SOLVING THE INFORMATION OVERLOAD PROBLEM: THE ROLE OF UNCONSCIOUS THOUGHT IN ENHANCING ONLINE PURCHASING DECISIONS

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ABSTRACT

The prosperity of online shopping has led e-commerce vendors to provide increasingly rich information to enhance consumers' shopping experience and satisfaction. However, there is little awareness that consumers cannot tolerate too much information. As human beings have a limited capacity to process information, online shoppers are easily confused when facing rich information, particularly when the information greatly exceeds their processing capacity. In contrast to previous research, which has focused on the formatting of appropriate information or user interfaces to solve the overload problem, this study explored a new solution based on the role of unconscious as opposed to conscious thought. By combining perspectives from the Unconscious Thought Theory.and Information Processing Theory in a unified model, we examined the role of thinking mode in consumers' decision satisfaction, as well as information processing factors that affect the efficiency of unconscious thought in the presence of rich information. Results show that unconscious thought is an effective way to solve the information overload problem and is thus worthy of special attention in the design of e-commerce web pages. The study also contributes to both unconscious thought theory and information processing theory by exploring the interaction of the quality and quantity of information with thinking mode in affecting the quality of purchasing decisions.

Keywords: unconscious thought theory, information processing theory, decision making

1 INTRODUCTION

One obvious advantage of electronic commerce (e-commerce) is its capacity to convey rich information to the customer easily and quickly (Chen et al., 2009). The feature has drawn much attention from information systems scholars. However, as most information systems research on e-commerce has focused on providing more 'good' information to satisfy users and on improving web designs, few seem aware that consumers may not be able to tolerate information overload. Any single piece of information can be designed to achieve an effect (e.g., comparison, presentation, illustration, trust, signalling, and reasoning) (Bettman, 1979). However, combining them could be a serious challenge to an individual's information processing capacity. Previous research has shown that too much information in e-commerce may cause the side effect of 'information overload' (Eppler and Megis, 2004; Reutskaja and Hogarth, 2009), triggered by individuals' limited ability to process information (Bettman, 1979).

Psychological research has demonstrated that the maximum amount of information that a person can be conscious of at any given time is about 7 units (Miller, 1956), but the amount of information one must digest when shopping online is much more than that. For example, a typical web page selling an iPhone on eBay usually contains a large and varied amount of information for customers to review before they make a purchasing decision. As rich information is common in contemporary e-commerce and individuals have a limited capacity to process information, potential customers are forced to focus narrowly on a subset of this information while ignoring other relevant information (Tan, Yi, Chan, 2008). This kind of inbalance weighting of information can usually results in a sub-optimal purchasing decision. All this rich information creates an obvious dilemma for both online vendors and their customers: as suggested by e-commerce research, the vendors must keep providing more and more varied information to satisfy customers and help them make better decisions. On the other hand, it is easy for customers to get lost in the increasingly rich information environment, which decreases their satisfaction.

These considerations led us to propose the following research questions: (1) given the limits of information processing capacity, what is the effective way to increase customers' satisfaction with and the quality of their purchasing decisions in the presence of rich information; (2) if such a way can be found, what characteristics of the information contribute to this satisfaction and quality?

Whereas most previous research has focused on designing optimal information formats or user interfaces to facilitate processing efficiency (e.g. Ackoff, 1967; Bawden, 2001; Schick et al., 1990; Schneider, 1987), investigators have recently begun to examine the effect of the users' thought processes on information overload. They discovered two mechanisms that people use to process information: conscious thought and unconscious thought. Conscious thought has been proved to be more systematic and more appropriate for routine tasks, whereas unconscious thought is less systematic and performs better in complex situations.(Dijksterhuis and Nordgren, 2006) Thus, unconscious thought is better when dealing with information overload. Unfortunately, exactly how unconscious thought processes interact with the characteristics of the information, most notably its quality and quantity, is still unclear. Our study was intended to shed light on this emerging issue by examining unconscious processing in the context of rich information. More specifically, the study investigated the effects of unconscious thought, the quality and quantity of the information, and their interaction, on individuals' satisfaction with and the quality of their purchasing decisions. We also sought to develop useful suggestions for solving the information overload problem in contemporary e-commerce.

