The Cognitive Styles of Satisfied Decision Support System Users: An Hypothesis

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Abstract

This paper presents an hypothesis for future testing to examine the relationship between user cognitive style and user satisfaction with Decision Support Systems (DSS). Preliminary research, in which subjects with different cognitive styles were found to have up to 17% difference in levels of satisfaction with a DSS, suggests the theoretical basis for the hypothesis. The DSS facilitated some users' processes of consciousness, or ways of selecting and forming views of the world, more than others. Some types therefore experienced more satisfaction with the system because the computerised task engaged their most preferred cognitive processes, while other types were forced into their least preferred processes. DSS have certain common characteristic tasks, and it is hypothesised that such tasks will always lead to certain cognitive types experiencing higher satisfaction.

Keywords

DSS, Cognitive style, MBTI, Organisational decision making, User satisfaction, Task/technology fit.

1. INTRODUCTION

Decision support has been defined by Keen and Scott Morton as

> " ... the use of computers to:
> 1. Assist managers in their decision processes in semistructured tasks.
> 2. Support, rather than replace, managerial judgement.
> 3. Improve the effectiveness of decisionmaking rather than its efficiency."

(Keen and Scott Morton, 1978, p1)

Semistructured tasks are those in which data can be manipulated by analytical techniques, but management judgement is required to place the results of the analysis in context. DSS are systems designed to assist in the performance of these tasks. Typical DSS have access to data stored in corporate databases, statistical and graphical tools to manipulate and display the data, and computational algorithms based upon the accepted mathematical models for the problem domain. 'What if' and sensitivity analyses play a big part in their usage, and these enable managers to survey a wide range of scenarios to get a feel for the behaviour of the phenomenon under examination. Subsequent decisions are thus based upon a better understanding of the problem, and hopefully are more effective than they otherwise would have been. The tasks involved in using a typical DSS include data gathering, assessment of the relevance and importance of this data, and choices about appropriate action based upon this data.

The issue of whether an Information System (IS) or Decision Support System (DSS) should be designed to conform to or complement the user's cognitive style has been debated for many years. Huber (1983) argued strongly that cognitive style research would not lead to operational guidelines for IS and DSS design. The research literature to date was weak and inconclusive and typically only 10% of the variance of the decision-making behaviour or performance was attributable to cognitive style. Robey (1983) substantially agreed with Huber, but argued that the relationship between cognitive style and User Satisfaction (US) had not been addressed in the literature. A system designed to conform to the user's preferred style might enhance job satisfaction. The debate resumed when Rao

et al (1992) argued that previously held beliefs that cognitive differences were the result of left and right brain hemispherical specialisation could no longer be sustained. Results obtained from more advanced technology for measuring brain activity suggested that many areas of the brain were involved in even simple tasks. This did not however mean that cognitive styles were no longer important in IS research. Behaviour should be the domain of interest for research, not the differences, if any, in hemispheres. Problem solving processes, ranging from the intuitive to the analytic, and the classification of the user as a novice or expert, were the focus of interest. Robey (1992) in reply argued that the integration of whole-brained cognitive processes into DSS design, not the dichotomous analytic-intuitive processes, would be more rewarding. Huber (1992) commented that the researchers did not clarify any further the issues associated with the conform or complement style question, and questioned whether such designed-in support would be ethical anyway.

2. COGNITIVE STYLE

Cognitive style is the term used to describe the relatively fixed patterns for experiencing the world used by decision-makers. The patterns encompass perceptive and intellectual activities. There are many aspects of cognitive style that can be measured and consequently many measurement instruments. A widely used measurement is the Myers-Briggs Type Indicator (MBTI) (Briggs Myers, 1988). It was designed to measure the characteristics of Jung's (1923) personality classification scheme. There are four dimensions to the typology: Extroversion-Introversion (EI), Sensation-Intuition (SN), Thinking-Feeling (TF), and Judgment-Perception (JP). Extroverts relate to the outer world of people and things, Introverts to the inner world of ideas and concepts. Sensing types use the senses to gain details of the world around them, Intuitives rely on inner hunches to understand the world. Thinking types use logical analysis of events to reach conclusions, Feeling types use feelings and personal values for decision making. Judging types understand life in terms of order and system while Perceptive types are more spontaneous and view life in less structured ways. The MBTI is administered in the form of a questionnaire in which subjects respond to over one hundred questions relating to personal preferences in life events. Scores are then assigned to each dimension based on these responses. Carlyn (1977) assessed the validity of the MBTI after studying the extensive research undertaken on it. This research concluded that it measures the personality dimensions postulated by Jung, and is a reasonably valid instrument which has practical use. The MBTI was used to measure cognitive style in the research described in this paper.

