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TEMPERAMENT AND COGNITIVE FIT: AN EMPIRICAL INVESTIGATION OF TASK PERFORMANCE

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Research-in-Progress

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Abstract

This study examines the fit between an individual's temperament (a biologically driven cognitive antecedent to personality) and information representation and their impact on decision making task performance. Building upon the theory of Cognitive Fit, we propose that varying temperaments meaningfully affect the way in which individuals perceive the problem task representation and therefore impact their decision making task performance.

Keywords: Decision making, cognitive fit, temperament

Introduction

The practice of management is fundamentally tied to the process of marshalling resources and the allocation of these resources across varied organizational activities. Therefore, decision making is a core element of successful management (Schachter, 2006). Finding new processes or techniques that enable an organization to facilitate improved decision making among its individual members will enable the organization to more effectively achieve its goals (Higgins 2000). In the context of decision making within an organization, the selection of the optimal alternative is required for success (Higgins 2000; Massey and Brown, 1998; Schachter, 2006), while poor selection can lead to catastrophic consequences (Higgins, 2000).

For the individual, decision making can be regarded as a cognitive process resulting in the selection of a course of action among several alternatives (Reason, 1990) or as the process of making choices among several competing courses of action (Baron and Brown, 1991). In each case, decision making is a cognitive process where an individual selects one alternative from a set that are embedded within a situational task. The presentation of the task itself can influence the decision making process (Vessey, 1991). Cognitive and personality based factors of the individual can influence their decision making process (Myers, 1962; Mason and Mitroff, 1973; Benbasat and Schroeder, 1977).

While some work has been done on cognition and personality in the context of technology enabled decision making (Aron, 1969; Driver and Mock, 1975; Fellingham et al., 1976; Schroeder and Benbasat, 1975), the focus of this paper is on a less well known cognitive factor, a biologically driven antecedent to personality – temperament and its role in moderating problem-task representation and performance. Therefore, our research question is:

RQ – What is the effect of an individual's temperament and information representation on the performance of a decision making task?

In the following sections we will review the relevant background literature on cognition and decision making, develop the hypotheses, describe the methodology and provide concluding remarks.

Background

Decision Making

The decision making process literature has a long and rich history (Cheri et al., 2003; Mahmood et al., 1987; Sambamurthy et al., 1994; Wolfe et al., 1983). Decision making in management is an important skill, where success is measured by the individual's ability to select the best or optimal option from a set of alternatives (Higgins 2000; Massey and Brown, 1998). The process of corporate decision making is of the utmost importance for an organization and good decision making is a must for successful management (Schachter, 2006). Even the slightest mistakes in decision making may yield catastrophic losses in an organization (Higgins, 2000). On the other hand good decisions can greatly improve an organization's profits and help them to achieve their goals.

Cognitive Factors and Decision Making

Decision making is an inherently cognitive process; therefore cognitive factors are important contributors to decision making performance. The view that psychological type of the user should be addressed in MIS experimentation was reinforced by Benbasat and Schroeder: "*Experiments should be designed to include both human and MIS design variables. ... Future work should focus on instruments to describe human characteristics and on incorporating these characteristics into research design (Benbasat and Schroeder, 1977 p. 47)".* Since then several researchers have studied the affect of individual's cognitive factors on various attributes such as job performance (Barrick et al., 2002; Barrick and Mount, 1993), job satisfaction (Heller et al., 2009), motivation (Wong and Csikszentmihalyi, 1991), and learning new things (Barrick and Mount, 1991) among several others. A person's decision making process also depends upon their cognitive style (Myers, 1962). Decision support systems (DSS), a class of Information Systems, can be utilized to support decision making activities of individuals through

an organization. However, a 'one-size-fits-all' approach may not be appropriate for such systems, because differing cognitive factors may undercut the effectiveness of such tools. When a DSS is implemented within an organization and the psychology of the intended users is not designed into the system, it may result in decreased utilization or preempt the establishment of routine behaviors of use (Bhattacherjee, 2001) and general dissatisfaction ensues (Aron, 1969; Driver and Mock, 1975; Fellingham et al., 1976; Schroeder and Benbasat, 1975). When the DSS matches the users' particular cognitive style, then enhanced performance can be realized (Mason and Mitroff, 1973).[1]

