Exploring the Effect of Cognitive Map on Decision Makers' Perceived Equivocality and Usefulness in the Context of Task Analyzability and Representation

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***Abstract*—Cognitive map (CM) has been widely accepted as a robust decision support mechanism with which decision makers can analyze causal relationships existing among relevant variables, and represent tacit knowledge explicitly in a form of causal relationships. In literature, there are many successful cases with CM. Nevertheless, there is no study that clearly investigates the potentials of CM in reducing decision maker's perceived equivocality, and enhancing perceived usefulness. To pursue the research objective like this, we organized an experiment in which participants are given two types of tasks (analyzable vs less-analyzable) and two types of task representation (text-based vs CM-based). Results clearly showed that the CM can provide significantly improved performance in decision making support.**

Keywords-cognitive map; task analyzabilit; perceived equivocality; perceived usefulness

I. INTRODUCTION

Cognitive map (CM) is used to capture perception of decision makers (DMs) faced with complex and unstructured decision problems. Many relevant literatures showed that CM can be used for solving many kinds of decision problems [1], [2], [3], [4] most of which belong to unstructured decision problems. And also, CM can describe and facilitate elaboration of real world for individuals. Elaboration is the cognitive process whereby individuals consciously or subconsciously establish paths between nodes in a semantic network representing newly learned material and nodes representing already known material [5.

This study attempt to verify that CM is an effective methodology by conducting an experiment which examines that CM is more effective than Text under analyzable tasks by comparing CM with Text. And further analyzes the difference in problem solving between analyzable tasks and less-analyzable tasks within the framework of equivocality of information in CM and Text. The focus is that that while CM method knowledge is important in solving all such tasks, the role of application domain knowledge is contingent upon the type of understanding task under investigation. We use the theory of cognitive fit to establish theoretical differences in the role of application domain knowledge among the different types of schema understanding tasks.

II. THEORY AND HYPOTHESIS

A. Semantic Network and Problem Solving

CM proposes that individuals will be able to better understand domain knowledge that complies with its criteria. This is supported by two bodies of theories of cognition. Firstly, the semantic network theory proposes that CM lead analysts to construct efficient mental representations of a domain [6]. Semantic network theory states that individuals store concepts in memory as nodes connected by paths [7]. In order to perform cognitive tasks, individuals must recall concepts from memory; which follows a process of spreading activation: a node is primed in memory, which leads to paths connecting to it being activated [7]. Activation has to be strong enough for a search to reach a connected node. Empirical tests show that greater activation strength enables faster and more accurate recall [7]. CM leads to efficient mental representations by reducing activation strength and excluding relevant nodes.

Secondly, the problem-solving theories suggest that the quality of a person's mental representation of a domain is a key driver of his/her ability to reason about the domain [8]. Specifically, problem solving theories suggest that a person reasons about a domain is by drawing on his/her mental representation of the domain together with his/her mental representation of the problem s/he faces about the domain to construct a "problem space" in memory [8]. Tests show that problem solving performance is driven by a person's ability to search his/her problem space [8], [9]. Since semantic network theory suggests that CM leads to efficient mental representations, we can therefore propose that CM reduce analysts' ability to construct inefficient problem spaces in memory and thereby increase analysts' ability to search their problem space when reasoning about the domain.

B. Conceptual Schema Understanding Task

Schema understanding tasks can be viewed as either read-to-do (with access to the schema) [10] or read-to-recall tasks (without access to the schema) [11]. Recall tasks have been used to investigate problem solvers' knowledge structures, that is, chunks of knowledge that are stored in internal memory and reused when appropriate [12].

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Two types of comprehension tasks that have been employed in prior Information Systems (IS) researches are supported in the education literature, which identifies two different types of knowledge, syntactic and semantic [13], [14]. Syntactic knowledge involves understanding the vocabulary specific to a modeling formalism and syntactic comprehension tasks are those that assess the understanding of just the syntax of the formalism associated with a schema. Semantic knowledge involves understanding the meaning, or the semantics, of the data embedded in the conceptual schema. Thus, semantic comprehension tasks are those that assess the understanding of the data semantics conveyed through constructs in the schema [15]. More recently, researchers have investigated tasks that require a deeper level of understanding than comprehension tasks, tasks that are referred to as problem-solving tasks [16].