3. USER SATISFACTION

User Satisfaction (US) is the degree to which a user has a positive experience with the use of a given IS. Ives et al (1983) regard US as a good surrogate for the degree of use of a system for decision making, and it is much easier to measure. The short-form User Information Satisfaction (UIS) scales derived by Ives et al (1983) were used to measure US in the research described in this paper. This measurement consists of 13 scales with two items per scale. For example, one scale is 'Accuracy of output information' which has the two items 'accurate-inaccurate' and 'high-low'. Users score an item in the range from -3 to + 3, 0 indicating neutrality. Scale scores are calculated by averaging items' scores. Each scale is a sub-component of one of three major components of the measured satisfaction, namely information product (five scales), electronic data processing (EDP) staff and services (five scales), and knowledge and involvement (three scales). Questions relating to EDP staff and services were not included in this research as they were considered irrelevant in the context of the study. Subjects in this study thus recorded scores between -24 and +24.

4. COGNITIVE STYLE AND USER SATISFACTION

The author has found in previous research that there are interesting relationships between cognitive style and user satisfaction (Williams, 1996). Table 1 shows the relationships found in a study of a software package designed to help primary school teachers decide on the content of their teaching programs. In table 1, mean satisfaction is arranged in ascending order for the two classifications on each of the four MBTI scales.

Satisfaction **MBTI Type**	Mean Satisfaction
E	7.67
J	8.45
S	8.80
F	9.16
T	9.76
N	10.31
P	10.63
I	11.48

Table 1. MBTI Type by Ascending Order of Satisfaction
(Source: Williams, 1996, p793)

Table 2 shows the results of testing the differences between means for satisfaction for the various MBTI scales and some combinations of scales.

Type 1	Type 2	n_1	$\bar{X}_1$	n_2	$\bar{X}_2$	$\bar{X}_1 - \bar{X}_2$	p	% Difference
I	E	24	11.48	29	7.67	3.81	0.0310*	7.94
P	J	23	10.63	30	8.45	2.18	0.1400	4.54
N	S	21	10.31	32	8.80	1.51	0.2400	3.15
T	F	21	9.76	32	9.16	0.60	0.3800	1.25
IJ	EP	17	10.44	16	9.16	1.28	0.3200	2.67
IP	EJ	7	14.00	13	5.85	8.15	0.0011**	16.98

* Significant at 0.05 ** Significant at 0.01
Table 2. Tests of Differences of Means for MBTI Types
(Source: Williams, 1996, p793)

The largest scale differential in US is the EI scale, followed in order by the JP, SN and TF scales. Only the EI scale difference in mean US of 3.81 is statistically significant for single scales. The I subjects had a mean US 7.94% higher than the E subjects when considering the entire possible range in US from -24 to + 24. The lowest US recorded was -8 and the highest +22, and hence this figure is 12.70% higher when considering the total sample range. When the mean US for the EI scale is considered together with the next largest differential scale, JP, there is a mean difference in US of 8.15, which is statistically significant at the 0.01 level. Thus IP types had on average 16.98 % higher satisfaction than EJ types. This difference is 27.16% higher when the total sample range is considered. The correlation coefficient between the EI and JP scores for US is -0.21 which is not statistically significant, indicating that in this case there was no relationship between the two scales. There were 7 IP types and 13 EJ types comprising 38% of the total sample.

5. DISCUSSION

Table 3 summarises the concepts of the dominant and auxiliary processes in the MBTI theory.

	ST	SF	NF	NT
I--J	I<u>S</u>TJ	I<u>S</u>FJ	I<u>N</u>FJ	I<u>N</u>TJ
I--P	IS<u>T</u>P	IS<u>F</u>P	IN<u>F</u>P	IN<u>T</u>P
E--P	E<u>S</u>TP	E<u>S</u>FP	E<u>N</u>FP	E<u>N</u>TP
E--J	ES<u>T</u>J	ES<u>F</u>J	EN<u>F</u>J	EN<u>T</u>J

	Extrovert	Introvert
The JP preference shows how a person prefers to deal with the _____ world	outer	outer
The _____ process shows up on the JP preference	dominant	auxiliary
The dominant process is used in the _____ world	outer	inner
The auxiliary process is used in the _____ world	inner	outer

Table 3. The Dominant Process of Each Type
(Source: Briggs Myers, 1988, p16)

The underlined letter of each type in the top grid indicates the dominant process for that type. A possible explanation as to why IP types were more satisfied on average than EJ types lies in the tenants of this theory. People have a preferred process of operating termed the dominant process. They also have an auxiliary process that supplements the dominant process, and provides a balance between extroversion and introversion - the outer and inner worlds. People function best with their dominant process - less important matters are left to the auxiliary process (Briggs Myers, 1988). The task of preparing a teaching program involved <u>decisions</u> about the suitability for a classroom lesson of ideas or <u>facts gathered</u> from the computerised system. This is a problem situation that falls within the domain of IP types most preferred mode of operation, and into the least preferred mode for EJ types, as explained in the following paragraphs.