For the purpose of this study, we focus on a distinct antecedent to psychological types – temperament. There is general agreement that temperamental processes are innate rather than learned (Kagan, 2005), rooted in biological systems, and that emotion is basic to temperament (Goldsmith et al., 1987). Theorists suggest that temperamental dimensions form the emotional substrate of an individual's personality (Goldsmith et al., 1987). For the purpose of this study we chose to use temperament (specifically KTS – Keirsey Temperament Sorter (Keirsey, 1984)) over the personality, because of the nature of the research question being studied in this paper. In contemporary psychology, the "Big Five" factors of personality, which were discovered and defined by several researchers, are considered as the five broad domains or dimensions of personality, used to describe human personality (Digman, 1990; McCrae & Costa, 1990; Costa & McCrae, 1992; John, 1990; Goldberg, 1990). The big five personality scale categorizes individuals according to extraversion, agreeableness, conscientiousness, neuroticism, and openness. It is difficult to relate a person's performance on a decision making task with these personality categories, as they are not directly related to decision making. Whereas the Keirsey classifications (judging, perceiving, sensing, intuiting) are more closely related to aspects of decision making and hence are more suitable for studying an individual's performance on a decision making task. As the KTS categorization of temperament are related to the fundamental differences in acclimatization to problem solving goals, they will be useful in discussing individual differences related to problem solving and decision making.

Accounting for the cognitive aspects of system users and their role in affecting task performance, Cognitive Fit Theory (CFT) is a valuable perspective to understand differential performance among system users. Integrating problem representation and the problem solving task (e.g. the situational task), CFT explains why individuals may perform differently on identical tasks (Vessey, 1991). In essence, CFT elaborates on the relationship between the problem solving task itself, the representation of the problem and how they lead to the individual mentally representing the task. The fit between the mental representation and the individual then leads to some level of performance in the problem solution, See Figure 1.

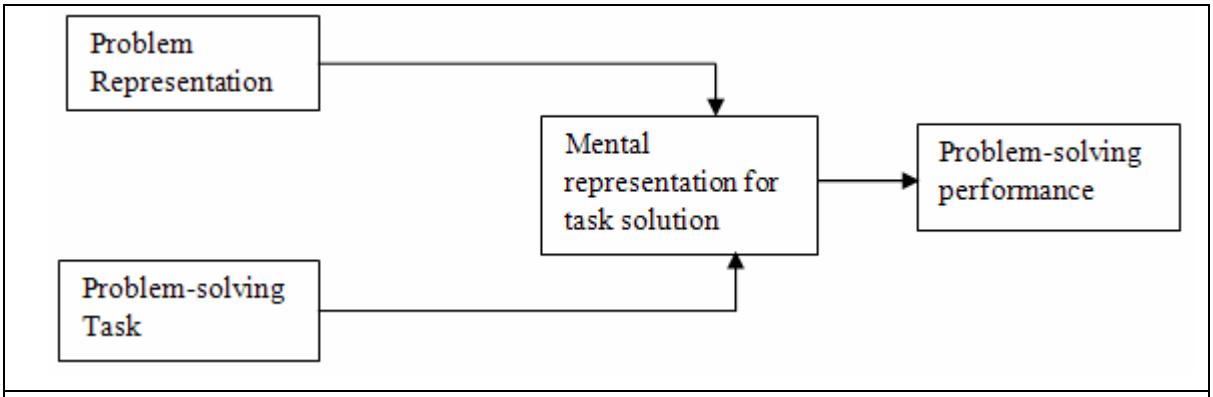

Figure 1. Cognitive Fit Theory

[1] The terms cognitive type, cognitive style, and psychological types, can be used interchangeably to refer to "an individual's way of performing 'perceptual and intellectual' activities (Gigch and John, 1978, p.90)".

