6	50.0	30	28.0	16	47.1	66	17.8	
criteria not met	12	54.4	227	86.3	6	50.0	77	72.0	18	52.9	304	82.2	

Note. *p<.001, **p=.002. GAD-7 = Generalized Anxiety Disorder 7 scale, PHQ-9 = Patient Health Questionnaire 9, ASRS = World Health Organization Adult Attention Deficit Hyperactivity Disorder self-report scale, OCI-R = Obsessive Compulsive Inventory - Revised.

Table 4.4. Independent samples T-Tests comparing scores on mental illness disability measures by internet gaming disorder classification

Community sample		n	Mean	SD	t	df	p	Effect Size (Cohen's *d*)
GAD-7	IGD	22	9.32	5.83	3.75	283	<.001	.83
	Non-IGD	263	4.94	5.21				
PHQ-9	IGD	22	13.32	8.03	4.55	283	<.001	1.01
	Non-IGD	263	7.00	6.09				
ASRS	IGD	22	35.82	18.18	3.44[a]	22.57	.002	1.07
	Non-IGD	263	22.22	12.07				
OCI-R	IGD	22	26.77	23.76	3.17[a]	21.68	.005	1.36
	Non-IGD	263	10.6	10.39				
Student sample		n	Mean	SD	t	df	p	Effect Size (*d*)
GAD-7	IGD	12	8.33	5.19	2.84	117	<.001	.86
	Non-IGD	107	4.24	4.68				
PHQ-9	IGD	12	13	6.81	4.55	117	<.001	1.38
	Non-IGD	107	5.41	5.32				
ASRS	IGD	12	40.17	9.08	4.58	117	<.001	1.39
	Non-IGD	107	24.17	11.67				
OCI-R	IGD	12	22.58	16.75	2.06	117	<.001	.62

Non-IGD	107	14.28	12.79

[a]Equal variances not assumed

Note. IGD = Internet gaming disorder, PIE-9 = Personal Internet Gaming Disorder Evaluation 9, GAD-7 = Generalized Anxiety Disorder 7 scale, PHQ-9 = Patient Health Questionnaire 9, ASRS = World Health Organization adult Attention Deficit Hyperactivity Disorder self-report scale , OCI-R = Obsessive Compulsive Inventory - Revised.

A series of independent samples t-tests indicated that participants who met the criteria for IGD scored significantly higher than those who did not on the mental disorder measures (ASRS; Kessler et al., 2005, GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006, OCI-R; Foa et al., 2002 and PHQ-9; Kroenke, & Spitzer, 2002). The effects sizes were large (Table 4.4).

Table 4.5 reports the two hierarchical multiple regression analyses (HMRA) used to test whether 'caseness' (meeting the criteria for IGD) on the PIE-9 accounted for a unique proportion of variance in distress (K10; Andrews, & Slade, 2001; Kessler et al., 2002) and disability (WHODAS-2.0; Andrews, Kemp, Sunderland, Von Korff, & Üstün, 2009; Üstün et al., 2010; Üstün, Kostanjsek, Chatterji, & Rehm, 2010), beyond that accounted for by caseness on the GAD-7, PHQ-9, ASRS and OCI-R. The two analyses were conducted on a combined sample of both the community and student samples to preserve power and minimise Type II error.

The first HMRA predicted distress. On step 1 the GAD-7, PHQ-9, ASRS, and OCI-R, accounted for 67% of the variance in distress, $R^2 = .67$, $F\ (4, 399) = 205.98$, $p < .001$. On step 2, the PIE-9 was added to the regression and accounted for an additional 1% of the variance in distress, $\Delta R^2 = .01$, $F\ (1, 398) = 8.95$, $p = .003$. In combination, the five predictor variables explained 68% of the variance, $R^2 = .68$, adjusted $R^2 = .67$, $F\ (5, 398) = 169.86$, $p < .001$. The effect size for IGD was small. Depression was the strongest predictor.

The second HMRA predicted disability. On step 1, the GAD-7, PHQ-9, ASRS, and OCI-R accounted for 39% of the variance in disability, $R^2 = .39$, $F\ (4, 399) = 65.05$, $p < .001$. On step 2, the PIE-9 was added to the regression and accounted for an additional 3% of the variance in disability, $\Delta R^2 = .03$, $F\ (1, 398) = 22.54$, $p < .001$. In combination, the five predictor variables explained 43% of the variance, $R^2 = .43$, adjusted $R^2 = .42$, $F\ (5, 398) = 59.35$, $p < .001$. As noted in Table 4.5, Each of the predictors of disability were significant in step 2 except anxiety (GAD-7). Interestingly, IGD accounted for more unique variance than

both anxiety and ADHD and was approaching the effect size for Depression. The largest effect size was for OCD.

Table 4.5. IGD as a predictor of distress and disability after controlling for co-morbidities in two hierarchical multiple regression analyses

Variables predicting distress (N = 404)	B [95% CI]	β	sr^2
Step 1			
Anxiety (GAD-7)	5.48 [3.90, 7.06]**	.25	.04
Depression (PHQ-9)	9.19 [7.79, 10.57]**	.48	.14
ADHD (ASRS)	3.20 [2.06, 4.34]**	.17	.02
OCD (OCI-R)	3.74 [2.35, 5.12]**	.17	.02
Step 2			
Anxiety (GAD-7)	5.24 [3.67, 6.81]**	.23	.03
Depression (PHQ-9)	9.09 [7.72, 10.47]**	.47	.13
ADHD (ASRS)	3.09 [1.95, 4.23]**	.16	.02
OCD (OCI-R)	3.52 [2.14, 4.90]**	.16	.02
IGD (PIE-9)	2.77 [.95, 4.59]**	.09	.01
Variables predicting disability (N = 404)	B [95% CI]	β	sr^2
Step 1			
Anxiety (GAD-7)	5.76 [1.61, 9.91]*	.13	.01
Depression (PHQ-9)	10.25 [6.60, 13.89]**	.28	.05
ADHD (ASRS)	4.02 [1.02, 7.03]*	.11	.01
OCD (OCI-R)	13.07 [9.43, 16.71]**	.31	.08
Step 2			
Anxiety (GAD-7)	4.77 [.71, 8.84]*	.11	.01
Depression (PHQ-9)	9.86 [6.31, 13.42]**	.27	.04
ADHD (ASRS)	3.57 [.64, 6.50]*	.10	.01
OCD (OCI-R)	12.18 [8.62, 15.45]**	.29	.06
IGD (PIE-9)	11.36 [6.66, 16.07]**	.19	.03

* $p < .05$ ** $p < .001$

Note. B = Unstandardized regression coefficient, β = Standardised regression coefficient, sr^2 = squared semi-partial correlations, CI = Confidence Interval, ADHD = Attention deficit hyperactivity disorder, OCD = Obsessive-compulsive disorder, IGD = Internet gaming

disorder GAD-7 = Generalized Anxiety Disorder 7 scale, PHQ-9 = Patient Health Questionnaire 9 , ASRS = World Health Organization adult Attention Deficit Hyperactivity Disorder self-report scale , OCI-R = Obsessive Compulsive Inventory - Revised.

Discussion

This study examined the comorbidity of internet gaming disorder with other mental disorders. The first hypothesis that participants with IGD based on the PIE-9 would display higher rates of comorbid symptoms of GAD, depression, OCD, and ADHD compared to those who do not meet the IGD criteria was partially supported. Participants who met the criteria for IGD, compared to those who did not meet the IGD criteria, reported higher rates of comorbid symptoms of depression (59% vs. 27%), ADHD (91% vs. 67%), GAD (47% vs. 17%), and OCD (47% vs. 18%). The second hypothesis that IGD would explain unique variance in distress and disability after accounting for symptoms of comorbid disorders was supported. IGD caseness explained unique variance in distress and disability after accounting for GAD, depression, ADHD, and OCD caseness. For disability, IGD explained a higher proportion of unique variance than GAD and ADHD, and a similar proportion of unique variance to depression.

IGD comorbidity with other mental disorders. The findings from this study were consistent with suggestions in the latest edition of the DSM (APA, 2013) that IGD is likely to be co-morbid with Major Depressive Disorder, ADHD, and OCD. In addition, GAD was investigated as a probable co-morbid disorder because of the potential relationship to two of the criteria for IGD, withdrawal symptoms and to 'escape or relieve a negative mood' (Petry et al., 2014b). In the current study, participants who met the criteria of IGD were more likely to have higher scores on each of the existing mental disorder measures. In the community sample, the strongest effect sizes were for OCD, ADHD, and major depressive disorder, in descending order. In the student sample, the strongest effect sizes were for ADHD and major depressive disorder followed by GAD and OCD. Our findings were consistent with recent research that also found higher rates of comorbid anxiety and attention problems (Müller et

al., 2015) and ADHD (Yen, Liu, Wang, Chen, Yen, & Ko, 2016) symptoms in people who met, or who were at risk of meeting, IGD criteria.

Unique variance in distress and disability. It is now often accepted that comorbidity across mental disorders is the norm rather than the exception (APA, 2013). In building evidence that IGD may be considered a separable disorder it is important to demonstrate that IGD uniquely contributes to distress and disability. The findings of the current study provide evidence that IGD is associated with statistically significant but limited unique variance in distress and disability. Specifically, IGD explains a relatively small proportion of unique variance in distress compared to symptoms of comorbid disorders such as depression, anxiety, ADHD, and OCD. However, IGD explained a similar proportion of unique variance in disability to depression and more than GAD and ADHD. The PIE-9 accounted for a larger portion of unique variance in disability (3%) compared to distress (1%).

IGD may have shown a stronger unique relationship with disability than distress due to the nature of the primary activity of IGD. Gaming itself is a pleasurable activity (i.e., not distressing per se), however, when the criteria of IGD are met this activity may become disabling. Similarly, individuals who excessively gamble typically do not find the activity of gambling distressing (Shaffer, & Korn, 2002), but considerable disability can ensue from the consequences of excessive gambling. The main impact of the disorder may therefore be reflected in adverse effects in the domains of life goals, social functioning, schooling, physical health, and mental wellbeing, which cumulatively account for what has been captured by the measure of disability. This is particularly the case for individuals who meet the criteria for IGD, which require the symptoms to be present for at least 12 months (APA, 2013).

Limitations. The effect sizes for IGD in each of the MRAs were relatively small and this does not necessarily imply practical significance. The limited number of cases of IGD in

the sample may have reduced power to detect true effects. However, this was addressed in part by combining the two samples for the MRA. Additionally, although the measures used for existing mental disorders are well established, caseness was not determined by structured diagnostic assessments. We would recommend that future studies utilise structured clinical interviews with clinical samples, rather than an online survey approach if attempting to replicate or extend the results of the current study.

Future research direction. Perhaps one of the more interesting incidental findings of the current study was the high number of cases that met both ADHD and IGD criteria. In particular, all participants who met the criteria for IGD in the student sample also met the criteria for likely having ADHD. There is currently research underway to investigate whether video gameplay can improve ADHD symptoms (Anderson, 2015) based on the premise that those with ADHD appear to be able to better focus for extended periods on video games, compared to other activities. Additionally, there appears to be a relationship between video gameplay and ADHD, with early research suggesting there may be bidirectional causality between ADHD and increased video gameplay (Gentile, Swing, Lim, & Khoo, 2012).

In addition to exploring the relationship between ADHD and IGD, continuing to develop our understanding of the underlying nature of IGD may further our understanding of why these relationships exist, both theoretically and practically for treatment purposes. As a first step towards this, we recommend investigating whether the results of the current study can be replicated by conducting a follow-up study in a clinical setting to assess whether these comorbidities present during diagnostic interviews in clinical samples. Finally, brief alternative measures of IGD were recently developed (The Internet Gaming Disorder Scale; Lemmens, Valkenburg, & Gentile, 2015, Internet Gaming Disorder Scale – Short Form; Pontes, & Griffiths, 2015), so it would be useful to compare these instruments to the PIE-9 in terms of the ability to discriminate between IGD and other mental disorders, and uniquely

predict distress and disability. Convergence between research using these instruments will strengthen confidence in our findings.

Conclusions. This study extends knowledge about the relationship of IGD to existing mental disorders. Despite comorbidities, the finding that IGD contributes unique variance in explaining distress and disability helps to build the case for including IGD in further editions of the DSM as a distinct disorder. However, further evidence of the uniqueness of IGD would assist in supporting the findings of the current study.

Chapter 5: Internet gaming disorder cognitions: A brief measure assessing thoughts associated with problematic gaming

Background and Aims: The Diagnostic and Statistical Manual of Mental Disorders (5th Edition; DSM-5) has included internet gaming disorder (IGD) in areas for further research, highlighting the need for research to investigate the disorder and its effect on the population. One promising avenue is investigating cognitions associated with IGD, as a preoccupation with gaming is one of the proposed diagnostic criteria. This study aimed to test a theoretical model of gaming cognitions and to validate a modified, and short version of the Problematic Gaming Cognitions Scale (PGCS) as a statistical predictor of IGD symptoms severity.

Design: Cross-sectional correlational design. An online survey was conducted as part of a broader study on IGD.

Setting: Online survey.

Participants: Adult participants (N = 285, Male = 75.4%, Female = 24.6%) were recruited through online forums to complete measures of IGD symptoms and gaming cognitions.

Measures: Problematic Internet Gaming Disorder Evaluation (PIE-9) and Problematic Gaming Cognitions Scale (PGCS).

Findings: The four-factor structure of the 26-item PGCS found in previous studies provided a poor fit to data. A bifactor model demonstrated the most acceptable fit, and the general preoccupation factor demonstrated a strong positive relationship with IGD symptoms, accounting for 61.62% of the variance. A short 12-item version was highly correlated with the longer version.

Conclusions: Our findings indicated that frequency of gaming-related cognitions overall (preoccupation) was a strong statistical predictor of IGD symptoms, but that distinguishing between different types of cognitions had little additional predictive utility.

Internet games are a hobby for many (McQuade, Gentry, & Colt, 2012), however, there are concerns about the negative consequences of internet gaming for some individuals. Recently, research has focused on the proposed internet gaming disorder (IGD; APA, 2013) criteria detailed in the Diagnostic and Statistical Manual for Mental Disorders (5th edition, DSM-5; APA, 2013), and a similar diagnosis named Gaming Disorder outlined in the 11th edition of the International Classification of Diseases (ICD-11; WHO, 2018; Discussed further, and compared in Chapter 7, and Table 7.1). IGD is posited as a behavioural addiction related to excessive internet game participation. The DSM-5 proposes nine IGD criteria, one of which includes preoccupation with gaming: "Preoccupation with internet Games. The Individual thinks about previous gaming activity and anticipates playing the next game; internet gaming becomes the dominant activity in daily life." (APA, 2013, p.795). Petry and colleagues (2014) further noted that this DSM-5 criterion was primarily a cognitive process, defined by thinking excessively about gaming, including at times when the individual is not playing games. Although the definition and commentary provide an indication of the frequency of preoccupation needed for diagnosis, they only provide preliminary indications of the content of these thoughts, such as fantasising about games or anticipation of playing (Petry et al., 2014b). Relatedly, the act of preoccupation itself does not distinguish between problematic and non-problematic behaviour associated with internet gaming (e.g., respectively as a hobby or pastime, compared to excessive use; Petry et al., 2014b). Increasing our understanding of thoughts about gaming that are associated with problematic gaming habits is important for developing effective treatments (King, & Delfabbro, 2014a; King, & Delfabbro, 2014b).

Several different models describe thoughts or cognitions that may be associated with IGD. Davis (2001) proposed the Pathological Internet Use Model, which provided a framework for future cognitive models of problematic internet use and its specific types,

including IGD. Davis (2001) proposed that maladaptive cognitions were key predictors of problematic internet use, which are reinforced by further internet use. Maladaptive cognitions may include ruminating on internet-related concerns (e.g., thinking of responses on online forums while attending to other activities), negative appraisals of one's self-worth, and 'all or nothing' thinking (e.g., I am connected to people only on the internet). Research has since demonstrated that cognitive distortions associated with problematic internet use are associated with IGD as well as problematic internet use more generally (Forrest, King, & Delfabbro, 2016; Huanhuan, & Su, 2013; King, & Delfabbro, 2016).

Dong and Potenza (2014) proposed a cognitive-behavioural model of IGD to inform treatment for IGD symptoms. Their model suggests that individuals with IGD may develop a diminished ability to inhibit their gaming due to compromised decision making, whereby short-term gaming rewards (e.g., stress reduction, sense of achievement) are repeatedly prioritised over the long-term negative consequences of extended gaming (e.g. not meeting studying, school work or employment responsibilities). Each time the individual makes the decision to engage in gaming rather than other activities, executive functioning becomes further compromised, thereby exacerbating a vicious cycle that increases gaming frequency and reduces functional behaviours in life areas such as study, work, or time with family and friends. Dong and Potenza's (2014) model describes a link between maladaptive cognitions that may precede gaming behaviours, although, like the DSM-5 definition of preoccupation, does not prescribe the content of these cognitions. Overall, Dong and Potenza's (2014) model furthers Davis' (2001) problematic internet use model by proposing that maladaptive cognitions reinforce IGD behaviours (King, & Delfabbro, 2016), and is consistent with previous research focusing on the frequency of preoccupation, rather than the content of the gaming-related thoughts.