2 LITERATURE REVIEW

Two streams of research dealing with information processing have made contributions to answering our research questions. One concerns the application of information processing theory to explore how the quality and quantity of the information affect the quality of purchasing decisions (Bawden, 2001;

Jacoby et al., 1977; Keller and Staelin, 1987; Schneider, 1987). The other concerns the application of theories on unconscious thought (UTT) to explore how information is processed unconsciously (Dijksterhuis and Nordgren, 2006).

From an information processing perspective, when individuals receive an external information stimulus, they perceive the information, divide it into meaningful units according its characteristics, and generate a response using working memory (Bettman, 1979). Research has shown that the span of information processing for human beings is between 5 and 9 chunks; in other words, people's processing capacity is quite limited (Miller, 1956). Thus when the information is complex, overload occurs (Jacoby et al., 1974). This burden causes confusion and limits the ability to process and respond to the information, as well as to perceive new information (Schick *et al*., 1990). Information overload is thought to occur when the volume of information exceeds the processing capacity. This overload can cause individuals shopping online to focus narrowly on a subset of the relevant information while ignoring other pieces of relevant information. The result is a suboptimal purchasing decision (Tan et al., 2008). The keys to effective information processing include the quality and quantity of the information, and how the information is processed.

As conscious processes have long been regarded as ideal for decision making, researchers have seldom paid much attention to unconscious thought. Most of the time, unconscious thought has been found to be more unpredictable and unsystematic than conscious thought, thereby leading to poor decisions (Dijksterhuis et al., 2006; Simon, 1955). This thesis changed when Dijksterhuis, drawing on the UTT, discovered the deliberation-without-attention (DWA) effect, which shows that people often do not make good decisions after careful (conscious) thought in complext information environment; instead, it is sometimes better to "sleep on it". The UTT suggests that unconscious thought can deal with information overload better than conscious thought because of its greater processing capacity.

As the discovery of DWA effect, psychologists begin to re-examine the unconscious thought and pay attention to the differences between intuition, interruption and the unconscious thought. The existence of unconscious thought implies that intuition is the first step in information processing (Sauter, 1999). Different from intuition which tends to be random and unpredictable, unconscious thought is a goal-dependent process to solve problems. Furthermore, unconscious thought is a decision process where decision makers must return to original decision task after the distraction occurred during the process has passed (Dijksterhuis et al., 2006). Interruption, on the other hand, usually causes a change in the original goal. The UTT states that interruption uses the same processing channel as the original task; thus, it can place great demands on cognitive processing (Speier et al., 1999). Given the above clarifications, it is clear that the value of unconscious thought theory has long been underestimated, and the proposal of the formal UTT represents a significant advance in the study of information processing.

Table 1 summarizes information processing theory and the UTT in terms of their objectives, assumptions, levels of analysis, research questions, concepts, and conclusions in an empirical research context. This comparison of the two theories shows that they share the same research objectives, research assumptions, and levels of analysis. More importantly, their research questions, concepts, and conclusions are complementary. Thus, the comparison shows a solid and potentially fruitful basis for integrating the two perspectives; this principle, in fact, is what motivated the present study.

Theory Comparison	Information Processing Theory	Unconscious Thought Theory
Research Objective	Decision making	Decision making
Research Assumption	Limited information processing capacity	Limited information processing capacity
Level of Analysis	Individual	Individual
Research Question	How information quality and quantity and processing capacity influence decisions	How thought mode (conscious or unconscious) influences decisions
Key Concepts	Working memory, Chunk (meaningful unit of information), Capacity	Unconscious thought, Conscious thought, Processing capacity
Key Conclusions	Decision making is a process that involves sensing an external stimulus, incorporating the information content of the stimulus, dividing the information into meaningful chunks, and generating responses using the limited capacity of working memory.	There are two different modes of information processing. Because unconscious processing has greater processing capacity than conscious processing, it can deal with more information.