C. *Cognitive Fit*

The notion of task-technology cognitive fit is viewed as an important factor determining whether the use of technology would result in performance improvement [17], [18], [19]. Briefly, the task-technology fit hypothesis argues that for an IS to have a positive impact on performance, it must be designed and utilized in such a way that it fits with the tasks it supports. When the information emphasized by the presentation matches the task, DMs can use the same mental representation and decision processes for both the presentation and the task, resulting in faster and more accurate solutions [19]. When a mismatch occurs, one of two processes will occur. Firstly, DMs may transform the presented data to better match the task, which might increase the time needed and might decrease accuracy because any transformation can introduce errors [19]. Secondly, DMs may adjust their decision processes to match the presentation [20], decreasing accuracy and increasing time because the information does not match the ultimate needs of the task.

To better understand this relationship, we first need to explain the key concept equivocality of information. High equivocality means confusion and lack of understanding [21]. Note that at times the literature uses the term equivocality to describe the characteristics of tasks. In this paper, the term exclusively uses to describe information characteristics. Furthermore, less-analyzable task is consists of syntactic and semantic knowledge. By contrast, problem solving task is presented as analyzable task. Therefore, we will examine whether quality in decision making can be changed by the task type (analyzable vs less-analyzable) of Text and CM and its equivocality.

D. *Hypotheses*

In this study, three hypotheses will be verified through one experiment. In this experiment, CM-based method is proposed to be more effective than text-based method under analyzable tasks by comparing CM-based method with Text-based method. This was done by analyzing the difference in problem solving between analyzable tasks and less-analyzable tasks within the framework of equivocality of information in CM and Text. For analyzable tasks, since the information needed to perform the task is known and clear guidelines about how to perform the task exist, the DM does not have to rely on subjective judgments or contextual information to interpret the situation or task. CM can capture perception of decision makers' knowledge in real world, and describe and facilitate elaboration. CM is to support a "what-if" and "goal seeking" analysis. In this regard, CM-based method can decrease the equivocality. It is because CM-based method can provide more accurate information than text-base method in solving analyzable tasks. Therefore, a CM-based representation is more effective than a text-based representation in supporting the information needs of analyzable tasks.

H1: For analyzable tasks, the CM-based representation, when compared to the text-based representation, will lead to a lower level of perceived equivocality.

In this study, less-analyzable task is consists of syntactic and semantic knowledge. In other words, less-analyzable task means that DMs need knowledge of surface level that asks simply the true and the false of the facts. In this case, it is assumed that there will be little difference between Text-based method and CM-based method.

H2: For less-analyzable tasks, there will be no difference between the multimedia and the text-based representation in terms of the perceived equivocality level.

Davis and his colleagues [22], [23] observed that if users perceive a system to be useful, they are more likely to use it. Other studies [24], [25] also found further support for the impact of perceived usefulness on system use. These studies established the theoretical and practical importance of perceived usefulness. Extending from the research in perceived usefulness, one can argue that users only perceive the system to be useful if the system helps them to perform the tasks it was designed for.

H3: The CM-based representation will be perceived as more useful than the text-based representation.

III. OVERVIEW OF THE EXPERIMENTS

The experiment involved less-analyzable tasks and analyzable tasks, and two representations, text-based and CM-based information, representing two levels of richness. The two were equivalent in terms of text and diagram information content. It is hypothesized that the task required only surface-level understanding of the domain. Thus, it is predicted that the text effect would dominate elaborative and inferential diagram effects. Participants who used CM would therefore outperform participants who used text only. In analyzable tasks, it is hypothesized that this task requires a deep level understanding of a domain if it is to be performed effectively. Thus, it is predicted that the elaborative and inferential effects would dominate the text effect. Participants who used causal map only would therefore outperform participants who used text. The results supported this prediction.

