The Role of Conscious and Unconscious Thought in Decision Making

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A Thesis Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

in

Psychology

The Chinese University of Hong Kong

September 2011

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ACKNOWLEDGEMENTS

This work was supported in part by grants from a dissertation grant from the Department of Psychology in The Chinese University of Hong Kong. I would like to express my gratitude to my thesis supervisor, Prof. Him Cheung, for his wisdom and valuable comments throughout my candidature. I am indebted to him for his insight, guidance, and generosity. Thanks are also given to my thesis/ assessment committee chair, Prof. Liqiang Huang, and my thesis committee member, Prof. Winton Wing-tung Au, and the external examiners, Prof. Ellick Kin-Fai Wong for their constructive advices. I would like to thank my husband David Bel for his unconditional support and encouragement, also my collaborator and good friends Yiu Kei Tsang and Ruiming Wang for their kind support.

ABSTRACT

Two distinctive but inter-related modes of thought, conscious and unconscious thought(i.e., CT & UT), have been identified for a long time. But what has been accompanying such recognition is a strong bias toward rational thought in terms of theorization and research. The rational choice theory has dominated the field of decision making for several decades. Recently, soçial psychologists proposed a theory of unconscious thought (UTT) with six principles supported by ample experimental evidence (e.g., Dijksterhuis et al., 2006). The present research aimed at investigating the roles of conscious and unconscious thought in complex decision making and some possible moderators of the unconscious thought effect (UTE, i.e., performance under the guidance of UT is better than that under the guidance of CT.) through a series of experiments on decision making.

In Chapter 2, Experiment 1 using the deliberation–without-attention paradigm replicated some previous findings surrounding the relations among thought mode (conscious vs. unconscious), complexity of the decision, and quality of the decision. The participants whose attention was distracted for some time (i.e., the unconscious thinkers) performed well in both simple and complex decisions whereas the participants whose attention was focused on the choices without distraction (i.e., the conscious thinkers) performed well in simple decisions but poorly in complex

decisions. However, for complex decisions, an expected significant difference between the unconscious and conscious conditions was not obtained, implying that there could be some UTE moderators. The possible moderating effect of decision complexity on quality of decision was investigated in Experiment 2 by increasing the numbers of attributes (and thus complexity) associated with the available options.

Chapter 3 investigated whether the unconscious effect would vary as a function of thought processing time (Experiment 3), and the reasons behind (Experiment 4). The results showed that given longer thought processing times, the unconscious thinkers outperformed the conscious thinkers. It implied that thought processing time was one of the possible UTE moderators. Given longer thought processing times, the conscious thinkers' attention was distracted to irrelevant information (i.e., noise) while the unconscious thinkers may gain more time to slowly integrate a large amount of information and weight the choices better (according to UTT principles). Hence a longer time hurts conscious thinkers but facilitates unconscious thinkers. This possibility was examined in Experiment 4.

Chapter 4 investigated whether expertise was one of the UTE moderators in complex decision making and the reasons behind. The results of Experiment 5 showed that the UTE varied as a function of expertise. Experiment 6 investigated whether the reason was because the experts were able to organize the relevant

information together into chunks which the non-experts were unable to do, and such a chunking effect benefited from the fact that UT could deal with a large amount of information and weight the information better compared to CT. Experiment 7 investigated another possibility, that is, experts' ability of filtering out irrelevant information benefits from UT which can weigh the option attributes better than CT.

The findings reported in Chapters 2, 3, and 4 therefore have indicated that unconscious and conscious thought both play important roles in different situations in decision making. Conscious thinkers perform well in simple decision but poorly in complex decision, whereas unconscious thinkers maintain good performance in both simple and complex decisions, or even sometimes better in complex ones. The UTE is not always strong in complex decision making. More moderators such as complexity of task, thought processing time, and expertise should be considered in order to make a good choice in complex decision making.

摘要

意識思維和無意識思維，這兩個既不同的但又相互關聯的思維模式， 已存在了很長時間。但是，一直伴隨這種認識的卻是對理性思維在理論和研究方面的很深的偏見。理性選擇理論佔據了決策領域的主導地位幾十年。最近，社會心理學家在大量的實驗證據支持的基礎上，提出了一個無意識思維理論（UTT）及其六項原則（例如，Dijksterhuis 等，2006）。 本研究旨在通過一系列決策實驗，探討意識思維和無意識思維在複雜的決策中所起的作用和一些可能存在的無意識思維效應（也就是無意識思維指導下的行爲顯著優於意識思維指導下的行爲，簡稱 UTE）的調節變數。

在第二章中，實驗一重複前人研究，研究思維模式（有意識思維與無意識思維），決策複雜性，和決策質量之間的關係。注意力被轉移了一段時間的實驗參與者（即無意識思考者）在簡單和複雜的兩種程度的決策中都表現出色，而注意力都集中在思考選項的參與者（即意識思考者）在作簡單決策中表現不錯，但在作複雜的決策時表現不佳。然而，在複雜決策中，在無意識思維和有意識思維的兩種條件下沒有獲取預期的顯著效應，這意味著可能會有一些 UTE 的調節變數。實驗二通過增加決策中選項的屬性數目（從而增加複雜性）來探討決策複雜性對決策質量調節作用。

第三章探討 UTE 是否會因思維處理時間的變化而變化（實驗 3），及其變化的原因（實驗 4）。結果表明，在有較長的思考時間時，無意識思考者明顯做

得比即意識思考者好。這意味著，思維處理時間是其中一個 UTE 調節變數。如果給予較長的思維時間，意識思考者的注意力就將被轉移到一些跟選擇不相關的資訊（即噪音，干擾），而無意識思考者可能從而獲得更多的時間來慢慢整合大量的資訊和更好地衡量每條資訊的重要性（UTT 原則）。因此，較長的思維處理時間不利於意識思考者，但有利於無意識思考者。這種可能性在實驗 4 進行了探討。

第四章考查是否專業知識是另一個複雜決策中 UTE 的調節變數，及其背後的原因。實驗 5 結果表明，UTE 因專業知識程度變化而變化。實驗 6 調查其原因是否是因爲專家們能夠組織相關的資訊並且匯集成塊，而非專家不能做到，這種“組塊效應”獲益於無意識能夠處理大量的資訊和衡量每條資訊的功能。實驗 7 研究另一種可能性，那就是專家過濾掉無關資訊的能力，獲益於無意識可以較好地衡量屬性的功能。

綜合第 2 ，3 和 4 章的研究結果報告可以看出，意識思維和無意識思維在複雜決策的不同情況下都起著重要的作用。意識思維可以令思考者在簡單決策任務中能夠做出較好的決策，但在複雜決策中表現很差，而無意識思考者在無論簡單還是複雜的決策任務中都保持較好的或者表現出更好的決策能力。這樣看來，複雜的決策中的 UTE 並不總是很強。人在無意識思維指導下進行複雜的決策時應考慮更多的影響因素（即 UTE 調節變數），例如任務複雜性，思維處理時間和專業知識程度等，從而作出一個更好的決策。

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CHAPTER 1:

INTRODUCTION

1.1 The conscious bias and unconscious influence

Two distinctive but inter-related modes of thought, conscious and unconscious thought, have been identified for a long time. However, UT has been mostly neglected and viewed as the shadow of a conscious mind by many psychologists. While there is general consensus that CT is intentional, controllable, consumptive of limited processing resources, and accessible to awareness (i.e., verbally reportable), no consensus for UT has been reached so far. Bargh & Morsella (2008) pointed out that different operational definitions lead to different views on the power and influence of the unconscious. UT has been defined by cognitive psychologists as subliminal thinking in which the thinker is unaware of the stimuli (e.g., Greenwald, Klinger, & Schuh, 1995; Loftus & Klinger, 1992). Bargh & Morsella (2008) have argued that cognitive psychologists' equating the unconscious with the subliminal is both unnatural and restrictive, because subliminal stimuli are too weak or brief to enter conscious awareness. It is unfair to measure the capability of the unconsciousness in terms of how well it processes subliminal stimuli because unconscious (like conscious) processes have evolved to deal with and respond to naturally occurring (regular strength) stimuli. On the other hand, social psychologists regard mental processes that

are outside of our awareness, rather than subliminally perceived stimuli per se, as the focus of defining UT (e.g., Nisbett &Wilson, 1977). Their studies have led to the view that the unconscious mind has pervasive, powerful influence over higher mental processes (see review in Bargh, 2006). Bargh and Morsella (2008) has proposed that unconscious processes are defined in terms of their unintentional nature; the inherent lack of awareness is of the influence and effect of the triggering stimuli, not of the triggering stimuli themselves (because almost all naturally occurring stimuli are supraliminal). Dijksterhuis and his colleagues (2004, 2006) have defined UT as objective-relevant or task-relevant cognitive or affective thought processes that occur while conscious attention is directed elsewhere, and CT as objective-relevant or task-relevant cognitive or affective thought processes that occur while the object or task is the focus of conscious attention. Bargh & Morsella (1992; 2008) have suggested that it makes a big difference that the operation definition of unconscious shifts from the processing of unaware stimulus to the influence or effects of the processing of unattended stimuli. I followed Dijksterhuis' definition throughout the present dissertation.

Infrequently, UT has been postulated and investigated by some scientists (e.g., Schopenhauer, 1970; Claxon, 1997; Bowers et al., 1990). Numerous researchers (e.g., Bargh, 1997; Chaiken & Trope, 1999; Epstein, 1994; Frederick, 2002; Kahneman,

2003; Sloman, 1996; Slovic, Finucane, Peters, & MacGregor, 2002) have emphasized the various aspects of automatic, unconscious, intuitive effects. Bargh (1997) stated that everything one encountered was pre-consciously screened and classified to be good or bad after initial processing. A conclusion that can be drawn from such research is that UT plays a relatively important role in many fields related to thought, mostly in judgments, choice, decisions, behaviors (Simonson, 2005).

What is more, our daily life experiences and some experimental studies have also shown that UT indeed plays a role in our daily life. For instance, implicit learning studies have shown that people can indeed learn complex rules and relations without being consciously aware of them (Frensch &Runger, 2003, Halford et al.2005, Lewicki et al. 1992, Nissen &Bullemer 1987). We follow grammatical rules often without being able to explain and verbalize them (Dijksterhuis &Aarts, 2009). Some existing evidences have also shown that UT is not less complex, flexible, deliberative, action-oriented, or controlling than CT, as it has always been assumed (see Bargh & Morsella, 2008). Numerous experimental studies have also shown that there are implicit, unconscious effects in our everyday life. For instance, holding a heavy or light clipboard will make people evaluate things as more or less important (Jostmann, Lakens, & Schubert, 2009); holding a cup of warm or cold coffee will make a person evaluate the confederate's personality as more or less warm (Williams & Bargh, 2008);

sitting straight predicts the person has more confidence about self-evaluation (Brinol, Petty, & Wagner, 2009). All these happen unconsciously and the influence from one behavior on another is often times beyond awareness. These evidences may suggest that unconscious influences take place without being noticed every day. However, questions such as how it works in our brain and what role it plays, where it comes from and how to reliably measure and manipulate it are still mysteries that need further exploration.

1.2 The conscious bias and the unconscious influence on decision making

In the field of decision making, the notion of "conscious-centric bias" has been around for a long time. There is ample evidence for the idea that conscious deliberation helps decision making in general (e.g., Newell, Lagnado,&Shanks, 2007). Most decision theories are normative or prescriptive, i.e., they have a concern of identifying the best decision to take, assuming an ideal decision maker that is fully informed, able to compute with perfect accuracy, and fully rational. Rational decision making models such as the Bayesian Probability Theory (BPT), the Subjective Expected Utility Theory (SEU), the Multi-attribute Utility Theory (MAUT), and Multi-Criteria Decision Making (MCDM) have dominated decision making and consumer research for a long time.

The BPT was firstly developed by Thomas Bayes (1764, 1958) and Pierre-Simon

de Laplace (1812, 1814, 1820), then became popular again in the 20th century. It provides a mathematical framework for performing inference, reasoning and decision making under uncertainty, using probability. The BPT interprets the concept of probability as "a measure of a state of knowledge". Such probabilities themselves are distinguished into objective and subjective probabilities. The Bayesian probabilist specifies some prior probabilities to evaluate the probability of a hypothesis and such prior probabilities then keep being updated in new relevant data. Bayesian interpretation provides a standard set of procedures and formulae to perform the calculation.

The SEU promoted by Savage (1954) is a method in decision theory in the presence of risk. This theory combines two subjective concepts: a personal utility function, and a personal probability distribution (based on the Bayesian probability theory). It has been proved that if decision makers adhere to axioms of rationality, and believe that an uncertain event has possible outcomes {xi} and each is with a utility of u(xi), then the choices might be interpreted as being raised from a function that they believe a subjective probability of each outcome P(xi) exits, hence the subjective expected utility is the expected value of the utility, $\sum_i u(x_i)\ P(x_i)$. Decision makers may be able to make a decision which changes the possible outcomes to {yj}, in which case their subjective expected utility will become $\sum_j u(y_j)\ P(y_j)$.

Eventually, the decision with higher subjective expected utility will be taken. Different people may make different decisions because they may have different utility functions or different beliefs about the probabilities of different outcomes. Savage also assumed that it is possible to take convex combinations of decisions and that preferences would be preserved. Therefore if one prefers x(= {xi}) to y and s to t then he will prefer $\lambda x + (1 - \lambda)s$ to $\lambda y + (1 - \lambda)t$, for $0 < \lambda < 1$.

Decisions involve comparing alternatives having strengths or weaknesses with regard to multiple objectives of interest to the decision makers. The MAUT proposed by Keeney& Raiffa (1976) is a structured methodology that handles the tradeoffs among multiple objectives. It focuses on the structure of multi-attribute alternatives or multi-criteria, usually under risk or uncertainty, and on methodologies of assessing individuals' subjective probabilities and values. It is a systematic approach for quantifying an individual's preferences, and is used to rescale a numerical value on some measure of interest with 0 representing the worst preference and 1 the best to identify the most preferred alternative or to rank order the alternatives. This allows the direct comparison of many diverse measures and a rank ordered evaluation of alternatives that reflects the decision makers' preferences. Early applications of MAUT focused on public sector decisions and public policy issues, and the military is also a leading user of this technique. The design of major new weapons systems

always involves tradeoffs of cost, weight, durability, lethality and survivability. One of the first applications of MAUT was a study on alternative locations for a new airport in Mexico City in the early 1970s. The factors considered included cost, capacity, access time to the airport, safety, social disruption and noise pollution.

The MAUT is actually one methodology in the broader field of Multi-Criteria Decision Making (MCDM). MCDM has been an active area of research since the 1970s. MCDM is a sub-discipline of operations research that explicitly considers multiple criteria in decision making environments and MCDM models are used to tackle complex problems involving a large number of decision variables that are subject to constraints. Dyer, J. S. and his colleagues' paper (1992) has described that the complex decisions involve a number of alternatives based on the evaluation of two or more criteria or attributes, and the alternatives can involve risks and uncertainties that may require sequential actions at different times, and the set of alternatives might be either finite or infinite. In the simplest cases, the decision maker usually acts to maximize a utility or value function that depends on the criteria or attributes. MCDM assumes that a decision maker is to choose among alternatives whose objective function values or attributes are known with certainty. "Solving" in MCDM can be interpreted as choosing the "the most preferred " alternative to decision maker from a set of available alternatives, or choosing a small set of good alternatives, or grouping

alternatives into different preference sets, or finding all "efficient" or "nondominated". When the alternatives are not explicitly known, and the number of alternatives is either infinite or uncountable (e.g., when some variables are continuous) or typically very large if countable (when all variables are discrete), it can be solved by a mathematical model.

All in all, these models above are all emphasizing that the consumer has the ability or skill in computation which enables the rational calculation of which options will maximize his or her received value and selects accordingly (Bettman et al., 1998, p 187). Other decision-making models such as descriptive models, decision models in natural settings, and models emphasizing situation awareness (SA) are all based on the conscious view. And in daily life, it is true that if the problem is complex, especially if with high cost, we tend to trust and apply CT to weigh the attributes or rationally calculate and analyze them before making a choice. Admittedly, in application of mathematic, military or physics, it should be useful to rely on these structured models to do efficient rational calculation. However, in everyday problems or decisions such as buying a house, a car, deciding a new job or new city to move into, do people actually apply such rational calculation and is it practical and useful? Is conscious calculation always appropriate? Do people always make sound decisions when applying conscious thinking to complex decision making? There are also some

experimental evidences demonstrating that many individuals do not behave in a manner consistent with subjective expected utility, e.g. most prominently Allais (1953) and Ellsberg (1961). With Tversky, Kahneman established a cognitive basis for common human errors using heuristics and biases (Kahneman & Tversky, 1973; Kahneman, Slovic & Tversky, 1982; Tversky & Kahneman, 1974), and developed prospect theory (Kahneman & Tversky, 1979), which aims to explain irrational human economic choices. Kahneman and Tversky's prospect theory also put less emphasis on rationality presuppositions. It describes decisions between alternatives that involve risk (i.e., alternatives with uncertain outcomes) where the probabilities are known. The model is descriptive: it tries to model real-life choices, rather than optimal decisions. They found three regularities —"losses loom larger than gains" in actual human decision-making; people focus more on changes in their utility–states than on absolute utilities; and the estimation of subjective probabilities is severely biased by anchoring.