According to the cognitive fit theory elementary tasks can be classified into two categories – 1) Symbolic tasks, and 2) Spatial tasks (Vessey, 1991). The basic difference between these two types of tasks is that, symbolic tasks require users to pick values, whereas spatial tasks require users to compare values. According to the cognitive fit theory, as graphs convey continuous information, they provide a better fit for performing spatial tasks, whereas tables, which convey discrete information provide a better fit for doing symbolic tasks (Vessey, 1991). CFT does not imply that one cannot perform a symbolic task using a graph, or a spatial task using a table; rather, that if one does so, the problem solving performance in each instance will be less efficient and less effective (Shaft and Vessey, 2006).

CFT has been applied to and evaluated in different contexts, such as object-oriented modeling (Agrawal et al., 1996) and programming (Sinha and Vessey, 1992). Expanding the original framework of CFT, it now includes representations beyond tables and graphs, such as maps (Mennecke at al. 2000; Smelcer and Carmel, 1997), multimedia (Hubona, 1998), visual and non-visual formats (Dennis and Carte, 1998), and multi-attribute data (Umanath and Vessey, 1994). CFT has been extended to assess performance on geographic tasks performed using either map-based presentations or tabular presentations (Dennis and Carte, 1998). Taken together, the way in which a problem is represented affects the individual's decision making performance.

Because problem representation is important for the decision making process, the current paper explores the relationship between a cognitive factor of a user and the problem representation. While much of the work on CFT has expanded the types of problem representation, they have not integrated the role of multi-faceted cognitive factors in predicting performance. The study presented in this paper tries to fill in this gap by studying the impact of the fit between the user's temperament and the information representation on their performance in completing a decision making task. Building upon CFT, this paper incorporates temperament to better understand problem solving performance, using tables and graphs as the distinct representations. Figure 2 shows the conceptual research model for this study. This research can later be extended to other forms of representations such as static or dynamic text, pictures, multimedia etc.

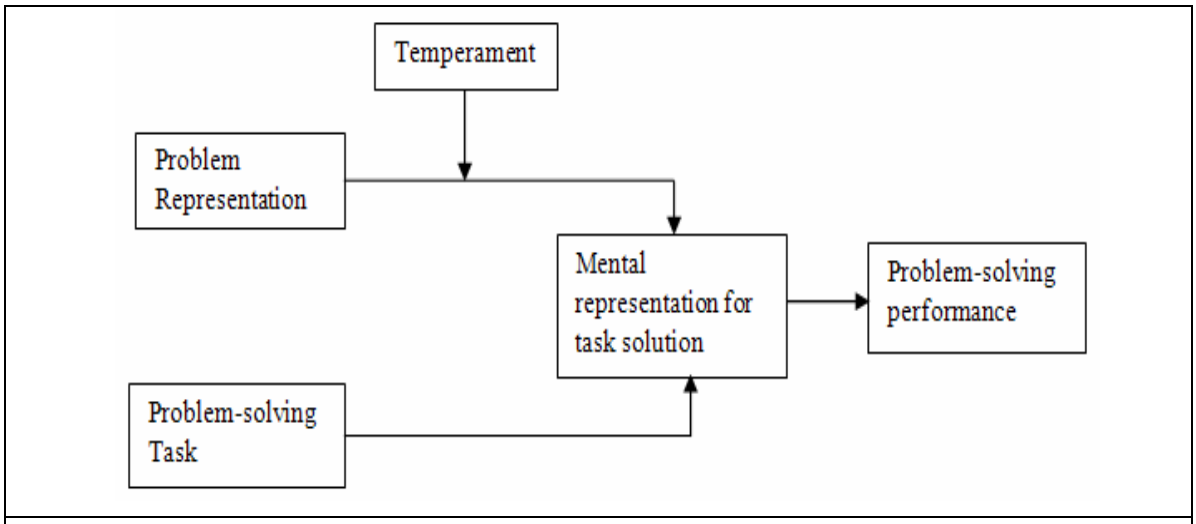

Figure 2. Conceptual Research Model

Temperament

Temperament is regarded as a constitutional predisposition tied to basic psychological processes (McCrae et al., 2000). It is a biologically driven antecedent of personality (Goldsmith et al., 1987) and is an in-born, innate characteristic of a person, which remains constant over a life time (Keirsey and Bates, 1984). Temperament includes dispositional attention processes (e.g., effortful attention, Rothbart & Bates, 2006), but it does not includes specific cognitions (Evans and Rothbart, 2007, p869). A good example to distinguish between temperament and personality would be to say that - "*specific cognitions may be influenced by temperament, as when an individual who is*

temperamentally fearful is biased toward developing pessimistic attitudes about the future (Evans and Rothbart, 2007)."