To further investigate the preoccupation criterion, King and Delfabbro (2014b) conducted a systematic literature review of internet gaming cognitions. Twenty-six illustrative client statements then described these internet gaming cognitions. The illustrative client statements were divided by four key cognitions: beliefs about in-game rewards, maladaptive and inflexible rules about gaming, gaming-based self-esteem, and gaming as a means of gaining social acceptance. The specific cognitions identified in King and Delfabbro's (2014b) review may help to differentiate between problematic and non-problematic cognitions and thereby inform the content of cognitions that constitute the preoccupation criterion proposed by DSM-5 (APA, 2013).

A follow up to King and colleagues'(2014b) study resulted in an 18-item measure of gaming cognitions, after removing four items due to factor structure issues and cross loading (Forrest, King, & Delfabbro, 2016). They found support for a four-factor model of gaming, however items loaded differently to the originally proposed model. The four factor themes that emerged were perfectionism, cognitive salience (which is a similar construct to the preoccupation criterion (King, & Delfabbro, 2014b), regret, and behavioural salience. The authors noted that participants who did not meet IGD criteria endorsed the same maladaptive cognitions, just to a lesser extent (Forrest, King, & Delfabbro, 2016), suggesting that these cognitions exist on a spectrum, with a higher frequency or endorsement of the cognitive beliefs predicting a higher likelihood of problematic gaming.

The current study. The first aim of this study was to test the proposed four factors of problematic gaming cognitions proposed by King and Delfabbro (2014b) in an independent sample. As the follow up study (Forrest, King, & Delfabbro, 2016) found a different set of four cognitive factors, it is important to demonstrate that the proposed cognitive model can be replicated. It was hypothesised that the four-factor model would provide a good fit to the data. The second aim was to examine the relationships between the resulting factors and IGD

symptoms. It was hypothesised that problematic gaming cognitions would significantly statistically predict IGD symptoms.

Method

Participants. A community sample of 285 participants (75.4% male, 24.6% female) was recruited through online forums. Participants were predominantly from Australia (*n* = 101, 35%), the United States (*n* = 90, 32%), and the United Kingdom (*n* = 30, 11%). Participants were mostly in full-time employment (*n* = 102, 36%), or full-time study (*n* = 94, 33%), while some were not in education, training or employment (*n* = 36, 13%). The inclusion criteria were (a) ≥ 1hour of internet gaming per week, and (b) ≥16 years of age. The mean age was 25.08 years (*SD* = 7.87), and the mean time playing online games was 19.82 hours/week (*SD* = 15.99).

Measures. The online survey was part of a larger project (Pearcy, Roberts, & McEvoy, 2016; Pearcy, McEvoy, & Roberts, 2017). Only measures relevant to the current paper are outlined below.

The Problematic Gaming Cognitions Scale (PGCS). King and Delfabbro (2014b) detailed 26 illustrative client statements relating to four proposed cognitive factors underlying IGD: 1) Beliefs about game reward value and tangibility, 2) Maladaptive and inflexible rules about gaming behaviour, 3) Over-reliance on gaming to meet self-esteem needs, and 4) Gaming as a method of gaining social acceptance. The statements were developed after reviewing literature in the area relating to cognitions associated with online gaming (Petry et al., 2014b). Minor amendments were made to the statements, to ensure the focus was on internet gaming (See amended statements in Table 5.1). Participants were asked to rate how frequently they experienced each thought using a 5-point Likert-type scale ranging from (1) never, (2) rarely, (3) sometimes, (4) often, to (5) very often, over the past year.

The PIE-9. The Problematic Internet Gaming Disorder Evaluation (PIE-9) was developed as a brief self-report measure to assess the DSM-5 criteria for IGD (Pearcy, McEvoy, & Roberts, 2016). The scale consists of nine questions corresponding to the nine proposed DSM-5 IGD criteria (APA, 2013), with a 5-point Likert-type scale ranging from never (1) to very often (5), indicating frequency of symptoms over the past 12 months. The measure has acceptable internal reliability (α =.89), test-retest reliability (*ICC* = .77), and convergent validity with existing problematic gaming scales (Pearcy, Roberts, & McEvoy, 2016; Pearcy, McEvoy, & Roberts, 2017).

Procedure. Following informed consent procedures, participants completed the online survey on Qualtrics.com.

Data analysis. SPSS (v22) was used for data preparation, descriptive statistics and correlations. Confirmatory factor analysis (CFA) was used to test the hypothesised structure of the PGCS, and structural equation modelling (SEM) to examine predictive utility with IGD symptoms, using MPlus (v7.4; Muthén, & Muthén, 1998-2015) with the Weighted Least Squares Means and Variance adjusted (WLSMV) estimator, as this is a robust approach with categorical variables, and does not assume normally distributed data (Brown, 2006). While exploring potential models, both conventional and bifactor models were tested. Bifactor models allow for the identification of the proportion of reliable variance that explains total and subscale scores within the measure by allowing all items to load on a common factor (general factor) as well as on their designated subfactor (group factor). If the measure is characterised by a strong general factor and unreliable group factors, this would suggest that the variance it is assessing is a unidimensional gaming cognitions factor. If the measure is characterised by strong and reliable group factors, multidimensionality is indicated. Furthermore, bifactor models allow the examination of the unique predictive utility of the general and group factors.

To assess the suitability of each model to the data, a number of fit indices were examined. The Chi-Square (χ^2) statistic is reported for each model but not considered to assess model fit because it is highly sensitive to sample size, thereby inflating Type II error. The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) can be interpreted as acceptable fit with values above .90 and excellent fit if values exceed .95 (Hu, & Bentler, 1999). Root Mean Square Error Approximation (RMSEA) values at or below .08 indicate acceptable fit, with lower values indicating a better fit (Hu, & Bentler, 1999). The Standardised Root Mean Square Residual (SRMR) was reported for EFA analyses, with a proposed cut-off of .08 (Hu, & Bentler, 1999), for comparison the experimental fit index of Weighted Root Mean Square Residual (WRMR; Muthén, & Muthén, 1998-2015) was reported for confirmatory bifactor analyses, and early evidence suggests a cut-off of 1.0 with lower indicating a better fit (DiStefano, Liu, Jiang, & Shi, 2017). The Difftest function in MPlus was used to compare nested models.

Ethics. The study was approved by the Institution's Human Research Ethics Committee (Approval No. RDHS-09-15). Information and contact details related to the study were provided to participants on the first page of the online survey. Participants provided their informed consent before continuing with the online survey.

Results

Descriptive statistics for the PGCS. The dispersion of scores, and measures of central tendency for each of the 26 items of the scale, are provided in Table 5.1.

Table 5.1. Descriptive statistics of the 26 items of the Problematic Gaming Cognitions Scale (*N* = 285)

Item	Mean	Standard deviation
*01. Rewards in internet games are as real to me as anything else in my life.	2.42	1.19
02. When my game character achieves something, I feel like I have achieved that.	3.15	1.18
03. I find myself thinking about internet games when I am not playing.	2.89	1.18
04. I often plan or think about the next thing I need to do in a game.	3.15	1.07
05. It is a waste to not try to complete a game once I have invested my time and energy.	2.83	1.26
06. When I make mistakes or fail in a game, I must reload and try again.	3.27	1.03
07. When I have a goal or objective in an internet game, I must complete it.	3.27	1.04
08. I feel unsatisfied until I have achieved 100% or unlocked everything in a game.	2.10	1.12
09. I always play internet games before doing something else, e.g., homework or chores.	2.75	1.19
10. I tell myself 'just a few more minutes' when I play a game, but then play much longer.	3.06	1.25
*11. I feel uncomfortable thinking about my unfinished games or objectives.	1.76	1.01
12. I am proud of my gaming achievements.	3.26	1.05
*13. I would be a failure without my gaming.	1.52	.95
14. I will feel better after playing internet games.	3.13	1.01
*15. I would feed bad if I was not able to play internet games.	2.47	1.13
*16. I feel more in control when I play internet games.	2.49	1.21
*17. An internet game is the only place I feel safe.	1.67	1.07
*18. I would not cope with stress in my life without internet games.	2.21	1,31

19. If I complete or master a internet game, I feel good about myself.	3.36	1.11
*20. People who do not play internet games do not understand me.	2.09	1.18
*21. I can only relate to people in the internet game.	1.53	.89
22. I become better than others by beating other game players.	2.20	1.24
*23. Playing internet games protects me from people and situations that make me uncomfortable.	1.97	1.18
*24. Internet games enable me to escape from my problems and responsibilities.	2.51	1.34
*25. If I am good at an internet game, players will notice and take me seriously.	2.27	1.28
26. Other players admire and respect my gaming achievements.	2.31	1.21
26-item Scale Total	65.65	16.95
12-item Scale Total	24.92	9.45

* = Item's used in the short version of the PGCS.

Confirmatory factor analysis. The proposed four-factor model demonstrated poor model fit, $\chi^2(293) = 1285.01$, $p < .001$, *CFI* = .813, *TLI* = .793, *RMSEA* = .109 [*C.I.* = 0.103 – 0.115], *WRMR* = 1.79. The modification indices indicated cross-loadings between most factors and items, which is consistent with a possible bifactor structure. Given the poor fit, we conducted exploratory factor analyses (EFA) to identify a factor model that may provide an acceptable fit.

Exploratory factor analyses. An exploratory bifactor analysis was conducted to concurrently evaluate the plausibility of group factors (measured by subscales), and a common factor assessed by all items. Bifactor models are ideal for accounting for the common factor reflected in extensive cross-loadings, as was found in the CFA. Bi-Oblimin rotation was used as the latent factors were expected to be correlated.

We explored conventional EFA models from 1 to 6 factors, and bifactor models from 2 to 7 factors. A bifactor model with one general factor and four group factors provided the best fit to the data and was most interpretable, although items 1, 2, 7, 12, and 14 cross-loaded, potentially due to the wording of the items each relating to the player gaining a sense of achievement or objectives within a game. The five-factor EFA demonstrated comparable fit to the bifactor model. However, items demonstrated extensive cross-loadings, and the solution was mostly uninterpretable thematically, providing further justification for the selection of the bifactor model (Table 5.3). The correlations of the final bifactor EFA are summarised in Table 5.2.

Table 5.2. Factor loadings of the 26 items of the Problematic Gaming Cognitions Scale from the final exploratory bi-factor model

Item	General factor	GF1 Self-esteem	GF2 Preoccupation	GF3 Perfectionism	GF4 Achievement
1. Rewards in internet games are as real to me as anything else in my life.	.61	.30			.26
2. When my game character achieves something, I feel like I have achieved that.	.50	.45			.41
3. I find myself thinking about internet games when I am not playing.	.58		.60		.17
4. I often plan or think about the next thing I need to do in a game.	.47		.55		.20
5. It is a waste to not try to complete a game once I have invested my time and energy.	.36			.62	
6. When I make mistakes or fail in a game, I must reload and try again.	.27			.53	
7. When I have a goal or objective in an internet game, I must complete it.	.38			.61	.36
8. I feel unsatisfied until I have achieved 100% or unlocked everything in a game.	.37			.59	
9. I always play internet games before doing something else, e.g., homework or chores.	.51	-.16	.37	.18	
10. I tell myself ‘just a few more minutes’ when I play a game, but then play much longer.	.34		.45	.27	

11. I feel uncomfortable thinking about my unfinished games or objectives.	.63			.45	
12. I am proud of my gaming achievements.	.47	.25			.44
13. I would be a failure without my gaming.	.75		-.18		
14. I will feel better after playing internet games.	.57	.28	.18		
15. I would feel bad if I was not able to play internet games.	.71		.29		
16. I feel more in control when I play internet games.	.79				-.20
17. An internet game is the only place I feel safe.	.77		-.14		-.36
18. I would not cope with stress in my life without internet games.	.75				-.31
19. If I complete or master an internet game, I feel good about myself.	.56	.12			.36
20. People who do not play internet games do not understand me.	.67			.14	
21. I can only relate to people in the internet game.	.77		-.20		
22. I become better than others by beating other game players.	.52				.35
23. Playing internet games protects me from people and situations that make me uncomfortable.	.76				
24. Internet games enable me to escape from my problems and responsibilities.	.69				-.32
25. If I am good at an internet game, players will notice and take me seriously.	.66				.53
26. Other players admire and respect my gaming achievements.	.53				.68

Note. GF = Group Factor. Estimator = Weighted least-squares mean and variance adjusted (WLSMV), Rotation method= Bi-Oblimin. Kaiser-Meyer-Olkin (KMO) = .902, Barlett's test of sphericity $\chi^2(325) = 3332.63$, $p<.001$. Only significant values are shown.

Table 5.3. Bi-factor and conventional exploratory factor analysis fit statistics and fit statistics for bi-factor structural equation models statistically predicting IGD Symptoms

	χ^2	df	p	CFI	TLI	RMSEA [C.I.]	SRMR
Bi-factor EFA, General and four specific factors	439.99	205	<.001	.96	.93	.063 [.055 - .072]	.038
Univariate EFA	1613.24	299	<.001	.75	.73	.124 [.118 - .130]	.113
Four factor EFA	550.26	227	<.001	.94	.91	.071 [.063 - .078]	.045
Five factor EFA	439.99	205	<.001	.96	.93	.063 [.055 - .072]	.038
Bi-Factor 1g+4 SEM, statistically predicting IGD symptoms	1327.67	528	.001	.89	.87	.073 [.068 - .078]	1.28*
Bi-factor 1g+4 SEM, final model	1247.77	531	<.001	,90	.89	.069 [.064 - .074]	1.27*

Note. While the fit statistics are identical comparing the Bi-factor solution and conventional five factor EFA, the factor structure of the five factor model contained considerable cross-loading of items between factors and was uninterpretable thematically. Fit statistics for all other models are available from the author. EFA = Exploratory Factor Analysis. χ^2 = Chi-Squared, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, C.I. = 90% Confidence Intervals, SRMR = Standardised Root Mean Square Residual, *WRMR = Weighted Root Mean Square Residual.

The bifactor model was then examined to assess the reliability of the common and group factors, and the plausibility of a unidimensional or multidimensional model, using the bifactor indices calculator (Dueber, 2016). The Percentage of Uncontaminated Correlations (*PUC;* .751) and Explained Common Variance (*ECV*) of the general factor (.659), and *Omega H* of the general factor (0.847) demonstrate that the model can be interpreted as primarily unidimensional. Although these statistics indicate some multidimensionality, Rodriguez, Reise, and Haviland's (2016) suggest that if the *ECV* of the general factor is above .60, *PUC* is less than .80, and *OmegaH* is greater than .70, then this level of multidimensionality does not prohibit unidimensional interpretation.

At a factor level, internal reliabilities of the general factor (*Omega*) and group factors (*OmegaS*) were acceptable (all > .70), and so all factors were used in the structured equation models. However, the *Relative Omega* (*OmegaH* divided by *Omega*), the correlations between factor scores and the factors (Factor Determinacy; *FD*), and construct replicability (*H*) indices suggested that the proportion of reliable variance, factor determinacy, and construct replicability, respectively, for each of the group factors should be viewed cautiously. Each of the group factors fell below the recommended cut-off value for factor determinacy (.90) and *H* (.80) (Hancock, & Mueller, 2001). While there are no explicitly assigned cut-off values for *Relative Omega*, in conjunction with *FD* and *H*, these values indicate that the scale would best be interpreted using the total score, rather than considering the subscale scores from each of the group factors. The general factor is likely to be most reliable and replicable in future studies (*H* = .95, *FD* = .97). The group factors explained sufficient unique and reliable variance to be retained within the SEM, but a substantial proportion of variance in observed subscale scores is explained by the general factor (see Table 5.4). The final bifactor model contained all 26 items, with all items loading

significantly on the general factor. Group factors were named to reflect item content (see Table 5.4 for loadings).