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IV. EXPERIMENT

To test the first hypotheses, we conducted a laboratory experiment. The experiment employs a 2 x 2 x 2 design. The within-subject factors are representation type (CM-based vs. text-based representation) and task type (analyzable vs. less-analyzable task). The between subject factor is the order (text-CM vs. CM-text).

A. Task Setting

1) Representation Type

Two representations, text-based and CM-based information, representing two levels of richness were compared. The two were equivalent in terms of text and diagram information content. Appendix A shows the corresponding subjects the text-based method when the same selection was made. In both methods, subjects could reexamine the information which was presented with CM-based method and text-based method.

2) Analyzable and Less-analyzable Task Type

In this study, the less-analyzable task consisted of syntactic and semantic comprehension tasks. By contrast, problem solving task was presented as analyzable task. The task employed consisted of evaluating the ambiguity/equivocality level of the information relating to 17 statements. Subjects were asked to evaluate the degree to which they felt that the information needed to evaluate the 17 statements, as provided by the method, was equivocal. Ten of these statements were related to facts that were surface-level understanding stated in the method; these formed the less-analyzable task. The other seven required subjects to make judgments about the deep-level understanding of problem solving task stated in the method; they formed the analyzable task. All subjects performed both tasks.

3) Order

Subjects performed the experimental task twice: once with the text-based method and once with the CM-based method. Half of the subjects were randomly assigned to use the text-based method first (text-CM condition) while the other half started with the CM-based system (CM-text condition). Helson's Adaptation-Level Theory [26], [27] suggests that a subject's response to a judgmental task depends on three things: (1) sum of the subject's past experiences, (2) the context or background (for making comparison judgments), and (3) the stimulus given (the representation type in this study). To the extent that there is no context/background given, the subject will make a judgment using the sum total of all his/her previous experiences about what he/she perceived as ambiguous. Given that each of the subjects has different experiences, when no context/background is provided there is no common frame of reference to make a judgment. The closer a context is provided to the judgment, the more it will be made within that context rather than based on the sum of all past experience. Following Helson's argument, we used the first representation to allow our subjects to establish a frame of reference. The second representation was then presented and subjects were asked to evaluate the ambiguity level of the second as compared to that of the first. To take into consideration the potential learning effect, as is customarily done, we used a counter-balanced design by asking half of the subjects to first evaluate using the text-based and the other half to first evaluate using the CM-based representation.

B. Participants

The participants are college students who took one or two of the five undergraduate computer science courses offered by the School of Business Administration. The participants were organized into two groups. The 34 pre-test responses from the first group were used to pretest the manipulation check between analyzable and less-analyzable tasks. Pair t-test was conducted to check analyzability after reviewing 17 analyzable and less-analyzable tasks with students. The results show that there is a difference between analyzable and less-analyzable tasks ($t(33) = 4.52$, $p<0.001$). These results suggest that the experimental manipulation between analyzable and less-analyzable tasks was successful.

The 64 responses of the second group were used to prove research hypotheses. They participated on a voluntary basis following the instruction that bonus points will be given for those who completed surveys successfully within the time limit. Of the respondents, 38 were male and 26 were female. On average, they were 24.5 years old, and they used the Internet for 21 hours per week.

C. Dependent Variables

Two dependent variables, perceived equivocality and perceived usefulness of the system, were used in the analyses.

1) Perceived Equivocality

Two Likert-type scales, adapted from [28], were used to measure perceived equivocality of the information used for evaluating the 17 statements which comprised the experimental task. Since this study focused on the equivocality level of information rather than solution, one item was not applicable to this study and was dropped. The internal reliability of the original instrument, as reported by Daft and Macintosh, was 0.73. The modified scale used in this study has a higher reliability score (0.86). For each of the 17 statements, subjects were asked to indicate (1) if the information used to evaluate the statement could be interpreted in several ways, and (2) if the information used to evaluate the statement could mean different things to different members of the website design team. The response scale ranged from –3 (full disagreement) to +3 (full agreement). For items (1) and (2), the higher score meant higher perceived equivocality.