Ones temperament affects, information processing (Mauer and Borkenau, 2007; Vonderlin et. al, 2008), creativity and intelligence (Rossman and Horn, 1972), and intrinsic motivation (McKeen and McSwain, 1990), all characteristics that can impact task performance. While there are multiple related classification schemes for temperament (Downey, 1922; Guilford and Martin, 1943; Guilford and Zimmerman, 1948; Humm and Wadsworth, 1935; Keirsey and Bates, 1984); for the purpose of this study, we use the Keirsey Temperament Sorter (KTS), which categorizes temperament based on the way in which humans interact with their environment. This study uses the Keirsey temperament types for the following reasons:

1) Two out of the four criteria for categorizing Keirsey temperament types are based on an individual's information-gathering (perceiving) functions *(Sensing vs. Intuition)* and their decision-making (judging) functions *(Thinking vs. Feeling)*. These two criteria are relevant, (if not directly related) to the research question address in this study, and

2) Keirsey temperament sorter provides a scale for assessing adult temperaments and uses self-reporting mechanism, whereas, most of the other temperament scales are used to assess children.

Four Keirsey temperament types in detail

There are four Keirsey temperament groups which describe human behavior. These four temperament groups are - 1) Artisans, 2) Guardians, 3) Rationals, and 4) Idealists. Keirsey temperament types are based on four dichotomous pairs of preferences, which reveal a person's temperament and character type. The four preference scales measure a respondent's preference for the attributes stated in table1:

Table 1. Four dichotomous preferences on which the Keirsey temperament types are based

Technical Terms	Meaning		Technical Terms	Meaning
(E) Extroversion	Expressive	vs.	(I) Introversion	Attentive
(S) Sensing	Observant	vs.	(N) Intuiting	Introspective
(T) Thinking	Tough-Minded	vs.	(F) Feeling	Friendly
(J) Judging	Scheduled	vs.	(P) Perceiving	Probing

According to the Keirsey-Bates categories:

- Guardians are SJ (valuing careful, thorough, accurate work)
  - Sensing - likely to trust information that is in the present, tangible and concrete
  - Judging - are structured and rely upon a regimented schedule

- Artisans are SP (valuing a clever way of making things happen or getting things done)
  - Sensing - likely to trust information that is in the present, tangible and concrete.
  - Perceiving – unconventional creativity, identify opportunities that others can't see

- Idealists are NT (valuing quality of ideas and intellectual competency)

  - Intuiting - tend to trust information that is more abstract or theoretical, that can be associated with other information
  - Thinking - make decisions based on what seems reasonable, logical, causal, consistent and matching a given set of rules

- Rationals are NF (valuing oneself as a person who makes important contributions)
  - Intuiting- tend to trust information that is more abstract or theoretical, that can be associated with other information.
  - Feeling - tend to come to decisions not only by looking at the rules, but by empathizing with the situation

Due to their predisposition for sensing, Guardians and Artisans tend to focus more readily on tangible facts and figures, as found in tabular representations, than do individuals who focus on intuition (Idealists and Rationals).

> H1a: For tabular representations, individuals with a Guardian or Artisan temperament will have higher decision accuracy than those with an Idealist or Rational temperament

Because of their predisposition for intuition, Idealists and Rationals tend to look for trends in the data, as found in graphical representations, than do individuals who focus on facts and figures (Guardians and Artisans).

> H1b: For graphical representations, individuals with Idealist or Rational temperament will have higher decision accuracy than those with an Idealist or Rational temperament

Guardians, who make a judgment, strictly following a regimented schedule, are more likely to focus on a specific path (leading to decision outcome) while solving a problem, than their sensing counterpart - Artisans, who due to their unconventional creativity and inclination to identifying new opportunities, are more likely to digress from the main path (leading to decision outcome).