Furthermore, some evidences have showed that conscious deliberation sometimes leads to worse decisions (Dijksterhui & Nordgren, 2006; Igou & Bless, 2007; Wilson & Schooler, 1991). A group of social psychologists hold the opinion that it was not always advantageous for people to make a decision by engaging in thorough conscious deliberative thought. They compared the quality of decisions by

carrying out a series of experiments and proposed a remarkable theory of unconscious thought (UTT) with six principles (e.g., Dijksterhuis, 2004b; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis& Meurs, 2006; Dijksterhuis & van Olden, 2006; Nordgren &Dijksterhuis, 2006). Their research raised up hot debate between conscious decision making and unconscious decision making in the field again.

1.3. The Unconscious Thought Theory (UTT)

1.3.1 The UTT & its six principles

The UTT is about the relative strengths and weaknesses of two modes of thought, conscious and unconscious. Compared to other social psychological models which have usually effortful and effortless routes (e.g., Brewer, 1988; Chaiken, 1980; Fazio, 1990; Petty & Cacioppo, 1986; Fiske & Neuberg, 1990), UTT contains three routes: an effortless route involving no thought at all, an unconscious route that takes time but relatively effortless, and a conscious route that is effortful. It is characterized with six principles and can be applied to decision making, impression formation, attitude formation and change, problem solving, and creativity with a series of supporting studies (Dijksterhuis & Nordgren, 2006).

a) The unconscious thought principle

The unconscious thought principle states that the two modes of thought

(conscious vs. unconscious) possess different characteristics making them suitable for different decision making situations. Attention is the key to distinguishing conscious from UT. CT is defined as thought with attention directed at the problem while UT is defined as thought without attention directed at the problem (Dijksterhuis & Nordgren, 2006).

According to Dijksterhuis and Nordgren (2006), it is not always advantageous for people to make a decision by engaging in thorough conscious deliberative thought. Dijksterhuis et al.(2006) claimed that UT and CT possess different characteristics that make each mode of thought preferable under different circumstances. Taking decision making for example, CT may tackle simple decisions (e.g., buy a new set of towels) better while UT may tackle complex decisions (e.g., buy a new house) better. Which new house to buy? Which new job to accept? Which car to buy? Which city to move into? These decisions differ on many dimensions with complicatedly different advantages and disadvantages. Dijksterhuis & Nordgren (2006) claimed that beside consciously thinking about making a choice based on considering all the attributes of the choices, another way was to take our time and "sleep on it" by which the labor of thinking is delegated to the unconscious mode, and the "right" feeling pops out at some point. CT is based on active unconscious processes and has not only conscious processes. For example, deciding the best city to travel may be complex for someone

when he consciously analyzes and thinks about the advantages and disadvantages, however, an idea of where to go might "pop out" suddenly after some days of stop conscious thinking. Even though the idea of where to go itself is conscious, the transition process from indecision to a preference results from the UT process (Dijksterhuis, 2004). Another example is making a speech. Speech is conscious itself but choosing the words or syntax is a process that is actively unconscious.

b) The capacity principle

The capacity principle states that UT has a higher capacity and not constrained, leading to good decision quality whereas CT has a low capacity and constrained, leading to poorer decisions. (Dijkshuister& Norgren, 2006). In the literature of decision making, many researchers have also pointed out that the capacity of CT is limited (e.g., Bettman, Luce, & Payne, 1998; Kahneman, 2003; Simon, 1955; Tversky & Kahneman, 1974). In Wilson and Schooler 's study (1991) , conscious thinkers who were asked to scrutinize the options (e.g., colleague courses or jams) made less accurate evaluations on the options than those who were asked to merely think about them in their study (cited by Dijksterhuis, 2006). The result implies that too much CT results in poor decisions because of its low capacity. With too much CT, people may be unable to deal with a large amount of information and only able to focus on limited attributes.

Capacity may consist of some dimensions such as the ability to weigh the attributes to make the best decision, and how many attributes the thinkers are able to take into account when they are engaged in the different modes of thought. In Dijksterhuis (2004), the participants were asked to choose the best one among four hypothetical apartments in three conditions (i.e., IM, CT, UT). Immediate condition is the condition in which participants are not given any time to carefully think or do an unrelated task, but make a decision immediately. One of the apartments was characterized with more desirable attributes than others. The results showed that participants chose the best apartment more often in the unconscious condition (59%) than in the conscious (47%) and immediate condition (36%). What is more, participants were also asked whether they made decision based on one or two specific attributes or on a more holistic judgment. Most of the conscious thinkers reported that they made decision based on only one or two attributes while the unconscious thinkers or immediate thinkers made holistic judgments. Based on these evidences, Dijksterhuis and his colleagues stated that consciousness had a limited capacity.

c) The bottom-up-versus-top-down principle

The bottom-up-versus-top-down principle states that CT follows the top-down principle (schematical), guided by expectancies and schemas, hence it produces more stereotyping and predecisional biases. On the contrary, UT follows the bottom-up

principle (aschematical) and is able to slowly integrate a large amount of information to form an objective summary judgment in decision making, and hence it does not produce predicisional biases (Brownstein, 2003; Davidson & Kiesler, 1964; Dijksterhuis& Nordgren, 2006; Dijksterhuis& Bos, 2005; Dijksterhuis & van Knippenberg, 1996; Srull& Wyer, 1989; Stangor& McMillan, 1992).

Barsalou (1992) stated that bottom-up processing was information from the environment flowing to the cognitive system via sensory modalities; while top-down processing was information from expectation flowing to guiding behavior. This principle is based on the idea that strategic thought processes are hierarchical while automatic processes are not (Sloman, 1996). CT works "top-down" and follows expectancies and schemas. Hence conscious thinkers are more stereotype-based than unconscious thinkers in impression formation. Conscious thinkers may concentrate more on stereotype-congruent information so that it is harder for them to recall the stereotype-incongruent information (Dijksterhuis& Bos, 2005; Dijksterhuis & van Knippenberg, 1996). Dijsterhuis et al. cited the person memory paradigm used in most of these experiments (e.g., Srull& Wyer, 1989; Stangor& McMillan, 1992). Participants were required to tell the impression of a target person after reading some detailed information about this person (stereotype-congruent vs. stereotype-incongruent information) in two conditions (conscious vs. unconscious

conditions). Before reading the information, the target person was given a stereotypical expectation by questions like " you are going to read information about Mr. Hamoudi, a Moroccan man." Their impression of the target person and memory for description information was assessed. The results demonstrated that conscious thinkers recalled more stereotype-congruent information (with bias) while unconscious thinkers told more stereotype-incongruent description (more neutrally).

Furthermore, conscious thinkers recalled less information in total than unconscious thinkers. Some other experiments on predecisional distortion (e.g., decide whether a defendant is guilty or not) also supported the top-down-versus-bottom-up principle that conscious thinkers might usually have expectance (i.e., prejudgment) (with bias) that influences the interpretation of the later information (Carlson& Russo, 2001; Simon et al., 2001)).

While CT works "top-down", UT works "bottom-up". UT is able to slowly integrate a large amount of information to form an objective summary judgment, and it's qualified to regard unconscious thinking to be a way of thinking that really involves changes in representation (Dijksterhuis &Nordgren, 2006). Since detecting unconsciousness is so difficult that it is really hard to get a clear idea of what it is and how it works. However, there are still some useful findings. By showing that people performed better in the unconscious than in the immediate condition, Dijksterhuis et

al(2004, 2006) proved that UT was not only merely distracted but also really engaged in thought.

Regarding the possibility that UT just gives people a chance to have a "fresh look" after a good rest which may eliminate the biasing effect of predecision, some experiments were carried out to prove that UT was an active process that leads to changed mental representation. For example, a recognition task in which participants were asked to decide which characteristic belonged to which roommate was taken in another experiment (Dijksterhuis, 2004b). The finding showed that participants responded much faster to the positive characteristics of the desirable people and the negative characteristics of the undesirable people in the unconscious condition but not in the conscious condition, indicating that UT leads to polarized evaluative representations but not CT.

Another paradigm in which participants were asked to tell the impression of a hypothetical man with 18 behavioral descriptions (6 implied that he was intelligent, 6 others implied idealistic, and the left 6 implied extraverted) was used in Experiment 5 (Dijksterhuis, 2004b). The finding showed that participants recalled information in a more blocked order, indicating a certain degree of clustering in the unconscious condition but not in the other two conditions. In another experiment in which participants were told that they would (or would not) answer questions about the

target person before reading the information about hypothetical objects (e.g., apartments, roommates) showed that the unconscious thinkers who had a goal (i.e., knew they would be asked about information later after reading the information) recalled better. The result demonstrated that UT enhanced memory organization and should be an active, goal-directed process(Dijksterhuis et al., 2006).

d) The weighting principle

According to the UTT, weighting was defined as giving "weight" on the relative importance of various attributes. According to *Wikipedia* (http://en.wikipedia.org/wiki/Weighting), the process of weighting involves emphasizing the contribution of some aspects of a phenomenon or of a set of data to a final effect or result — giving them 'more weight' in the analysis. That is, some data contribute more than others rather than each variable in the data contributing equally to the final result. According to the weighting principle of UTT, the unconscious mind is without conscious interference, hence can naturally weights the relative importance of various attributes leading to more consistent decisions whereas the conscious leads to suboptiomal, poor and inconsistent weighting as it produces "conscious noise" that disturbs this natural weighting process (Dijksterhuis & van Olden, 2005; Levine et al.1996; Nordgren& Dijksterhuis, 2006; Wilson et al., 1993). It is assumed that if people weigh the attributes well, the quality of decision should be high. The quality of

decision was tested normatively in most of the previous experiments (e.g., the apartment is the best if it has more positive attributes than negative attributes) done by Dijksterhuis and his colleagues (2004, 2006, 2009). However, people have individual idiosyncratic preferences (i.e., the desirable car labeled by the experimenter may not be the best one for individuals). Especially, weighting the relative importance of attributes should also be subjective with individual preferences, hence subjective measure of quality of decision is in need (i.e., post-choice satisfaction which is subjective should be a appropriate index of quality of decision). Post-choice satisfaction is about how satisfied or happy participants feel with what they have chosen earlier. [1] It has been assumed that UT weights the relative importance of attribute better, people therefore knows which attribute is more important compared to others, then make a choice with more consistency, leading to higher levels of

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[1] It will make more sense if the post-choice satisfaction is measured on options which are taken home and used. However, in the laboratory, it is hard to present such options which should meet the requirement of being complex enough (e.g., house, car) as well as being able to be taken home and used. It will also make sense, if not the best, that giving subjects an instruction that they will be asked to select the best option they think in an exhibition and then be asked how satisfied with the option they have chosen as the best in the exhibition after some period. In this case, post-choice satisfaction should be collected in short period of time because we believe a positive correlation between complexity of decision and time of reporting post-choice satisfaction. For example, it makes more sense if collecting post-choice satisfaction in years after selecting someone to be a wife, in months after buying a new house, in weeks after picking up a new car, or in hours if being only asked to tell the best car or painting in an exhibition.

happiness and satisfaction. Several evidences have showed that decision makers who thought little (who merely thought) felt more satisfied about what they have chosen than conscious decision makers (who made a choice after carefully scrutinizing the reasons)(e.g., Wilson et al., 1993; Wilson & Schooler, 1991; Levine et al., 1996). The task was choosing one art poster out of five to take home. The participants were asked about their satisfaction a few weeks later. The result revealed that introspection changed an optimal weighting scheme into a suboptimal one. CT made people analyze reasons and focus on some attributes of the target object which seem to be plausible causes of an evaluation and put disproportion weight on the attributes that are accessible, plausible and easy to verbalize and less weight on other attributes (Wilson et al., 1993, Schooler et al., 1993).

Further post-choice satisfaction study on decision making (choosing a poster out of five to take home) was carried out by Dijksterhuis and Van Olden in 2005 using three conditions (make decision after reading information immediately (IM), thinking about 9 minutes after reading (CT), or being distracted for 9 minutes after reading (UT)). The result was that unconscious thinkers were happier with their choice than those who thought consciously. Unconscious thinkers were also willing to sell their poster at a price twice as high as that indicated by conscious thinkers. The correlations between the attitude and post-choice satisfaction revealed that immediate and

unconscious thinkers' attitude predicted post-choice satisfaction while conscious thinkers did not. Conscious thinkers made strong preferences that were "wrong" to them.

Studies also demonstrated that CT made more varied and inconsistent weighting (Levine et al., 1996; Nordgren & Dijksterhuis, 2006). In Levine et al.'s (1996) study, participants were asked to evaluate faces that varied on six dimensions merely or after carefully thinking of the reasons. The result demonstrated that thorough conscious thinkers always showed more inconsistency on their judgment. Another experiment of repeated judgment on the quality of pieces of arts (good and bad art) also demonstrated that conscious thinkers were less consistent than unconscious thinkers.

e) The rule principle

The rule principle indicates that CT follows strict rules so that it is more precise (e.g. figuring out the average money returns for a share) (Betsch et al., 2001, Dijksterhuis, 2006), while UT conforms to rules and is less precise, so it is more general with rough estimates, not in real arithmetic but accurate; (e.g., what the best or worst shares are) (Betsch et al., 2001). According to this principle, CT is rule-based and more precise while UT is more general with rough estimates so that less precise. For example, CT can figure out the product of 13 times 14 after some time but UT cannot do so because UT cannot follow rules so that it cannot deal with logical

problems like CT does. The distinction between CT and UT is quite similar to the distinction between rule-based and associated thinking (Claxon, 1997).

Even though UT is not rule-based, it can conform to rules. Some studies showed that UT could roughly (but accurate) estimate numbers but did not engage in real arithmetic (Betsch et al., 2001). Participants in this study were presented with 75 units of information on shares briefly and were either asked some specific questions about each share or asked what the best or worst shares were after reading information. Unconscious thinkers were unable to answer any specific questions (e.g. what the average money returns were for this share), but were able to tell what the best or worst shares were, indicating that UT was able to actively integrate a large amount of information to form an impression.

Implicit learning studies have also indicated that UT is quite good at detecting recurring patterns even if they were rather complicated (e.g., Lewicki et al., 1992). As for CT, it can follow rules and also self-generated rules, hence it may quickly decide to resist it when the information is inconsistent with the self-generated rules (Dijksterhuis, 2004b). UT helps to evaluate generally and roughly (but correctly) while CT sets a strict rule to judge the targets entirely differently. For example, an apartment costing $595 is similar to one costing $605 for UT, but these two apartments will be very different if CT set a rule such as the apartment in need should

cost less than $600.

f) The convergence-versus-divergence principle

Lastly, the convergence-versus-divergence principle states that CT is convergent and focused while UT is divergent leading to more unusual & creative ideas. This principle is more related to creativity than decision making or making choices (Dijksterhuis& Nordgren, 2006).

A series of related studies were carried out (Dijksterhuis & Meurs, 2006). In all the experiments, three experimental conditions were set as those in the other earlier studies on UT: immediate condition (IM), conscious thought condition (CT), unconscious thought condition (UT). Participants were asked to create a list that was considered much creative (e.g., new names of pasta, names of place starting with "A"). The result came out that unconscious thinkers usually have more unusual and creative ideas. For example, when they were asked to create a list of new names of pasta being offered five examples ending with "i", unconscious thinkers generated more names with other endings while conscious thinkers used the cue and listed almost only names with exact ending "i"; when they were asked to generate a list of Dutch place names starting with "A", unconscious thinkers came up with more small villages while conscious thinkers generated obvious and highly accessible items such as Amsterdam that is big city; when they were asked to generate things that one can do

with a brick, unconscious thinkers also have more unusual and creative ideas.

These evidences support the idea that CT is more convergent whereas UT is more divergent that might increases the probability of generating creativity. Dijkesterhuis & Meurs (2006) described this phenomenon as: "CT stays firmly under the searchlight, whereas UT ventures out of the dark and dusty nooks and crannies of the mind".

1.3.2 The UTT & the deliberation-without-attention effect hypothesis

Based on the UTT and its six principles with supportive evidence, a "deliberation-without-attention effect" hypothesis was formulated and tested in a series of studies by Dijksterhuis and his colleagues (2006). The hypothesis is that CT leads to good decisions in simple decision, but very poor ones in complex task, whereas UT lead to good choices in both simple and complex circumstances. That is, the quality of decision varies as a function of complexity for conscious thinkers but not for unconscious thinkers (see figure 1, Dijksterhuis & Nordgren, 2006).

In this study (Dijksterhuis & Nordgren, 2006), the quality of decision was operationalized both normatively (as the accuracy of choosing the best car among four choices in Experiment 1) and later subjectively (as post-choice satisfaction in Experiment 4). First, participants were subjected to a 2 (mode of thought: conscious vs. unconscious) X 2 (complexity of decision: simple vs. complex) factorial design.

Complexity was defined using the amount of information available (simple: 4 attributes vs. complex: 12 attributes). Participants read information about four cars. One car was characterized by 75% positive attributes, one by 25% positive attributes and two by 50% positive attributes. Participants were asked to read the randomly presented attributes piece by piece on the computer screen, then choose the best car under either of the two conditions (CT v.s. UT). The analysis of result showed that conscious thinkers performed significantly better in simple decisions than in complex situations while unconscious thinkers performed relatively well in both simple and complex conditions without significant difference between the two conditions. We call such effect the "unconscious thought effect (UTE)" later in the present study, which is an interaction effect between mode of thought and complexity of decision (i.e., UT: Complex >/= Simple; CT: Complex < Simple). Strick, el al. (2010) defined the UTE as an improvement in decision making following distraction from the decision context for a period of time and the explanation is that the unconscious processes continue to deal with the problem during the distraction period.