2) Perceived Usefulness

The 10 item scale proposed by [22] was adapted for this present study. The reliability of the instrument, as originally reported by Davis, was 0.92. Subjects were asked to rate the perceived usefulness of the second method relative to using the first method.

D. Experimental Procedures

Subjects were run through the experiment one at a time. Prior to the experiment, subjects were trained on how to use the CM method. The training session lasted about 30 minutes. Next, subjects were handed a task description (see Appendix A) and the questionnaire for this experiment, which contained 17 statements. They were told to read through the questionnaire before examining the information in the method. This procedure was used to help them focus on the information needed to respond to the 17 questions. Depending on their assignment, subjects first used either the text-based method or the CM-based method to examine the described with information. After they had completed the questionnaire, the subjects were given a five minute rest break. After the break, subjects proceeded to second experiment. Second experiment was a repeat of first experiment, except that subjects used the other method (either text-based or CM-based system). At the end of the experiment, subjects were given the perceived usefulness questionnaire. The entire experiment took about an half and hour to complete.

E. Results

Data associated with perceived equivocality was analyzed using a repeated-measures ANOVA test with the three independent variables, representation, task, and order. Table I reports the results. The mean values and standard deviations are shown in Table II.

TABLE I. RESULTS OF THE REPEATED-MEASURES ANOVA FOR PERCEIVED EQUIVOCALITY LEVEL

	DF	Mean Squared	F-value	P
Between-Subjects				
Order Type	1	1.071	0.443	0.508
Error (Order Type)	62	2.419		
Within-Subjects	192			
Task Type	1	80.492	80.073	0.000***
Task × Order	1	9.492	9.443	0.003**
Error (Task)	62	1.005		
Representation type	1	38.392	19.773	0.000***
Representation × Order	1	35.750	18.413	0.000***
Error (Representation)	62	1.942		
Task × Representation	1	28.226	38.323	0.000***
Task × Representation × Order	1	2.507	3.404	0.070
Error (Representation × Task)	62	0.737	-	-

There are several significant outcomes: task ($F = 80.073$, $p < 0.000$), representation ($F = 19.773$, $p < 0.000$), representation x order ($F = 18.413$, $p < 0.000$), and task x representation ($F = 38.323$, $p < 0.000$). The focus is on the task x representation interaction effect, which provides direct evidence for testing H1 and H2.

TABLE II. MEANS (STANDARD DEVIATIONS) FOR PERCEIVED EQUIVOCALITY LEVEL

Analyzable Task		Less-Analyzable Task	
First Rating	***Second Rating***	***First Rating***	***Second Rating***
CM: -2.08 (1.07)	Text: -0.13 (1.45)	CM: -1.96 (0.77)	Text: -2.1 (0.99)
Text: 0.31 (1.24)	CM: -0.62 (1.57)	Text: -1.23 (1.28)	CM: -1.66 (1.29)

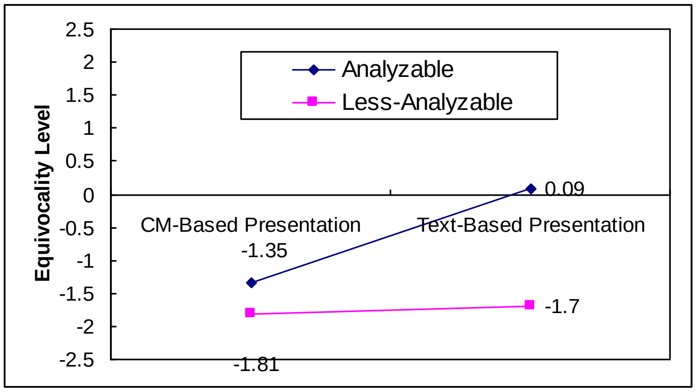

Figure 1. Task x Representation Interaction Effect

The task x representation interaction effect is depicted in Figure 1. For analyzable tasks, the perceived equivocality ratings (summarized over the first and second set of ratings) associated with CM is lower than that of text (–1.35 for CM and 0.09 for text; $t = 5.93$, $p = 0.000$). This supports H1, which states that for analyzable tasks, CM-based representation will lead to lower level of perceived equivocality than the text-based representation. For less-analyzable tasks, the perceived equivocality rating associated with the two representations are about the same (-1.81 for CM and -1.7 for text; $t = 0.536$, $p < 0.594$). This supports H2, which states that for less-analyzable tasks, the CM-based representation, when compared to the text-based representation, will be no difference in level of perceived equivocality.