Table 5.4. Bi-factor model and factor level statistics

	ECV	Omega / OmegaS	OmegaH/ OmegaHS	Relative Omega	H	Factor Determinacy
General Factor	.66	.95	.85	.89	.95	.97
Specific-Factor 1 (Gaming-based Self-esteem)	.23	.79	.16	.21	.34	.67
Specific-Factor 2 (Preoccupation)	.39	.85	.31	.37	.61	.83
Specific-Factor 3 (Perfectionism)	.63	.83	.53	.63	.71	.87
Specific-Factor 4 (Gaming-based Achievement)	.40	.89	.35	.39	.69	.87

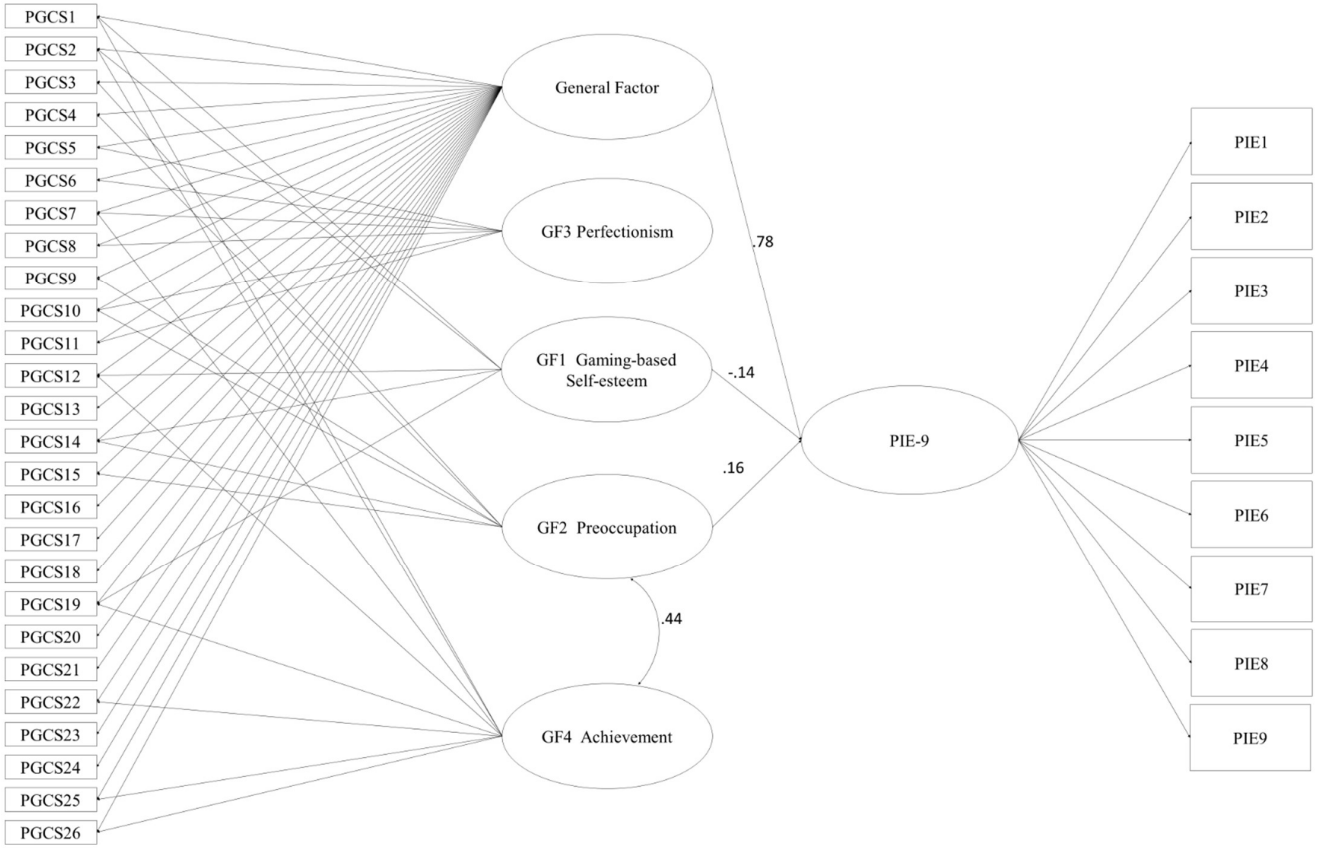
Note. Percentage of Uncontaminated Correlations (PUC) = .751, 'Gaming-based Self-esteem' included items 1, 2, 12, 14, and 19. 'Preoccupation' included items 3, 4, 9, 10, 14, and 15. 'Perfectionism included items 5 to 9, and items 10, and 11. 'Gaming-based Achievement' included items 1, 2, 7, 12, 19, 22, 25, and 26. ECV = Explained Common Variance. Omega (Omega or ω) and OmegaS (OmegaS or ω_s) are estimates of the model's internal reliability. Omega utilises all items to assess the general factor, and OmegaS utilises only the items that load on each group factor. Omega, and OmegaS can be interpreted similarly to Cronbach's alpha in that scores above .70 are considered acceptable for internal reliability of the factor. Omega Hierarchical (OmegaH or ω_H), provides the systematic variance in raw total scores on the general factor as a percentage. The subscale version of Omega H, Omega HS (OmegaHS or ω_{HS}) indicates the reliable systematic variance of the subscale score, after accounting for variance related to the general factor. To obtain a percentage value of the reliable variance of the general factor in a

multidimensional composite, Omega is divided by OmegaH, known as the Relative Omega. H is a measure of construct replicability for latent factors. Factor determinacy (FD) provides a correlation between the scores on a factor and the factor.

Structural equation modelling to statistically predict IGD symptoms. Structural equation modelling was conducted to test the utility of the PGCS bifactor model in statistically predicting IGD symptoms. A restrictive model was first used with covariances between the group or general factors fixed to zero. The model fit was unacceptable (see Table 3). Several sources of model strain were identified after reviewing pathways and modification indices. Items 9 (r = .097, p = .092) and 20 (r =.073, p =.247) were found to have non-significant loadings on the Perfectionism group factor, so these pathways were removed from the model. Modification indices indicated that the covariance between the Preoccupation and Gaming-based Achievement group factors (MI = 77.97) should be freed. The Preoccupation and Gaming-based Achievement group factor items contain similar wording related to gaining achievement, for example, thoughts related to the next in-game action, so the covariance was freed to reflect this common method variance.

The fit of the modified model was marginally improved (see Table 5.3 and Figure 5.1). The modification indices were reviewed. However, no further changes were deemed theoretically justifiable. The general factor was strongly correlated with IGD symptoms (r = .78, p <.001), accounting for 61% of the variance. The Preoccupation group factor demonstrated a weak positive correlation (r =.16, p =.001), and accounted for 2.62% of the variance in IGD symptoms. The Gaming-based Self-esteem group factor demonstrated a weak negative correlation with IGD symptoms (r =-.14, p =.009) and accounted for 1.93% of the variance in IGD symptoms.

Figure 5.1. Standardised model two of the structural equation model of the PGCS



Note: Only significant pathways are shown. GF = General Factor, GF1 = Gaming-based Self-esteem, GF2 = Preoccupation, GF3 = Perfectionism, GF4 = Gaming-based Achievement, PIE-9 = Latent factor representing IGD symptoms. PIE# = PIE-9 item. PGCS# = Problematic Gaming Cognitive Scale item.

Short PGCS development. Given that the bifactor indices indicated that the scale was primarily unidimensional, and the general factor of the bifactor model provided the strongest statistical predictor of IGD symptoms, we explored whether a short version of the PGCS would demonstrate comparable predictive utility for IGD symptoms. Briefer measures reduce respondent burden and may prove more practical for clinicians and researchers. Items were selected if they loaded above .60 on the general factor in the final bifactor model. Twelve items were selected for analysis, PGCS items 1, 11, 13, 15-18, 20, 21, 23-25 (See Table 5.1). Total scores for the 26 item and 12 item versions of the scale were strongly positively correlated ($r = 0.92$, $p < .01$). A structural equation model revealed that correlations with IGD symptoms were similar when gaming cognitions were assessed using the PGCS12 ($r = .70$, $p < .001$) and PGCS26 (general factor, $r = .67$, $p < .001$).

Discussion

This study aimed to test a four-factor model of gaming cognitions (King, & Delfabbro, 2016), and to evaluate the relationship between the identified factors and IGD symptoms. We found that a bifactor model was the best fit to the data, with the general factor explaining the vast majority of reliable variance in the PGCS items. The group factors explained a small (gaming-based self-esteem, 16%) to medium (perfectionism, 53%) proportion of the unique variance in item scores for the cognition measure, after accounting for the general factor. A general gaming cognitions factor demonstrated a strong relationship with IGD symptoms, whereas the group factors only weakly or non-significantly related to IGD symptoms, after controlling for the general factor. Given the structure could be interpreted as primarily unidimensional, a shorter 12-item version of the PGCS was created from the full 26-item version, which demonstrated a comparable correlation with IGD symptoms to the longer version.

Factor structure. The PGCS loaded onto one general factor, and four group factors (gaming-based self-esteem, preoccupation with gaming, perfectionism, gaming-based achievement), with the general factor accounting for approximately two thirds of the explained common variance in the PGCS. In combination with *OmegaH* being above .80 on the general factor, it is reasonable to interpret the scale as primarily unidimensional (Reise, Bonifay, & Haviland, 2013; Reise, Scheines, Widaman, & Haviland, 2013) and so the scale is best represented by a total score, rather than subscale scores. Our findings provide support for the preoccupation criterion remaining broadly defined by the frequency of cognitions rather than the specific content of gaming-related cognitions. Given that the PGCS response scales assess the *frequency* of thoughts, the general factor may represent the broader *process* of repetitive negative thinking that substantially overlaps with the definition of preoccupation. However, the PGCS items do appear to assess relevant cognitive *content* of the preoccupation, as evidenced by all items loading on the general factor and the strong association with IGD symptoms.

The Preoccupation group factor had a weak correlation with IGD symptoms. Previous research using subscales derived from conventional factor analyses found that 'cognitive salience' (Forrest, King, & Delfabbro, 2016), similar to preoccupation (Petry et al., 2014b), was the strongest statistical predictor of IGD symptoms. We propose that the preoccupation factor in our study may, in fact, represent the specific *content* of the negative thoughts towards gaming, after accounting for the broader *process* of repetitive negative thinking in the general factor. The weak association between the Preoccupation group factor and IGD symptoms is likely a consequence of the general factor already accounting for most of the pathological influence of repetitive negative thinking on an individual's decision making abilities (short term rewards vs long term consequences) and executive function (response inhibition towards gaming) (Dong, & Potenza, 2014). Our findings provide evidence for how

cognitive factors such as the process and content (specific negative thoughts) of repetitive thinking may predict problematic gaming behaviours. Therefore, the process of repetitive negative thinking and maladaptive cognitions in IGD may be functionally similar to other emotional disorders. Repetitive negative thinking has been found to predict symptoms across emotional disorders such as depressive or anxiety disorders (McEvoy, Watson, Watkins, & Nathan, 2013; McEvoy et al., 2019). Repetitive negative thinking may be a transdiagnostic factor that explains comorbidity amongst IGD and other emotional disorders.

Previous research has found that Gaming-based Self-esteem is statistically predictive of IGD (Beard, Haas, Wickman, & Stavropoulos, 2017; King, & Delfabbro, 2016), but in our study this group factor only explained a small proportion of reliable unique variance after taking into account the general factor, and it was weakly and negatively correlated with IGD symptoms. The negative relationship is counterintuitive but is likely to be a consequence of a small proportion of residual error variance (noise) remaining in the gaming-based self-esteem factor after taking into account the general factor.

Comparison of findings to existing theoretical models. Our findings demonstrated a broad overall cognitive process that predicted IGD. Our study is the first to assess cognitions associated with gaming using bifactor modelling. The advantage of bifactor modelling is that it enables researchers to concurrently investigate the reliability of common and group factors across all items, along with the variance that each explains in total and subscale scores. Previous research has found that factors within the PGCS are highly correlated (Forrest, King, & Delfabbro, 2016; King, & Delfabbro, 2016). Additionally, Forrest and colleagues (2016) adapted 22 of the original 26 statements developed by King and Delfabbro (2014b) into their statements and removed four items for "…not contributing to a simple factor structure," pp. 402 leaving 18 items loading onto four factors. Cross-loading items, difficulties identifying a simple factor structure (Forrest, King, & Delfabbro, 2016), and

strong correlations between factors in previous studies (Forrest, King, & Delfabbro, 2016; King, & Delfabbro, 2016) could be explained by a common general factor, as it was with our research.

Forrest and colleagues (2016) theorised that there were cognitions associated with problematic gaming beyond preoccupation with gaming. For example, some participants reported thinking about video-games while not playing and have had difficulty concentrating on activities other than video-games, which was used to explain how problematic gaming cognitions could significantly impact on individuals' lives. It may be that these cognitions are elements of the general preoccupation factor. Alternatively, it is possible that important cognitions are not assessed by the PGCS and future research should investigate whether adding these cognitions explains additional variance in problematic gaming. However, based on the current PGCS, we propose that our findings are consistent with the definition of preoccupation in the DSM-5 (APA, 2013). The *process* of preoccupation with gaming-related thoughts appears to be best explained by a broad and frequently occurring set of maladaptive cognitions captured by the general factor, similar to the construct of repetitive negative thinking that is a transdiagnostic feature of other emotional disorders (Ehring, & Watkins, 2008). Future research should investigate whether a general tendency to engage in repetitive thinking (i.e., with gaming and non-gaming cognitions) is a vulnerability or maintenance factor, or whether the repetitive thinking tends to be solely focused on gaming cognitions for individuals with IGD. It may be that repetitive negative thinking is a general vulnerability factor for psychopathology, whereas preoccupation with gaming-related cognitions is a specific vulnerability factor for IGD (Nolen-Hoeksema, & Watkins, 2011). In our study, the general factor statistically predicted IGD symptoms much more strongly than the preoccupation group factor. Although the frequency and content of cognitions cannot be clearly delineated in the PGCS, given that it assesses the frequency of specific cognitive

content, we conceptualised the preoccupation group factor as capturing residual variance in the *content* of thoughts about gaming after taking into account the *process* of repetitively thinking about gaming. After accounting for the general factor, the residual variance captured by each of the group factors had little statistical predictive power. Therefore, we conclude that the current definition in the DSM-5 (APA, 2013) of the preoccupation criterion that is broadly defined and focused on the process or frequency of thoughts, may be more useful to clinicians than the content itself.

Limitations. While the proposed bifactor model was a strong statistical predictor of IGD symptoms, the fit statistics for the structural model fell below typically accepted cut-off values (Hu, & Bentler, 1999). The results should, therefore, be viewed with caution and require replication. We also used a cross-sectional design for the study, so causal conclusions could not be made about the relationship between gaming cognitions and IGD symptoms. Future research could also investigate measurement invariance across individuals who do versus do not meet criteria for IGD, to ensure that the instrument is interpreted similarly across these groups and thus, valid comparisons can be made. It is plausible that the measurement model for the PGCS would provide a better fit for individuals who engage in problematic gaming than for individuals who engage in recreational but not problematic gaming.

Conclusions. Our findings are consistent with cognitive models that consider maladaptive thoughts about gaming to be important predictors of future behavioural problems (Dong, & Potenza, 2014), and with previous research demonstrating a positive relationship between maladaptive cognitions and IGD (Forrest, King, & Delfabbro, 2016; King, & Delfabbro, 2016). However, by using bifactor modelling for the first time, our findings demonstrated that an overarching preoccupation factor was a better statistical predictor of IGD symptoms than specific factors. When diagnosing IGD, our findings suggest that the

DSM-5 (APA, 2013) preoccupation criterion, which encapsulates the frequency of gaming-related cognitions, may be more important than the qualitative distinctions in the content of thoughts defined by PGCS subfactors found in previous studies. Gaining an understanding of the cognitions is still useful for understanding the underlying mechanisms. However, it appears that the frequency of gaming-related thoughts is more important than distinguishing the content. The findings may inform the development of treatment approaches that assist individuals in reducing problematic gaming behaviours by targeting the frequency of gaming-related cognitions. We hope that the short 12-item scale will be feasible in most clinical settings to inform case formulation, treatment planning, and outcome evaluation, and in research settings to continue improving our understanding of the role of that preoccupation plays in increasing vulnerability to, and maintenance of, IGD.

Chapter 6: A structured interview for assessing internet gaming disorder: The Personal Internet Gaming Disorder Evaluation - Interview (PIE-Interview)

The Personal Internet Gaming Disorder Evaluation (PIE-9) is a brief self-report measure of internet gaming disorder (IGD) based on the Diagnostic and Statistical Manual for Mental Disorders (5th Edition; DSM-5) criteria. The current study compared the PIE-9 to a newly developed clinical interview version (PIE-Interview) using a community sample (N = 45) who reported participating in at least 20 hours of video games per week. The PIE-9 and PIE-Interview demonstrated a strong correlation with each other, and the PIE-9 demonstrated strong correlations with measures of distress and disability. The interview version identified a similar proportion of individuals with IGD as the self-report PIE-9, with reasonable specificity between the two measures. Measures with high specificity are useful in ensuring a low false-positive rate to avoid overdiagnosis. Given IGD is in its early stages of recognition as a disorder, the PIE-Interview shows promise as a brief clinician-administered tool for diagnosis of IGD. The PIE-Interview also provides important information about the clinical features of pathological gaming, including a preoccupation with gaming-related thoughts, withdrawal symptoms, and the use of deception, which demonstrate the highest agreement between the two measures.

Internet gaming disorder (IGD) has received increasing interest and recognition in the past five years since its inclusion in the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; APA, 2013) as an area for future research. More recently, IGD has been included in the International Classification of Disease 11th Edition (WHO, 2018). Within the research community, ongoing debate is occurring around IGD and the degree to which it impacts those affected, and whether a diagnosis pathologises a common and harmless pastime in video-gaming (van Rooij et al., 2018). However, several prominent researchers have put forward a rationale for the inclusion of problematic gaming in the ICD-11 on the basis of established epidemiological, neurobiological, and clinical evidence of adverse public health and clinical impacts (King, 2018; Rumpf et al., 2018; Sussman, Harper, Stahl, & Weigle, 2017).

One critique of the current body of literature on IGD is that research often relies on self-report survey measures (King et al., 2017; King, Delfabbro, Griffith, & Gradisarc, 2011). Surveys can provide useful information and are generally a very cost-efficient way to acquire data. However, online surveys rely on the individual to interpret and report their current symptoms without the ability of the researcher to probe for further information. Individuals meeting IGD criteria, particularly children and adolescents, may lack the insight or awareness that their gaming is causing them problems across several domains, including sleep, physical activity, dietary problems, psychological wellbeing, social areas, and academic or job performance concerns (Koo, 2017). Therefore, individuals completing a self-report measure of IGD may be less likely to provide accurate or reliable information about their current gaming habits, compared to a structured or semi-structured diagnostic interview (Mihara, & Higuchi, 2017).

As a first step to assessing these concerns, self-report measures can include validation questions, asking the participant about whether they believe their gaming is problematic, and

whether others believe their gaming is problematic (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). However, the development of a structured clinician-administered interview to assess IGD would provide additional benefits beyond the inclusion of validation questions in self-report measures. A clinician-administered interview would also help to guide clinicians who need to conduct a structured and comprehensive clinical assessment of IGD for case formulation, treatment planning, and outcome evaluation.