In the second experiment (Dijksterhuis & van Olden, 2006), the hypothesis was tested again subjectively by investigating post-choice satisfaction. After briefly observing five art posters (15s per images), participants were assigned to three conditions. In the conscious condition, each poster appeared individually for 90s, and

the participants were asked to list reasons why they liked or disliked them and to carefully analyze their preferences. In the unconscious condition, the participants were asked to solve anagrams for 450s. In the immediate condition, participants were asked to observe the five posters simultaneously presented, then chose a favorite one. Then, they took the poster they chose back home, and were phoned 3-5 weeks later about their post-choice satisfaction and whether they would regret on a 10-points scale, irrespectively. The post-choice satisfaction scores were subjected to an analysis of covariance using with condition and as a factor and knowledge of art as a covariate. The results showed that unconscious thinkers were more satisfied with their choice than those in other two conditions and experienced no regret.

1.4 The inconsistent evidences of UTE

As was mentioned earlier, there has been a hot debate between rational approach and unconscious approach in decision making. Rational choice theories such as the Bayesian Probability Theory (BPT), the Subjective Expected Utility Theory (SEU), the Multi-attribute Utility Theory (MAUT), and Multi-Criteria Decision Making (MCDM) have dominated decision making research field for a long time and all are full rational with supporting evidences. They emphasize the decision makers' ability or skill in computation and the rational calculation. The application of these decision-making models has mostly been in the field of mathematic, military or

physics which are more relevant to numerical stimuli, digits and logistic reasoning. However, do people actually apply and benefit from logistic analysis, conscious reasoning and rational calculation in everyday complex decision making? There have been some experimental evidences demonstrating that many individuals do not behave in a manner consistent with subjective expected utility, e.g. Allais (1953) and Ellsberg (1961). Some later developed theories such as Daniel Kahneman and Amos Tversky's prospect theory (1979) also put less emphasis on rationality presuppositions.

Furthermore, there are many studies demonstrating unconscious decision makers outperformed conscious decision makers for complex decision making (e.g., Bargh &Morsella, 2008; Bos, M.W., Brownstein, 2003; Davidson & Kiesler, 1964; Dijksterhuis & van Knippenberg, 1996; Igou & Bless, 2007; Penlham & Neter, 1995; Wilson & Schooler, 1991; Wilson et al., 1993; Levine et al., 1996; Srull& Wyer, 1989; Stangor& McMillan, 1992). UTT (Dijksterhuis &Nordgren, 2006) have demonstrated with supporting evidences (e.g., Dijksterhuis, 2004b; Dijksterhuis& Bos, 2005; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis,& Galinsky, 2008; Dijksterhuis, A., & van Baaren, R.B., 2008; Dijksterhuis& Meurs, 2006; Dijksterhui & Nordgren, 2006; Dijksterhuis & van Olden, 2006) that CT works well for simple decisions, but it is unable to maintain the decision making well when the decision

becomes more and more complex. The reason may be that CT has limited capability and is unable to deal with large amount of information. whereas UT is good at making a good decision for complex decisions because of its high capacity and being able to deal with extensive information. That is, doing rational computation, calculation, logistic reasoning and analysis is able to deal with the problem when the problem is not so complex, but unable to maintain the quality of decision when the decision becomes more and more complex. On the contrary, UT is able to do so. Hence, UTT has provides another angle for people to look at the question about how to make a good decision such as buying a new house, buying a new apartment or selecting a new city to move into, and a valuable approach to make good use of our unconsciousness for dealing with complex decision making.

Recently, however, some researchers challenged UTE , the key hypothesis of UTT. UTT has postulated that decision makers continue processing information unconsciously while they are distracted and such process changes decisions after initial on-line impression formation. That is, unconscious thinking process changes decision during the attention distraction period. Some researchers challenged this interpretation of UTE, recently (e.g., Lassiter, Lindberg, Gonzalez-Vallejo, Bellezza, & Phillips, 2009; also Cleeremans, Waroquier, David, & Klein, 2009). Lassiter et al.(2009) did two experiments to show that unconscious thinkers performed better

than conscious thinkers and the participants were able to form an on-line impressions of choices, but the pattern was reversed when the participants were told to memorize the decision information, which kept them from forming an on-line judgement. Hence they argued that the UTE was artificial as the decision was an on-line judgment before the unconscious distraction (i.e., decision makers have already made decision before their attention being distracted). Conscious thinkers were engaged in memory-based processing when being asked to think over their options so that they often underperformed unconscious thinkers. Cleeremans et al. (2009) asked unconscious thinkers whether they had already made their decision on-line and the result embraced Lassiter et al's reasoning.

However, there have been numerous findings reported that unconscious decision makers outperformed immediate decision makers who could only reply on on-line judgment and no time given to think or being distracted (Dijksterhuis, 2004; Dijksterhuis, Bos, vander Leij, & van Baaren, 2009; Dijksterhuis & van Olden, 2006; Ham & van den Bos, in pressl Ham et al., 2009; Lerouge, 2009). These findings have showed that there was significant difference between UT with some time of attention distraction and immediate decision without any thought or attention distraction. Some previous studies on goals have also shown that unconscious thinkers with a goal outperformed merely-distracted participants without a goal(Bos et al., 2008; Zhong,

Dijksterhuis, & Galinsky, 2008). This finding indicated that UT process is indeed active thinking process and goal-directed rather than a merely attention-distracted process. Another study(Dijksterhuis, 2004) also showed that the representation of information in memory became more polarized and more integrated after unconscious thinking, that after immediate thinking or after conscious thinking. Recently, Strick et al. (2010) demonstrated that the UTE took place off-line and there was obviously significant improvement in unconscious condition than in immediate condition in which participants were asked to make decision immediately. These studies have proven that UT can indeed improve the quality of decision making in complex decision.

As for some studies which failed to obtain an UTE (e.g., Acker, 2008; Newell, Wong, Cheung, & Rakow, 2009; Waroquier, Klein, Marchiori, & Cleeremans, 2008), meta-analyses (Acker, 2008; DeCoster, 2004) suggested several potential UTE moderator such as thought processing time, information presenting format, attention-distraction task, etc. However, few evidence has shed light on investigating moderators of the unconscious effect as well as the reasons behind (except the studies by Dijksterhuis et al., 2009, 2010). The study done by Payne, et al. (2008) has showed that shorter time of thinking increases conscious power and make conscious thinkers perform as well as unconscious thinkers, implying time of thought processing is a

possible UTE moderator. However, they did not test what could happen to UT if there was longer thought processing time. Study by Dijksterhuis et al. (2009) showed that expertise as a UTE moderator by using soccer matches predicting task, but they only, did not test whether the result could be generalized to situations when attributes were provided by experimenter and what the reasons were.

1.5 Aims of the present study

Based on the inconsistent evidence and arguments on the UTE mentioned above, the aims of the present study is: firstly, to further investigate what kind of the relationship is among mode of thought, complexity of decision, and the quality of decision and confirmed UTE (i.e., whether there is an interaction effect between mode of thought and complexity in complex decision making?); secondly, to investigate in what kind of circumstance do the unconscious thinkers outperform the conscious thinkers (therefore there is UTE)? Are there any variables moderating the effect of unconscious on complex decision making? What are they? Lastly, why do they have an impact on complex decision making? Some previous studies (Dijksterhuis, 2006) have shown that as task complexity increases, conscious thinkers perform poorer whereas unconscious thinkers perform better.. Hence, the present study firstly replicated the previous study on UTE, then further confirmed whether complexity was one of the UTE component by increasing the numbers of attributes associated with the

options in a decision task in Chapter 3.

Chapter 4 investigated whether the UTE varied as a function of thought processing time in decision-making when the thought of time was increased to 8 minutes (experiment 3) and the reason behind (experiment 4). Chapter 5 investigated whether expertise was one of the UTE moderators in decision making (see experiment 5) and the reasons behind(Experiment 6 &7). Experiment 6 investigated why UTE varied as a function of expertise was because experts' chunking mechanism benefited from the characteristic of UT that UT could organize and integrate a large amount of information well and weight the information better offline compared to CT. Experiment 7 investigated another possibility, that is, UT facilitated experts' ability of filtering out irrelevant information because it was able to weight attributes better (Dijksterhuis, et. al, 2006).

The findings in the present study (i.e., discovering some of these UTE "moderators") can contribute to understanding the debate between rational choice theories and UTT as well as UTE more deeply and possibly resolving it. It means that without these moderators, we may not absolutely obtain a reliable, stable UTE. Not in all situations but only when there are these potential moderators involved and in very complex situations that is UT reliable. That is to say, for simple decisions or problems, conscious analysis, reasoning or calculation is the proper approach. However, when

the decision becomes more and more complex, the unconscious approach could be considered to be applied in order to make better decisions. Also, knowing why these moderators work and how helps us better understand UT and the rational/unconscious debate better. For example, knowing that chunking operates even "unconsciously" may provide evidence for the following: expert works better than non-experts in CT condition because of an advanced chunking mechanism, and they works even better in UT because UT and capability of chunking together magnified the UTE; CT and UT are not that different after all; both rely on similar cognitive processes, e.g., chunking, which is a well-known conscious memory process. Knowing that UT can play a role of "filter" to filter out irrelevant information provides evidences that UT has a similar ability like expert who can "filter" out irrelevant information in extensive knowledge or information base. All these help us understand CT/UT decision making debate much better.

1.6 Rationale for testing time of thought processing as a UTE moderator

Evidence has shown that constraint thought time may be a deficient instantiation of CT. The attention might shift to less relevant information (like dilution) if there was too much time to think. The effectiveness of judgment would be undermined in this case (Payne, Samper, Bettman, & Luce, 2008). In their experiment, self-paced thinkers (given only 24s on average to think about the options) performed as well as

unconscious thinkers (with an attention-distraction task) over the conscious thinkers who were constrained to think in a long fixed time interval (4 mins). The finding indicated that self-paced conscious thinking had a positive impact on complex decision making while longer UT processing benefits more complex decision making. The time period might be a critical moderator of the UTE.

According to the unconscious thought principle, the capacity principle and the weighting principle, CT may produce "conscious noise" that disturbs this natural process and lead to poor and inconsistent weighting whereas UT is able to naturally "detect" and weigh the relative importance of various attributes of the target to form an impression leading to more consistent decisions and produce more post-choice satisfaction (Dijksterhuis & van Olden, 2005; Levine et al.1996; Nordgren& Dijksterhuis, 2006; Wilson et al., 1993;). Given longer thought processing time, beside thinking about the relevant information of decision, conscious thinkers' attention could even be distracted to less relevant or irrelevant information (i.e., noise) causing cognitive interference while unconscious thinkers may gain more time or space to slowly integrate a large amount of information and weight the choices better offline when their attention was distracted somewhere else. Hence longer thought processing time probably hurts CT but facilitates UTE.

Experiment 4 investigated whether conscious thinkers performed significantly

worse than unconscious thinkers in complex decision making. Experiment 5 investigated whether the conscious thinkers performed worse when there are more irrelevant information compared to unconscious thinkers when they were given more time to process their thought.

1.7 Rationale for testing expertise as a UTE moderator

Although many researches have found that experts typically outperform non-experts in many fields such as music, sports, chess (e.g., Ericsson & Lehmann, 1996, Haerem & Rau, 2007), studies on expert decision making and judgments found no performance differences between experts and non-experts (e.g., Camerer & Johnson, 1991). Halberstadt and Levine's (1999) studies showed that experts who predicted basketball games performed worse when they had to explain the reasons for their choices to other people than when they merely had to predict. Such research based on CT has indicated that CT could jeopardize weighting (Dijksterhuis & Nordgren, 2006).

One example given by Gladwell (2004) in his recent book *Blink* was that some art experts intuitively sensed a statue bought by the Getty Museum was fake but unable to verbalize the reasons. The first few tests were carried on but indicated that nothing wrong with the statue. Finally what they intuitively sensed was proven right by tests later. This example has shown that an expert can achieve much more with

relatively brief UT than a novice can (Dijksterhuis & Nordgren, 2006) .The reason may be that experts' intuition is based on UT that has already integrated a large amount of information based on their experience.

Research on unconsciousness also suggested that experts would outperform non-experts if they applied unconscious thinking rather than conscious thinking (Dijksterhuis et al., 2006). A recent study using the task of predicting soccer matches found that there was no difference between thought conditions for non-experts, whereas significant for experts. Among experts, unconscious thinkers predicted soccer results significantly better than conscious thinkers(Dijksterhuis, 2009). However, the limitation of their study was that compared to making decision among options characterized by 12 attributes for each option, the participants had to generate the relevant attributes for the decision by retrieving information from memory to predict soccer matches. It is hard to tell whether the complexity of the task in their study was actually simple or complex as the amount of attributes in individuals may vary from "few" to "a lot". Hence the decision must be quite subjective because the range of complexity varies(i.e., the number of attributes of options was decided by subjects themselves, not objectively provided by experimenters).

Furthermore, Dijksterhuis and his colleagues also claimed that it was not yet clear whether the result could be generalized to situation when the attributes were

provided by the experimenter, as in most of the previous studies on UT. Hence the UTE as a function of expertise was investigated in the present study (see Experiment 4), and those 12 attributes of each option in Experiment 4 were provided by the experimenter.

Why would the UTE vary as a function of expertise? It was found that compared to non-experts, experts had superior long- and short-term memory in their areas of expertise and the information was stored in meaningful patterns or chunks rather than individual pieces of information. Such a mechanism was called chunking (Chase & Ericsson, 1982). In this case, experts can recall more than novices do when all related information in the patterns is activated. Also, the chunks of information are integrated into a richer and more meaningful knowledge base (Hutton & Klein, 1999). It means that expert has a very special knowledge base that is stored with extensive but well-blocked information (in patterns or chunks) and these pieces of information may be automatically activated through the special pattern in their brain when experts need to retrieve the important attributes from the special knowledge base.

What is noticeable is that such a process is automatic and unconscious. The "Semantic Spreading Activation theory" also claims that any activation of any conceptual node can active all related or connected conceptual nodes (in the semantic network) through the automatic spreading activation process(Collins & Loftus, 1975).

Take playing chess as an example, the chess players may have already predicted the following 10 steps when they take the first step in playing chess, which indicates that expert may recall 10 chunks of information when they recall one piece of important information. Hence, compared to non-experts, there is extensive but well-organized information in experts' mind in which UT has an advantage because it can slowly integrate large amount of information. Experts' special knowledge base with chunking mechanism in that area also provides a solid foundation for the UT process to integrate piecemeal information, thus enhancing performance.

On the other hand, non-experts do not have such special knowledge base and chunking mechanism, which to a certain extent limits the UT process's integration work. The UTT (Dijksterhuis, 2006) has stated that UT is able to work offline by slowly integrating a large amount of information at the background, hence UT can deal with extensive information in the chunks for experts, enhancing their performance. CT equipped with low ability is unable to integrate large amount of information, but just merely rehearse the information presented when they consciously analyze the attributes. Furthermore, UT's ability of integrating extensive information is to some extent similar to experts' chunking mechanism. Hence it may benefit non-experts when they face a large amount of information.

Given the chunking effect of experts and the characteristic of UT, both

non-experts and experts should both benefit from UT and experts benefit more than non-experts do. Hence experts can rely on UT more than non-experts. This explanation of chunking effect was investigated in experiment 5.

Both experts and non-expert know how to recognize and make use of multiple sources of information, but non-experts lack the ability or experience to separate relevant from irrelevant information (James, 1992). Experts can ignore irrelevant information more efficiently compared to non-experts (Marko, 2009). James' study showed that top experts through insights gained from experience know which cues were relevant and which were not, that is, experts were able to ignore the irrelevant attributes to catch the related information while non-expert would consider also the irrelevant attributes (i.e., noise, interference). According to UTT, UT is good at weighting attributes and integrating large amount of information offline, hence it can weight relevant and irrelevant information well by organizing them into relevant and irrelevant categories, then helps decision makers filter out irrelevant information. When there is a complex decision with many attributes including relevant and irrelevant attributes, UT facilitates expert's ability of ignoring irrelevant information more than non-expert. This explanation was investigated in Experiment 7.

CHAPTER 2

Some important issues

After UTT was proposed, even thought there were supportive studies (e.g., Bargh &Morsella,2008; Bos, M.W., Dijksterhuis, A., & van Baaren, R.B., 2008; Dijksterhuis, 2004b; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis& Meurs, 2006; Dijksterhuis & van Olden, 2006; Nordgren &Dijksterhuis, 2006), there was also counter-evidence (e.g., Gonzalez-Vallejo, Lassiter, Bellezza &Lindberg, 2008; Payne, Samper, Bettman, & Luce, 2008; Simonson, 2005). For instance, some claimed that UTT might overstate the ability and influence of UT (e.g., Payne, Samper, Bettman, & Luce, 2008; Simonson, 2005). Some argued about the paradigm used in the study on the unconscious, and some argued about what the index of quality of decision should be. Hence, it is necessary to justify and clarify some important issues before carrying out future studies.

2.1 Issue 1: Power of the unconscious & deliberation-without-attention paradigm

So far there has been disagreement on the power of the unconscious and on how to measure the unconscious effect. Most of the arguments against with the UTT are from cognitive psychologists. How to measure the UT better has become a focus for researchers. Bargh & Morsella(2008) pointed out that how one views the power and influence of the unconscious largely depends on how one defines the unconscious.