Table 1: Comparison of information processing theory and the UTT with respect to empirical research

3 MODEL AND HYPOTHESIS DEVELOPMENT

To solve the dilemma that customers need rich information, which, in return, may reduce their decision efficiency, we considered the problem of limited information processing capacity from two theoretical perspectives: (1) the UTT, which explores how information processing capacity can be increased by unconscious processing (Dijksterhuis et al.,, 2006), and (2) information processing theory, which explores how the quantity and quality of the information can affect the quality of the decision (Bettman, 1979; Miller, 1956). As the two theories share the same assumption of limited information processing capacity and the same focus on decision making, and their research logic and conclusions are complementary, the integration of the two theories can provide in-depth theoretical insights into the overload dilemma.

It is hard to find a universally best product for every consumer as they all have respective needs. Therefore, we decided to use customer satisfaction, a more subjective measurement, to examine the decision quality. One of the key assumptions in the decision-making literature is that better purchasing decisions lead to greater customer satisfaction (Tan et al., 2009). This assumption implies that people who have made a good decision often experience a high level of satisfaction during and after the process. Thus, in this study it is reasonable for us to use satisfaction with the decision as our measure of decision quality.

3.1. Effects of Thought Mode on Decision Quality

As psychologists have found that different information processing modes require different processing capacities (Evans, 2008), it makes sense to seek a mode of thought that offers a greater capacity to handle rich information (Dijksterhuis and Nordgren, 2006). When the information processing requirement exceeds the processing capacity of conscious thought, unconscious thought can take advantage of its larger processing capacity to foster better decisions than those decisions made using conscious thought. Numerous studies have shown that when information is complex, unconscious thought can lead to better decisions than conscious thought (Dijksterhuis *et al.*, 2006; Dijksterhuis and Older, 2006). Thus we proposed the following hypothesis:

H1: When one is dealing with rich information, using unconscious thought results in better decision quality than using conscious thought.

3.2. Effects of Information Quality and Quantity on Decision Quality

An important factor affecting the effectiveness of decision making using conscious thought is the quality of the information. Information quality is defined as the usefulness of the available information about an attribute of a product in helping a decision maker evaluate the usefulness of the product (Keller and Staelin, 1987). In literatures, information quality has been defined according to many different dimensions such as accessibility, appropriate amount, believability, completeness, concise representation and so on (Swanson, 1985). In general, information quality can be understood in two different ways: intrinsic and contextual. Intrinsic information quality refers to the quality of the information in its own right; examples include accuracy, believability, and completeness. Contextual information quality highlights the requirement that the quality must be considered in the context of the task at hand; examples include relevance, usefulness, and timeliness (Lee *et al.*, 2002). In our research, we focused on contextual information quality, which we operationally defined as the importance of the information to the consumer (Keller, Staelin, 1987).

A large amount of low-quality information can increase the complexity of a task to the point that information overload occurs. For a given amount of information, an increase in the quality of the information can increase the likelihood of an effective decision (Keller and Staelin, 1987). It also has been demonstrated that information overload can prevent people from identifying the information that is relevant, which leads to suboptimal weighting of the product's attributes (Dijksterhuis and Nordgren, 2006; Wilson, 1993). If much irrelevant and unimportant information are involved in the decision process, it is less possible for the consumers to grab the essential of the decision and thus make suboptimal decisions. For example, if too much information are provided about a camera, consumers may focus on its color instead of its weight and shutter speed. The increase of low quality information decrease the possibility that consumer weight the attributes reasonably. Thus, when people are dealing with high-quality information, they are more likely to examine the useful information despite the deficiency of the weighting. Thus, we came to the following hypothesis:

H2: When one is dealing with rich information, an increase in the total quality of the information leads to an increase in the quality of the decision.