Two structured clinician-administered interview tools have been developed. Koo, Han, Park, and Kwon (2017) developed their interviewer scale called the Structured Clinical Interview for DSM-5 Internet Gaming Disorder (SCI-IGD). They conducted interviews with 236 adolescents in both community and clinical settings in South Korea. Koo et al. (2017) used likelihood ratios to report their results, which utilise sensitivity and specificity in their calculations. The positive likelihood ratio (LRP or LR+) is the odds that a positive result is a true positive, and the negative likelihood ratio (LRN or LR-) is the odds that a negative result is a true negative. An LRP above 10, and an LRN below .1 provide strong evidence towards the presence or absence of a diagnosis respectively (Deeks, & Altman, 2004). Their results showed that the SCI-IGD could accurately identify cases of IGD, with acceptable ranges for both positive (*LRP* = 10.93) and negative (*LRN* = .35) likelihood ratios. However, they only compared their measure against clinician ratings with indeterminate reliability and validity rather than to existing validated measures.

The second structured clinician-administered interview tool is The Clinical Videogame Addiction Test 2.0 (C-VAT 2.0; van Rooij, Schoenmakers, & van de Mheen, 2017). The Clinical Videogame Addiction Test (C-VAT) was designed to assess videogame addiction (van Rooij et al., 2012), and has since been amended to cover the DSM-5's IGD criteria (version 2.0; van Rooij, Schoenmakers, & van de Mheen, 2017). The authors noted they developed the test in recognition that clinicians inherently struggled with identifying

problematic gaming. The authors tested the scale's validity on a clinical sample ($N = 32$) of males aged between 13 to 23 years. All participants were currently being treated for IGD, and the majority of patients were also being treated for at least one comorbid disorder ($n = 21$). The authors recognised they were unable to draw comparisons between problematic and non-problematic gaming, given that individuals within the sample had a prior diagnosis of IGD. The specificity of the test could not be evaluated as there was no comparison to healthy, regular gamers. However, the test proved to be highly sensitive, correctly identifying 91% of the sample as meeting 5 of the 9 IGD criteria, which is the cut-point for IGD in the DSM-5 (APA, 2013).

The purpose of the current study was to develop and evaluate a clinician-administered version of an established self-report measure of IGD symptoms (PIE-9) that can differentiate between problematic and non-problematic gaming. The PIE-9 assesses all DSM-5 IGD criteria, is internally reliable, correlates with other measures of internet gaming (Pearcy, Roberts, & McEvoy, 2016), and is uniquely associated with distress and disability due to internet gaming after accounting for symptoms of generalised anxiety disorder, depressive symptoms, attention-deficit hyperactivity disorder, and obsessive-compulsive disorder (Pearcy, McEvoy, & Roberts, 2017). Therefore, it is a strong candidate measure to adapt to a structured interview and compare to existing measures. A structured interview version of the PIE-9 will provide clinicians with an efficient way to comprehensively and efficiently assess for IGD criteria with fidelity.

Method

Participants. Participants were recruited through a university psychology research participant pool and convenience sampling of volunteers in the community ($N = 45$). Participants were included in the study if they spent 20 hours or more gaming per week. Most participants were male ($n = 32$, 71%; female $n = 13$, 29%), with a median age of 22 (Range

from 18 to 60) and studying full-time (64.4%). Participants reported spending an average of 27.42 hours of gaming per week (*SD* = 10.92).

Measures.

The Personal Internet Gaming Disorder Evaluation (PIE-9; Pearcy, Roberts, McEvoy, 2016). The PIE-9 is a self-report, nine-item measure that was designed to quickly assess whether an individual met the criteria for IGD, according to the DSM-5 criteria. Pearcy and colleagues reported the scale has good internal reliability (α = .86-.89), test re-test reliability over three weeks (*ICC*=.77-.84), and a single factor structure. The scale reported good concurrent validity by having strong correlations with existing gaming disorder scales (Pearcy et al., 2016). The PIE-9 also asked participants to respond to two validity questions, with responses options from strongly disagree (1) to strongly agree (4) to avoid neutral or misleading responses. The two items were "I personally believe that my internet game playing behaviour is problematic" and "Significant others in my life would consider my internet game playing as problematic".

The PIE-Interview. The interview version of the PIE-9 (PIE-Interview) was developed for this study (Appendix C). It is structured similarly to the online self-report version to cover each of the nine IGD criteria, as proposed by the DSM-5. The scale is divided into three sections: validity item questions in section A, diagnostic questions in section B, and onset related questions in section C. Section A include two validity questions asking the interviewee if they believe their game playing behaviour is problematic, and whether others believe their game playing behaviour is problematic. A 'yes' or 'no' response is recorded. For most questions, there is an opportunity for the researcher to ask further probing questions to help with diagnostic decision-making. For example, if the participant stated yes to either of the validity questions, the researcher is prompted to ask, "Can you provide me with an example?" This branching structure, based on answers provided by the participant, helps to

streamline the interview process and provides the clinician with an interview structure that only asks further probing questions as required.

The next section of the interview includes a set of questions for each of the DSM-5 criteria. For example, question B1a asks “Have you been preoccupied with internet games?” with the option of yes or no. Preoccupation is defined to the participant to alleviate possible misunderstanding (“thinking excessively about gaming, even when you should be concentrating on other things”). Continuing the branching structure of the interview, if the participant answered yes to B1a, they would be asked B1b “About how often were you preoccupied with internet games over the past year?” with the options of less than once per week, 1 to 2 days per week, up to every day, and B1c “Can you provide me with an example of a specific game or time over the past year when you were preoccupied?”. The interviewer then assesses if the participant answered yes to 5 or more questions in section B, indicating that the participant likely has IGD according to the DSM-5 criteria. If so, the questions in section C are asked. Otherwise, the interview is concluded.

Section C includes questions related to the onset of symptoms. For example, question C1 asks “When did you first recognise your internet gaming habits may be an issue?”. The onset questions help provide diagnostic clarity to the origin of IGD for that individual, providing the clinician with information regarding whether they have received prior treatment, or if the individual is aware of any other comorbid problems in their life that may have contributed to or resulted from their problematic gaming habits.

Mini International Neuropsychiatric Interview 7.0. Sections of the Mini International Neuropsychiatric Interview (M.I.N.I. v7.0; Sheehan, 2014) were used to assess for the presence of DSM-5 disorders. Participants were screened for major depressive episode (past and current) and major depressive disorder (Module A), agoraphobia (Module E), social anxiety disorder (Social phobia; Module F), Obsessive-compulsive disorder (Module G),

generalised anxiety disorder (Module N), and attention deficit hyperactivity disorder (Adults; Module Q) according to DSM-5 criteria.

The Kessler 10 scale. The Kessler-10 (K10) is a brief 10-item measure used to assess non-specific psychological distress (Kessler, Andrews, Colpe, et al., 2002). The K10 has excellent internal reliability (α = .93) and validity and has been extensively tested in the Australian population (ABS, 2009). Participants are asked to rate each question on a scale of None of the time (0) to All of the time (4). For example, "During the last 30 days, about how often did you feel nervous?". The scale item ratings are summed, and a higher total score is indicative of psychological distress. ABS (2009) suggested categorising total scores to indicate the level of psychological distress from low (0-5), moderate (6-11), high (12-19), to very high (20 or more) levels of psychological distress.

The World Health Organization Disability Assessment Schedule 2.0. The World Health Organization Disability Assessment Schedule 2.0 (WHODAS) is a brief measure of disability across cultures. The WHODAS has excellent internal reliability (α = .94 - .98) and validity and is widely accepted (Üstün et al., 2010). Participants were asked to rate each of the 12 questions across different life areas across the past 30 days. For example, "In the past 30 days, how much difficulty did you have in…getting dressed?". Participants were asked to rate each question from None (0) to Extreme/cannot do (4). The scale is scored by summing the 12 items. A total score above 10 is indicative of global disability (Andrews, Kemp, Sunderland, et al., 2009).

Procedure. Ethics approval was obtained from the university ethics committee. Each participant was interviewed by a qualified Psychologist with over seven years of interviewing experience. The interviewer had completed training in conducting clinical interviews as part of his doctoral training prior to administering the interviews. Participants completed a brief online survey that included consent, demographic questions, the self-report version of the

PIE-9, the K10, and WHODAS 2.0. The interviewer was blind to the self-report online measure results of each participant. The interviewer then completed selected sections of the M.I.N.I. 7.0 with the participant. Finally, the participant was asked questions about their online gaming habits in the form of the PIE-Interview. The interviews took up to 30 minutes to complete, with the PIE-Interview section taking between five and fourteen minutes, depending on the number of items endorsed, with more items being endorsed increasing the time taken.

Data analysis. We calculated several different indices of diagnostic accuracy to assess concordance between the PIE-Interview with the established PIE-9 measure, and assess the clinical utility of the test, as reported in Table 6.1. Sensitivity provides the proportion of the sample classified as true positives (TP) within those with the disorder and is calculated as the TP divided by the true positive plus the false negative (FN; TP/TP+FN; Altman, & Bland, 1994). A test with high sensitivity is unlikely to miss a patient with the disorder. Specificity reports the number of true negative (TN) cases amongst those in the sample who do not have the disorder. Sensitivity is calculated as the true negative divided by the true negative plus the false positive (FP; TN/TN+FP; Altman, & Bland, 1994). A highly specific test ensures that the test does not overclassify a disorder, and those who have the disorder are more likely to meet criteria than for a test with low specificity.

Table 6.1. Statistics on the specificity and sensitivity of the PIE-9 and PIE-Interview

	Validity Items	PIE-9	PIE-Interview +	PIE-Interview -	Sensitivity (%)	Specificity (%)	Likelihood Ratio+	Likelihood Ratio-	Accuracy	DOR	Misclassification Rate	Youden's Index	AUC	Cramer's V
1	I personally believe that my internet game playing behaviour is problematic	+	6	2	.75	.92	9.25	.27	89%	34.00	.11	.67	.88	.65
		-	3	34										
2	Significant others in my life would consider my internet game playing as problematic	+	18	1	.95	.69	3.08	.08	80%	40.50	.20	.64	.88	.65
		-	8	18										
	DSM-5 IGD Criteria													
1	Preoccupation	+	30	5	.86	.90	8.57	.16	87%	54.00	.13	.76	.88	.69
		-	1	9										
2	Withdrawal	+	11	1	.92	.85	6.05	.10	87%	61.60	.13	.77	.88	.72
		-	5	28										
3	Tolerance	+	11	14	.44	.95	8.80	.59	67%	14.93	.33	.39	.70	.47
		-	1	19										
4	Control	+	14	7	.67	.71	2.29	.47	69%	4.86	.31	.38	.69	.63

		-	7	17									
5	Loss of interest	+	13	9	.59	.87	4.53	.47	73%	9.63	.27	.46	.73	.51
		-	3	20									
6	Continue despite problems	+	11	3	.79	.68	2.44	.32	71%	7.70	.29	.46	.73	.45
		-	10	21									
7	Deception	+	9	1	.90	.89	7.88	.11	89%	69.75	.11	.79	.89	.72
		-	4	31									
8	Escapism	+	37	4	.90	.25	1.20	.39	84%	3.08	.16	.15	.56	.50
		-	3	1									
9	Jeopardised life area	+	2	3	.40	.88	3.20	.69	82%	4.67	.18	.28	.64	.55
		-	5	35									
	Total Scale comparison	+	13	8	.62	.75	2.48	.51	69%	4.88	.31	.37	.69	
		-	6	18									

Note. For the PIE-9 self-report scale, Strongly Disagree and Disagree responses were combined, as were the Strongly Agree and Agree responses. TP= True Positive, TN = True Negative, FP = False Positive, FN = False Negative, Sen = Sensitivity, Spe = specificity, LR+ = Likelihood Ratio Positive, LR- = Likelihood Ratio Negative, DOR = Diagnostic Odds Ratio, AUC = Area under the curve.

Table 6.2. Spearman's Rho correlations between the PIE-9, PIE-Interview, validity items, K10, and WHODAS 2.0 Measures

	PIE-9 number of items endorsed	PIE-Interview number of items endorsed
PIE-9 total items endorsed	1**	.76**
PIE-9 Validity Question 1. I personally believe that my internet game playing behaviour is problematic	.64**	.52**
PIE-9 Validity Question 2. Significant others in my life would consider my internet game playing as problematic	.62**	.49**
PIE-Interview Validity Question 1. I personally believe that my internet game playing behaviour is problematic	.54**	.37*
PIE-Interview Validity Question 2. Significant others in my life would consider my internet game playing as problematic	.51**	.43**
K10 total score	.40**	.24
WHODAS total score	.35*	.22

Note. *$p < .05$, **$p < .01$. PIE-9 = Personal Internet Gaming Disorder Evaluation 9 (Pearcy, Roberts, & McEvoy, 2016). PIE-Interview = Personal Internet Gaming Disorder Evaluation Interview, Kessler-10 = Kessler 10 scale (Kessler et al. 2002), WHODAS 2.0 = World Health Organization Disability Assessment Schedule 2.0 12 item version (Üstün et al.2010)

The accuracy of a test is effectively a summary statistic that indicates the percentage of cases that have been correctly classified as either true positive or true negative, within the sample (Shaikh, 2011). The misclassification rate is the opposite of accuracy and provides a proportion of the sample that has been classified as a false positive or false negative (Shaikh, 2011). The diagnostic odds ratio (DOR) is used to provide an overall summary statistic of test performance. The DOR is the positive likelihood ratio divided by the negative likelihood ratio. A DOR above 10 is generally indicative of a useful test (Glas et al., 2003). Youden's Index is a similar overall index of test performance, however, ranges from 0 to 1, with a score of 1 indicating a 'perfect' test. Youden's index is best used as an 'at a glance' index as its calculation does not discriminate well between different levels of sensitivity and specificity. For example, a test with a sensitivity of .8 and specificity of .7 would derive the same Youden's index score (.5) as a test with a sensitivity of .6 and specificity of .9 (Shaikh, 2011; Youden, 1950).

The area under the curve (AUC), sometimes also referred to as the receiver operator characteristic (ROC), is an alternate measure of the accuracy of a test and is calculated as sensitivity versus 1-Specificity (Hanley, & McNiel, 1982; Swets, 1979). Cramer's V is a correlation coefficient for measuring two dichotomous variables and ranges from 0 to 1.

Results

Comparison between the PIE-9 and PIE-Interview measures. The PIE-9 was compared to the clinician-rated version of the scale. The total scores of the two scales were strongly correlated ($r_s = .76$, $p < .001$). The number of items endorsed for both scales also showed significant moderate to strong positive correlations with the validity questions from each measure (Table 6.2). The PIE-9 total score demonstrated significant positive correlations with the K10 and WHODAS measures. However, the correlations between the number of items endorsed on the PIE-Interview and the K10, and WHODAS, were non-

significant. The PIE-9 and PIE-Interview respectively showed acceptable internal consistency (a = .87, a = .76).

The PIE-9 and PIE-Interview demonstrated similar results with respect to the two validity questions relating to whether they believed (question 1) or others believed (question 2) their game playing was problematic. Most participants on the PIE-9 reported they did not believe their gaming was problematic (Question 1, 82%), and that others did not believe their gaming was problematic (Question 2, 58%). The PIE-Interview demonstrated similar results, with 80% of participants reporting they did not believe their game playing was problematic. For the second validity question on the PIE-Interview, 42% stated that others did not believe their gaming was problematic. In combination, the results across the PIE-9 and PIE-Interview demonstrate a high proportion of participants denied problematic gaming from their own and others' perspectives.

Participants reported similar results on the PIE-9 and the PIE-Interview. According to the first validity question on both scales, most participants (76%) did not believe their game playing was problematic. Additionally, only 6 participants (13%) agreed that their game playing was problematic on both measures. Forty percent of participants endorsed that significant others in their life believed their game playing to be problematic on both measures, with 40% also stating that they did not believe others thought their gaming was problematic on both measures. The remaining 20% stated yes on one measure, and no on the other measure. Interestingly, participants were more likely to report that others thought their gaming was problematic at interview, with an additional eight participants (18%) stating at interview others believed their gaming was problematic, despite stating they did not believe this on the self-report measure. Both validity questions appeared to show good specificity and sensitivity, and likelihood ratios, respectively (See Table 6.1).

Clinical utility of the PIE-Interview. The PIE-Interview showed variable sensitivity and specificity scores across items (See Table 6.1). Six of the nine PIE-Interview questions, in addition to the two validity items, met Attia's (2003) criteria for a useful item concerning their positive and negative likelihood ratios. The strongest performing items were those related to the preoccupation, withdrawal, and deception criteria of the DSM-5 (APA, 2013). The remaining items generally had lower accuracy, diagnostic odds ratios (DOR), or Youden's Index scores. The escapism item yielded the lowest DOR and likelihood ratios compared to the other items on the measure.

Comorbid mental health disorders between IGD and non-IGD groups. As part of the interview, sections of the M.I.N.I. 7.0 were administered to assess potential co-morbid mental health disorder symptoms. The PIE-Interview indicated that 19 participants met the criteria for IGD (and the remaining 26 participants did not meet the criteria for IGD). Participants who met the criteria for IGD according to the interview measure were more likely to have more than one comorbid disorder (37%), compared to those who did not meet IGD criteria (8%). The IGD group was more likely to endorse symptoms of anxiety disorders including generalised anxiety disorder (n = 3, 16%), agoraphobia (n = 1, 5%), social anxiety disorder (n = 1, 5%), compared to the non-IGD group (n = 1, 4% for GAD, and no other anxiety symptoms). Both non-IGD and IGD groups reported similar percentages of comorbid cases for both past (n = 7, 27%, and n = 7, 37%) and current (n = 2, 8%, and n = 1, 5%) episodes, respectively, with no participants endorsing major depressive disorder. Symptoms of ADHD were much more common in the IGD group (n = 19, 42% of the IGD group endorsing ADHD and subtypes) compared to the non-IGD group (n = 26, 12% of the non-IGD group endorsing ADHD and subtypes). While an equal number of participants in each group endorsed ADHD combined type (n = 3, 12%, and IGD group n = 3, 16%), the IGD

group included four cases of inattentive type (21%), and one case of hyperactive only type (5%), compared to no sub-types in the non-IGD group.