Different operational definitions lead to different conclusions about the power and scope of the unconscious (Bargh & Morsella, 2008). Cognitive psychologists equate unconscious with subliminal thinking and usually use the experimental paradigm of masked priming (e.g. studies on visual perception, implicit learning, etc.), while social psychologists tend to approach this from a different angle and take the mental processes without being aware as the focus, but not the unaware stimuli per se (e.g., Nisbett &Wilson, 1977). Then attention-distraction paradigm has been generally used in social psychology whereas the masked priming paradigm has been generally used in cognitive psychology. Bargh & Morsella(2008) suggested that cognitive psychologists' way of equating the unconscious with the subliminal is both unnatural and restrictive. Subliminal stimuli are too weak or brief to enter conscious awareness. It's unfair to measure the capability of the unconsciousness in terms of how well it processes subliminal stimuli because unconscious (like conscious) processes have evolved to deal with and respond to naturally occurring (regular strength) stimuli.

It makes a big difference that the operation definition of unconscious shifts from the processing of unaware stimulus to the influence or effects of an unaware stimulus processing (Bargh & Morsella, 1992; Bargh & Morsella, 2008). Bargh and Morsella (2008) has proposed that unconscious processes are defined in terms of their unintentional nature and the inherent lack of awareness is of the influence and effect

of the triggering stimuli and not of the triggering stimuli (because almost all naturally occurring stimuli are supraliminal).So far, it is not hard to understand why there is hot debate on the power of the unconscious and the proper paradigm to manipulate the UT.

To manipulate attention, Dijksterhuis and his colleagues (2006) used the following deliberation-without-attention paradigm. Firstly, the participants read the experimental stimuli (e.g. cars, apartments, roommates) randomly presented piece by piece for some time on the computer screen (e.g. 8 seconds per piece of information), then were randomly assigned to one of the following experimental conditions: a) immediate decision (IM)(no time was given to decision makers to think before making a decision); b) conscious thought (CT) (limited time (e.g., 3 minutes) was given to them for thinking consciously and carefully before choosing); c) unconscious thought (UT) (some time (e.g., 3 or 4 minutes) was given to decision makers to do another unrelated task (e.g. word puzzle, anagram) before making a choice) (a two-back task; see Jonides et al., 1997). Finally, the participants were asked to choose the best among several options. In the unconscious condition, participants' attention was distracted so that they would not have a chance to think about the options consciously. This paradigm was also used in the present study investigating the UTE and its moderators.

2.2 Issue 2: The index of quality of decision & the "best" option material design

In most of Dijksterhuis et al.'s studies, the participants were asked to choose the "best" among some options. Some researchers questioned, however, what "the best" is. What is "right"? What is "optimal/ suboptimal"? Dijksterhuis et al.' defined the "best/optimal" as possessing the greatest number of positive attributes. What if the less positive option gets a very high score in an attribute that is quite important to the decision maker? (Gonzalez-Vallejo, et al., 2008) "We may not want a car with sticky manual transmission even it gets very high score in other attributes" said by Gonzalez-Vallejo, et al. (2008). They claimed that the basic tenets of the decision theory is based on "personal utility" first which is subjective and idiosyncratic and proposed by Bernoulli, (1783, as cited by French, 1986), then the rational choice theory later (formulated by von Neumann& Morgenstern, 1947; Savage, 1954). Gonzalez-Vallejo, et al. (2008) criticized data in UTT studies were inconclusive by pointing out that Dijksterhuis et al. didn't apply any measure of internal consistency but just equated the best option with the one with the positive values (without taking negative values into account), and they also didn't provided any evidence that the participants had weights and values that would conform the experimenter's best option with their best option. The definition of "best" is very important prerequisite for any evidence in favor of any mechanism that is to select the best option. The

personal value level related to features and importance level of attributes both matter in defining "the best". Another aspect criticized by Gonzalez-Vallejo and his colleagues is the subjective comment of the "right" decision.

These opinions suggested that quality of decision might include two important indices (i.e., accuracy of the best choice and their personal post-choice satisfaction, respectively). Besides whether participant make a right choice on the "best" option considered by others, whether decision makers feel satisfied about what they chose was also an important index of evaluating whether participants made a really good decision. For example, choosing a house which is considered as the "best" one by the majority may not be the one decision maker feel satisfied with after he or she choose it. If he or she regrets his or her decision after one or two weeks, reporting very unsatisfied with his or her choice later, this house may not be considered as the best choice to decision maker. Dijksterhuis and his colleagues (2004, 2006) did test the quality of choice normatively and subjectively (as post-choice satisfaction), but the study testing normatively and the one testing subjectively are separate studies. We suggest collect scores of accuracy firstly and post-choice satisfaction scores based on accuracy of choices in every study to ensure a "right" "best" choice.

Hence, in the present study, the evaluation of quality of decision was based on both objective and subjective dimensions. An objective dimension means whether the

decision is relatively "good" or "bad", "right" or "wrong" based on an average evaluation standard of society. In this case, there is a "relative accuracy" that whether decision makers make a "good" or "right" decision in the majority's opinion. Subjective dimension means the personal preference or evaluation, i.e., whether the decision makers themselves feel satisfied with their choice after some time or not. The proportion of participants who chose, say, the best car (i.e., the right car) was firstly collected. Based on this index, another index, the post-choice satisfaction degree of the "best" car choice was collected. If the participants made a right choice on the designed "best" car, and also felt satisfied with their choices after one or two weeks(the time depends on the complexity of task), they made a good and right choice.

As for the material design of the best option in the present study, the best car was designed with more strict requirements. It was firstly designed as the one characterized by 75% positive attributes following previous study done by Dijksterhuis and his colleagues. Hence, it was the "best" one for experimenter. Secondly, the four cars were evaluated by 10 car experts who were from the department of mechanical engineering and 10 non-experts from the department of psychology. The car gained 1.0 point if it was evaluated as the "best" among four by the evaluators. Eventually, the car defined as the "best" car was the one that more than

85% of the 20 independent evaluators (not the subjects participating in the main experiment) evaluated as the best one in a pilot study.

CHAPTER 3: Complexity of decision as a UTE component

3.1. Experiment 1: Replication study

The aim of Experiment 1 was 1) to investigate the relation between mode of thought, complexity, and quality of decision. That is, to replicate Dijksterhuis' (2006) study testing the attention-distraction hypothesis that the unconscious thinkers' performance maintained relatively well in both simple and complex task whereas conscious thinkers' performance significantly decreased in complex decision and 2) to investigate whether there is significant difference between unconscious and conscious thought in complex decision. If there is strong UTE, there must be also significant difference between unconscious and conscious condition besides significant two-way interaction effect between the two factors.

Method

Participants. Twenty-four native Chinese-speaking-speaking postgraduate students from the South China Normal University participated in this experiment (range 22-24 years old , mean age= 22.75, SD=0.85). Each participant received RMB 10 as reward.

Material and procedure. The experiment was a 2 (mode of thought: conscious

vs. unconscious) X 2 (complexity of decision: simple vs. complex) mixed factorial design. Mode of thought was a between-subject factor, while complexity was a within-subject factor, which was defined as the amount of information available (simple: 4 attributes about the target vs. complex: 12 attributes). Participants were informed that they would be presented with information about four cars and they were asked to choose the best one after reading the information about them. Materials were forward-translated from those in Dijksterhuis' study (2006) into Chinese by a fluent bilingual (senior English major) and backward-translated by another. One car was described as being characterized by 75% of positive attributes (Thus 25% of them were negative), another 25% positive attributes and two others 50% positive attributes. The attributes could only be either positive or negative. In material selection, the "best" car had to meet two strict requirements: First, the car should be characterized by 75% positive attributes; second, it should be the one that more than 85% of the 20 independent evaluators (not the subjects participating in the main experiment, including 10 common people and 10 car experts from Automobile Occupational and Technician Training college.) evaluated as the best one in their opinion in a pilot study. This material selection method was employed in all the subsequent experiments.

In the experiment, the participants were asked to read the attributes presented randomly one at a time on the computer screen (8s for each attribute), then choose the

best car under either of the two conditions (CT v.s. UT). In the CT condition, 4 minutes were given to them after stimulus presentation for thinking consciously and carefully before making a choice. In the UT condition, participants were distracted after stimulus presentation for 4 minutes to accomplish an unrelated task (i.e., brainteaser). Since the participants in this study were all native Chinese-speaking students whose mother language was not English, they were not familiar with English words. In our pilot study, five participants could only write out 1-2 new words when they were shown a list of 60 words in the anagram. Given the requirement that the irrelevant task should draw the participants' attention away from thinking about the problem itself and at the same time cost the participants' administrative function, if the unrelated task is too difficult, the participants may give up doing the irrelevant task altogether but think about the previous information even in the unconscious condition. In order to secure a "real" UTE, "Brainteaser" was used instead of the irrelevant task because it is interesting enough yet not too difficult. After the 4 minute period of conscious thinking or attention-distraction, participants were asked to choose the best car they think. Accuracy of choosing the "best" one was the main index of the quality of decision so it was firstly collected. Then post-choice satisfaction was also collected to double evaluate the quality of decision.

After accomplishing the experiment on the computer, participants were asked to

answer the following questions after one hour: "How satisfied do you feel now about the decision you made in "the task of choosing the best car"? Please rate your satisfaction on a 5-point scale (1 very unsatisfied, 2 unsatisfied, 3 so-so, 4 satisfied, 5 very satisfied)?" This piece of information was collected as post-choice satisfaction. "Do you think the presentation time of each attribute was long enough? Was it too short, adequate, or too long?" "Do you think that the time allowed for you to think was long enough?" "Do you think the task is complex? Please rate on a 5-point scale(1 very simple, 2 simple, 3, soso, 4, complex, 5 very complex)" These information was necessary to be collected for possible future moderators testing.

Results and discussion. For accuracy of choice, each participant was given one point if (s)he chooses the best option, or else a zero. As hypothesized, An ANOVA showed the expected two-way interaction effect $F(1,22)=5.500$, $p<.05$. (see figure1). Conscious thinkers' performance significantly decreased in complex decisions than simple ones, $T(11)=2.345$, $p<.05$; whereas unconscious thinkers performed relatively well in both complexity conditions and no significant difference was obtained, i.e., the accuracy of choices did not decrease when the decision was getting complex. (see Figure 1) Such result replicated the previous Dijksterhuis' study (2006). It indicated that UT facilitated decision makers to make a relatively better decision with higher accuracy of choice compared to CT when decision was complex. However, there was

no expected significant difference between the unconscious condition and the conscious condition in complex decision. Furthermore, they did not report significantly more satisfied with their choices than conscious thinkers in complex decisions, either. The finding suggested that the UTE was not strong enough.

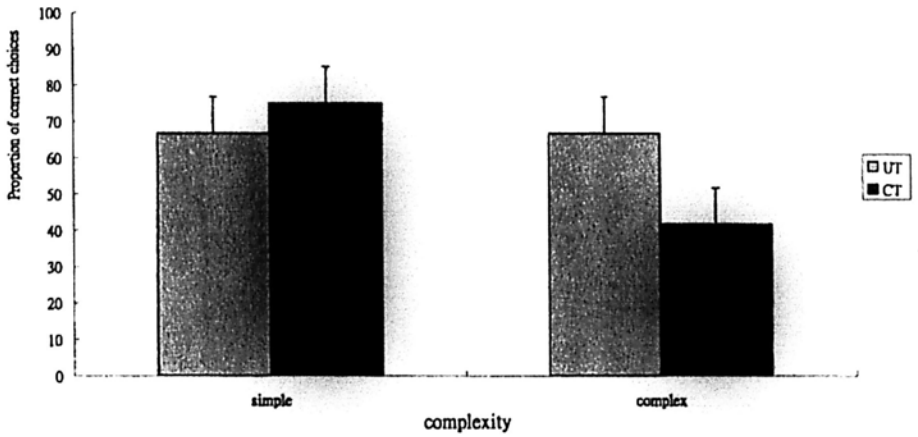


Fig. 1. Proportion of correct choices as a function of complexity and mode of thought. Error bars represent the standard errors.

Some recent researchers also failed to find significant differences between the performance of unconscious thinkers and conscious thinkers (Ackers, 2008; Newell, Wong, Cheung, & Rakow, 2009; Waroquier, Klein, Marchiori, & Cleeremans, 2008), suggesting that there may be more moderating factors to be identified (Dijksterhuis et al., 2009). Meta-analyses (Acker, 2008; DeCoster, 2004) also suggested that the complexity of the decision, thought processing time, information presenting format, attention-distraction task as the UTE moderators. The change of "attention-distraction task" should not be the reason of absence of UTE in the present replication study(i.e., significant difference between unconscious and conscious condition in complex

decision) because the " brainteaser" presented in participants' local language costs their administrative function and draws their attention and interest a lot. 91.7% of participants reported the presenting time of each item is adequate and 86% of participants reported that thinking time (i.e., time interval between item presentation and decision) was too short. Only 8.3% of participants reported that the decision task was "very complex" and 66.7% of participants reported the decision was "complex". Hence, the following experiments were designed to test complexity as one of the components of UTE and the possible UTE moderators such as time of thought processing. If the complexity of decision task which is supposed to be one of the components of UTE increases, the UTE should be especially pronounced according to deliberation-without-attention hypothesis. If the thought processing time is longer for UT, probably the improvement of quality of decision under complex situation will be significant.

Some participants advised the instruction of the task was too general and their evaluation on different styles of cars such as family car, sport car, and business car usually vary. For instance, the security device, the design with human factor, the space inside the car, enough seats, and their degree of comfort are important for evaluation of the quality of a family car, while high requirements on speed, brake device, security system, etc. for the sport car (e.g.). The standard of evaluation of the best car

may also vary between choosing a car in car exhibition and choosing one for personal use. Some scholars also questioned the standard for the "best" car may vary individually and full of subjectivity (Gonzalez-Vallejo, et al., 2008). In order to secure a real " best" choice , it is better to change the instruction to be more specific. Hence the instruction of the following series of experiments was changed to "There are four family cars in a car exhibition: A, B, C , and D. Please carefully read their attributes and objectively select the best one you think among them." instead of "Please choose the best car among the following four cars" used in previous studies (Dijksterhuis, 2006)

3.2. Experiment 2: Complexity of decision

In Experiment 1, only 8.3% of participants reported that the decision task was "very complex" and 66.7% of participants reported the decision was "complex". If the complexity of decision task increases, the UTE should be especially pronounced. Experiment 2 aimed at further testing whether UTE varies as a function of complexity of the decision. It was hypothesized that there was a significant difference between unconscious and conscious conditions when the task becomes much more complex by increasing attributes of each option from 12 to 16.

Participants. Thirty native Chinese-speaking-speaking postgraduate students from the South China Normal University participated in this experiment (range 22-24

years old, mean age= 22.75, SD=0.8). They were randomly assigned to either unconscious or conscious thought condition. They received RMB 10 as reward.

Procedure and design. The procedure and design were identical to those in Experiment 1 except that there was only one independent factor (i.e., thought mode) involved, and each option was characterized by 16 attributes. Some scholars also questioned the standard for the "best" car may vary individually and full of subjectivity (Gonzalez-Vallejo, et al., 2008). The instruction given before experiment started was changed to be more specific to avoid individual difference and subjectivity of evaluation. Participants were required to do the task following every instruction given on the computer screen. They were informed that there were four family cars in a car exhibition and they were asked to read their attributes piece by piece appeared randomly in the center of the computer screen firstly, then follow the instruction of every step, and choose the best one among these four family cars objectively later.

Material. Materials were identical to that in Experiment 1 except that the number of attributes per option was increased from 12 to 16 so that the decision task was much more complex.

Result and discussion. The accuracy of choice, i.e., each participant was given one point if (s)he chose the best option, or else a zero. Mean scores of the correct

choice for the different conditions were calculated. T-test performed on a mean accuracy score showed a result of significant difference between unconscious thinkers' and conscious thinkers' performance, T (28) =2.479, p= .01, that is, unconscious thinkers performed significantly better than conscious thinkers in such a more complex decision. (see Fig. 2)

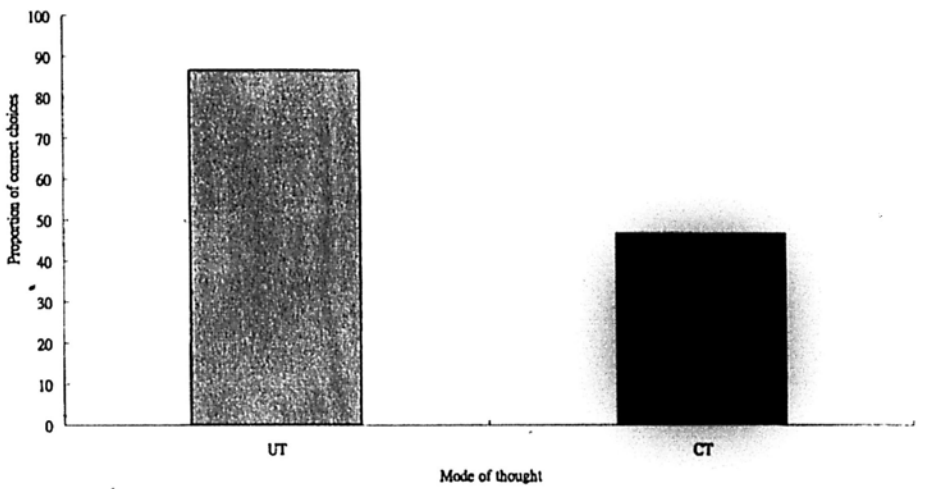


Fig 2. Proportion of correct choices as a function of mode of thought. Error bars represent the standard error.