> H2a: For tabular representations, individuals with a Guardian temperament will have lower decision time than those with Artisan temperament

Idealists, who tend to follow a given set of rules, are more likely to focus on a specific path (leading to decision outcome) while making a decision, than their intuiting counterparts – Rationals, who due to their tendency to empathize with the situation and feel about the consequences, are more likely to digress from the main path (leading to decision outcome).

> H2b: For graphical representations, individuals with an Idealist temperament will have lower decision time than those with Rational temperament

Methodology

A 2x4 between subjects experiment will be conducted. Participants will be assigned to one of experimental conditions, based on their temperament types (4 types) and random assignment to one of two information representations. Table 2 below, gives a diagrammatic representation of the 8 cells in this research study.

Table 2. Pictorial Representation of the 8 cells of the study design

Guardian – Graphical representation	Guardian – Tabular representation
Artisan – Graphical representation	Artisan – Tabular representation
Idealist – Graphical representation	Idealist – Tabular representation
Rational – Graphical representation	Rational – Tabular representation

The three dependent variables are decision accuracy measured by the distance of the user's solution from the correct solution (Benbasat et al, 1986; Dickson et al, 1986), decision time measured in seconds from the time the subjects begin working on the task until they submit final decision, and user's satisfaction with the decision making process. An online survey will be designed in a way to accurately capture the time user entered the screen until they submit their decision.

Approximately 400 students enrolled in an introductory business course at a large north western university will participate in the study. The experiment will be conducted in a computerized research laboratory. Each participant will work on same decision making task; however, the subject will be randomly assigned into one of two treatments (that vary the information representation e.g. graphical and tabular representations). Participants in each treatment will be required to perform an intellective decision making task, with definitive correct answers on a continuous scale. The task will be such that the information needed to make the decision could be equally effectively displayed both in graphical as well as tabular format. Sufficient and complete information will be provided to the participants using both the representations to ensure that the study does not suffers from any problems associated with incomplete information (Reitman 1964; Simon 1973).

Care has been taken to ensure that the task is relevant to the study participants. They will be asked to make ordered recommendation of rental options for a friend based on provided requirements and information provided about housing options in three different housing agencies. Participants will be given access to an online web-link, where the requirements will be listed in plain text. On the next page, information about housing options in three different housing agencies will be provided, either in graphical or tabular form (based on the cell of study). This task is selected for its relevance and familiarity with the participant group. At some level or other, most of the undergraduate students are familiar with the process of choosing a rental option, either for themselves or for their friends. Also, the task will be neutral to the representation (that is, it will neither favors a graph representation nor a table representation), as this research intends to study the effect of temperament on information representation, controlling for the task. In order to make the task neutral to information representation, both spatial as well as symbolic activities will be included in the rental option selection process.

Conclusion and Possible Implications

Building upon CFT, we have introduced temperament as a moderator of task performance. By integrating temperament, a biologically derived antecedent of personality, we have proposed a model that may explain varying levels of task performance when we control for facets of the task, subject experience, and problem representation. Because temperament explains innate differences in how people interact with their environment through differing processes such as sensing, judging, intuiting and perceiving (e.g. how they think), it is used to explain why people with varied temperaments perform differently on identical task, when other individual characteristics are controlled.

In this study, we examine the impact of fit between user's temperament and information representation on his/her performance on a decision making task. By extending the CFT, this study introduces temperament as an important cognitive factor that may be relevant for a variety of technologies and task types. Many organizations use decision support system (DSS) tools to manage information and to facilitate the decision making process. Appropriate information visualization can help to leverage the individual's perceptual processes more effectively (Tegarden 1999), and it has been recognized as one of the methods to improve performance on decision making tasks (Card et al. 1999; Tegarden 1999; Tufte 2001). The results of this study will help in maximizing the potential of decision making tools, by giving the opportunity to consider the differences among the individuals and building the representations accordingly. By introducing the concept of temperament to design science research, the outcomes from this study should provide insight for both practitioners and researchers alike.