Discussion

Overall, the PIE-Interview presents as a useful measure by identifying a similar proportion of individuals with IGD as the self-report PIE-9 scale. The interview demonstrated good specificity, which is useful in ensuring a very low false-positive rate and high sensitivity, thereby limiting false negatives. The advantage of the PIE-Interview over the PIE-9 is its capacity to guide clinicians to conduct a comprehensive yet efficient assessment of IGD criteria to inform individualised case formulations and treatment planning. The PIE-9 may be a useful screening tool for IGD and, indeed, can provide indicative diagnoses that can be followed up with the PIE-interview.

The validity items included as initial screening questions demonstrated some of the highest specificity and sensitivity of the items tested. The inclusion of the validity items provides the interviewer with an indication of whether an individual is aware of their gaming habits being problematic. The first validity item, “I personally believe that my internet game playing behaviour is problematic” (validity item A1), was highly specific. A highly specific item is useful in that if a participant endorses the item, it is highly likely that the item is not a false negative. The second validity item, “Significant others in my life would consider my internet game playing as problematic” (validity item A2), was highly sensitive. If this item is endorsed, it is likely to detect those who have IGD, albeit potentially at the cost of some false positives. In combination, the two questions increase the probability of identifying individuals who likely have IGD will be identified, demonstrating the PIE-Interview to be a useful test.

Our findings demonstrate that some criteria show evidence of being more useful in identifying the presence of a diagnosis of IGD than others. For example, in our study, the

escapism criterion did not distinguish between problematic and non-problematic gaming, which is consistent with previous findings (Koo et al., 2017). Given that most participants were regular gamers, as defined by our inclusion criteria, it would be expected that they would enjoy, and thus utilise, gaming as a coping strategy. It is also possible that the criterion may not differentiate the positive or negative motivators to use gaming to escape or relieve a negative mood (Kardefelt-Winther, 2014).

The questions relating to preoccupation with gaming-related thoughts, withdrawal symptoms, and use of deception, were more accurate at identifying either a true positive or true negative result. Therefore, these items are likely to be the most useful to distinguish between problematic and non-problematic gaming behaviour.

Preoccupation with gaming is the only DSM-5 criterion that assesses cognitions associated with gaming. The act of being preoccupied with gaming-related thoughts for prolonged periods is likely to have a functional impact on an individual's life. For example, the longer an individual is preoccupied with gaming-related thoughts, the more time is lost to other essential life activities. Although our previous research (Chapter 5) has suggested that the frequency, rather than the content of preoccupying thoughts is important, research has indicated that the content of preoccupying thoughts is relevant, in addition to the time lost (King, and Delfabbro, 2016; Sussman et al., 2017).

The withdrawal criterion relates more directly to emotional responses to when gaming is taken away. The question is phrased in a way that allows the individual to directly reflect on past gaming activities and how they felt when they were unable to play. The withdrawal symptoms described in the measure include frustration, sadness, and anger. Participants endorsing this item are acknowledging the negative emotional experience brought on directly from the absence of gaming. It could be hypothesised that the withdrawal criterion is a good predictor because individuals who have limited emotion regulation skills may be more

susceptible to IGD, or that low emotion regulation could be an associated feature of IGD itself. Difficulty regulating emotions is a feature of ADHD, and ADHD is associated with IGD (APA, 2013; Pearcy, Roberts, & McEvoy, 2016; Sussman, Harper, Shalh, & Weigle, 2017; Yen et al., 2016). Many participants in our sample endorsed ADHD, and of those, the majority endorsed IGD as well across both measures. Future research could explore whether low emotion regulation skills is a unique predictor of IGD symptoms after controlling for ADHD.

A further comparison between our sample, and Koo and colleagues (2017) sample with regards to the withdrawal symptoms criterion, was that they found a very small proportion (3% of $N = 111$) of participants who endorsed the withdrawal symptom criterion as a true positive (positive across clinician ratings and their measure). In our community sample, a significantly larger portion of participants (11%) endorsed the withdrawal criterion as a true positive (across both measures). Our sample had a higher proportion of participants who met the criteria for IGD. We had 19 IGD cases of 45, whereas they had 12 of 111. The difference could have been related to sampling methods. Our inclusion criteria required participants to report more than 20 hours of gaming a week to participate. Koo and colleagues' sample was sourced from the community, and a small group seeking treatment with no inclusion criteria related to hours of gameplay per week. Based on our previous research (Chapter 3), the IGD group had an average gameplay time of 26.77 hours per week.

Interestingly, our results regarding the deception criterion were contrary to Koo and colleagues' (2017) finding that deception was not a useful criterion. We found it to be one of the most accurate criteria. We can only speculate why this might be the case. Koo and colleagues (2017) used a sample that included five participants who were undergoing treatment for IGD, and community volunteers from schools and internet cafes with no prerequisites regarding the time spent gaming. In comparison, our community sample

included participants in a research project, who experienced no direct consequences for their answers, were not treatment seeking, and were required to report at least 20 hours of gaming per week to participate in the study. One potential hypothesis for the variation between samples may be a difference in the willingness to change behaviours. The Transtheoretical Model, (Also referred to as the stages of change model), initially proposed in relation to smoking cessation research (DiClemente, & Prochaska, 2005; Prochaska, & DiClemente,1983), explains different stages concerning willingness to change behaviours. The Transtheoretical Model has five proposed stages of change from pre-contemplation, contemplation, preparation, action, and maintenance (in addition to relapse to old patterns of behaviour, which could occur at any stage). Individuals in the pre-contemplation stage tend not to think their behaviour is a problem and are not planning to change their behaviour (DiClemente, & Prochaska, 2005). Those who hide their gaming habits and use deception may not be ready to change their behaviours or view their gaming as a problem. These behaviours, including the use of deception, appear to reflect the pre-contemplation stage of the Transtheoretical Model (DiClemente, & Prochaska, 2005). Whereas Koo and colleagues study participants had already engaged in treatment and help seeking behaviours, therefore, may be further along the 'stages of change' in terms of recognising and addressing their problematic gaming behaviours.

Limitations and future directions. This study aimed to compare a clinician-rated interview (PIE-Interview) to the PIE-9 self-report scale. The sample size was sufficient for a preliminary investigation into problematic versus non-problematic gaming but was insufficient to investigate additional sociodemographic and clinical correlates of IGD. Future studies with larger samples would be useful by providing sufficient statistical power for such analyses, including Chi-square testing of differences comparing whether IGD presents

differently in adults, adolescents and children, or establishing temporal precedence of IGD compared to comorbid conditions or disorders.

The study used convenience sampling to source participants. Half of the sample were university students, while the remainder was sourced from volunteers in the community. Individuals seeking treatment may present with different profiles compared to the sample used in this study. For example, those seeking treatment would likely be aware of the impact of their gaming activities on other areas of their lives, resulting in their help-seeking behaviour (King et al., 2018), although that may not be the case if parents or partners request their children or spouse seek professional help for their problematic gaming. In the current sample, most participants who met the criteria for IGD denied their gaming was a problem. Further research is also required to test whether the PIE-Interview is suitable for use with children and adolescents.

Furthermore, the PIE-Interview did not meet all recommended cut-off values across all metrics of test accuracy. In particular, LRP and LRN ratios were less than the recommended cut-off values for a strong measure to detect the presence or absence of a diagnosis across the measure (Deeks, & Altmen, 2004). Additionally, the PIE-Interview scores were not significantly correlated with the WHODAS and K10 scores, despite high concordance with the PIE-9. There are two likely reasons for the values falling below the cut-off, both increasing the risk of Type II error: the use of nominal response categories, and the size of the sample being too small to detect an effect between the PIE-Interview and the WHODAS and K10. Using yes or no questions across the scale is useful clinically for ease of scoring and speed of testing. However, it limits the statistical power of the study. This issue could be addressed by testing the interview in a larger sample to gain statistical power needed to more accurately detect the effect between the PIE-Interview, and the WHODAS and K10 measures, therefore reducing the risk of type II error.

The PIE-Interview showed good sensitivity and specificity across a number of items, however further testing is needed to address the above noted limitations. These limitations can be addressed by conducting research that uses the PIE-Interview on adolescent and child populations to provide validity in these samples, and larger samples to test the reliability of the interview while reducing the risk of type II error.

Conclusion. The current study demonstrates preliminary evidence that the PIE-Interview as a useful, and brief clinician-administered measure of IGD. The PIE-Interview provides qualitative information and context surrounding gaming habits and is well placed to assist clinicians by comprehensively but succinctly assessing the DSM-5 criteria to inform clinical decision-making. The use of a brief and direct measure of IGD is likely to be more accurate than clinical judgement alone (van Rooij, Schoenmakers, & van de Mheen, 2017). The PIE-Interview shows promise as a useful tool to develop further knowledge of IGD in clinical and research settings.

Chapter 7: General Discussion

The following chapter provides an update on the literature related to IGD since the commencement of this program of research, including the addition of gaming disorder in the ICD-11 (WHO, 2018) and new measures of IGD that have been developed since 2014. The literature review provides a summary of the current state of research regarding IGD, and relatedly provides context for the discussion of the findings from my research program. Following the literature review, I provide a summary of the research conducted, in relation to each of the research objectives outlined in the introduction chapter (see Table 1.2, Chapter 1). The theoretical and methodological implications of my research are then discussed. The implications are followed by suggested applications of my research, including which measures of IGD I recommend using in future research or clinical practice. The strengths and limitations of the research program are discussed, followed by recommendations on the future direction of research related to IGD, before concluding the chapter.

An update on the literature related to the measurement of internet gaming disorder since the inception of this research program. IGD has experienced an increase in research interest since the release of the DSM-5 (APA, 2013) and the inception of this research program. The increase in research related to IGD includes the development of gaming disorder in the ICD-11 (WHO, 2017; 2018). The following summary of the recent history of IGD research since 2014 helps to provide context to the findings of this research program by detailing advances in the field of IGD. The summary begins from where the Introductory chapter concluded, the debate surrounding the criteria of IGD proposed in the DSM-5 (APA, 2013).

As noted in the introductory chapter, the Substance Use Disorders workgroup (Petry, & O'Brien, 2013) chose to include IGD in section III of the DSM-5, conditions for further study, to provide a set of criteria for researchers to assess and refine. A fundamental critique

of studies published before the release of the DSM-5 was of the use of inconsistent criteria (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). This inconsistency had limited comparisons of study findings because measures used a variety of criteria. However, new issues have emerged that could be considered as further hindering progress in the field. First, the latest version of the International Classification of Diseases (11th edition; WHO, 2018) included a new disorder called gaming disorder, with different criteria to those proposed for IGD in the DSM-5 (APA, 2013), potentially dividing future research efforts. Table 7.1 provides a summary comparison of the criteria between the proposed IGD in the DSM-5 and gaming disorder as defined by the ICD-11. The third criterion of gaming disorder overlaps with several of the IGD criteria and has been repeated adjacent to each criterion that it relates to in Table 7.1. Second, several new measures to assess IGD have been developed over the past five years. These measures include those tested in this body of research (Such as the PIE-9, Pearcy, Roberts, & McEvoy, 2016). Having several measures to choose from has the potential to increase the difficulty in identifying a suitable measure to assess IGD. Furthermore, having several measures reintroduces one of the key critiques before the release of the DSM-5: multiple measures being used across multiple studies increases the difficulty in comparing findings across the field. Each of these issues is described further below.

Table 7.1. Proposed DSM-5 IGD criteria compared to the ICD-11 gaming disorder criteria

IGD criteria	Gaming disorder criteria
Persistent and recurrent use of the internet to engage in games, over 12 months with at least 5 of the following criteria	Evident over 12-months, or a shorter duration if all criteria are met and symptoms are severe.
1. Preoccupation with internet games.	
2. Withdrawal symptoms when internet gaming is taken away.	
3. Tolerance – the need to spend increasing amounts of time engaged in internet games.	*3. Continuation or escalation of gaming despite the occurrence of negative consequences. (The behaviour pattern is of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning.)
4. Unsuccessful attempts to control the participation in internet games.	1. Impaired control over gaming (e.g., onset, frequency, intensity, duration, termination, context)
5. Loss of interest in previous hobbies and entertainment as a result of, and with the exception of, internet games.	2. Increasing priority given to gaming to the extent that gaming takes precedence over other life interests and daily activities.
6. Continued excessive use of internet games despite knowledge of psychosocial problems.	*3. Continuation or escalation of gaming despite the occurrence of negative consequences. The behaviour pattern is of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning.
7. Has deceived family members, therapists, or others regarding the amount of internet gaming.	
8. Use of internet games to escape or relieve a negative mood.	
9. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in internet games.	*3. Continuation or escalation of gaming despite the occurrence of negative consequences. The behaviour pattern is of sufficient severity to result in significant impairment in personal, family,

	social, educational, occupational or other important areas of functioning.

Note. IGD = internet gaming disorder, DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, ICD-11 = International Classification of Diseases, 11th Edition.

*Criterion 3 for gaming disorder has been repeated across the table to demonstrate the overlap between IGD criteria.

The recent development of gaming disorder in the ICD-11 and a comparison to internet gaming disorder. In 2017, the World Health Organization (WHO) proposed the inclusion of gaming disorder in the 11th edition of the International Classification of Diseases (WHO, 2017), outlining similar criteria to those proposed by the DSM-5 (APA, 2013) for IGD (Pontes, Schivinski, Brzozowska-Wos, & Stavropoulos, 2019). The WHO conducted several conferences and openly requested contributions in the development decisions relating to gaming disorder's potential inclusion. Documenting the history of the development and inclusion of gaming disorder in the ICD-11 (WHO, 2018) over the past two years, provides both a recent history of IGD research development and debate and update of research in the field of IGD since the literature covered in the introductory chapter of this thesis. The most helpful approach to provide this history is by explaining the development of gaming disorder becoming included in the ICD-11(WHO, 2018).

Aarseth and colleagues (2017) wrote an open debate letter in opposition to the inclusion of gaming disorder in the ICD-11(WHO, 2017). Aarseth and colleagues' (2017) primary concerns were related to over-diagnosis of gaming activities resulting in false-positive diagnoses, heavy reliance on substance addiction and gambling criteria, the poor quality of research conducted, and a lack of consensus on symptoms and treatment. This resulted in a number of commentaries from researchers in the field, each contributing evidence supporting the inclusion of gaming disorder, addressing the research quality concerns, in addition to the remaining noted concerns above (Billieux et al., 2017b; Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017; Higuchi et al., 2017; Kiraly & Demetrovics, 2017; Lee, Choo, & Lee, 2017; Müller & Wölfling, 2017; Saunders et al., 2017; Shadloo et al., 2017; van den Brink, 2017).

Billieux and colleagues (2017b) responded to the concern that the diagnosis of gaming disorder would result in an increase in false-positive cases. The definition of gaming disorder, like IGD, includes an important description similar to other established mental health

conditions. The condition must result in clinically significant impairment or distress as a result of recurrent or problematic gaming to qualify for diagnosis (ICD-11; WHO, 2018). The probability of pathologising normal gaming activities is highly unlikely if considerations of functional impairment are made during screening for gaming disorder (Billieux et al., 2015; Billieux et al., 2017a).

The criticism that gaming disorder (and IGD similarly) relies heavily on substance addiction and gambling criteria (Aarseth et al., 2017) highlights the lack of knowledge of the development of criteria. As discussed in the introductory chapter of this thesis, early conceptualisations of internet addiction (Young, 1996a, 1996b, 1998), and subtypes like IGD, were based on gambling disorder criteria (O'Brien, 2010). The reliance on gambling disorder criteria for IGD was acknowledged in the early development and release of the DSM-5 (Petry et al., 2014b) and the key similarities and differences between gambling disorder and IGD have been detailed in the literature (Saunders, Degenhardt, & Farrell, 2017). However, one important difference between the two disorders is that gambling disorder only requires 4 of 9 criteria, whereas IGD requires 5 of 9 criteria to be met for diagnosis. The decision to have a higher threshold for diagnosis was deliberate, given the criteria were not finalised, and evidence of IGD was in the early stages of recognition (Petry, & O'Brien, 2013). Gaming disorder criteria were deliberately developed from gambling disorder, which is the most historically recognised behavioural addiction (Petry, & O'Brien, 2013).