The unconscious thinkers also reported more satisfied compared to conscious thinkers, T(28)=5.735, p<.001. The result was consistent with the hypothesis that as complexity of decision increases, UTE becomes significant, which further confirmed complexity of the decision task is one of components of the UTE.

CHAPTER 4: Thought processing time as a UTE moderator

4.1. Experiment 3: Time of thought processing

The conscious thinkers' attention might shift to less relevant information (like dilution) if there is too much time for them to think. The effectiveness of judgment

would be undermined in this case (Payne, Samper, Bettman, & Luce, 2008). Payne and his colleagues' finding has indicated that shorter but proper conscious thinking time has a positive impact on complex decision making while longer UT processing benefits more complex decision making. In Payne et al.'s study(2008), participants' performance of making complex decisions among three conditions were tested(i.e., conscious thinking at self-pace (CT-SP), conscious thinking at a artificially fixed 4 minutes (CT-FT) and distracting attention for 4 minutes (UT-FT)). The result showed that decision makers performed worse in CT-FT condition than UT-FT, but performed well when they consciously think at their self-pace (average 24s), implying that self-paced conscious thinking(i.e. shorter conscious thinking) could lead to a decision that as good as that made in unconscious condition. However, conscious thinkers in CT-FT condition made a rather poorer decision than UT. The findings has suggested that the time of thought processing might be a critical UTE moderator. Given longer thought processing time, besides thinking about the relevant information of decision, conscious thinkers' attention could be distracted to less relevant or irrelevant information (i.e., noise) causing cognitive interference while unconscious thinkers may gain more time or space to slowly integrate a large amount of information and weight the choices better offline when their attention was distracted somewhere else. Hence longer thought processing time probably hurts CT but facilitates UTE.

Experiment 3 was to validate the second hypothesis that given longer time for thought processing, there is a significant UTE.

Participants. Seventy-six native Chinese-speaking-speaking postgraduate students from South China Normal University participated in this experiment (mean age= 22.75, SD=0.8). They received RMB 10 as reward. They were randomly assigned to either unconscious or CT condition

Procedure and design. The procedure and design were identical to those in Experiment 1 except that the thought processing time was changed from 4min to 8min in both the conscious and unconscious condition.

Material. Materials were identical to those in Experiment 1

Results and discussion. The accuracy of choice, i.e., each participant was given one point if (s)he chose the best option, or else a zero. Mean scores of the correct choice for the different conditions were calculated. As expected, an ANOVA on the mean scores in the different experimental conditions showed that a significant two-way interaction was obtained, $F(1,74)=26.812$, $p<.001$. In the complex condition, there was a significant difference between the unconscious and conscious thinkers' performance, $F(1,74)=4.000$, $p<.05$. What is more interesting is that unconscious thinkers' performance dramatically increased, $T(37)=4.132$, $p<.001$) while conscious thinkers' performance dramatically decreased, $T(37)=3.141$, $p<.005$. The unconscious

thinkers also reported significantly more satisfaction compared to the conscious thinkers in this circumstance, $T(74)=3.772$, $p<.001$. (see Fig. 3)

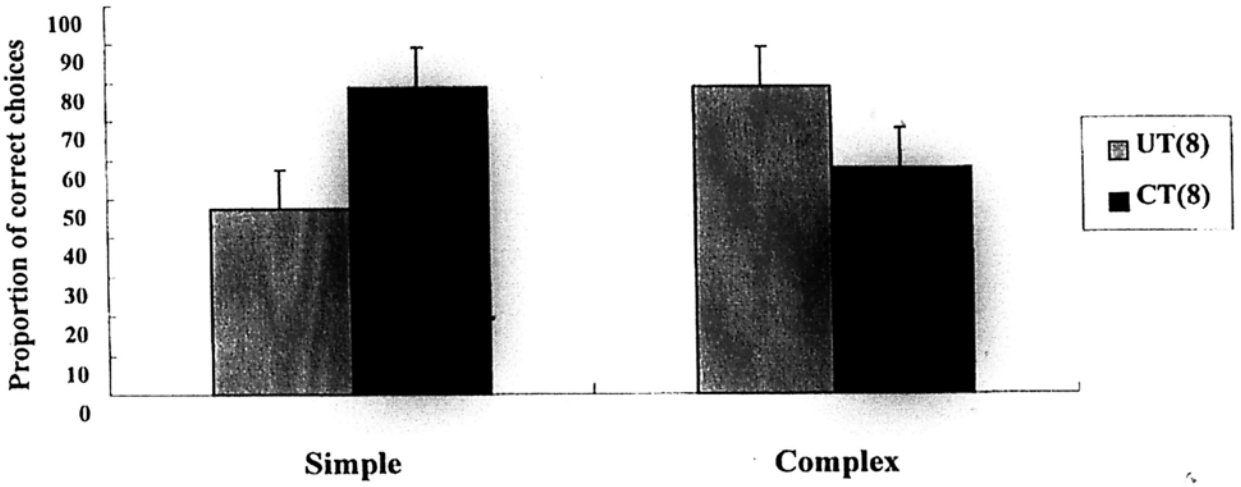


Fig.3 Proportion of correct choices. Proportion of correct choices as a function of mode of thought and complexity when the thought processing time is 8 minutes. Error bars represent the standard error.

The result has showed that thought processing time is one of UTE moderators in complex decision making, and UTE benefits from longer time of attention-distraction (i.e., 8 minutes). It must be interesting to carry out future studies to explore the reasons why thought processing time matters and how it matters, why longer thinking time hurts CT but facilitated UT in complex decision making.

Some recent studies indicated that perhaps participants' attention was distracted to less relevant information when participants were given too much time to CT processing (Payne, et al., 2008). It also implied that participants would pay attention to and scrutinize those pieces of irrelevant information. Such pieces of irrelevant information included those that were completely unrelated to the car or those that

were ambiguously irrelevant (i.e., those that were somewhat related to car but actually irrelevant to judging the quality of car. For example, the information that " The seller of the car is very ugly." was related to car but not related to judging the quality of car at all. On the contrary, UT managed to deal with large amount of information and filter out those pieces of irrelevant information with its higher capacity (Payne, et al., 2008). Some may argued that participants' attention was also distracted to unrelated task (i.e., irrelevant to quality of car) in unconscious condition for the same period of time as that in conscious condition. However, unconscious thinkers' attention was distracted totally to irrelevant task but "sleep" on the decision-related information without conscious thinking effort whereas conscious thinkers took effort on scrutinizing all pieces of information including relevant and irrelevant attributes. Such conscious scrutinizing on the information may cause cognitive interference leading to inconsistent weighting on the decision. Experiment 4 was designed to test the possibility that given more thought processing time, conscious thinkers performed worse because their attention is distracted by the irrelevant information but unconscious thinkers make better decision.

4.2 Experiment 4: Attribute irrelevance to choice

Experiment 4 aimed at validating the hypothesis that as attributes irrelevant to choice increased, conscious thinkers performed significantly worse whereas

unconscious thinkers maintain their performance well.

Method

Participants: One hundred native Chinese-speaking students (22-24 years old) participated in this experiment. Participants were selected according to the same selection requirement for participants as that in Experiment 1.

Procedure and Design: The experiment was a 2 (mode of thought: UT vs. CT) *2 (Relevance : more irrelevant(MI) vs. less irrelevant (LI)design. These two factors were both between-subject. The two levels of the factor of thought were UT and CT. And the two levels of the factor of relevance were the condition when there were more attributes irrelevant to good decision evaluation and the condition when there were less attributes irrelevant to decision. The experimental procedure was identical to that in Experiment 1.

Materials. Firstly, four hypothesized cars were characterized by positive and negative attributes mainly according to the requirements of the "best" car as those in Experiment 1. Each car was characterized by both relevant and irrelevant attributes. Firstly, each of them was characterized by 12 attributes that were relevant to judging whether the car is good or bad. Furthermore, in the LI condition, each of these four family cars were characterized with 8 more pieces of car-irrelevant information. For instance, "The car factory is owned by Mr. Cheung." ; "The boss of the car company

is very rich."; "The seller of the car is ugly." etc. These description all seem to be related to cars but actually not related to the car itself, let alone the relevance to evaluation of the quality of the car (i.e., whether the car is good or bad, or whether it is the best one). In MI condition, each car was characterized by the same 12 car-relevant attributes as those in LI condition plus 12 pieces of car-irrelevant information. In order to make sure the relevant and irrelevant information really differed in the degree of relevance, 50 pilot participants (not those participating the main experiment) were recruited to judge whether the relevant and irrelevant information really differed in the degree of relevance on a 7-point scale.

Result and discussion. First, the result of the pilot study indicated a significant difference between relevant and irrelevant attributes in terms of the degree of relevance , $T(49) = 22.71$, $p < .001$. In the formal experiment, 5% of the participants were excluded because their self-reported scores of knowledge of car were higher than 70 points. Hence, to ensure the UTE, the participants with high knowledge were excluded. The accuracy of choice, i.e., each participant was given one point if (s)he chose the best option, or else a zero. Mean scores of the correct choice for the different conditions were calculated. As hypothesized, an expected result of significant two-way interaction between the factors "mode of thought" and "relevance" was obtained, $F(1, 91)=3.923$, $p=.05$. In CT condition, decision makers

performed significantly worse when the irrelevant information increased, T(42)=2.272, p<.05. However, in UT condition, decision makers performed relatively well in both MI and LI conditions, T(49)=.455, p>.05. (see Fig. 4)

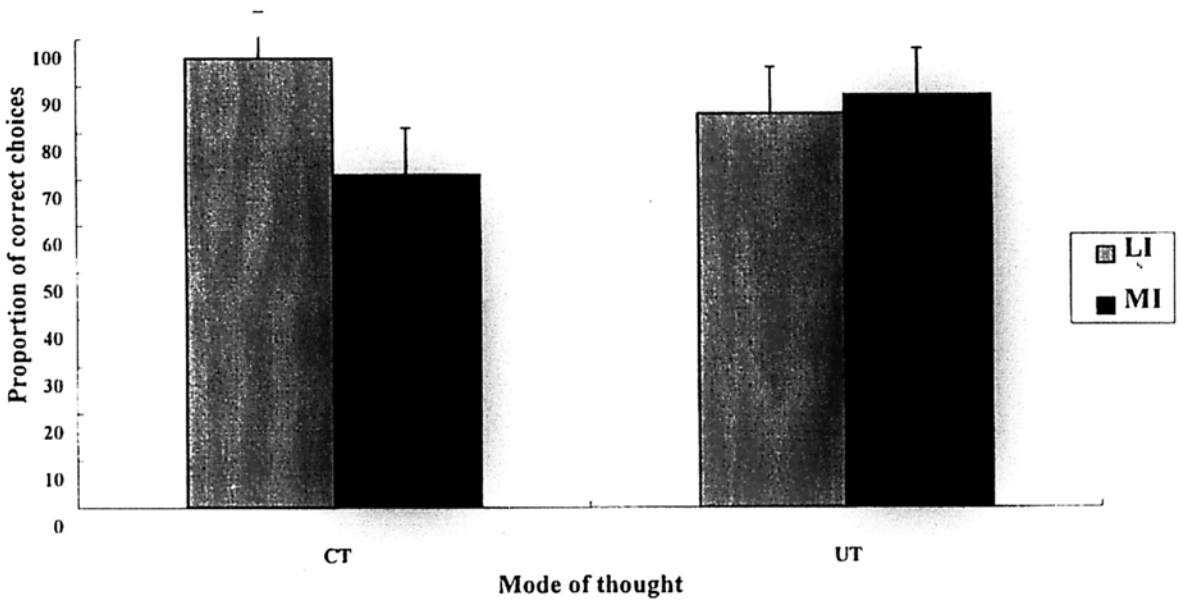


Fig. 4. Proportion of correct choices as a function of attribute irrelevance and mode of thought. Error bars represent the standard error.

Participants' post-choice satisfaction scores were also calculated. Conscious participants reported marginally significantly less satisfied in the "MI" condition compared to the "LI" condition, T(42)= 1.955, P=.057, but unconscious participants showed no significant difference for their satisfaction between conditions.

For CT, participants' performance and post-choice satisfaction significantly decreased if the decision was involved more irrelevant information, whereas for UT, it did not vary across the relevance conditions. The findings have suggested that given more time to consciously think about the decision, the participants perform worse because their attention is distracted to irrelevant information that leads to cognitive

interference and inconsistent weighting. On the contrary, given more time to do something else (i.e., UT processing), they can manage to make a good or even better decision.

In line with experiment 3, these two experiments have shown the possibility that there may be "optimal" processing time for both CT and UT; that for CT is probably shorter whereas that for UT is probably longer. The findings have also shown that CT and UT are not that different after all; they may obey similar principles of time: there are boundary conditions of the time for CT and UT to make a sound decision. For CT, the thinking time should not be too long (probably the shorter, the better); for UT, the thinking time should be long enough. How long time is the best to obtain a CT effect and a UT effect in making a decision of high quality deserves further investigation.

CHAPTER 5: Expertise as a UTE moderator

5.1. Experiment 5: Expertise

Although many researches found that experts typically outperformed non-experts in many fields such as music, sports, chess (Ericsson & Lehmann, 1996, Haerem & Rau, 2007), studies on expert decision making and judgments found no performance differences between experts and non-experts (Camerer & Johnson, 1991). Halberstadt and Levine's (1999) studies showed that experts who predicted

basketball games performed worse when they had to explain the reasons for their choices to other people than when they merely had to predict. All these researches were based on CT, indicating that CT could jeopardize weighting (Dijksterhuis & Nordgren, 2006).

One example given by Gladwell (2004) in his recent book *Blink* was that some art experts intuitively sensed a statue bought by the Getty Museum was fake but unable to verbalize the reasons. The first few tests were carried on but indicated that nothing wrong with the statue. Finally what they intuitively sensed was proven right by tests later. This example has shown that an expert can achieve much more with relatively brief UT than a novice can (Dijksterhuis & Nordgren, 2006) .The reason may be that experts' intuition is based on UT that has already integrated a large amount of information based on their experience. Recent research on unconsciousness also suggested that experts would outperform non-experts if they applied unconscious thinking rather than conscious thinking (Dijksterhuis et al., 2009). The study found that there was no difference on predicting soccer matches between thought conditions for non-experts, whereas significant for experts. Among experts, unconscious thinkers predicted soccer results significantly better than conscious thinkers (Dijksterhuis, 2009). However, the limitation of their study was that the participants had to generate the relevant attributes for the decision by retrieving information from memory to

predict soccer matches which make the complexity of task vary, compared to making decision among options characterized by a fixed of 12 attributes for each option,. What's more, Dijksterhuis and his colleagues also claimed that it was not yet clear whether the result can be generalized to situation ,when the attributes are provided by the experimenter, as in most of the previous studies on UT. Hence the UTE as a function of expertise was investigated in the present study

Experiment 5 is to investigate the hypothesis that UTE varies as a function of expertise and experts can benefit more from UT than non-experts.. In other words, experts perform significantly better in UT condition than in CT condition for complex decision-making, and such difference should be more obvious than that for non-expert.

Method

Participants: 100 native Chinese-speaking undergraduate students (mean age= 22.75, sd=0.85) participated in this experiment. The fifty car experts were senior students majoring in automobile maintaining and testing in the department of mechanical engineering from automobile occupational and technician training college. The 50 non-experts were from the psychology department in South China Normal University. The experts were those who had passed and got the qualification of the National Senior Automobile Expertise Test. They were required to self-report how

knowledgeable about cars on a 100 points scale. The ones from car department who reported scores that were lower than 70 points were excluded from expert group. The ones from psychology department that reported scores that higher than 40 points were considered as non-experts. Four participants were excluded eventually. Participants received RMB 20 as reward. All participants declared that they were not familiar with the purpose of the experiment.

Design. The experiment used a 2(mode of thought: unconscious vs. conscious)*2 (expertise: expert vs. non-expert) between-subject factorial design.

Procedure. The procedure was identical to that in Experiment 1.

Material. Four hypothetical family cars were designed. Each car was characterized with 16 attributes. One car was characterized by 75% positive attributes, one by 25% positive attributes and two by 50% positive attributes. For counterbalance, 8 attributes were common description of car attributes which were understandable by non-experts (e.g., Naki is easy to handle.——positive; Das has poor mileage——negative.) whereas the other 8 attributes were designed to be more professional (technical attributes) but were also understandable by non-expert (e.g., Naki is equipped with mechanical steer gear.——negative; Das is equipped with electronic power steering system——positive). The technical attributes were edited by an expert (a senior lecturer from automobile occupational and technician training

college) and the whole set of material was firstly edited according to experimenter's requirements of material editing. Then 10 more experts and 10 non-experts were asked to evaluate which car among four was the best and the best car must be the one chosen by up to 85% of the evaluators as the best one in their mind.