It has also been found that a large quantity of information, apart from high quality, plays a positive role in consumers' purchasing decisions (Chen et al., 2009). However, other studies have shown that increasing the quantity of information can decrease processing efficiency due to information overload (Eppler and Megis, 2004; Reutskaja and Hogarth, 2009). The quantity of information is primarily defined by two dimensions: the number of choices and the amount of information per choice (Chen et al., 2009; Jacoby et al., 1974). Research shows that choice accuracy decreases when the number of alternatives increases from 5 to 10 or more, and when the number of attributes per alternative increases from 5 to 15 or more (Malhotra, 1982). These studies found that as people suffer from the effects of information overload, a further increase in the quantity of information causes a decrease in the quality of the decision. Thus, we came to the following hypothesis:

H3: When one is dealing with rich information, an increase of the quantity of the information results in a decrease in the quality of the decision.

3.3. Effect of Information Quality and Quantity on Thought Mode

When the information supply exceeds the information processing capacity, an individual usually has difficulty in identifying the relevant information, becomes highly selective, ignores much of the information, and fails to reach a satisfying decision (Eppler and Mengis, 2004). If the decision is made consciously and the information processing requirement has already exceeded the capacity for conscious thought, any additional increase in the quantity of information increases further the processing capacity needed, resulting in a decrease in decision quality. However, as unconscious thought has a quite large capacity, this further increase in information does not cause information overload and a good decision has a better chance to be reached. Also, it has been shown that people are able to use high-quality information more quickly and more effectively than poorly structured or unclear information (Reilly and Holman, 1977). As unconscious thought does not suffer from

information overload, it can identify the relevant information better than conscious thought can. Highly relevant information can help people acquire a better understanding of the product, which can lead to greater satisfaction with the purchasing decision. Thus we came to the following hypotheses:

H4a: When one is dealing with rich information using unconscious thought, the higher the quality of the information, the higher the quality of the decision.

H4b: When one is dealing with rich information using unconscious thought, the greater the quantity of information, the higher the quality of the decision.

The full research model is shown in Figure 1.