Research in the field of IGD, and relatedly gaming disorder, has rapidly increased since the release of the DSM-5 (APA, 2013). A key criticism of research investigating IGD after the release of the DSM-5 was related to a lack of consensus on symptoms (Griffiths et al., 2016; King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Király, Griffiths, & Demetrovics, 2015; Kuss, Griffiths, & Pontes, 2017), which Aarseth and colleagues (2017) noted. Indeed, there have been continued calls for a unified approach to assessing IGD

criteria since the DSM-5 was released (Griffiths, King, & Demetrovics, 2014). Continued debate regarding the symptoms may result from IGD being heterogeneous (Griffiths et al., 2016; Lee, Lee, & Choo, 2016). According to the DSM-5 (APA, 2013) definition of IGD, an individual may meet a diagnosis if they endorse 5 of the nine criteria, and, polythetic criteria can result in diverse clinical presentations. Identification of necessary and sufficient criteria that distinguish IGD from other clinical problems, and from non-clinical gaming, will help to increase consistency in the field. Scientific debate, scrutiny, and refinement is a normal part of the scientific process, and such debate occurred before and after the release of the proposed criteria for IGD (King, et al., 2013; Griffiths et al., 2014; Petry et al., 2014b, Petry et al., 2015), and more recently before the release of the ICD-11 (WHO, 2017) and introduction of gaming disorder (Billieux et al., 2017b; Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017; Higuchi et al., 2017; James & Tunney, 2017; Kiraly & Demetrovics, 2017; Lee, Choo, & Lee, 2017; Müller & Wölfling, 2017; Saunders et al., 2017; Shadloo et al., 2017; van den Brink, 2017).

Some of the original authors who were opposed to the inclusion of gaming disorder in the ICD-11 (see Aarseth et al., 2017) responded to those commenting in favour of including gaming disorder in the ICD-11, reiterating their concerns (van Rooij et al., 2018). Largely dismissing the existing evidence (Billieux et al., 2017b; Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017; Higuchi et al., 2017; James & Tunney, 2017; Kiraly & Demetrovics, 2017; Lee, Choo, & Lee, 2017; Müller & Wölfling, 2017; Saunders et al., 2017; Shadloo et al., 2017; van den Brink, 2017). Van Rooij and colleagues (2018) argued that the functional impairment of gaming disorder has yet to be proven, gaming is better conceptualised as a coping mechanism for existing disorders (initially discussed by Kardefelt-Winther, 2016), and that stigmatisation of non-problematic gamers and moral panic could occur. Rumpf and colleagues (2018) provided a detailed reply addressing van Rooij and colleagues' (2018)

concerns. First, the WHO included gaming disorder in the ICD-11 (WHO, 2018), after considering the above evidence. Second, Rumpf and colleagues (2018) noted Saunders and colleagues' (2017) first reply detailing several national level epidemiological studies demonstrating unique functional impairment of IGD (as defined by the DSM-5; APA, 2013; Addiction Suisse, 2015; Gentile, 2009; Kaess et al.,2016; Király et al.,2014; Lemmens, Valkenburg, & Gentile, 2015; Müller et al., 2015; Pontes, & Griffiths, 2015; Pontes, Macur, & Griffiths, 2016; Rehbein, Kliem, Baier, Mößle, & Petry, 2015; Wittek et al., 2016). These studies provide strong evidence that IGD (and similarly gaming disorder) is a unique disorder, rather than a coping mechanism for other underlying mental health concerns. Furthermore, if an individual is initially using gaming as a means of escape, it is plausible that this may develop into problematic gaming (Griffiths, 2017). Third, Rumpf and colleagues (2018) noted the assumption that acknowledging gaming disorder would incite moral panic (van Rooij et al., 2018) is challenging to prove and lacked any evidence. Furthermore, Kiraly and Demetrovics (2017) note that officiating a diagnosis is more likely to reduce stigmatisation by providing clarity between a high engagement in games and gaming disorder by outlining the functional impairments, rather than assuming gaming participation itself is unhealthy. Finally, acknowledging that there is healthy debate across the literature about IGD and similarly gaming disorder, particularly regarding symptomology (Griffiths, Kuss, Lopez-Fernandez, Pontes, 2017), several authors in the field agree that gaming disorder is a phenomenon that should be official recognised as a mental disorder (Griffiths, Kuss, Lopez-Fernandez, Pontes, 2017; van den Brink, 2017) to facilitate public awareness (Shadloo et al., 2017) and treatment options (Lee, Choo, & Lee, 2017; Shadloo et al., 2017; van den brink, 2017), and to continue to advance research (Kiraly & Demetrovics, 2017; Lee, Choo, & Lee, 2017) and potential funding to meet existing demand for services (Higuchi et al., 2017; Lee, Choo, & Lee, 2017).

Measurement of IGD since the inception of this research program. Several self-report measures to assess the proposed IGD criteria (APA, 2013) have been developed since the release of the DSM-5 (APA, 2013). I have provided a summary of measures that address all the proposed IGD criteria in Table 7.2, for comparison to measures developed as part of this research program. As previously discussed in the Introduction chapter, there are nine criteria proposed for IGD (APA, 2013). The DSM-5 also stated that these criteria had to occur over 12 months (APA, 2013). The self-report measures that cover all of the proposed criteria are noted below, in addition to two structured interviews for IGD that has been published, the Structured Clinical Interview for IGD (SCI-IGD; Koo, Han, Park, & Kwon, 2017), and the Clinical Video-game Addiction Test 2.0 (C-VAT 2.0; van Rooij, Schoenmakers, & van de Mheen, 2017). Both structured interviews are discussed in detail in Chapter 6.

The self-report measures developed that address the nine proposed IGD criteria include the IGD-20 test previously mentioned in Chapter 2-3 (Pontes, Kiraly, Demetrovics, & Griffiths, 2014). Some of the same authors also published the Internet Gaming Disorder Test (IGDT-10; Kiraly, Sleczka, & Pontes, 2017), and the Internet Gaming Disorder scale, short-form (IGDS-SF9; Pontes, & Griffiths, 2015). The GAS scale (Lemmens, Valkenburg, & Peter, 2009) discussed in Chapters 2 and 3 has been updated to cover the proposed IGD criteria (APA, 2013), and is called the Internet Gaming Disorder Scale (IGD Scale; Lemmens, Valkenburg, & Gentile, 2015). The Scale for the Assessment of Internet and Computer game Addiction (AICA-S; Wölfling, Beutel, & Müller, 2016) was included in the comparison as it covered the proposed criteria, however cut-off criteria were unclear (von der Heiden, Braun, Müller, & Egloff, 2019) on whether an individual had met 5 or more of the 9 proposed criteria for IGD (APA, 2013). Two scales were excluded from the brief comparison table (Table 7.2) for different reasons. The Gaming Addiction Identification Test was

excluded for only addressing 7 of the 9 criteria (GAIT; Vadlin, Aslund, & Nilsson, 2015) and the Internet Gaming Disorder Questionnaire was excluded for not specifying the duration of symptoms (i.e. over 12 months, Jeromin, Rief, & Barke, 2016). The recommended measures are discussed later in this chapter under the applications section.

Table 7.2. Summary of self-report and structured interview measures addressing IGD criteria since 2014

Measure name	Number of items	Measure Type	Response format	IGD endorsement criteria
PIE-Interview[a]	9+	Structured Interview	Dichotomous and qualitative.	Criterion endorsed on 5 or more items
PIE-9	9	Self-report	Ordinal (5-point, frequency)	Criterion score of 3 or more on 5 or more items
IGD-20 test	20	Self-report	Ordinal (5-point, endorsement)	Score ≥ 71
IGDS-SF9	9	Self-report	Ordinal (5-point, frequency)	Indicative from the total score of 36 or more, or a score of 4 or more on 5 or more items.
IGD Scale[b]	27	Self-report	Dichotomous	Not applicable
IGD Scale (Short version)	9	Self-report	Dichotomous	Endorsement on 5 or more items.
IGDT-10	10	Self-report	Ordinal (3-point, frequency)	Endorsement on 5 or more items.
C-VAT 2.0	14	Structured Interview	Dichotomous	Endorsement on 5 or more items.
SCI-IGD	9	Structured Interview	Dichotomous	Criterion endorsed on 5 or more items

Note. PIE-Interview = Personal Internet Gaming Disorder Evaluation Interview, PIE-9 = Personal Internet Gaming Disorder Evaluation (Pearcy, Roberts, & McEvoy, 2016), AICA-S = Scale for the Assessment of Internet and Computer game Addiction (von der Heiden, Braun, Müller, & Egloff, 2019; Wölfling, Beutel, & Müller, 2016), C-VAT 2.0 = The Clinical Video-game Addiction Test 2.0 (van Rooij, Schoenmakers, & van de Mheen, 2017), IGD-20 test = Internet Gaming Disorder-20 test (Pontes, Kiraly, Demetrovics, & Griffiths, 2014), Internet Gaming Disorder scale, short-form (IGDS-SF9; Pontes, & Griffiths, 2015), IGD scale = Internet Gaming Disorder Scale (Lemmens, Valkenburg, & Gentile,

2015), IGDT = Internet Gaming Disorder Test (Kiraly, Sleczka, & Pontes, 2017), SCI-IGD = Structured Clinical Interview for IGD (Koo, Han, Park, & Kwon, 2017).

a) The PIE-Interview contains nine core questions relating to the IGD criteria, with additional questions if a diagnosis is confirmed relating to onset and treatment.

b) The IGD Scale tested both a 27-item and 9-item version, and both 6-point Likert scale and dichotomous format, and chose the dichotomous format due to comparable internal reliability (Cronbach's alpha of .94 and .93 respectively).

A summary of the findings related to each research objective across the two research studies

The research program described in this thesis covered six specific research objectives. The following section details the key findings relating to each of these objectives (summarised by Table 1.2). Objectives 1 to 3 were covered by paper 1.

Objective 1. To develop and conduct preliminary psychometric testing on a new diagnostic self-report measure for internet gaming disorder, using the existing DSM-5 Criteria. The focus of Chapter 3, *Psychometric testing of the PIE-9: A new measure designed to assess internet gaming disorder*, was to develop a self-report measure that assesses each of the nine proposed DSM-5 (APA, 2013) criteria of internet gaming disorder. The measure was called the Personal Internet Gaming Disorder Evaluation (PIE-9) and demonstrated acceptable reliability and validity. Exploratory and confirmatory factor analyses were used to evaluate the factor structure of the scale, supporting a unidimensional structure across the nine items. The internal reliability was excellent (α = .89), and test-retest reliability was good (*ICC* = .77) over two weeks. Overall, the PIE-9 demonstrated acceptable reliability and validity, providing preliminary evidence that it could be used as an efficient and straightforward measure to assess IGD symptoms according to the DSM-5.

Objective 2. To compare the reliability and validity of existing self-report diagnostic measures with respect to their ability to measure internet gaming disorder, as defined by the DSM-5. As discussed in Study 1 (Chapter 3), the preliminary testing of the PIE-9 demonstrated criterion and concurrent validity with other measures of problematic gaming released before the DSM-5 (ρ = .43 - .69), PVP (Salguero. & Moran, 2002), GAS (Lemmens, Valkenburg, & Peter, 2009), and shortly after the release of the DSM-5, the IGD-20 test (IGD-20 test; Pontes, Kiraly, Demetrovics, & Griffiths, 2014). The concurrent validity demonstrated by medium to strong correlations with each of these measures demonstrated

that the PIE-9 appears to measure the intended construct of IGD symptoms. The criterion validity was demonstrated by comparing the answers to the two validity questions, between the group who endorsed IGD criteria, and the group who did not. The finding was that the IGD group demonstrated a higher rate of endorsement of the validity items (See Chapter 3).

Objective 3. To compare the level of distress and disability between IGD symptoms and DSM-5 anxiety, depressive, and attention disorder symptoms. In Chapter 3 I found that those who met the proposed criteria for IGD, according to the DSM-5 (APA, 2013), using the PIE-9 (as represented by scoring 3 (sometimes) or more on 5 of the 9 questions), demonstrated statistically significantly higher distress and disability compared to those who did not meet the criteria. Therefore, predictive validity was established through significant differences in distress and disability between those who met the criteria for internet gaming disorder and those who did not. Second, the distress and disability associated with those who met the proposed IGD criteria fell within the range of other common DSM-5 disorders such as anxiety, depression, OCD, and ADHD. The comparison between the scores on the PIE-9 and existing disorder measures is discussed further in addressing Objective 4 below and was the focus of Chapter 4 (Pearcy, McEvoy, & Roberts, 2017).

The review of each of the above objectives addressed by Chapter 3 suggests that the PIE-9 is a reliable and valid self-report measure for IGD. The PIE-9 demonstrated acceptable internal reliability and test-retest reliability over two weeks. The PIE-9 items also loaded onto a univariate model, providing support for the notion that the cluster of items represents a unitary construct, namely, IGD. The PIE-9 was compared to established measures of problematic gaming and IGD and found medium to strong correlations between measures. The strong correlations demonstrate concurrent validity. The demonstration of the PIE-9's reliability and validity provide evidence supporting the use of the PIE-9 to measure IGD in future studies.

Objective 4. To evaluate evidence that internet gaming disorder is distinct from existing disorders and symptoms. The critical finding of Chapter 4 (Pearcy, McEvoy, & Roberts, 2017) was that IGD explained a small proportion of unique variance in distress (1%) and disability (3%) after controlling for the existing disorders of OCD and ADHD, and symptoms of anxiety and depression. Importantly, IGD accounted for a larger proportion of unique variance in disability than anxiety and ADHD, and a similar proportion to depression. Those who met the criteria for IGD also reported higher rates of comorbidity with depression, OCD, ADHD, and anxiety compared to those who did not meet the IGD criteria. These findings are consistent with a recent systematic review (Sussman, Harper, Shalh, & Weigle, 2017) that found varying rates of comorbid IGD, ranging from 9% to 23% across nine anxiety studies, and 20% to 22% of IGD in at least two ADHD studies. These findings provide evidence supporting IGD as a unique construct, including when comorbidities are present.

Objective 5. To use the illustrative client statements discussed by King and Delfabbro (2014) to create a measure of internet gaming cognitions that distinguishes those with and without internet gaming disorder. Chapter 5 investigated the illustrative client statements proposed by King and Delfabbro (2014b) and sought to replicate either their theoretical four-factor model, or the different four-factor model proposed by Forrest, King, and Delfabbro (2016). The original four-factor model was not a good fit to the data, and so exploratory factor analyses were used to find a model that was an acceptable fit to the data. The result was a bi-factor model with one general factor representing gaming cognitions and four specific factors representing preoccupation, self-esteem, achievement, and perfectionism. The resulting bi-factor model was then correlated with the PIE-9, and the general internet gaming cognitions factor was strongly correlated with IGD symptoms as measured by the PIE-9. The specific factor representing preoccupation demonstrated a very

weak association with the PIE-9. The outcome of Chapter 5 was the creation of a 26 -item measure of internet gaming cognitions named the Problematic Gaming Cognitions Scale (PGCS), and a shorter 12-item version of the scale (PGCS12). Both scales were strongly associated with IGD symptoms as measured by the PIE-9 (r = .70 PGCS12, and r = .67 PGCS).

The findings of this study revealed an interesting theoretical insight related to our understanding of IGD and associated cognitions. The *process* of preoccupation appeared to be more important than any specific *content* of cognitions concerning IGD, and that specific gaming-related cognitions may or may not be associated with problematic gaming and IGD. These implications are further discussed below in the *Theoretical implications* section of this discussion.

Objective 6. Conduct a pilot study of a clinician-administered version of the PIE-9 developed in Study 1, continuing to adhere to the DSM-5 criteria. The sole focus of Chapter 6 was on developing a clinician-administered interview version of the PIE-9 to address objective 6. The PIE-Interview provides a useful measure able to identify individuals who meet IGD criteria at a similar rate to the PIE-9. The interview demonstrated good specificity, which means the PIE-Interview is likely to have a low false-positive rate, alleviating some concerns in the area for overdiagnosis of IGD (Aaraseth et al., 2017; van Rooij et al., 2018). Additionally, the PIE-9 also demonstrated high sensitivity, limiting false negatives, which is also important in this stage of development in IGD as those who most need treatment are unlikely not to be diagnosed. The advantage of the PIE-Interview over the PIE-9 is the capacity to guide clinicians to conduct a comprehensive yet efficient assessment of IGD criteria to inform individualised case formulations and treatment planning. The PIE-9 may be a useful screening tool for IGD and can provide indicative diagnoses that can be followed up with the PIE-interview by the clinician. In combination, the measures

demonstrate good clinical utility due to their efficiency of use, and promising reliability and validity from psychometric testing, and piloting the PIE-Interview. Several theoretical and methodological implications, and applications arising from the findings summarised above, are discussed in the sections below.

Theoretical implications

Is internet gaming disorder a genuine mental health disorder? When Petry and O'Brien (2013) first proposed the inclusion of IGD in section III (Conditions for further study) of the DSM-5 (APA, 2013) they explained that of the types of disorders that appeared as part of internet addiction (e.g. sexual preoccupation, and e-mail or text messaging; Block, 2008), excessive video gaming demonstrated the most evidence towards its existence. In addition to providing a set of proposed criteria for IGD, Petry and O'Brien (2013) noted that IGD would not be included in Section II of the manual in future editions unless enough evidence had been provided across four key areas relating to the disorder. First, the features of the disorder needed to be clearly identified. Second, the reliability and validity of these criteria needed to be established cross-culturally. Third, epidemiological studies were required to provide prevalence rates across the world for the disorder. Fourth, the underlying biological effects and aetiology of the disorder needed to be understood. Additional to Petry and O'Brien's (2013) request for evidence, the functional impact of IGD needs to be determined (Billieux et al., 2017b). Functional impact refers to whether IGD has a unique contribution to an individual's distress and disability. My research findings have provided evidence towards the first, and second areas identified by Petry and O'Brien (2013), and provided partial evidence towards the additional area of functional impact.