Results and discussion. Accuracy of the best car was calculated. Two non-experts and two experts' data was excluded because their self-reported scores of knowledge of car were higher than 70 points or lower than 40, respectively. The result showed that a significant two-way interaction among the factors "expertise" and "mode of thought" was obtained, $F(1, 92)=3.873$, $p=.05$. Experts made more correct decisions in unconscious condition than in conscious condition and the difference was significant, $T(46)=2.045$, $p<.05$, whereas non-experts performed worse in both thought conditions and no difference between conditions. (see Fig. 5)

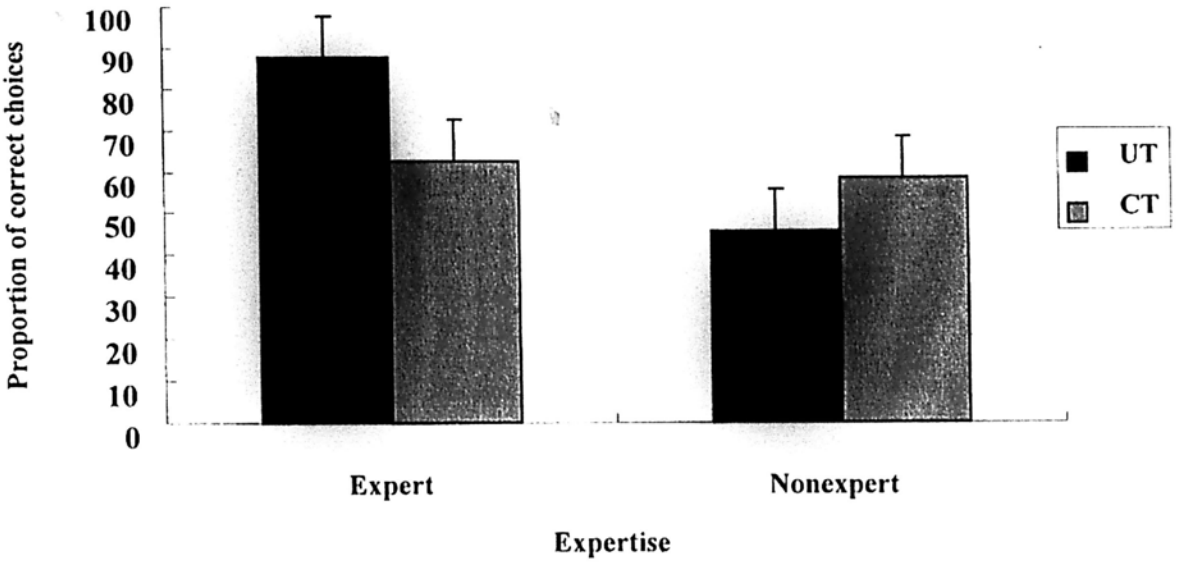


Fig. 5 The proportion of correct choices as a function of expertise and mode of thought. Error bars represent standard errors.

Participants' post-choice satisfaction scores were also calculated. There was no significant interaction effect between expertise and mode of thought. What is more important, experts reported significantly more satisfied in the unconscious condition than in the conscious condition, $T(46)=2.429$, $p<.05$. For non-experts, there was a marginally significant difference between two conditions, and they reported more satisfaction in the unconscious condition, $T(46)= 1.993$, $p<.06$. Such finding suggested that for experts, they made more correct choices and also be more satisfied with their choices if their attention was distracted for a while before making a complex decision compared to keeping consciously thinking about the options, whereas non-experts only made more accurate decisions if they consciously think about the options. But the interesting thing was that non-experts did not feel more

satisfied with the choices they made in conscious condition.

Why UTE varies as a function of expertise? Experts had a mechanism of chunking that superior long- and short-term memory in their areas of expertise and the information was stored in meaningful patterns or chunks rather than individual pieces of information. (Chase & Ericsson, 1982). In this case, when all related information in the patterns are activated, experts are able to recall more than novice do. Also, the chunks of information are integrated into a more meaningful and richer knowledge base (Hutton & Klein, 1999). It means that expert has a very special knowledge base that is stored with extensive but well-blocked information (in patterns or chunks) and these pieces of information may be automatically activated through the special pattern in their brain when experts need to retrieve the important attributes from the special knowledge base. What is noticeable is that such a process is automatic and unconscious. The "Semantic Spreading Activation theory" also claims that any activation of any conceptual node can active all related or connected conceptual nodes (in the semantic network) through the automatic spreading activation process(Collins & Loftus, 1975). Take playing chess as an example, the chess players may have already predicted the following 10 steps when they take the first step in playing chess, which indicates that expert may recall 10 chunks of information when they recall one piece of important information. Hence, compared to non-experts, there is extensive

but well-organized information in experts' mind in which UT has an advantage because it can slowly integrate large amount of information. Experts' special knowledge base with chunking mechanism in that area also provides a solid foundation for the UT process to integrate piecemeal information, thus enhancing performance. On the other hand, non-experts do not have such special knowledge base and chunking mechanism, which to a certain extent limits the UT process's integration work.

Furthermore, UT's ability of integrating extensive information is to some extent similar to experts' chunking mechanism. Hence it may benefit non-experts when they face large amount of information. Given the chunking effect of experts and the characteristic of UT, both non-experts and experts should both benefit from UT and experts benefit more than non-experts do. Hence experts could rely on UT more than non-experts. This explanation why UTE varies as a function of expertise was investigated in experiment 6.

5.2. Experiment 6: The chunking effect of expertise

Experiment 6 was to investigate whether UTE varied as a function of expertise because the experts' mechanism of chunking helped organize all relevant information of the same category, or one aspect strongly and hence provided a solid foundation for UT to integrate all information more efficiently. UT integrates large amount of

information in a way which is similar to the chunking mechanism so that it facilitates both non-experts and experts but especially more for experts, hence magnified the UTE.

If so, it was hypothesized that the characteristic and capability of UT and experts' chunking mechanism together magnified UTE. In the present experiment, car attributes were blocked into categories according to different aspects of the car to be present to participants randomly in the blocked condition where there is a chunking mechanism. There should be expected significant difference between the blocked and unblocked conditions in complex decision making for conscious non-experts and they should perform better in the blocked condition whereas no difference between these two conditions for experts. Since UT has its high capacity and is able to slowly integrate large amount of unblocked information offline that is similar to the function of the chunking mechanism, making unconscious non-experts be able to perform well and hence no difference between blocked and unblocked conditions. UT should also benefit experts that unconscious experts may perform better than conscious experts even though no difference between the blocked and unblocked conditions.

Method

Participants: Two hundred Chinese students (mean age= 23, SD=0.45) participated in the experiment including 100 car experts and 100 non-experts. The

selection requirement was the same as that in Experiment 5. Participants received RMB 25 as reward. All participants declared that they were not familiar with the purpose of the experiment.

Design. The participants were subjected to a 2 (attribute organization: blocked vs. unblocked)* 2(mode of thought: UT vs. CT) *2 (expertise: expert vs. non-expert) between-subject factorial design.

Procedure and materials. The procedure was identical to that in Experiment 5 except there was one practice trial before the formal experiment. The reason was the task in the present study became more complex with more attributes as well as blocks. In order to make participants familiar with the experiment procedure, one practice trial was set. Four hypothesized cars and each of them will be characterized with 16 attributes. One car was characterized by 75% positive attributes, one by 25% positive attributes and two by 50% positive attributes. The best car was the one with 75% positive. In the blocked condition, 16 attributes of car were categorized into four aspects (e.g. security, etc.). Four attributes of the same category were blocked together into one chunk and were presented randomly. And four chunks refer to four aspects of car and these chunks were presented by random. For example, one chunking was about the security aspect of car (e.g., "A is equipped with a good air bag system ---positive; A is equipped a poor Intelligent electronic anti-theft system ---negative; A

has a short brake distance---negative; For A, human security is considered in the body design. ---positive"). Every "block" of attributes was preceded by one heading labeling the aspect (e.g. The security aspect of car A:). The four chunks with the headings were randomized to appear. In the unblocked condition, there were 16 attributes in total and each of them separately describe one attribute of the car, hence no chunking or "blocks" in this condition. For counterbalance, four headings were designed to precede the car information (e.g., About car A:), followed by randomly appeared attributes of each car. Among these 16 attributes for each car, eight of them were common car attributes which were understandable by non-experts (e.g., For A, human security is not considered in the body design. ——negative) whereas the other eight attributes were designed to be more professional (technical attributes) but were also understandable by non-expert (e.g., A is equipped with mechanical steer gear.——negative; D is equipped with Electronic power steering system——positive). The requirements of material edition, material evaluation, and selection of the best car were identical to those in Experiment 5. The technical attributes were edited by expert (as that in experiment 5) and the whole set of material will be evaluated by 10 more subjects about which one is the best car.

Results and discussion. One non-expert and two experts' data was excluded because their self-reported scores of knowledge of car were higher than 70 and lower

than 40, respectively. Hence, to ensure the UTE, their data was excluded. The accuracy of choice, i.e., each participant was given one point if (s)he chose the best option, or else a zero. Mean scores of the correct choice for the different conditions were calculated. As hypothesized, an ANOVA on the mean scores in the different experimental conditions showed a marginally significant three-way interaction performed among thought of mode, expertise and attribute organization, $F(1, 189)=3.278$, $p=.07$. For conscious thinkers, there was a significant two-way interaction obtained between expertise and attribute organization, $F(1,94)=4.000$, $p<.05$. For conscious non-experts, there was significant difference between blocked and unblocked conditions, $T(48)=2.26$, $p<.05$, and more subjects chose correctly in blocked than unblocked condition, whereas experts fared well in both conditions without any significant difference. For unconscious thinkers, there was no significant interaction effect between expertise and attribute organization. There was no robust difference between blocked and unblocked conditions for both unconscious non-experts and unconscious experts, but these two groups of people both performed relatively better in unconscious condition than conscious condition.(see Fig. 6)

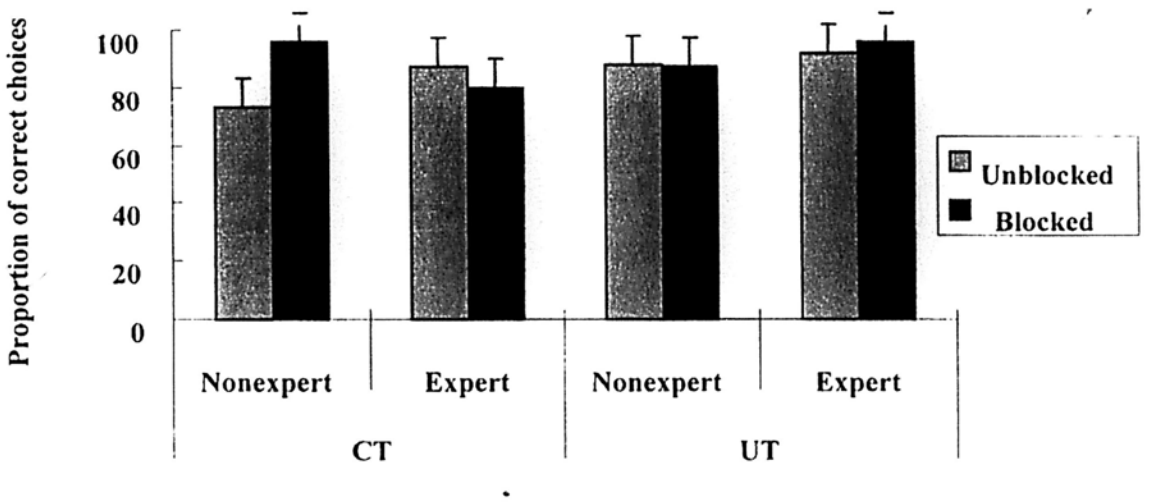


Fig. 6 Proportion of correct choices as a function of expertise, mode of thought and attribute organization. Error bars represent stand errors.

Participants' post-choice satisfaction scores were also calculated. There was significant difference of post-choice satisfaction between the unblocked and blocked conditions for conscious non-experts. They reported less satisfied in the unblocked condition compared to the blocked condition, $T(48)= 2.356$, $P <.05$, but unconscious non-experts reported no significant difference for their satisfaction between conditions. For experts, there was no significant satisfaction difference between conditions reported in both conscious and UT situations. Their satisfaction to their choices maintained stably high.

The findings have showed that experts possess mechanism of chunking which non-experts do not have, so that non-experts performed well in the blocked condition where there was artificial chunking, but not in unblocked condition whereas experts

do well in both conditions without any difference. Under UT, non-experts' performance was improved in the unblocked condition and there was no difference between their performance in the blocked and unblocked conditions, which has implied that UT can integrate large amount of information and weigh information to some extent that it had the same impact on decision making as experts' mechanism of chunking. UT should also benefit experts more but there was no expected magnified UTE for them in this experiment. However, there was a marginally significant difference between conscious experts and unconscious experts' performance, $F= (1, 96)=2.82$, $p=.09$, and there was an enhancing trend of performance from conscious experts to unconscious experts. Why there was no significant UTE for experts obtained were probably because the materials used in the present experiment were not complex enough for experts and also simpler that those in Experiment 5 in which there are half more difficult technical attributes. Therefore, there was a ceiling effect for experts' performance. Another possibility is that the artificial chunking designed by experimenter may be slightly different from experts' natural mechanism of chunking which may have an impact on the expected UTE.

Table 1. Summary of differences in proportion of participants who made right choice across conditions.

	Non-Expert	Expert
Condition	Attribute Organization	Attribute Organization
CT	UB(.73) < B(.96)*	UB(.87) =B (.80)
UT	UB(.88) = B (.88)	UB(.92)=B (.96)

Note: CT=conscious thought, UT= unconscious thought, UB=unblocked, B=blocked

5.3. Experiment 7: The attribute irrelevance to decision

There should be other possible reasons why UTE varied as a function of expertise. Previous researchers stated that what separated the experts from the non-experts was the ability to discriminate what was diagnostic from what was not. Both experts and non-experts know how to recognize and make use of multiple sources of information, but non-experts lack the ability or experience to separate relevant from irrelevant information (James, 1992). James' study showed that top experts through insights gained from experience know which cues were relevant and which were not, that is, experts were able to ignore the irrelevant attributes to catch the related information while non-expert would consider also the irrelevant attributes. According to UTT (Dijksterhuis et al., 2006), UT was good at weighing attributes and integrating large amount of information, hence it was hypothesized that experts' ability of filtering out irrelevant information would be facilitated by UT. Experiment 7 was to investigate this hypothesis. As a result, given more irrelevant attributes,

non-experts will perform significantly worse than what they do when there are less irrelevant attributes because of a lack of ability of ignoring them. However, there will not be a significant difference between the more irrelevant (i.e., MI) condition and less irrelevant (LI) condition for experts. Furthermore, in the unconscious condition, non-experts will perform well even when there is more irrelevant information and hence no difference between the MI and LI conditions. There will be a magnified UTE for experts in the UT condition.

Method

Participants: One hundred and ninety-two native Chinese-speaking students (mean age= 22.85, SD=0.65) participated in this experiment. Half of them were experts and the other half of them were non-experts. Participants were selected according to the same selection requirement for participants as that in Experiment 5. Participants received RMB 25 as reward. All participants declared that they were not familiar with the purpose of the experiment.

Procedure and design: It was a 2 (mode of thought: UT vs. CT) *2 (attribute irrelevance : more irrelevant(MI) vs. less irrelevant (LI)) *2 (Expertise: expert and non-expert) design. These three factors were with all between-subject design. The experimental procedure was identical to that in Experiment 5.

Materials. Materials were identical to those in Experiment 4.

Result and discussion. One non-expert's and eight experts' data was excluded because their self-reported scores of knowledge of car were higher than 70 and lower than 40, respectively. Hence, to ensure the UTE, their data was excluded. The percentage of participants who chose the best car was shown in the figure 6. As hypothesized, a marginally significant three-way interaction on the mean scores of accuracy among the factors of expertise, mode of thought and attribute irrelevance was obtained, $F(1, 175)=2.763$, $P= .09$. For conscious thinkers, there was a marginally significant two-way interaction between the expertise and attribute irrelevance, $F(1, 80)=3.775$, $p=.056$. For conscious non-experts, there was significant difference between the "LI" and "MI" conditions, $F(1, 42)=5.161$, $p<.05$, and more subjects chose correctly in "LI" than "MI" condition, whereas conscious experts fared well in both conditions without any significant difference. For unconscious thinkers, there was no significant interaction effect between expertise and attribute irrelevance. There was no robust difference between "LI" and "MI" conditions for both unconscious non-experts and unconscious experts, but they performed relatively well in unconscious condition. (see Fig. 7)

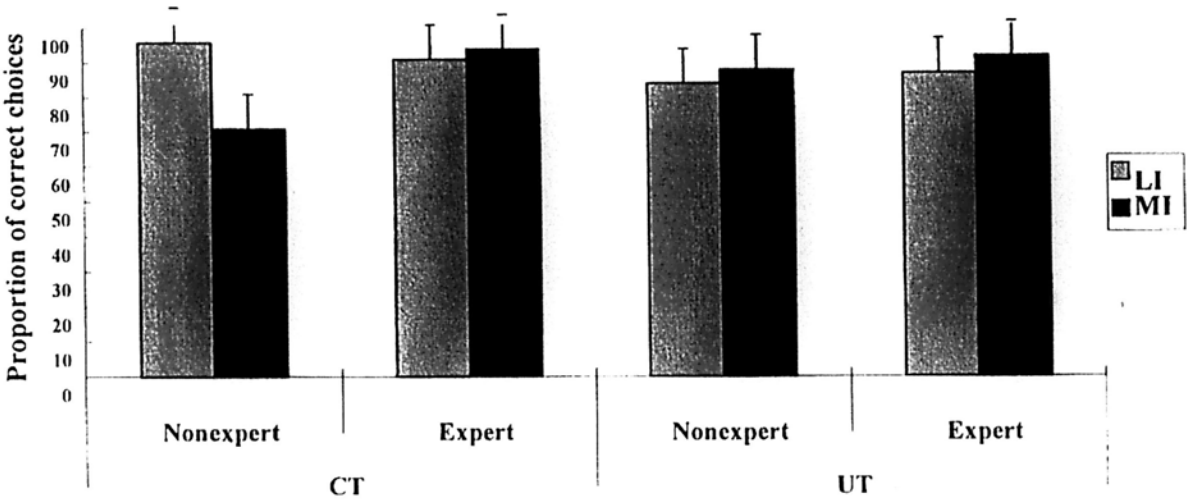


Fig. 7 Proportion of correct choices as a function of expertise, mode of thought, and attribute irrelevance. Error bars represent standard errors.