References

Agarwal, R., Sinha, A.P., and Tannini, M. 1996. "The role of prior experience and task characteristics in object-oriented modeling: An empirical study" *International Journal of Human-Computer Studies* (45:6), p639-67.

Ahlberg, C, and Shneiderman, B. 1994. "Visual Information Seeking: Tight Coupling of Dynamic Query Filters With Starfield Displays," in *Proceedings of the 1994 SIGCHI Conference,* C. Plaisant(ed.), ACMPress, New York, p 313-317.

Aron, J. D. 1969. "Information Systems in Perspective", *Computing Surveys*, p213-236.

Barkin, S.R., and Dickson, G.W. 1977. "An investigation of Information System Utilization" *Information and Management*, p35-45.

Baron, J., and Brown, R. V. 1991. *Teaching decision making to adolescents.* (Ed) Hillsdale, NJ, England: Lawrence

Barrick, M. R., & Mount, M. K. 1991. "The Big Five Personality Dimensions and Job Performance: A Meta Analysis." *Personnel Psychology*, 44(1), 1–26.

Barrick, M. R., & Mount, M. K. 1993. "Autonomy as a moderator of the relationships between the big five personality dimensions and job performance." *Journal of Applied Psychology*, 78, 111–118.

Barrick, M. R., Stewart, G. L., & Piotrowski, M. 2002. "Personality and job performance: Test of the mediating effects of motivation among sales representatives." *Journal of Applied Psychology*, 87, 43-51.

Benbasat, I., and Dexter, A. S. 1982. "Individual Differences in the Use of Decision Support Aids" *Journal of Accounting Research,* (20:1).

Benbasat, I., and Schroeder, R.G. 1977. "An Experimental investigation of some MIS Design Variables" *The Management Information Systems Quarterly*, p37-49.

Benbasat, I., Dexter, A. S., and Todd, P. 1986. "An Experimental Program Investigating Color-Enhanced and Graphical Information Presentation: An Integration of the Findings," *Comm. ACM,* (29:11), p1094-1105.

Bhattacherjee, A. 2001. "Understanding Information Systems Continuance: An Expectation-Confirmation Model" *MIS Quarterly* (25:3), p351-370.

Bloom, M. 1964. "Life-span analysis: A theoretical framework for behavioral science research" *Journal of Human Relations,* p538-554.

Card, S. K., Moran, T. P., and Newell, A. 1983. *The Psychology of Human-Computer Interaction,* Lawrence Erlbaum Associates, Hillsdale, NJ.

Carlyn, M. 1977. "An assessment of the Myers-Briggs Type Indicator" *Journal of Personality Assessment* (41:5), p461-473.

Daniel Heller, D. Lance Ferris, Douglas Brown, and David Watson. 2009. "The Influence of Work Personality on Job Satisfaction: Incremental Validity and Mediation Effects" *Journal of Personality*.

Dennis. A.R., and Carte. T. A. 1998. "Using geographical information systems for decision making: Extending cognitive fit theory to map-based presentation" *Information Systems Research,* (9:2), p194-203.

Dickson, G. W., DeSanctis, G., and McBride, D. J. 1986. "Understanding the Effectiveness of Computer Graphics for Decision Support: A Cumulative Experimental Approach," *Comm. ACM,* (29:1), p40-47.

Dickson, G.W., Senn, J.A., and Chervany, N.L. 1977. "Research in Management Information Systems: The Minnesota Experiments" *Management Science*, p913-933.

Digman, J.M. 1990. "Personality structure: Emergence of the five-factor model." *Annual Review of Psychology, 41*, 417–440.

Dong, J., Du, H. S., Lai, K. K. and Wang, S. 2004. "Xml-Based Decision Support Systems: Case Study for Portfolio Selection" *International Journal of Information Technology & Decision Making* (3:4), p651-662.

Dong, J., Du, H. S., Wang, S., Chen, K. and Deng, X 2004. "A framework of Web-based Decision Support Systems for portfolio selection with OLAP and PVM" *Decision Support Systems* (37), p367– 376.