The order x representation interaction effect shows that the perceived equivocality reduced only when the CM-based representation was used after the text-based representation ($t = 4.01$, $p < 0.000$) but not vice versa ($t = 0.78$, $p = 0.542$). Consistent with H1 and H2, this suggests that only the CM-based representation led to lower perceived equivocality.

Recall the earlier discussion of Helson's Adaptation Theory [26], [27]. How then can we interpret these findings within the context of this theory? Given that the first ratings were made in the absence of an established frame of reference for comparison, based on Helson, we would expect that the theoretical differences between text-based and CM-based representations will be less evident for the first set of ratings, but more so for the second set, as they were made with a clear basis for comparison. In short, the differences as

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delineated in H1 and H2 should be more evident in the second ratings than the first.

Therefore, for H1 (analyzable tasks), we expect to observe significant differences in the second ratings between CM-based and text-based representations. For the first pair of ratings, there is a major difference (0.304 for text vs. -0.28 for CM; $t = 8.23$, $p < 0.000$). However, such differences are expected to be weaker in the second ratings, due to lack of a frame of reference. For the second pair of ratings (-0.127 for text vs. -0.621 for CM; $t = 1.292$, $p = 0.200$), there was a no significant difference between the text and CM conditions.

For H2 (less analyzable tasks), as stated previously, we will not expect to see any differences between CM and task in either the first or second ratings. But, for less analyzable tasks, for both the "text-CM" and the "CM-text" conditions, the first equivocality ratings are significant difference between the text and CM conditions (-1.295 for text versus –1.955 for CM; $t = 2.451$, $p = 0.02$). For the second time (-2.10 for text and –1.661 for CM; $t = 1.53$, $p = 0.13$), the equivocality level are no significant difference between the text and CM conditions. t-test on the aggregated score on perceived usefulness.

TABLE III. RESULTS OF THE INDEPENDENT SAMPLE T-TEST ON PERCEIVED USEFULNESS

Perceived Usefulness	**Representation Type**		**t-Value for difference (Text-Based vs CM-based)**	**p-Value**
	Text-Based representation	***CM-Based representation***		
n	32	32		
Mean	1.55	5.89	18.174	0.000***
S.D	0.56	1.23		

The results of the independent sample t-test on perceived usefulness, together with the means and the standard deviations for the two conditions, are summarized in Table III. Subjects perceived the CM-based representation as being more useful than the text-based representation in helping them to perform the task ($t(62) = 18.174$, $p < 0.000$; mean score 5.89 vs. 1.55, for the range of 1 to 7). The results on perceived usefulness support H3, which states that the CM-based representation will be perceived as more useful than the text-based representation.

V. DISCUSSION AND CONCLUDING REMARKS

In this study, we observed a task cognitive fit relationship with regard to perceptions of equivocality. For analyzable tasks, only CM-based representation led to lower perceived equivocality levels. When subjects were given a second representation to perform the task, only those subjects who used CM method as the second representation reported a level of perceived equivocality that was lower than that reported after the first representation was used. This result indicates that conventional text-based representation is inferior in reducing equivocality for analyzable tasks compared to CM-based representation. For less-analyzable tasks, whether subjects use a text-based representation or a CM-based representation for the second task, their perceived equivocality level is the minor difference. This is because both representations are effective in conveying the information needed to perform less-analyzable tasks. However, it should be emphasized that this conclusion is based on subjects' self-reported perceived equivocality levels rather than actual task performance, which is often difficult to measure when dealing with less-analyzable tasks [20]. Overall, we set forth to test our theory in the context of an individual decision maker interacting with a CM method to decision that was previously experienced and found support for the theory.