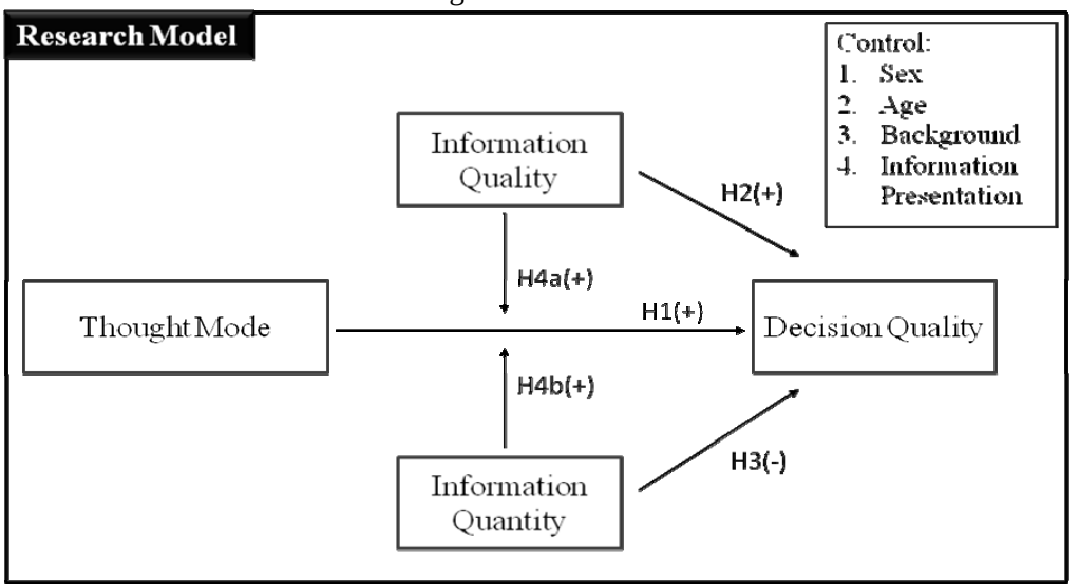

Figure 1: Research model and hypotheses. (+/-) refers to the hypothesized positive/negative relationship between the factors. Thought mode is a categorical variable, with unconscious thought coded as 1 and conscious thought coded as 0. (+) between thought mode and decision quality means that unconscious thought, but not conscious thought, increases decision quality.

4 RESEARCH METHODS

The hypotheses tested in a laboratory experiment with 2*2*2 design (i.e., 2 thought modes (conscious thought and unconscious thought) * 2 levels of information quality * 2 levels of information quantity). The two thought modes were conscious thought and unconscious thought. There were two levels for each of the two information variables. Subjects' sex, age, and background, and how the information was presented, were added as control variables.

In the main experiment, 72 students were recruited and randomly assigned to the 8 conditions, with 9 per group. When the experiment started, all subjects were clearly told that their job was to choose the film they liked most, based on the provided movie information. They were asked to study the information carefully. This procedure was intended to promote goal-dependence, which, in turn, is intended to facilitate a later shift to unconscious thought (Bos, Dijksterhuis and Baaren, 2008).

Specifically, the subjects were first told to read all the information about all the films and get general impressions of them. To avoid undo pressure (Suri and Monroe, 2003), they were given sufficient time to do this (12 min). Next they were told to choose the film they would most like to watch. Members of the conscious thought group were given 3 minutes, which is obtained by measuring the sufficient decision time of the subjects during the pre-test, to evaluate the movies and write down their choices on a blank piece of paper. Members of the unconscious thought group were each given 3 minutes to complete a written grammar test consisting of 30 multiple-choice questions, although no one was able to answer all the questions in the allotted time. This is a well-developed procedure to

encourage unconscious thought (Dijksterhuis and Older, 2006). After the 3 minutes, they were asked to make their choice immediately. After all the subjects made their choices, they were shown the movie they chose. The movies lasted about 15 minutes. After watching the movie, they were asked to measure their satisfaction with the movie. Finally, the subjects were paid and thanked for their participation. As all of the films are documentaries, it is most likely that the subjects haven't watched them beforehand. We confirmed this by asking this question in the pre-experiment survey.

5 RESULTS

5.1. Subject Background Information

The 72 subjects were university students recruited from arts and sciences programs. There were 35 males (48.6 percent) and 37 females (51.4 percent). Most were undergraduates and their average age was 22.8 years. There were no significant differences in gender and age across conditions. Data on subjects' familiarity with the 8 films were also collected; all the subjects reported little or no familiarity with all the films, so this factor did not bias the results.

5.2. Hypothesis Tests

We used a general linear model (GLM) to analyze the data. GLM can be seen as an extension of linear regression. An important way in which GLM differs from linear regression is its ability to solve normal equations when the independent variables are not linearly independent. Another advantage of GLM is its ability to analyze the effects of multiple categorized factors. Both between-subject and within-subject designs have traditionally been analyzed by analysis of variance (ANOVA). In GLM, a linear combination of all the experimental treatments can be tested for significance, whereas ANOVA requires separate statistics for each main effect and interaction. As illustrated in Table 2, the GLM revealed that the full research model is significantly supported ($p<0.001$). The power, defined as the squared multiple correlation, is 0.431.

Test of the Between-Subject Effects		
Dependent Variable: Decision Quality		
Variables	F-value	Significance.
Sex	4.025	.049
Background	3.604	.019
Age	.000	.989
Information Presentation	1.095	.300
Thought Mode	5.772	.020
Information Quality	5.568	.022
Information Amount	11.837	.001
Thought Mode * Information Quality	3.599	.063
Thought Mode * Information Amount	.026	.873
Thought Mode * Information Quality * Information Amount	3.116	.052
Corrected Model	3.380	.001
R Squared = .431 (Adjusted R Squared = .304)		

Table 2 Significance test of the model. Note that the interaction between information quality and information quantity is not significant by adding it in the model. Since the interaction is not what the study aims, we don not report it in the table.