Chapter 3 provided evidence addressing Petry and O'Brien's (2013) first criterion by investigating the underlying construct of the nine proposed criteria of IGD as measured by the PIE-9. A unitary structure was identified in the 9-item measure of IGD symptoms (The

PIE-9; Pearcy, Roberts, & McEvoy, 2016). A unitary structure, in addition to strong internal validity and reliability, provides support for the notion that IGD with respect to the proposed DSM-5 (APA, 2013) criteria, is a single construct or syndrome representing a cluster of symptoms (Shaffer et al. 2004).

Accumulating evidence for the reliability and validity of the proposed IGD criteria cross-culturally addressed Petry and O'Brien's (2013) second criterion. Study 1 used two samples across chapters 3, 4 and 5, which included a community sample comprised primarily of participants from Australia (35%), the United States of America (32%), and the United Kingdom (11%) (n = 285), and a student sample comprised of students attending an Australian University (n = 110). The reliability and validity of the PIE-9 was tested using these samples in study 1. The PIE-9 was found to be a reliable and valid measure in testing IGD symptoms and was demonstrated to measure a unitary latent construct. Therefore, study one provided evidence towards Petry and O'Brien's second criterion in a sample comprising of individuals primarily in Australia (in the case of the student sample), and other Western counties. Study 2 interviewed 45 adults residing in Perth, Western Australia as part of a pilot study of the PIE-Interview. The inclusion criteria to participate in study two included playing 20 or more hours of video games per week to increase the probability of identifying potential IGD cases. As discussed in Chapter 6, the PIE-Interview appeared to have high sensitivity and specificity, indicating that it may be a useful measure in assessing IGD. Therefore, together with evidence from a sample including the United States, the United Kingdom, Canada, and Germany (Przybylski, Weinstein, & Murayama, 2017), and earlier work in Australia (King, Delfabbro, Zwaans, & Kaptsis, 2013), my research provided evidence towards Petry and O'Brien's second criterion by demonstrating the reliability and validity of the PIE-9 and PIE-Interview, and identification of IGD symptoms in Australian samples using these measures.

Further, the IGD measure (PIE-9) statistically predicted a small but significant proportion of unique variance in distress and disability after accounting for the variance of disorders noted to be related to IGD (ADHD, OCD, depression, and anxiety). These findings contribute evidence that IGD is unique and help to demonstrate the functional impact of IGD. The functional impact of IGD is meaningful (Billieux et al., 2017b) because if IGD did not contribute any distress or disability, then IGD would not pose a mental health concern. My research has addressed concerns of some researchers (Aarseth et al., 2017; van Rooij et al., 2018) that IGD/gaming disorder is only secondary to other existing disorders by demonstrating small but unique distress. My research has contributed evidence that it is unique, and indeed, accounted for a more substantial proportion of variance in disability compared to anxiety and ADHD, and a similar proportion of variance to depression. My findings are also consistent with other literature demonstrating a unique contribution of IGD to functional impairment (Gentile, et al., 2011; Mihara, & Higuchi, 2017; Müller, Dreier, Duven, Giralt, Beutel, & Wölfling, 2017; Sakuma et al., 2017; Sussman, Harper, Stahl, & Weigle, 2017; van Rooij, et al., 2017), building a body of literature in support of, and in recognition of, the functional impact of IGD.

What are the cognitions associated with IGD? In Chapter 5 a brief 12-item measure of IGD cognitions (PGCS) was developed that strongly correlated with IGD symptoms as represented by the PIE-9. A key finding was that the process of preoccupation was more important than the content of the cognitions themselves, which is consistent with the definition of IGD proposed by the DSM-5 (APA, 2015). The important cognitive component appears to be the *process* of preoccupation or the time spent thinking about gaming while not gaming, rather than the specific thoughts.

Assessment of the content of gaming cognitions is still likely to be helpful for guiding individualised case formulations and treatment plans, but clinicians may need to target

processes that maintain over engagement in the process of repetitive thinking about gaming rather than modifying each individual thought (as discussed in Chapter 6). Due to IGD being currently defined by a cluster of polythetic symptoms (Shaffer et al., 2004; Griffiths 2017), it is reasonable to hypothesise that the motivations towards gaming, and therefore the cognitions associated with gaming, may vary on an individual level.

In addition to the possibility that preoccupation with gaming is more important than specific beliefs, there are several potential reasons why specific internet gaming cognitions were not found to be statistically predictive of problematic gaming and IGD in the research of this thesis. First, participants in my sample were required to spend at least 1 hour of gaming per week, and only a small proportion of the sample met criteria for IGD. The hours of participation were not controlled for, and therefore, may have mitigated against finding an effect. A replication study, with some adjustments to inclusion criteria, could address this issue. For example, the use of a stratified sample, whereby you would recruit an equal proportion of individuals across the dimension of gaming hours per week (e.g., 20% of 1-5 hours, 20% 6-10 hours, 20%, 11-15 hours, 20% 16-20 hours, 20% 21+ hours) to control for the frequency of gaming hours per week. Second, although King and Delfabbro (2014b) were systematic and comprehensive in their identification of gaming-related cognitions, it is possible that some key cognitions were not included in their illustrative client statements of IGD cognitions, and hence were not included in this research. Third and finally, while the cognitions were explored in terms of their association with IGD, several potential extraneous variables were not accounted for as part of the study. Research has since found that motivations towards gaming, negative affect, and other life factors such as school and home life may impact on IGD (Heiden, Braun, Muller, & Egloff, 2019; Mihara, & Higuchi, 2017). The relationship between these factors and cognitions related to gaming is not yet well understood and requires further exploration to understand how to differentiate the unique

contribution of gaming cognitions, and other factors, that distinguishes between those with and without internet gaming disorder (Objective 5). Similarly, other life factors may contribute to or influence cognitions related to gaming. These factors may include variations between cultures, differences in age, intelligence, and comorbid risk factors such as gambling, or other mental health concerns. These factors were not explored in this these due to a focus on the relationship between gaming related cognitions and IGD symptoms specifically. However, future research may want to include research questions that address these additional factors and how they may influence gaming related cognitions and IGD.

In conclusion, although Chapter 6 helped demonstrate the association between gaming-based cognitions and IGD symptoms, it did not shed light on which gaming-related cognitions differentiate between problematic and non-problematic gaming. These considerations are important for future study design and analysis of gaming-based cognitions to help differentiate the unique contributions that specific cognitions may have, in addition to the process of being occupied with gaming-related thoughts. Relatedly, the methodological implications of the future study of gaming cognitions are discussed below.

Methodological implications

One of the difficulties researchers have faced in exploring the nature of cognitions associated with gaming is the lack of consistent factor models between studies using the same illustrative client statements as items (Forrest, King, & Delfabbro, 2016; King, & Delfabbro, 2016; King, & Delfabbro, 2014b, Chapter 5 of this dissertation). Forrest and colleagues (2016) identified a four-factor model, different to King and Delfabbro's (2016) four-factor model, while I identified a bifactor model with one general and four specific factors (the rationale for using bifactor modelling has been discussed at length in Chapter 5). As discussed in the theoretical implications section above, there are several potential theoretical reasons for these discrepancies, including time spent gaming, unintentional exclusion of key

cognitions, and extraneous variables. It seems appropriate to propose that research attempts to differentiate between problematic and non-problematic gaming cognitions. My findings from chapter 5 provided evidence that the process of gaming-related thoughts was a strong statistical predictor of IGD symptoms. However, I was unable to differentiate between problematic and non-problematic gaming cognitions. I have discussed a potential approach to the issue of problematic and non-problematic gaming cognitions in the limitations and future directions section below.

Applications

Across the research program, four different measures were developed. The PIE-9 was developed as a measure of IGD, which is detailed in chapters 3 and 4 (Pearcy, McEvoy, & Roberts, 2017; Pearcy, Roberts, & McEvoy, 2016). The PGCS and the 12-item version (PGCS12) were developed to assess gaming-related cognitions (Chapter 5). Finally, the PIE-Interview protocol was developed in Study 2 (Chapter 6). The following section details which of these measures I would recommend for future research.

At the time of publication of the PIE-9 (Pearcy, Roberts, & McEvoy, 2016), there were very few measures that directly assessed the nine proposed criteria for IGD according to the DSM-5 (APA, 2013). However, there are now several brief self-report measures, and two structured interviews, available that directly assess the IGD criteria (as covered above in this chapter, under the section titled *Measurement of IGD since the inception of this research program*). King and Delfabbro, (2018, p. 130) probably said it best when they stated "…each new tool derived from IGD criteria may offer little more than another white swan joining the lamentation of white swans. These tools can confirm, but cannot disprove, the existence of IGD". King and Delfabbro's commentary is in recognition of the plethora of brief self-report measures that have been developed to assess the proposed IGD criteria in the DSM-5 (APA, 2013), with limited new or different findings emerging as a result of new measure

development studies. Table 7.2 provided a summary of each of these measures, in addition to the two structured interviews, that have been developed to assess the proposed IGD criteria in the DSM-5 (APA, 2013). Future researchers and clinicians may then be interested to know which of the described measures would be useful in measuring IGD.

Which measure(s) to use to assess IGD? As noted above, there are a vast number of measures to choose from to assess IGD as proposed by the DSM-5 (APA, 2013). The purpose of the research will depend on the type of measure that may be appropriate for use.

I would recommend the use of the PIE-9 for survey research purposes for the following reasons. First, evidence for the reliability and validity of the PIE-9 has been provided throughout the current research program (Chapter 3; Pearcy, Roberts, McEvoy, 2016). The PIE-9 was tested in a community sample with participants in Australia, the UK and the US, and a separate Australian student sample. The PIE-9 demonstrated strong reliability and validity across both samples (Pearcy, Roberts, & McEvoy, 2016). The response format of the PIE-9 is continuous rather than dichotomous. A continuous response format provides greater variance compared to a dichotomous format (Tabachnick, & Fidell, 2019), and so is more useful for research purposes investigating the underlying nature of IGD. The PIE-9 is also quick to administer, demonstrating clinical utility in its brevity. The PIE-9 is also the only measure that includes validity questions that directly ask the respondent about their views, and their views of others, about their video gaming behaviours. The demonstration of the consistency of measurement across samples, and the robust nature of the measure development (including following the COSMIN guidelines; Mokkink et al., 2010), the inclusion of two validity questions, while maintaining brevity, is why I would recommend the PIE-9 over other similar measures for use in survey research. A paper copy version of the PIE-9 is attached as Appendix B.

Research other than survey research, may want more detailed information regarding IGD symptoms for a variety of reasons, such as interview studies or clinical research. My second study involved a pilot study for the PIE-Interview, a structured interview protocol for assessing IGD. The PIE-Interview showed promise as a useful measure to assist researchers in diagnosing IGD by demonstrating high diagnostic accuracy in the pilot study (Study 2, Chapter 6). The PIE-Interview demonstrated acceptable sensitivity and specificity, and good concurrent validity through correlations with the PIE-9. Additionally, the PIE-Interview includes validity questions, and questions relating to onset, treatment, and previous engagement in health services, providing further clinical utility. These additions relating to the validity, and clinical utility are not included in other structured interview measures of IGD (SCI-IGD, Koo, Han, Park, & Kwon, 2017; and the C-VAT 2.0, van Rooij, Schoenmakers, & van de Mheen, 2017). For these reasons, I would recommend the use of the PIE-Interview in research studies that require both qualitative and quantitative information, such as clinical research seeking to assist in the diagnosis of IGD. The PIE-Interview protocol is attached as Appendix C.

If a clinician is seeking measures to assist in their diagnosis of IGD, I would maintain my recommendation of using the PIE-Interview, and PIE-9. However, clinicians may also consider using the shorter 9-item version of the IGD Scale developed by Lemmens, Valkenburg, and Gentile (2015). The IGD scale (Lemmens et al., 2015) is a nine-item scale that assesses all nine of the proposed IGD criteria (APA, 2013) in a dichotomous yes or no format, with comparable internal consistency to the measure using a 6 point Likert scale (Lemmens et al., 2015). The IGD scale has also demonstrated good reliability and validity and precise language (Lemmens et al., 2015), similar to the PIE-9 (Pearcy, Roberts, & McEvoy, 2016; Pearcy, McEvoy, & Roberts, 2017). Therefore, the PIE-9 and the IGD Scale are comparable measures. The key differences are in the response formats discussed, the

inclusion of the validity questions on the PIE-9, and the samples where the scales have been tested. The IGD Scale was tested on a sample including Dutch adolescents, and the PIE-9 has only been tested in adult samples, which may factor into a clinician's decision making when choosing between the two scales. Given the above, it would then ultimately be up to the clinician to determine which of the two scales they might consider appropriate in their circumstance. In clinical practice, I would also recommend the PIE-Interview, to provide further contextual information and as a secondary measure to confirm diagnostic criteria are met.

In combination, the PIE-Interview, and IGD scale or PIE-9 provide qualitative and quantitative data from multiple sources. However, these measures were designed and intended to assess symptomology and not as diagnostic instruments, and to assist clinicians with diagnosis, rather than provide one. In combination, the measures provide comprehensive and complementary information to assist with diagnosis, treatment or research while maintaining clinical utility.

Strengths of this research programme

This thesis has contributed in the following ways: the measures developed (The PIE-9, PGCS, and PIE-Interview), the insights into the nature of IGD, and the rigour with which the research was conducted. The following is a summary of these contributions, as each has been detailed in the previous chapters.

Throughout this research program, a reliable and valid self-report measure of IGD, the PIE-9 (Chapter 3, Pearcy, Roberts, & McEvoy, 2016) was developed. The CONSORT guidelines for measure development (Plint et al., 2006) were followed, reporting reliability and validity information to assist future researchers in evaluating each measure, demonstrating robust methodological procedures. The PIE-9 uses all of the proposed criteria in the DSM-5 (APA, 2013), addressing the issue of inconsistency between measures before

the release of the DSM-5 (APA, 2013). Additionally, both community and student samples were used in the development of the PIE-9. Community samples better enable greater generalisation of results compared to studies using student samples alone. As noted in the theoretical implications, the sample used in study 1 included individuals across Western nations (Australia, the United Kingdom, and the United States of America), providing some support for the cross-cultural validity of the findings. The samples across each of these populations are small, and therefore require further study to provide greater assurance in the findings. The research into developing measures of IGD has also provided interesting insights towards the nature of IGD.

The current research program has detailed two key findings that have contributed to our understanding of IGD. The first key finding was that IGD contributed to unique distress and disability after controlling for existing mental health disorders (Pearcy, Roberts, & McEvoy, 2017). As previously discussed, the finding that IGD contributed unique distress and disability is inconsistent with the proposition that IGD is only secondary to existing disorders (Aarseth et al., 2017, van Rooij et al., 2018). In addition, IGD accounted for more unique variance in disability than anxiety and ADHD, and a similar proportion of variance in distress as depression. The second key finding was that gaming-related cognitions as measured by the PGCS statistically predicted IGD symptoms (Chapter 5). No specific cognitions appeared to statistically predict IGD, which lead to the hypothesis that the *process* of excessive and repetitive thinking about gaming-related cognitions was more important than the *content* of gaming-related cognitions. The theoretical implications of this finding has been discussed at length in the related section (Chapter 7: Theoretical implications).

The developed structured interview protocol, the PIE-Interview, shows promise as a reliable and valid measure of IGD (Chapter 6). The PIE-Interview pilot study compared the PIE-9 and PIE-Interview to assess IGD and found the PIE-Interview to be an accurate

measure in identifying IGD. The approach used the COSMIN checklist to measure development (Mokkink, et al., 2010), ensuring a robust approach to developing the measure, in addition to ensuring all information reported in the study is provided for future comparisons. As previously suggested, the PIE-Interview presents as a useful measure to assist clinicians in diagnosing IGD. The development of the PIE-Interview also directly responds to a call for more structured interviews to be developed to diagnose IGD (Rumpf et al., 2019).

Limitations and future directions

This thesis has made a number of meaningful contributions to the field of IGD. However, some limitations need to be considered to build upon this research program in future. The limitations include the lack of child or adolescent samples, the unknown relationship between specific gaming-related cognitions and IGD, limited exploration of extraneous variables that may have influenced IGD symptoms, and the preliminary nature of the PIE-Interview study.

The current research program did not use children or adolescents in testing and validating measures of IGD. Therefore, further testing of the PIE-9 and PIE-Interview would need to be conducted to establish if these measures are suitable for use in child and adolescent populations. Additionally, future research could investigate whether there are differences between children, adolescents, and adults who present with IGD.

The research into gaming-related cognitions and IGD resulted in the development of the Problematic Gaming Cognitions Scale (PGCS, and short version, PGCS12). The key finding outlined in Chapter 5 suggested that the process of gaming-related cognitions was more important than the content of thoughts. However, no study has demonstrated consistency in the underlying structure of cognitions, or the nature of cognitions associated

with IGD. Further work is needed in the area of gaming-related cognitions to differentiate problematic and non-problematic gaming cognitions.

The research presented in this thesis and previous research into the associations of IGD and gaming-related cognitions has used the illustrative client statements proposed by King and Delfabbro (2014b) as a starting point for gaming-related cognition measure development (Forrest, King, & Delfabbro, 2016; King, & Delfabbro, 2016). However, as previously noted in the theoretical implications, no study has been able to replicate previously identified models of gaming-related cognitions. There are several potential reasons why replication has been difficult. As previously discussed above in the theoretical implications, these may include individual differences, the nature of cognitions of gaming being polythetic (Shaffer et al., 2004; Griffiths, 2017), variations in the inclusion criteria (such as hours played), other cognitions not accounted for, the types of games played, or other life factors that may influence gaming-related cognitions that we're yet to understand (Heiden, Braun, Muller, & Egloff, 2019; Mihara, & Higuchi, 2017). Therefore, a potential avenue for future research is exploring gaming-related cognitions through qualitative research, such as structured interviews or the collection of open ended statements. To ensure a broad set of cognitions are captured, the design could include stratified sampling based on time spent gaming. The PIE-9 or the PIE-Interview could be used to evaluate the presence of IGD symptoms. This proposed design addresses each of the discussed methodological weaknesses identified in Chapter 5, and helps to address the originally proposed question (Is there a different set of problematic and non-problematic gaming cognitions?). The qualitative approach does not assume the underlying nature of IGD, nor does it assume that King and Delfabbro's (2014b) original illustrative client statements are exhaustive. This seems appropriate, given IGD is still a proposed disorder in the DSM-5. Therefore, more exploratory research is in alignment with

developing further evidence towards the disorder, and does not assume our current understanding of gaming-related cognitions is exhaustive or complete.