Participants' post-choice satisfaction scores were also calculated. Conscious non-experts reported marginally significantly less satisfied in the "MI" condition compared to the "LI" condition, T(42)= 1.955, P=.057, but unconscious non-experts showed no significant difference for their satisfaction between conditions. For experts, there was no significant satisfaction difference reported in both conscious and unconscious conditions.

Table 2. Summary of differences in proportion of participants who made right choice across conditions.

	Non-expert	Expert
Condition	Attribute irrelevance	Attribute irrelevance
CT	LI(.96) > MI (.71)*	LI(.91) = MI (.94)
UT	LI(.84) = MI (.88)	LI(.88)= MI (.92)

Note: CT = conscious thought; UT = unconscious thought; LI = less irrelevance; MI= more irrelevance

The findings in the present experiment have suggested that experts are equipped

with the ability of filtering out irrelevant information but non-experts do not. UT is able to weigh attributes better hence splitting relevant and irrelevant information to form a organized information base, which hence provides a solid foundation for experts to filtering out irrelevant information more efficiently. Such capability also benefits both experts and non-experts. As a result, given more irrelevant attributes, conscious non-experts performed significantly worse than what they did when there were less irrelevant attributes indicating a lack of ability of ignoring them. There was no difference between MI and LI conditions for non-experts in UT, indicating that UT to some extent has the same effect on decision making as what experts' ability of filtering out irrelevant information has. UT facilitates nonexperts to perform well in a situation when there are m ore irrelevant information. Experts are able to ignore the irrelevant attributes and catch the related information while non-expert would consider also the irrelevant attributes, So there was no significant difference between the more irrelevant (i.e., MI) condition and less irrelevant (LI) condition for experts. Even though there was no expected magnified UTE for experts, it might be due to the ceiling effect (the percentage of correct choices are very high, i.e., .92 and .90) and the materials in the present experiment are not complex enough for experts.

Chapter 6 General Discussion

The present research has contributed to a clearer and deeper understanding to the UTT, UT and the nature of the UTE , an interaction effect between mode of thought and complexity in complex decision making, and hence a better understanding of the relationship is among mode of thought, complexity of decision, and the quality of decision. The series of studies has a great contribution to a better understanding how to apply UT is the best way to make good use of UT for complex decision making. That is, simply distracting attention to somewhere else after acquiring some information when facing a complex decision does not always lead to a stably satisfied decision. Factors such as the complexity of the decision, whether there is enough knowledge and experience, whether there is enough time given for unconscious thought processing which have been confirmed or proven in the present studies are important. Furthermore, some more potential crucial UTE moderators deserve further examination. For example, too less conscious information acquisition of the decision itself may not be sufficient for knowing a decision well for an objective judgment. Without knowing necessary basic information about the decision, merely applying UT in making a decision is not reliable and meaningful. The power of UT is to some extent based on the sufficient basic information acquisition. Another, knowing too much information may not be good though because the interference may lead to a

poorer decision. The present studies have also contributed to knowing why these moderators have an impact on UTE in complex decision making by examining the mechanism or reasons behind, leading to a better understanding of UT/CT. These findings in the present study (i.e., discovering all these UTE "moderators" and why they have an impact on UTE) can contribute to understanding the debate between rational choice theories and UTT more deeply and possibly resolving it. For simple decisions or problems, conscious analysis, reasoning or calculation is the proper approach. However, as the complexity of decision increases, CT approach may not be proper any more, UT approach, however, should be applied in order to make a better quality of decision. The main difference between CT and UT is attention. Given more thought processing time, with attention focused on the problem, CT may lead to more interference, whereas UT thinkers' attention is directed to other unrelated task hence no conscious interference. Given shorter time, CT may perform better but UT may not gain enough time to process thinking because UT is slow at integrating large amount of information (Dijksterhuis, & Nordgren, 2006). Knowing that mechanism of chunking operates "unconsciously", knowing the ability of "filtering out" irrelevant information "unconsciously" will magnified UTE which benefit experts in complex decision making, knowing there is an "boundary time" for CT/UT to reach a decision of better quality and irrelevant information will be filtered out if given longer time of

thinking all help us understand CT/UT decision making debate much better.

6.1 The unconscious power and quality of decision

Usually, we tend to trust our conscious thinking to scrutinize all information related to the decision options, compare their advantages and disadvantages, the costs and benefits in different aspects and in different actions. However, it often happens that we feel frustrated with the huge workload of scrutinizing, comparing, and analyzing for long time and unable to make a decision, hence we have to put down the problem and have a rest. It also often happens that eventually, we suddenly get strong "pop out" "intuition" of decision when we are "sleeping" on the decision. Admittedly, such unconscious influence via intuition indeed often benefits us in our daily life. Numerous studies have demonstrated that it is not always beneficial to think consciously about decisions (e.g., Claxton, 1997; Dijksterhuis, 2004; Dijksterhuis, Smith, van Baaren, & Wigboldus, 2005; Levine, Halberstadt, & Goldstone, 1996; Pelham & Neter, 1995; Schooler, Ohlsson, & Brooks, 1993; Simonson & Nowlis, 2000; Wilson & Schooler, 1991; Wilson et al., 1993). However, so far, relatively few empirical works have been done to understand the power and the mechanism of the unconscious underlying its production and comprehension in decision making. There are also virtually no well-established theories of the unconscious. The recently-established UTT with its six principles(Dijksterhuis & Nordgren ,2006) has

a great contribution to UT literature by doing a series of systematic experiments investigating the influence of the UT in decision making, attitude and impression formation, etc. The UTT (Dijksterhuis &Nordgren, 2006) has suggested that a large amount of information is involved if a decision becomes very complex and the capability of CT is limited. It is hard for decision makers to compare or retrieve a large amount of information from memory.

One of the key hypotheses based on UTT proposed by Dijksterhuis et al. is the deliberation-without-attention hypothesis that the quality of decision decreases in conscious condition as complexity of decision increases but stay stably well in UT condition(Dijksterhuis, 2004b; Dijksterhuis& Bos, 2005, Dijksterhuis, et al, 2006; Dijksterhui & Nordgren, 2006). Some succedent studies replicated Dijksterhuis' findings (e.g.,; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis,& Galinsky, 2008; Dijksterhuis, A., & van Baaren, R.B., 2008; Dijksterhuis& Meurs, 2006;; Dijksterhuis & van Olden, 2006), but some failed (e.g., Newell, Wong, Cheung, & Rakow, 2009; Waroquier, Klein, Marchiori, & Cleeremans, 2008). In what kind of situations will the UT has a stably significant influence on decision making? And in what kind of situations will the UT not only maintain the quality of decision-making but also facilitate it (i.e., quality of decision increases as the decision becomes complex)? Whether does the time of thought processing, the decision maker's

expertise, the complexity of decision, etc. matter in obtaining a significant UTE? All these are still left in doubt. A better understanding about the fundamentals of UT processing in decision making is in need. Given the constraints of the previous studies and inconsistent evidences, the present research aimed at answering the research questions above by further verifying the deliberation-without-attention hypothesis about the relationship among mode of thought, complexity and quality of decision, and demonstrated more moderators of UTE in complex decision as well as the reasons behind.

As was mentioned earlier in the introduction, one important issue is the definition of the quality of decision. In the previous studies, even researchers measured the accuracy of decision, and post-choice satisfaction, attitude in different experiments, but not in the same experiment. In our opinion, whether it is a "good" decision or the" best" decision should be determined by not only the objective factor (accuracy of choice, i.e., "whether the decision maker choose the best option which was considered as the best by other evaluators (including other common people such as experimenter, nonexperts, and experts) but also the subjective factor(post-choice satisfaction)i.e., "whether decision maker feels satisfied with what he has chosen earlier"). Hence, the accuracy of choosing the car considered by other evaluators including (as a standard)the post-choice satisfaction after some time should be

collected based on Then it leads to another important issue deserving researchers' attention about the time of data collection of post-choice satisfaction (i.e., When we can collect the "post-choice satisfaction"?). We hold the opinion that it depends on the complexity of the decision. For example, buying a house, choosing a car are quite complex decisions involving many factors for consideration before making a choice. His or her satisfaction in 2 hours or 2 days may not be very reliable. Whether the decision maker feel satisfied with his or her choice in 2 weeks or even 2 months are much convincing and reliable. However, on contrary, buying a dress, or buying a tower are simpler choices that the decision makers' post-choice satisfaction collected after 1 weeks or 2 days is trustable. Hence, the time of collecting decision makers' subjective post-choice satisfaction of a "best" car should be careful decided before data collection. Our survey before the formal experiment asking 20 subjects how long do you think is a proper time to report your satisfaction after choosing a car showed in a car exhibition (Note: it is different from buying a car.) is proper and reliable? 90% reported "one hour" for choosing a car in a car exhibition, and 80% reported "one month" for buying a car for themselves. Hence, in our study, we asked subjects their post-choice satisfied in one hour. However, future study on decision making in a more real scenario such as buying a car, the post-choice satisfaction collected in one month will be more reliable.

Furthermore, some scholars argued that it might not be meaningful to test post-choice satisfaction if the options could not be taken home or used. That is reasonable, but may not be practical for manipulation in a laboratory for complex decision. It is hard to present complex options (such as houses, apartments, and cars) to be taken home or used for asking post-choice satisfaction later. It will be possible for simple decisions such as dresses, handbags. However, in our studies, we are examining complex decisions. Hence, our ways of giving a specific instruction in which participants were asked to choose the best option in an exhibition can avoid such an "artificial problem". The post-choice satisfaction on the option the participants have chose as the best in an exhibition should be reasonable and valuable.

6.2 Complexity of decision making as a UTE component

The present study firstly replicated the previous studies (Dijksterhuis et al., 2004; 2005; 2006) that conscious thinkers performed poorly when the decision became more and more complex whereas unconscious thinkers performed well in both simple and complex decisions. However, an expected significant UTE was absent (Experiment 1). The lack of robust difference between conscious and unconscious conditions in Experiment 1 in line with some previous studies failing to replicate Dijksterhuis and his colleagues's study(e.g., Ackers, 2008; Newell, Wong, Cheung, & Rakow, 2009; Waroquier, Klein, Marchiori, & Cleeremans, 2008) has implied that

there are some moderators for obtaining a stably strong UTE.

Secondly, we tested whether significant UTE would occur when the complexity of decision was increased and the result was consistent to the hypothesis(Experiment 2). The result showed that the UTE became significant when the complexity of decision increases (i.e., the attributes of options were increased from 12 to 16), which suggested that we should consider applying UT only when the decision is complex enough, otherwise, UT may not help as much as we expect, and consciously thinking about the choices could be useful for simple decision. These two experiments have further confirmed that complexity is indeed a UTE component which has a remarkable influence.

6.3 Time of thought process as a UTE moderator

Thirdly, we suspected that time of thought should be a UTE moderator based on some supportive evidences(Payne, et al., 2008), and we found that when the time of thought processing was increased from 4 minutes to 8 minutes, significant UTE was obtained (Experiment 3). What is more interesting is, we found a rising trend for UT as the complexity of decision increases (i.e., significant UTE), which indicated that UT benefit us more significantly when our attention was distracted for a longer time after information acquisition. The effectiveness of judgment was improved when conscious thinkers thought for rather short time on their own pace(self-paced,

average 24s) , compared to a 4 min-conscious thinking (Payne, Samper, Bettman, & Luce, 2008). Based on Payne and his colleagues' study and our experiment, we believe that there should be a boundary effect for time of thought. There should be "optimal time" for CT and UT. Shorter time of thought benefits CT but hurts UT, longer time may benefit UT. But too long time of thought may both hurt conscious and UT and it should be correlated with the complexity of decision, because people may forget information if their attention is distracted for too long time. Such forgetting should hurt the quality of decision, too. It will be interesting to investigate whether people's decision will be worse when time of UT becomes too long and the relation among time of thought, complexity of decision, and the quality of decision in the future. Since UTT has stated that we have our freedom to choose an effortful(CT), effortless(immediate thought) or relatively effortful route(UT) to process our thought, probably when we face a complex decision, we can decide how long time we should allow our attention be distracted when we apply our UT and then come back to the decision after that time period, otherwise, the decision may not be secured after too long time of attention-distraction. We also believe there will be strong correlation between time of UT and complexity of decision, which means that how long we can apply UT to making a decision depends on how complex the decision is.

In Experiment 4, we demonstrated that one of the reasons why longer time hurts

UT was that given longer thought processing time, conscious thinkers' attention was distracted to irrelevant information causing cognitive interference whereas unconscious thinkers performed as well as before since they were not distracted to think about irrelevant information but got more time to let the UT process relevant information. The findings were consistent with the literature (UTT, Dijksterhuis & Nordgren, 2006) that UT was an active thinking process, and it could integrate a large amount of information and weight naturally and objectively the relative importance of attributes. With the weighting ability, UT is able to "filter" out relevant and irrelevant information and at the same time slowly integrate the large amount of information without being aware. On the contrary, CT is with limited capacity and is unable to weight the importance of attributes naturally and objectively, and easy to be interfered by the irrelevant information (i.e., "noise, interference"). Given longer time, CT is interfered by irrelevant information, but UT keeps processing with a good weighting ability. Additionally, the finding was consistent with the result of meta-analyses by Acker(2008) and DeCoster(2004) that the thought processing time is one of the UTE moderators. Besides given longer time, decision makers are distracted to irrelevant information which leads to a poor decision in conscious condition, more reasons why longer thought processing time hurts CT but not UT could be investigated. For example, given more thought processing time, probably conscious participants'

attention was distracted not only to irrelevant information, but also to less relevant, less important or ambiguous information.

Hence, the findings have also shown that CT and UT obey similar principles of time: there are boundary condition of the time for CT and UT to make a sound decision. For CT, the thinking time should not be too long (probably the shorter the better); for UT, the thinking time should be long enough. How long time is the best to obtain a CT effect and a UT effect in making a decision of high quality deserves further investigation. Furthermore, the ability of "filtering out" irrelevant information unconsciously of UT thought benefits complex decision making when longer time of thought was given, whereas the attention-distraction on scrutinizing less relevant or irrelevant information in CT condition hurts complex decision.

6.4 Expertise as a UTE moderator

Fourthly, we suspect that experts can reply on UT and intuition that come through UT processing much more than non-experts. Previous studies(Dijksterhuis, 2009 showed that experts apply their expertise more in UT condition than conscious condition for predicting soccer matches. Therefore, we investigated expertise was investigated as a UTE moderator in Experiment 5 to see whether they performed better than non-experts in choosing a good car which is a normative decision and the attributes are offered by experimenter. It was found that experts performed

significantly better when they apply unconscious thinking rather than conscious thinking but not for non-experts. The finding was consistent with the relevant literature indicating experts have reliable intuition, and performed worse if they are involved with too much conscious thinking whereas CT could jeopardize weighting leading to a worse decision(Gladwell, 2004; Halberstadt &Levine, 1999)., One reason we hypothesize was a "chunking effect" in expert's unconscious decision making. That is, experts have a mechanism of chunking benefited from UT and vice versa (Experiment 6). We have found that a) by applying conscious thinking, non-experts performed much better when the attributes were blocked than unblocked whereas experts fared relatively well in both conditions without any significant difference, which has suggested that non-experts are lack of the capability of organizing relevant information into chunks that experts possesses(i.e., the chunking effect); b) by applying unconscious thinking, the difference of performance between the blocked and unblocked conditions for non-experts disappeared and experts maintained their performance well in both blocked and unblocked without difference. Even though an expected two-way interaction between mode of thought and attribute organization were not obtained probably because of the ceiling effect but experts performed much better in UT than they did in CT. Our findings have suggested that UT and the chunking mechanism of experts benefit each other. UT benefited both non-experts and

experts by "helping" them weight the relevance of attributes (i.e, be able to tell attributes that were more relevant, less relevant or irrelevant), then organize large amount of information and block the relevant attributes together into chunks like experts' mechanism of chunking. For experts, their natural mechanism of chunking also block the relevant information together into chunks which provide a solid knowledge base for UT to effectively process the information. Such interaction between chunking mechanism and UT magnified the UTE for experts. These findings were consistent with the expertise and UT literature (e.g., Dijksterhuis, et al., 2006; Dijksterhuis & Nordgren, 2006; Dijksterhuis, et al, 2009; Gladwell, 2004; Halberstadt &Levine, 1999 ; Kiesel & Kunde ,2009).