There is a significant relationship between thought mode and decision quality ($p<0.05$). Figure 2 shows that the decision quality was higher with unconscious thought than with conscious thought, meaning that unconscious thought helped individuals make better decisions than conscious thought when confronted with rich information. Thus, H1 is supported.

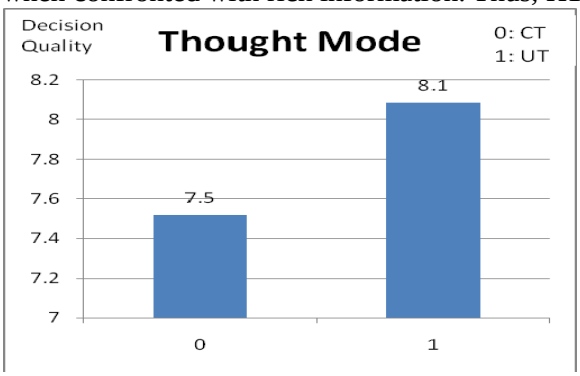

Figure 2. Effect of thought mode on decision quality. CT: conscious thought, UT: unconscious thought.

Information quality ($p<0.05$) and information quantity ($p<0.01$) are both significantly related to decision quality. Figure 3 shows that the increase in information quality led to an increase of decision quality. Thus, H2 is supported. Unexpectedly, an increase in information quantity *increased* decision quality. But the result is also explainable. According to Schroder's study (Schroder, et al., 1967), with the increase of the information quantity, it can cause a U-shape decision quality, which implies that the information quantity may not affect decision quality significantly after people have already been experiencing information overload. As our research about making decision under the circumstance of information overload, it is highly likely that information quantity may not contribute a lot to the decision quality. Thus, H3 is not supported.

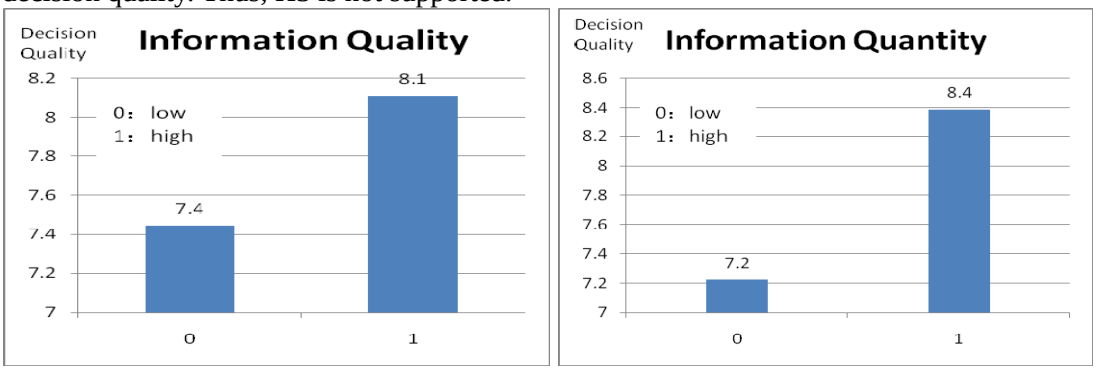

Figure 3. Effects of information quality and quantity on decision quality

The results in Table 5 and Figure 4 indicate that information quality interacted with unconscious thought ($p<0.1$). The increase of information quality increased the effect of unconscious thought on decision quality. Thus, H4a is supported. However, H4b is not supported.