For IP types, the dominant process is the TF scale (decision making process, used in the inner world i.e.. for the mental component of the task undertaken for this research). The auxiliary process is the SN scale (perceiving process, used in the outer world i.e. for the fact-gathering component of the task undertaken for this research). The appropriate processes are directed to the appropriate tasks. For IP types there is a strong relationship between both these scales' scores and US. For EJ types, the dominant process is the TF scale (decision making process, used in the outer world i.e.. for the fact gathering component of the task undertaken for this research). The auxiliary process is the SN scale (perceiving process, used in the inner world i.e.. for the mental component of the task undertaken for this research). There is a mismatch between processes and tasks. For EJ types there is a weak relationship between both these scales' scores and US. Table 4 summarises these findings.

Task	IP Features	IP Fit	EJ Features	EJ Fit

Internal Activity	Decisional	Dominant, Decisional	High	Auxiliary, Fact gathering	Low
External Activity	Fact gathering	Auxiliary, Fact gathering	High	Dominant, Decisional	Low
n	53	7		13	
Mean US	9.40	14.00		5.85	

Table 4. Task-Type Fit and User Satisfaction
(Source: Williams, 1996, p795)

It is shown that when there is a strong fit between the task and cognitive style, US is well above average, and when the fit is weak, US is correspondingly below average. The task, as controlled by the computer software, was appealing to IP types because it enhanced their natural style of operation, leading to a positive experience of the package, expressed as above average satisfaction. The software forced EJ types into their least preferred mode of operation, causing them discomfort, manifesting itself in below average satisfaction.

6. THE HYPOTHESIS

H1: *The most highly satisfied users of a DSS will be those with the IP cognitive style*
The author suggests here that for a DSS, IP type users will always be the most satisfied users of the system, because the tasks involved in using a DSS are in the preferred cognitive domains of IP types. As previously stated, the tasks involved in using a typical DSS include data gathering, assessment of the relevance and importance of this data, and choices about appropriate action based upon this data. The preliminary research discussed in this paper supports this hypothesis, and the author suggests that these findings will be repeated with all DSS, because the basic DSS tasks will always be similar and engage the same cognitive processes. Further research is now needed with a number of DSS to test the validity of this hypothesis.

7. CONCLUSION

This paper has shown, based on some preliminary research evidence, an hypothesis that IP types will always be more satisfied with using a DSS than other types, because of the relationship between the cognitive tasks involved in using a DSS and the IP types preferred modes of operation. The findings of the supporting research suggest that the answer to the debate as to whether to support or complement the user's cognitive style at design time is in the affirmative - an IS should be designed to perform a task that conforms to the user's cognitive style because this leads to higher levels of US with the system. However, the closer the users' cognitive styles are to the IP type, the more satisfied they will be. Research is now needed to test this hypothesis.

REFERENCES

Briggs Myers, I. (1988) *Gifts Differing*, Consulting Psychologists Press, Inc, Palo Alto.
Carlyn, M. (1977) An Assessment of the Myers-Briggs Type Indicator, *Journal of Personality Assessment*, 41, 5, 461-473.

Huber, G. (1983) Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing ?, *Management Science*, 29, 5, 567-579.

Huber, G. (1992) Response to Rao, et al: How to Deal With Cognitive Style, *MIS Quarterly*, 16, 2, 153-154.

Ives, B., Olson, M., and Baroudi, J. (1983) The Measurement of User Information Satisfaction, *Communications of the ACM*, 26, 10, 785-793.

Jung, C. (1923) *Psychological Types*, Harcourt, Brace, New York.

Keen, P.G. and Scott Morton, M.S. (1978) *Decision Support Systems: An Organisational Perspective,* Addison-Wesley, Reading, Mass.

Rao, H., Jacob, V. and Lin, F. (1992) Hemispheric Specialisation, Cognitive Differences, and Their Implications for the Design of Decision Support Systems, *MIS Quarterly*, 16, 2, 145-151.

Robey, D. (1983) Cognitive Style and DSS Design: A Comment on Huber's Paper, *Management Science*, 29, 5, 580-582.

Robey, D. (1992) Response to Rao, et al.: More Ado About Cognitive Style and DSS Design, *MIS Quarterly*, 16, 2, 151-153.

Williams, R. (1996) The Impact of Cognitive Style on User Satisfaction with an Information System: A Preliminary Study, *Proceedings of the 7th Australasian Conference on Information Systems,* 789-798.