Downey, J. E. 1922. *Downey group will-temperament test.* Oxford, England.

Driver, M.J., and Mock, T.J. 1975. "Human Information Processing, Decision Style Theory, and Accounting Information Systems" *The Accounting Review,* p490-508.

Evans, D. E., Rothbart, M.K. 2007. "Developing a model for adult temperament", *Journal of Research in Psychology*, p868-888.

Fellingham, J.C., Mock, T.J., and Vasarhelyi, M.A. 1976. "Simulation of Information Choice" *Decision Sciences*, p219-234.

Gigch, V., and John, P. 1978. *Applied General Systems Theory.* Harper and Row, New York.

Goldberg, L. R. (1990). "An alternative ''description of personality'': The Big Five factor structure." *Journal of Personality and Social Psychology,* **59,** 1216–1229.

Goldsmith, H.H., Arnold, H.B., Plomin, R., Rothbart, M.K., Thomas, A., Chess, S., Hinde, R.A., and McCall, R.B. 1987. "Roundtable: What is Temperament? Four Approaches" *Child Development*, p505-529.

Guilford, J.P, Martin, H.G. 1943. *The Guilford-Martin temperament profile chart*. Oxford, England.

Guilford, J.P, Zimmerman, W. S. 1948. "The Guilford-Zimmerman Aptitude Survey" *Journal of Applied Psychology* (32:1), p24-34.

Haan, N., Millsap, R., and Hartka, E. 1986. "As time goes by: Change and stability in personality over fifty years" *Psychology and Aging,* p220-232.

Hartzler. G. J., and Hartzler, M. T. 1982. "Management uses of the Myers-Briggs Type Indicator" *Research in Psychological Type*, p20-29.

Higgins, E. T. 2000. "Making a Good Decision: Value from Fit" *American Psychologist*, p1217-1229.

Hubona, G.S. 1998. "Mental representation of spatial language." *International Journal of Human-Computer Studies* (48:6), p705-728.

Humm. D. G., Wadsworth, G. W. 1935. "The Humm-Wadsworth temperament scale" *The American Journal of Psychioatry,* p163-200.

John, O. P., 1990. The ''Big Five'' factor taxonomy: Dimensions of personality in the natural language and in questionnaires. In L.A. Pervin (Ed.), *Handbook of personality theory and research* (pp. 66–100). New York: Guilford.

Kagan, J. 2005. *Temperament,* Encyclopedia on Early Childhood Development.

Keirsey, D., Nates, M. 1984. *Please Understand Me: Character and Temperament Types.* Gnosology Books Limited.

Mahmood, Mo A.; Lawrence, Edward C. 1987. "A Performance Analysis Of Parametric And Nonparametric Discriminant Approaches To Business Decision Making." *Decision Sciences* (18:2), p308-326.

Mason, R. O., and Mitroff, I. I. 1973. "A Program for Research in Management Information Systems." *Management Science*, p475-487.

Massey, A. P. and Brown, S. A. 1998. "IN-QUOTES: A Knowledge-Based System for Supporting Decision Making in Weakly Structured Domains" *International Journal of Intelligent Systems in Accounting, Finance & Management*, p153-171.

Mauer, N., and Borkenau, P. 2007. "Temperament and early information processing: Temperament-related attentional bias in emotional Stroop tasks" *Personality and Individual Differences*, p1063-1073.

McCrae, R. R., & Costa, P. T. 1990. *Personality in adulthood.* New York: Guilford.

McCrae, R. R., & John, O. P. 1992. "An introduction to the five-factor model and its applications." *Journal of Personality,* **60,** 175–215.

McCrae, R. R., Costa, P. T., Ostendorf, F., Angleitner, A., Hrebickova, M., Avia, M. D., Sanz, J., Sanchez-Bernardos, M.L., Kusdil, M. .E., Woodfield, R., Saunders P.R., and Smith, P.B. 2000. "Nature over Nurture: Temperament, Personality and Life Span Development" *Journal of Personality and Social Psychology*, p173-186.