There are two limitations of this experiment that warrant further discussion and need to be kept in mind when interpreting the results observed. The first limitation relates to the two tasks used in the experiment. The two tasks were chosen based on the construct level definition of task analyzability and to maximize the treatment effect variance [30]. Since these are two specific operationalizations of the construct, more tasks need to be tested to further validate the theory. The second limitation relates to the choice of the two representations used. To maximum the treatment variance, we chose to use text and CM in our operationalization of the rich versus lean representation construct. As such, these operational definitions only represent two specific instances. One interesting future research direction is to test a system that has various combinations of text and CM-based representation.

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REFERENCES

[1] Lee, K.C. and Kwon, S.J., "The use of cognitive maps and case-based reasoning for B2B negotiation", Journal of Management Information Systems, 22 (4), 2006, pp. 337-376.

[2] Clarke, L. and Mackaness, W., "Management 'Intuition': An Interpretative Account of Structure and Content of Decision Schemas Using Cognitive Maps", Journal of Management Studies 38 (2), 2001, pp. 147-172.

[3] Liu, Z.Q. and Satur, R., "Contextual fuzzy cognitive map for decision support in geographic information systems", IEEE Transactions on Fuzzy Systems 7 (5), 1999, pp. 495–507.

[4] Satur, R. and Liu, Z.Q., "A Contextual Fuzzy Cognitive Map Framework for Geographic Information Systems", IEEE Transactions on Fuzzy Systems 7 (5), 1999, pp. 481-494.

[5] Bradshaw, G.L. and Anderson, J.R., "Elaborative encoding as an explanation of levels of processing", J. Verbal Learning and Verbal Behavior 21, 1982, pp. 165–174.

[6] Collins, A.M. and Quillan, M.R., "Retrieval time from semantic memory", J. Verbal Learn. Behavior 8, 1969, pp. 240–247.

[7] Ashcraft, M.H., Cognition. Prentice Hall, Upper Saddle River, NJ, 2002.

[8] Newell, A. and Simon, H.A., Human Problem Solving. Prentice Hall, Englewood Cliffs, NJ, 1972.

[9] Pretz, J.E., Naples, A.J. and Sternberg, R.J., Recognizing, defining, and representing problems. J. E.Davidson, R. J. Sternberg, eds. The Psychology of Problem Solving. Cambridge University Press, Cambridge, U.K., 2003, pp. 3–30.

[10] Khatri, V., Ramesh, V., Vessey, I. Clay, P. and Park, S.J., "Understanding conceptual schemas: Exploring the role of application and IS domain knowledge", Inform. Systems Res 17 (1), 2006, pp. 81–99.

[11] Burkhardt, J.M., Détienne, F. and Wiedenbeck, S., „Object-oriented program comprehension: Effect of expertise, task and phase", Empirical Software Engineering, 7(2), 2002, pp. 115–156.

[12] Bodart, F., Sim, M., Patel, A. and Weber, R., "Should optional properties be used in conceptual modelling? A theory and three empirical tests", Information Systems Research 12 (4), 2001, pp. 385–405.

[13] Schneiderman, B. and R.E. Mayer., "Syntactic/semantic interactions in programmer behavior: A model and experimental results" Internat. J. Comput. Inform. Sci 8, 1979, pp. 219–238.

[14] Mayer, R. E., Thinking, Problem Solving, Cognition. W.H. Freeman and Company, New York, 1991, pp. 560–578.

[15] Elmasri, R. and S. B. Navathe., Fundamentals of Database Systems, 2nd ed. Benjamin/Cummings Publishing Co., Redwood City, CA, 1994.

[16] Gemino, A., "Empirical comparisons of animation and narration in requirements validation", Requirements Engineering 9 (3), 2004, pp. 153–168.

[17] Goodhue, D.L. and Thompson, R.L., "Task Technology Fit and Individual Performance", MIS Quarterly 19, 1995, pp. 213-236.

[18] Tan, J.K.H. and Benbasat, I., "The Effectiveness of Graphical Presentation for Information", Decision Sciences 24, 1993, pp. 167-191.