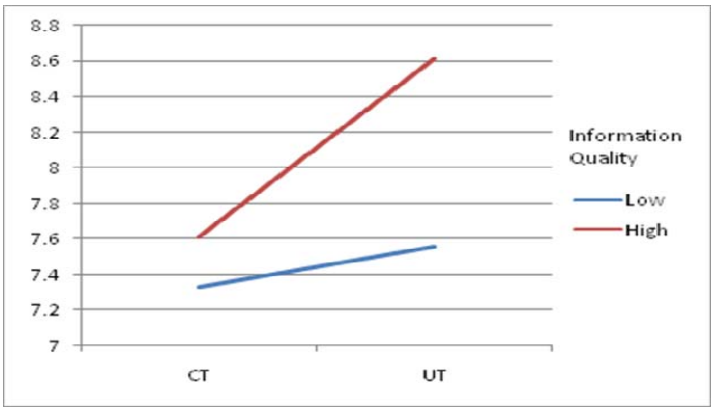

Figure 4 Interaction of thought mode and information quality

6 DISCUSSIONS

E-commerce vendors keep providing more and more 'good' information to satisfy consumers, but few are aware that consumers cannot tolerate the resulting information overloaded. As humans have limited information processing capacity, online shoppers are easily confused by rich information. In contrast to previous studies, which focused on the format of information presentation or user interfaces to solve the overload problem, this study explored the mode of thinking or the style of information processing. Drawing on the Unconscious Thought Theory and Information Processing Theory,we examined how unconscious thought processes might improve the quality of online consumers' decisions, as measured by their satisfaction with these decisions, in the presence of information overload. We also examined how the quantity and quality of the information interacts with the mode of thought to affect decision quality. The results suggest that: (1) unconscious thought can lead to better decision quality than conscious thought under conditions of information overload, (2) an increase in the quality or the quantity of the information leads to an increase in decision quality, and (3) an increase in information quality increases the positive effect of unconscious thought on decision quality.

Although the UTT has been discussed by many researchers, and many possible explanations of the deliberation-without-attention effect have been put forward (e.g., the capacity principle and the weighting principle), precise explanations of the mechanisms involved have been lacking (Dijksterhuis and Nordgren, 2006). Our research has filled this gap by revealing the role of unconscious thought in decision making when one is confronted with information of varying quality and quantity. To understand how unconscious thought can lead to optimal decisions, we chose to examine first the quality and quantity of the information, because of their essential effects on decision quality when conscious thought is applied. We found that an increase in information quantity and quality can lead to increased decision quality when unconscious thought is applied.

Researchers have suggested that rich information can lead to better decisions, but only if the information does not exceed the person's processing capacity. As unconscious thought has almost infinite processing capacity, when it is used, any increase of information, regardless of level, can be expected to lead to better decision quality, and that is what our results suggest. It has been proved that for any given quantity of information, an increase in its quality can result in an increase in decision effectiveness (Keller and Staelin, 1987), because people are able to use high-quality information more quickly and more effectively than poorly structured unclear information. Thus we suggest a positive relation between information quality and unconscious thought decision quality.

Before the discovery of the effects of information overload, conscious thought was regarded as the ideal for decision making. After researchers discovered that information overload can lead to suboptimal decisions, they began to search for methods to eliminate the effects of this overload. Most of this research focused on the formatting of appropriate information or information systems (Ackoff,

1967; Bawden, 2001; Keller and Staelin, 1987; Meglio and Kleiner, 1990). However, the rise of the UTT led to the proposal of a new way to solve the overload dilemma. Dijksterhuis noted that unconscious thought does not suffer from the information overload effect, because of its almost infinite capacity for processing information (Dijksterhuis and Nordgren, 2006); thus, unconscious thought helps one make better decisions in the presence of information overload. Our experiment has once again shown the superiority of unconscious thought to conscious thought in such situations. According to Eppler and Mengis(Eppler and Mengis, 2004), the reason for the superiority of unconscious thought is that people using conscious thought are not able to effectively identify the relevant information, thereby leading to poor weighting of the information units and low decision quality.

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