McKeen, R. L., and McSwain C. 1990. "Keirsey-Bates temperament categories: A basis for motivational interventions" *Human Resource Development Quarterly,* p237-250.

Mennecke, B.E., Crossland, M.D., and Killingsworth.B.L. 2000. "Is a map more than a picture? The role of SDSS technology, subject characteristics, and problem complexity on map reading and problem solving." *MIS Quarterly,* (24:4), p601-629.

Michael, Q. 1992. "A cross-correlation of Myers-Briggs and Keirsey Instruments" *Journal of College Student Development*.

Myers, I.J. 1962. *Introduction to Type: A description of the theory and applications of the Myers-Briggs type indicator*. Consulting Psychologists Press, Palo Alto Ca.

Reason, J. 1990. *Human error*. New York: Cambridge University Press.

Rossman, B.B., Horn, J.L. 1972. "Cognitive, motivational and temperamental indicants of creativity and intelligence" *Journal of Education Measurement,* p265-286.

Rothbart, M.K., Bates, J.E. 2006. Temperament Handbook of child psychology: Vol. 3, Social, emotional, and personality development (6th ed.) Hoboken, NJ, US: John Wiley & Sons Inc..

Sambamurthy, V.; Chin, Wynne W. 1994. "The Effects of Group Attitudes Toward Alternative GDSS Designs on the Decision-making Performance of Computer-Supported Groups." *Decision Sciences* (25:2), p215-241.

Schachter, D. 2006. "The importance of good decision making" *Information Outlook* (10:4).

Schroeder, R.G., and Benbasat, I. 1975. "An experimental evaluation of the relationship and uncertainty in the environment to information used by decision makers" *Decisions Sciences*, p556-567.

Shaft, Teresa M. and Iris Vessey, 2006. "The Role of Cognitive Fit in the Relationship between Software Comprehension and Modification", *MIS Quarterly*, Volume 30, Issue 1, pp. 29-55.

Sinha. A.P., and Vessey. I. 1992. "Cognitive fit: An empirical study of recursion and iteration" *IEEE Transactions on Software Engineering* (18:5), p368-379.

Smelcer. J.B.. and Carmel. E. 1997. "The effectiveness (of different representations tor managerial problem solving: Comparing tables and maps." *Decision Sciences* (28:2), p391-420.

Speier, C. and Morris, M. G. 2003. "The Influence of Query Interface Design on Decision-Making Performance" *Management Information Systems Quarterly* (27:3), p397-423.

Speier, Cheri; Vessey, Iris; Valacich, Joseph S. 2003. "The Effects of Interruptions, Task Complexity, and Information Presentation on Computer-Supported Decision-Making Performance." *Decision Sciences* (34:4), p771-797.

Tegarden, D. P. 1999. "Business Information Visualization" *Communications of AIS* (1:4), pp. 1-37.

Tufte, E. R. 2001. *The Visual Display of Quantitative Information,* Graphics Press, Chesire, CT.

Umanath. N,S,, and Vessey. I. 1994. "Multiattribute data presentation and human judgment: A cognitive lit perspective." *Decision Sciences* (25:5-6), p795-824.

Vessey, I. 1991. "Cognitive fit: A theory-based analysis of the graphs versus tables literature" *Decision Sciences* (22:2), p219-240.

Vessey. I., and Galletta. D. 1991. "Cognitive fit: An empirical study of information acquisition." *Information Systems Research* (2:1), p63-85.

Vonderlin, E., Pahnke, J., and Pauen, S. 2008. "Infant temperament and information processing in a visual categorization task" *infant behavior and Development,* p559-569.

Watson, D., and Walker, L. M. 1996. "The long-term stability and predictive validity of trait measures of affect" *Journal of Personality and Social Psychology,* p567-577.

Wolfe, J.; Chacko, T. I. 1983. "Team-Size Effects on Business Game Performance and Decision-Making Behaviors." *Decision Sciences* (14:1), p121-133.

Wong, M. M. and Csikszentmihalyi, M. 1991, "Motivation and Academic Achievement: The Effects of Personality Traits and the duality of Experience." *Journal of Personality*, 59: 539–574.