[19] Vessey, I., "Cognitive Fit: A Theory-Based Analysis of the Graphs Versus", Decision Sciences 22, 1991, pp. 219-240.

[20] Perrig, W. and Kintsch, W., „Propositional and situational representations of text", Journal of Memory and Language, 24, 1985, pp. 503-518.

[21] Daft, R.L., Lengel R.H. and Trevino, L.K. "Message Equivocality, Media Selection and Manager Performance", MIS Quarterly (11), 1987, pp. 355- 364.

[22] Davis, F.D., "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly 13, 1989, pp. 319-340.

[23] Davis, F.D., Bagozzi, R.P. and Warshaw, R.P., "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models", Management Science (35), 1989, pp. 982-1003.

[24] Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D., "User acceptance of information technology: toward a unified view", MIS Quarterly 27 (3), 2003, pp. 425-478.

[25] Taylor, S. and Todd, P., "Assessing IT usage: the role of prior experience", MIS Quarterly 19 (4), 1995, pp. 561-570.

[26] Mayer, R.E. and Gallini, J.K., "When is an illustration worth a thousand words", J. Ed. Psych 82, 1990, pp. 715-726.

[27] Helson, H., Adaption-Level Theory, Harper & Row, New York, 1964.

[28] Streitfeld, B. and Wilson, M., "The ABCs of Categorical Perception", Cognitive Psychology 18, 1986, pp. 432-451.

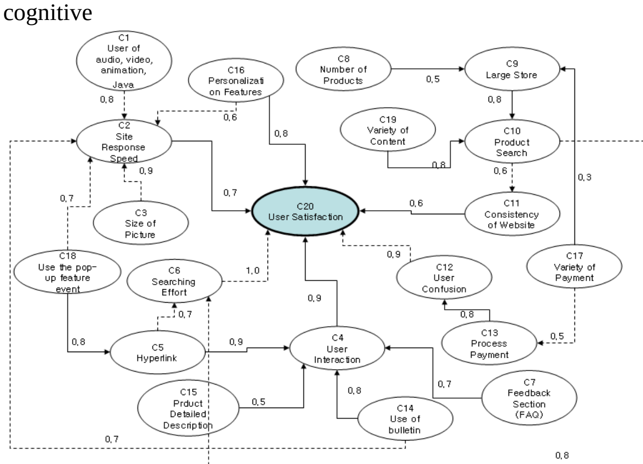
[29] Daft, R. L. and Macintosh, N. B., "A Tentative Exploration into the Amount and Equivocality of Information Processing in Organizational Work Units", Administrative Science Quarterly 26, 1981, pp. 207-224.

[30] Cook, T.D. and Campbell, D.T., Quasi Experimentation: Design and Analysis Issues for Field Settings. Houghton Mifflin, Boston, MA, 1979.

APPENDIX A. CM-BASED METHOD

Graph below [Appendix_Figure 1] shows a variety of factors affecting user's satisfaction in a web store that was derived through interviews of the experts. The graph below also shows a variety of possibility outcome.

[Appendix_Figure 1] Web site design and usability assessment of cognitive



The table below shows a variety of factors affecting user's satisfaction in a web store that was derived through interviews of the experts. In addition, [Appendix_Table 4-1] displayed the input node for various values, and this value shows a variety of possibility outcome.

[Appendix_Table 1] Table of Website Development

Audio, video, animation, Java-enabled node(C1)		**Size of Picture (C3)**		**Feedback Section (C7)**	
1st use per page	0.6	Big	1.0	Within 24 hours	0.7
2nd use per page	0.7	Medium	0.8	Within 1 to 2 days	0.8
3rd use per page	0.8	Small	0.6	Within 2 to 5 days	0.9
4th use per page	0.9	-	-	After 5 days	1
Personalization Features (C16)		Using events popup		Number of Products	
Total 1st use	0.3	1 number	0.5	Less than 100	0.3
Total 2nd use	0.5	2 number	0.8	101-300	0.5
Total 3rd use	0.7	3 number	1.0	301-500	0.8
Total 4th use	0.9	-	-	More than 500	1.0

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