The pilot study of the PIE-Interview showed promise as a structured interview assessing IGD, demonstrating acceptable specificity and sensitivity (Chapter 6). However, testing in a larger sample, which may also include testing in children and adolescent populations, could provide further evidence of reliability and validity of the measure. Using the PIE-Interview in future research would also help to accumulate evidence as requested by Petry and O'Brien (2013) in consideration of IGD's inclusion in future editions of the DSM (APA, 2013; See theoretical considerations above in Chapter 7). For example, establishing the reliability and validity of the proposed IGD criteria cross-culturally, and in epidemiological studies to assess prevalence rates.

Research into the epidemiology of IGD has mostly used convenience sampling, cross-sectional designs, and a variety of methods, which has resulted in variability in findings and prevents direct comparisons from being made (Fam, 2018; Mihara, & Higuchi, 2017). Additionally, most of these studies, including my own, have relied on self-report measures. Self-report measures are useful, as outlined in Chapter 2. However, researchers have requested studies with stronger methodological rigour to help provide stronger evidence concerning IGD (Rumpf et al., 2019). One aspect of providing such rigorous research would be to use a structured clinical interview, such as the PIE-Interview, to provide qualitative, and quantitative information in clinical samples. Furthermore, my own research did not compare people across counties, in terms of measurement invariance, and their scores on the measures. Therefore, I did not test the utility of the criteria across samples directly and would recommend future research complete comparisons between samples to identify cross-cultural differences or similarities.

In addition, there is a possibility that other extraneous variables could account for variations in relationships between the measured variables of gaming-related cognitions and IGD symptoms. In particular, lifestyle related variables such as sleep, diet, exercise, and health could all influence the variables measured across this research program. For example, a recent systematic review highlighted evidence that IGD has a strong negative impact on sleep and schoolwork for children and adolescents (Sugaya, Shirasaka, Takahashi, & Kanda, 2019). Given the broader reaching impacts of sleep in particular, it seems appropriate to measure and assess sleep and other lifestyle factors in future research investigating the relationship between IGD and gaming-related cognitions.

The types of games may influence gaming-related cognitions, and evidence is increasingly suggesting that first-person shooters (FPS), and massive-multiplayer online role playing games (MMORPGs) players are more likely to meet IGD criteria compared to other types of popular games (such as sports games, or real-time strategy games; King & Delfabbro, 2016b; Na et al., 2017; Sugaya, Shirasaka, Takahashi, & Kanda, 2019). The types of games were not considered or reported in analyses throughout this research program. However, future research would benefit in accounting for whether different types of games influence gaming-related cognitions, or variations in the presentations of IGD symptoms.

Another factor that could impact the relationship between IGD and gaming-based cognitions is drug and alcohol use, and other potential co-morbid conditions. There has been limited empirical studies assessing the co-occurrence of alcohol and substance use, and IGD (Burleigh, Griffiths, Sumich, Stravropoulos, & Kuss, 2019). The current research program did not investigate or record drug or alcohol use. Future research would benefit from considering co-occurring addictions and conditions, and the relationship with IGD, as this appears to be a limited area of study in the field (Burleigh, Griffiths, Sumich, Stravropoulos, & Kuss, 2019).

In summary, while the current research program has provided useful measures for future use, several limitations have been identified. These include the lack of child and adolescent samples, implications regarding gaming-related cognitions including the potential influence of extraneous variables, and the limitations of the research involving the PIE-Interview. Future research into IGD should consider using more robust research designs and additional sources of information such as the use of structured clinical interviews.

Conclusion

Does IGD warrant concern? In short, yes. Evidence continues to accumulate that IGD should be considered a mental health disorder (Mihara, & Higuchi, 2017; Sussman, Harper, Stahl, & Weigle, 2018). The original proposition of IGD by Petry and O'Brien (2013), and earlier researchers in the area of internet addiction (See Gentile, 2009, O'Brien, 2010; Young 1996b), was that there is more evidence for IGD compared to other internet use behaviours (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; O'Brien, 2010; Petry, & O'Brien, 2013; Tau et al., 2009). This trend has continued forward, over the past decade, with the proposed IGD definition (APA, 2013) helping to provide guidelines towards common diagnostic criteria. The inclusion of gaming disorder in the ICD-11 (WHO, 2018) has contributed to considerable debate in the field, due to less restrictive diagnostic criteria compared to those proposed by DSM-5 (Pontes, Schivinski, Brzozowska-Wos, & Stavropoulos, 2019). However, evidence for the existence of IGD (Griffiths, Kuss, Lopez-Fernandez, & Pontes, 2017; Rumpf et al., 2018; Saunders et al., 2017; Sussman, Harper, Stahl, & Weigle, 2017) and its functional impact (Billieux et al., 2017b; King, 2018) continue to accumulate.

My research has contributed to the literature about IGD in several ways. I created measures of the proposed IGD criteria, such as the PIE-9 self-report measure, and PIE-Interview. These measures demonstrated good psychometric properties from their initial

testing studies. Additionally, the studies revealed interesting findings towards the nature of cognitions associated with IGD. Finally, the interview protocol, PIE-Interview, answers a call for a structured interview (Rumpf et al. 2019) that can be used in the future to diagnose IGD using the DSM-5 (APA, 2013) proposed criteria. In summary, my research has made significant contributions to the field of IGD, particularly in the area of measure development.

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Appendices

Appendix A: Ethics Approval for the project

MEMORANDUM

Curtin University

To:	A/Prof Lynne Roberts School of Psychology and Speech Pathology
CC:	Mr Benjamin Thomas Draper Pearcy
From:	Professor Peter O'Leary, Chair HREC
Subject	Ethics approval Approval number: RDHS-09-15
Date:	13-Jan-15

Office of Research and Development
Human Research Ethics Office

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your application submitted to the Human Research Ethics Office for the project: 5860

Internet gaming disorder: associated cognitions, measures and clinical utility

Your application has been approved through the low risk ethics approvals process at Curtin University.

Please note the following conditions of approval:

1. Approval is granted for a period of four years from **13-Jan-15** to **13-Jan-19**
2. Research must be conducted as stated in the approved protocol.
3. Any amendments to the approved protocol must be approved by the Ethics Office.
4. An annual progress report must be submitted to the Ethics Office annually, on the anniversary of approval.
5. All adverse events must be reported to the Ethics Office.
6. A completion report must be submitted to the Ethics Office on completion of the project.
7. Data must be stored in accordance with WAUSDA and Curtin University policy.
8. The Ethics Office may conduct a randomly identified audit of a proportion of research projects approved by the HREC.

Should you have any queries about the consideration of your project please contact the Ethics Support Officer for your faculty, or the Ethics Office at hrec@curtin.edu.au or on 9266 2784. All human research ethics forms and guidelines are available on the ethics website.

Yours sincerely,

[redacted]

Professor Peter O'Leary
Chair, Human Research Ethics Committee

Appendix B: Paper copy of the PIE-9

Personal Internet Gaming Disorder Evaluation (PIE-9)

Video-games include games played online or offline, on consoles (such as PlayStation, Xbox or Nintendo Switch), mobile phones or computers (PC or Mac).

Please circle how much you agree or disagree with the following two statements:

I personally believe that my video game playing behaviour is problematic [Strongly Disagree] [Disagree] [Agree] [Strongly Agree]

Significant others in my life would consider my video game playing as problematic [Strongly Disagree] [Disagree] [Agree] [Strongly Agree]

Please provide an answer stating how much you agree with each of the following statements, stating your answer as how much it applies to you *over the past year*.	Never	Rarely	Sometimes	Often	Very Often
1. I have been preoccupied with video games.	1	2	3	4	5
2. I have experienced withdrawal symptoms when video gaming is taken away (such as anger, frustration or sadness).	1	2	3	4	5
3. I find a need to spend increasing amounts of time engaged in video games.	1	2	3	4	5
4. I have had unsuccessful attempts to control the participation in video games.	1	2	3	4	5
5. I have lost of interest in previous hobbies and entertainment other than video games.	1	2	3	4	5
6. I continue excessive use of video games despite knowing it causes me problems.	1	2	3	4	5
7. I have deceived family members, therapists, or others regarding the amount of time I spend video gaming.	1	2	3	4	5
8. I use video games to escape or relieve a negative mood.	1	2	3	4	5
9. I have jeopardised or lost significant relationships, jobs, or educational opportunities because of participation in video games.	1	2	3	4	5

Pearcy, B. T., Roberts, L. D., & McEvoy, P. M. (2016). Psychometric Testing of the Personal Internet Gaming Disorder Evaluation-9: A New Measure Designed to Assess Internet Gaming Disorder. *Cyberpsychology Behavior and Social Networking*, *19*(5), 335-341. doi:10.1089/cyber.2015.0534

Appendix C: PIE-Interview Protocol

PIE-Interview protocol

I will now ask you a series of questions related to your gaming behaviours **over the past year**. For the following questions, please provide an answer of yes or no. If you are unsure or do not know, please say so and I can repeat the question or move on to the next question. After each question I may ask for an example to demonstrate your answer, if you are able, please provide an example when asked to do so.

[Define internet Gaming for the participant:]
For your reference, internet gaming is defined as participation in online video-games, usually including a social component.

A1 a) Do you personally believe that your internet game playing behaviour is problematic? NO YES

b) **[if yes]** Can you provide me with an example?

_____
_____
_____
_____

A2 a) Would significant others in your life consider your internet gaming as problematic? NO YES

b) **[if yes]** Can you provide me with an example?

_____
_____
_____
_____

PIE-9 Questions

Over the past year…

B1 a) Have you been preoccupied with internet games? NO YES

[Define preoccupied if the participant is unsure:]

Preoccupied: thinking excessively about gaming, even when you should be concentrating on other things.

[IF NO – GOTO B2] [IF YES - GOTO B1b]

b) About how often were you preoccupied with internet games over the past year?

Was it … Less than once per week
1 to 2 days per week
3 to 4 days per week
5 to 6 days per week
Every day

c) Can you provide me with an example of a specific game or time over the past year when you were preoccupied?

_____
_____
_____
_____

Over the past year…

B2 a) Have you experienced withdrawal symptoms when internet gaming was taken away, you were unable to play, or the game was unavailable? Withdrawal symptoms may include negative feelings such as frustration, sadness or anger. NO YES

[IF NO – GOTO B3] [IF YES - GOTO B2b]

b) When was the last time you noticed these feelings?

c) Can you provide me with an example of a time you experienced withdrawal symptoms?

_____
_____
_____
_____

Over the past year…

B3 a) Have you found a need to spend increasing amounts of time engaged in internet games? NO YES

[IF NO – GOTO B4] [IF YES - GOTO B3b]

b) When did you last notice the need to spend more time engaged in internet games?

c) Can you provide me with an example?

_____
_____
_____
_____

Over the past year…

B4 a) Have you had unsuccessful attempts to control your participation in internet games? NO YES

[IF NO – GOTO B5] [IF YES - GOTO B4b]

b) Why do you believe your attempts to control your gaming were unsuccessful?

_____
_____
_____
_____

Over the past year…

B5 a) Have you at any time, lost interest in previous hobbies and entertainment because your time was increasingly spent playing internet games? NO YES

[IF NO – GOTO B6] [IF YES - GOTO B5b]

b) Are there any other reasons you lost interest in previous hobbies and entertainment, or was it solely due to your increasing use of internet gaming?

_____
_____
_____
_____

Over the past year…

B6 a) Have you continued excessive use of internet games despite knowing it causes you problems? Such as at home, school, work, with family, friends or other areas of your life? NO YES
[IF NO – GOTO B7] [IF YES - GOTO B6b]

b) In what area's do you think it has caused you problems? [list]

c) Can you provide me with an example of how it has caused problems?

_____
_____
_____
_____

Over the past year…

B7 a) Have you deceived family members, therapists, or others regarding the amount of time you spend internet gaming? NO YES
[IF NO – GOTO B8] [IF YES - GOTO B7b]

b) About how often have you deceived others regarding the amount of time you spend internet gaming?

_____

c) Why did you choose to hide your internet gaming?

_____
_____
_____
_____

Over the past year…

B8 a) Have you used internet games to escape from or relieve a negative mood? NO YES
[IF NO – GOTO C1] [IF YES - GOTO B8b]

b) About how often do you use internet games to escape from or relieve a negative mood?

c) Can you provide me with an example of a time when you used internet games to escape from or relieve a negative mood?

_____
_____
_____
_____

Over the past year…

B9 a) Have you jeopardized or lost significant relationships, jobs, or educational opportunities because of participation in internet games? NO YES
[IF NO – GOTO P10] [IF YES - GOTO B9b]

b) Can you provide me with an example?

_____
_____
_____
_____

PIE-9 Summary

B10 [Did the interviewee answer Yes to 5 or more of B1a to B9a?]

Yes GOTO C1

No GOTO Debrief

Onset questions

C1 a) When did you first recognise your internet gaming habits may be an issue?
Within the last 12 months?
More than 12 months ago?

C2 a) Do you believe your internet gaming problems occurred as a consequence of a pre-existing problem? NO YES

b) If so, please describe these pre-existing problems.
[if not mentioned, prompt for anxiety, depression, interpersonal problems, or any other emotional problems]
Description:_____
_____

C3 a) Do you believe your internet gaming caused other problems in your life?
NO YES
b) If so, please describe these other problems that you believe were caused by your internet gaming.
[if not mentioned, prompt for anxiety, depression, interpersonal problems, or any other emotional problems]
Description:_____
_____

C4 Have you ever talked to a medical doctor or health professional about your internet gaming? [PLEASE SPECIFY:] By health professional, we mean Psychologists, Social Workers, Counsellors, Physiotherapists, Occupational Therapists or other health professionals. NO YES
[IF YES GOTO C5, IF NO SKIP TO C8]

C5 Did you ever receive treatment for your symptoms? NO YES
[IF YES GOTO O6, IF NO SKIP TO C8]

C6 a) Did you find this treatment helpful or effective? NO YES

b) Please explain how you found the treatment [helpful/effective OR not effective]
[Note details here]
_____
_____
_____
_____

C7 Was this treatment within the past 12 months or at a time earlier than the past 12 months? Within 12 months / Earlier

C8 Have you ever been hospitalised overnight or otherwise due to your gaming? NO YES

Debrief

Appendix D: Copyright permissions for Paper 1 and Paper 2

FW: Request permission to use published articles in my doctoral thesis

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BK Ballen, Karen <KBallen@liebertpub.com>
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Tue 3/12/2019 2:02 AM

You replied to this message on 3/12/2019 9:06 AM.

Dear Ben:

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Kind regards,

Karen Ballen
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Cc: Peter McEvoy <peter.mcevoy@curtin.edu.au>; Lynne Roberts <Lynne.Roberts@curtin.edu.au>
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Dear Mary Ann Liebert,

I have previously published two articles in the journal titled *Cyberpsychology, Behavior, and Social Networking*. Can I please have written permission that I can include the postprint manuscript in my doctoral thesis?

The following articles are:

Pearcy B.T.D, Roberts L.D., and McEvoy P.M. (2016). Psychometric testing of the PIE-9: a new measure designed to assess Internet Gaming Disorder. *Cyberpsychology, Behavior, and Social Networking*, 19, 335–341. Doi: 10.1089/cyber.2015.0534

Pearcy, B.T.D., McEvoy, P.M., and Roberts, L.D. (2017). Internet Gaming Disorder Explains Unique Variance in Psychological Distress and Disability After Controlling for Comorbid Depression, OCD, ADHD, and Anxiety. *Cyberpsychology, Behavior, and Social Networking*, 20. Doi: 10.1089/cyber.2016.0304

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Also, written permission would be helpful all the same to meet thesis completion requirements.

Kind regards,

Ben Pearcy

Appendix E: Author Attribution Tables

Paper 1, Chapter 3:

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	Paper 1 (Chapter 3)	Paper 2 (Chapter 4)
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Acquisition of Data & Method	Lead Author	Lead Author
Data Conditioning & Manipulation	Lead Author	Lead Author
Analysis & Statistical Method	Lead Author	Lead Author
Interpretation & Discussion	Lead Author	Lead Author
Final Approval	Lead Author	Lead Author

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Acquisition of Data & Method	Review and supervision	Review and supervision
Data Conditioning & Manipulation	Review and supervision	Review and supervision
Analysis & Statistical Method	Review and supervision	Review and supervision
Interpretation & Discussion	Review and supervision	Review and supervision
Final Approval	Review and supervision	Review and supervision
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Acquisition of Data & Method	Review and supervision	Review and supervision
Data Conditioning & Manipulation	Review and supervision	Review and supervision
Analysis & Statistical Method	Review and supervision	Review and supervision
Interpretation & Discussion	Review and supervision	Review and supervision
Final Approval	Review and supervision	Review and supervision
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