In Experiment 7, we found another reason why UTE varied as a function of expertise was that experts possess ability of filtering out irrelevant information which benefits from UT and vice versa. It was found that by consciously thinking about the decision, non-experts performed badly when there were more irrelevant information, whereas experts performed well in both MI and LI conditions without significant difference, implying that experts were not influenced by more irrelevant information. What is more, by applying UT, non-experts performed well even in the condition in which there were more irrelevant information, which implied that UT helped non-experts by weighting the attributes and ignoring the irrelevant information like

what experts did. These findings were consistent with the literature that non-experts lack the ability or experience to separate relevant from irrelevant information (Shanteau, 1992), but experts can ignore irrelevant information more efficiently compared to non-experts (Marko, 2009). In a study done by Phelp (1997)(cited Shanteau, 1992), experts and novices differed in their ability to discriminate between relevant and irrelevant information. In the study by Bamber et al. (1991) (cited Shanteau, 1992), inexperienced auditors were influenced by more irrelevant information but not for senior auditors when they were asked to review two audit cases and to revise their probability assessments. This result has implied that inexperienced auditors can not ignore irrelevance. Furthermore, the UTT (Dijksterhuis et al. 2006) and previous relevant studies have showed that UT is good at weighting attributes and integrating large amount of information offline. Hence it facilitates decision makers to filter out relevant and irrelevant information.

Experiment 5, 6 and 7 helps us further understand UT and the rational/unconscious debate. Experts work better than non-experts in the CT condition because of an advanced chunking mechanism which works "unconsciously", and UT which is good at integrating information seems to have similar ability of "chunking" relevant information. Such characteristics of UT and capability of chunking together magnified the UTE. Why UTE benefits from expertise is also because UT can "filter"

out irrelevant information with its weighting ability, and such characteristics and experts' ability of "filtering" out irrelevant information in extensive information base magnified the UTE, too. It has also showed that CT and UT both rely on similar cognitive processes such as chunking, which is a well-known conscious memory process.

To summarize, the findings of the present research has a contribution to the UT research literature by further demonstrating that merely applying UT (distracting the attention) for complex decision will not necessarily secure a stable sound decision at any time. Some other factors such as time of thought processing, complexity degree of the decision, and the participants' expertise should be considered when we apply UT in complex decision making. The findings have implied that when the decision is simple, both conscious and UT is beneficial. When the decision is very complex, however, it is better apply UT rather than CT. The more complex the decision, the more beneficial the UT. For CT, the shorter the thought processing time, the better the quality of decision. Whereas for UT, the longer, the better. What is more, whether to apply UT or CT in complex decision making, it depends. For experts, compared to non-experts, they can trust and rely on their UT and "intuition" more when they are facing complex decision. For non-experts (i.e., common people) without experience and expertise, it is not always beneficial to apply UT in decision making except it is

extremely complex or there is enough time to process UT (i.e., the attention is distracted for a longer time). Whether the decision is complex enough, whether there is enough time for UT to be processed, and whether there is enough knowledge and experience or sufficient information acquired is very important for considering applying UT.

Through out all the experiments in this study, the characteristics of UT play important roles in decision making among non-experts and experts. Besides the characteristics and principles stated by UTT researchers, we also found out UT possess similar function like experts' chunking mechanism and ability of filtering irrelevant information out.

6.5 Implications for the decision making process

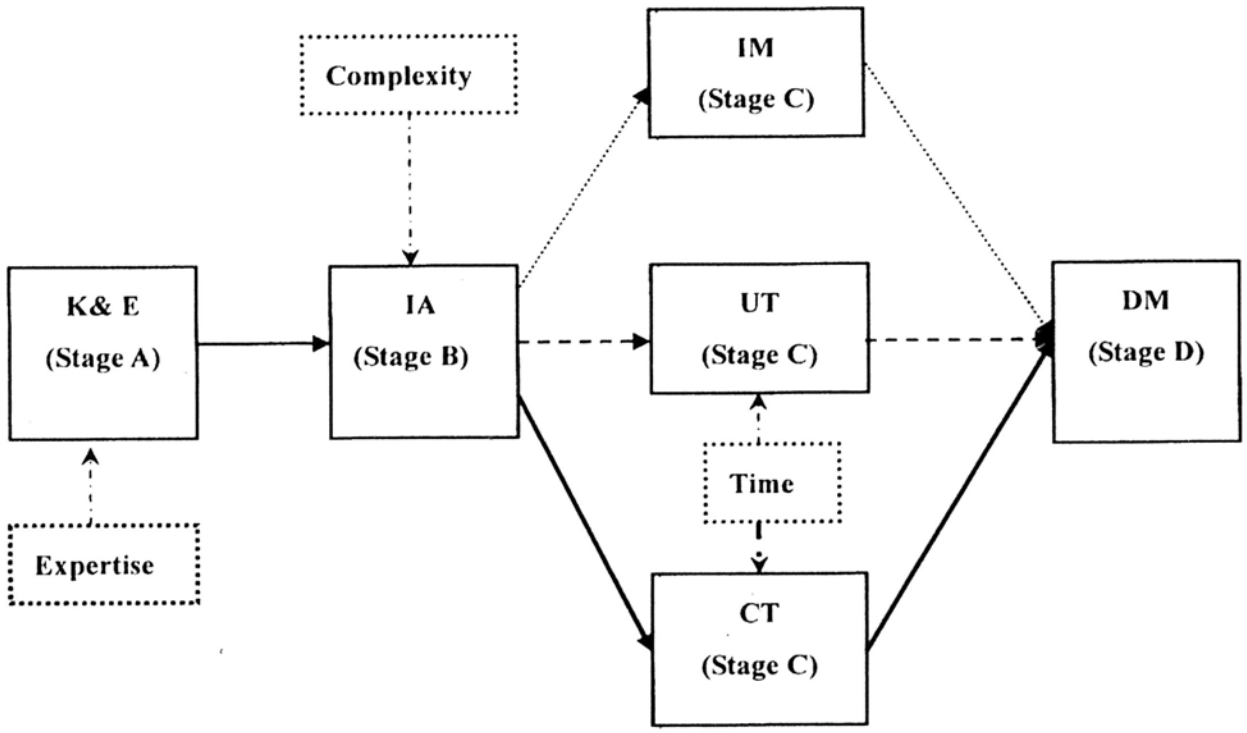
UT shows its effect via intuition. Intuition is defined as gut feeling based on unconscious past experience and a result of UT by Dijksterhuis & Nordgren (2006). Dijksterhuis and Nordgren (2006) have stated that gut feeling (i.e., intuition) is not always right and there are various moderators for it. Firstly, it should be based on extensive UT possessing high capability and can slowly integrate information to form a summary evaluative judgment based on better weighting. Secondly, it should be based on enough basic conscious information acquisition and being able to access to the most important information. Thirdly, given enough time to engage in UT (neight

immediate thought nor short UT). Lastly, it should be based on unconscious integration of past experience or information (i.e., where intuition comes from). The more knowledgeable and experienced you are, the more trustable your intuition is. Usually, experts can tell the difference much faster and more accurately than normal people. In short, good intuition is based on unconscious thought, extensive information, sufficient conscious information acquisition, enough time of thought processing, past experience and knowledge.

Compared to other social psychological models whose central assumption is that there are usually effortful and effortless routes (e.g., Brewer, 1988; Chaiken, 1980; Fazio, 1990; Petty & Cacioppo, 1986; Fiske & Neuberg, 1990), UTT contains three routes: an effortless route involving no thought at all, an unconscious route involving some thought but relatively effortless, and a conscious route that is effortful. The present studies have demonstrated that time of thought processing, and expertise are moderators of UTE and also further confirmed that complexity is one of the component of UTE. In line with the previous findings, and based on the moderators for "good" intuition and its relationship with UT stated by Dijksterhuis (2006), I have got a clearer picture of the whole decision making process (i.e., four stages in decision making :A) "offline" knowledge and experience stage; B) information acquisition stage; C) thought processing stage, and D) decision making stage.) (see Figure 7). In

the whole process of decision making, various factors are involved in the following different stages: As tested, expertise of decision makers which is a UTE moderator (Dijksterhuis, et al., 2009; Experiment 5,6,7) is a variable which plays a role in the knowledge & experience stage(i.e., a pre-decision making stage). How knowledgeable or experienced the participants are directly affect the participants' mindset which prepare for the decision making as the information base and cognitive mechanism. Complexity of task, a UTE component, is a variable having an impact in information acquisition stage. Whether the decision is simple or complex is directly having an impact on the amount of information to acquire in the information acquisition and on the cognitive expense. Time of thought processing is a variable that having an impact on the thought processing stage of the whole process of decision making (Dijksterhuis, 2004, 2006; Experiment 2, 3, 4;). Longer or shorter time is directly affecting how much thought can be obtained for the decision making. These four stages of decision making process and the variables that have been tested in the previous studies and involved in the stages are depicted as follow: (see Figure 8)

Figure 8. Three-Route- Decision Making Process



Note: K & E =Knowledge& Experience (Stage A); IA=Information Acquisition (Stage B); IM= No/Immediate Thought Processing; UT=Unconscious Thought Processing; CT= Conscious Thought Processing

An effortful route: ——→

No thought but a relatively effortless route: - - - - - →

An effortless route: ·····→

Factors: - · - · - · →

Names of Stages: □

Moderators: ┈┈┈

The present dissertation has contributed to a clearer picture of decision making process and a clearer research direction to examine various potential moderators of UTE in different stages of decision making process. Only with such clear picture can decision makers make better use of CT/UT approach to make a decision of high quality. One important implication of these stages of decision making process and the

UTE is that it is very important to realize that simply UT will not necessarily lead to a good decision making, pre-decision making stage and information acquisition stage are very important and essential for obtaining a strong UTE. Accumulative knowledge and experience is very important for leading a reliable and effective UT because it provides a solid database for UT to process,. Enough information acquisition is also basic requirement for a reliable UTE to occur. Without acquiring enough information, the intuition come via UT must not be accurate. For application, before people trust their UT or intuition, they have to make sure that they have acquired enough basic and important information about the decision. Hence, how much information is enough, how the information should be presented and how long one piece of information should be presented deserves further investigation. For example, we usually have clearer picture about a problem or a decision when we acquire information with a sound or an image. In daily life when we go to buy a car, we tend to read the instruction booklet at the same time when a seller is introducing the car. we also see the car in reality. When we read the booklet comparing the cars or examining the function of cars, we tend to read information about a function aspect of a car first then another, we got information about Car A first, then about Car B. It suggested presenting information with image or with sound is more realistic than reading boring information piece by piece randomly, and information should be presented in blocks

of function or blocks of car. All these should be considered in improving the information acquisition and the paradigm used in the experiment. Meta-analyses (Acker, 2008; DeCoster, 2004) have also suggested that presenting time of each piece of decision information, the presenting format (with image or not, by options or all randomly appear), are moderators of UTE.

Bargh (1990; 2001) proved that goals could be activated out of awareness and operate unconsciously to guide self-regulation effectively and the unconsciously activated goals could effectively guide action, enabling adaptation to ongoing situational demands. Some recent studies have also suggested that UT is an active and goal-directed process (Dijksterhuis& Aarts, 2010; Dijksterhuis et al., 2006), without a goal, people do not engage in UT (Bos, Dijksterhuis, & van Baaren, 2008). Hence, before the information acquisition, the instruction which is actually setting a goal for the decision maker should be more specific.

In the K&E stage, mindfulness may have also an influence on the UTE in decision making. It is also a potential UTE moderator. What is mindfulness? First of all, there are two different concepts of mindfulness in psychology world: eastern "mindfulness" which has been mainly applied in meditation and Buddhism and western "mindfulness" which has been mainly applied in health, business and education (Langer, 1989). What we are talking about being a moderator of UTE in the

present dissertation is the western concept of mindfulness. "Mindfulness is not an easy concept to define but can be understood as the process of drawing novel distinctions." (Langer & Moldoveanu, 2000) The common thing between these two different concepts is that they both emphasize "situation awareness". However, eastern mindfulness is applied in meditation which emphasizes situation awareness and having self-awareness by keeping still and quiet, whereas western mindfulness is cognitive mindfulness which emphasizes drawing novel distinctions whose process keeps us situated in the present and open to new information, flexible, more sensitive to information or situation around, attentive to multiple perspectives and alternatives in problem solving (Langer & Moldoveanu, 2000). Mindfulness was described as the practice of three basic principles: drawing novel distinctions, going beyond premature cognitive commitments, and being aware of alternative perspectives (see Langer, 1989, 1992, 2002; Langer & Moldoveanu, 2000). Mindful individuals have been proved to be engaged, novelty producing, *flexible* and also *open to alternative perspectives* (see Langer, 1989, 1992, 2002; Langer & Moldoveanu, 2000).

As such, more mindful individuals are more likely than their less mindful counterparts to (1) have a greater sensitivity to their environment, (2) be more open to new information, (3) be more likely to create new categories, which in turn structures their perception, and (4) develop enhanced awareness of multiple perspectives in

problem solving (Langer, 1997). In this case, more mindful people are somewhat like experts who have more extensive knowledge and information base that should benefit more from UT that can deal with large amount of information due to its high capacity than CT that is limited. We suspect that UT may benefit more mindful people than less mindful people. The reasons are, firstly, more mindful people tend to draw novel distinctions, being more creative with out- of- box thinking, and UT has also been proved by researchers that it is divergent in terms of memory search and thinking, subjects become more open-minded and creative if engaged in such thought (Dijksterhuis, et al., 2006). Previous studies have demonstrated that UT works bottom-up without schema and guidance and do not confirm to rules, indicating people in UT should be more flexible, open-minded without bias. For example, in a study that subjects were asked to generate a list new names for pasta after given five examples ending with "i", conscious thinkers listed almost only names ending with an i whereas unconscious thinkers listed more names with other endings. Unconscious thinkers also came up with more unusual ideas when they were asked to generate things one can do with a brick. This finding has showed that unconscious thinkers are not constraint to conscious "cues" as conscious thinkers do. Such characteristics of UT must benefit more mindful people than less mindful people. Secondly, more mindful people have been proved to be more open-minded, creative having a stronger

situation awareness, and being attentive to alternatives, possibilities to solutions (i.e., divergent thinking), so that they must have a more extensive information base. The Bottom-up-versus-Top-down principles of UTT has stated that UT is good at slowly organize, integrate large amount of information so that it may facilitate mindful people organize their knowledge base better. Thirdly, the rule principle of UTT also states that UT is divergent and flexible. Hence more mindful people can reply on UT much more than less mindful people who have a relatively constraint, focused mind with convergent thinking (similar to expert and nonexpert).

6.6. Limitation & future direction

As was mentioned earlier, the paradigm used should be improved to manipulate UT better. The instruction as a goal before the task is very important. Participants' decision may vary between judging a family car or sports car, it may also vary between buying a car, choosing a car in an exhibition or choosing a car for someone else because they may consider quite different evaluation standards according to different situations. Furthermore, more moderators related to the paradigm improvement should be investigated(e.g., the presenting time of each attribute, whether the information is presented by options or all information of all options was randomly presented, whether the information is presented with image or not, , which attention-distraction task to be used in the UT processing, etc.) (Meta-analysis, Acker,

et al., 2009)

Another important issue needs to be further investigated. Is decision making actually a dynamic and interactive "come-and-go" process of repeated but upgraded conscious and unconscious interaction? The UTE is probably not merely one-time effect but based on effect accumulated in previous repeatedly occurring unconscious and conscious thinking processes. Usually, when decision is very complex, we tend to consciously think about the problem first, then give up to have a rest because of the complexity. However, since we would like to solve the problem as soon as possible, we usually come back to the problem after resting for a while and think over it, and then give up again and do something else because the problem is too hard and too complex to think about, then go on until get a pop-out feeling. In such situation, decision makers usually felt frustrated after thinking over the problem without solution because they are afraid that such repeated "come-and-go" work is useless. However, what is noticeable is, each "come-and-go" thinking process is probably an active process of the conscious and UT accumulated effect so that it is actually quite useful for making a decision. Having a rest after complex information acquisition is not merely non-sense rest. It is an active process consisting of conscious thinking and unconscious thinking earlier. The "new" UTE is based on previous "old" conscious and UTE. Hence the final sound decision is based on various UTE.

Some other possible future studies should probably shed more light on the following questions: How does UT work? When, how does the unconscious transfer its information (which is gain in conscious processing stages) to unconscious process, and then to consciousness? When does UT deliver its solution? Whether unconsciousness is much more related to affective emotion so that it weights the relative importance of information better and brings decision makers more post-choice satisfaction? What about gender difference on UTE? Can women rely on unconscious decision making more than men? What's more, some recent studies show supportive evidences but some failed to replicate the previous. Does it imply that UTE is social-context dependent? These interesting questions may also need further studies.

6.7 Conclusion

The present research has contributed to a clearer and deeper understanding to the UTT, UT and UTE. It has also contributed to resolving the debate between the rational approach and the unconscious approach in decision making. Admittedly, UTT is still lack of impregnable theory foundation with convincing evidences to stand. However in cognitive and social psychological research literature, there have been many existing convincing demonstrations showing that unconscious mental process does have a considerable influence on judgments, memory, behavior and evaluations in

some circumstances (e.g., Bargh, 1990; Bargh & Chartrand, 2000; Jacoby, 1991; Nisbett & Wilson, 1977; Shiffrin & Scheneider, 1977; Zajonc, 1980). The idea of "unconscious thought" of UTT is indeed rather valuable drawing us from the "stuck conscious bias" into a new different angel to look at UT and its influence in many aspects of psychology research. On this point, UTT indeed makes a large contribution to psychology research. As a newly-proposed theory and a daring hypothesis, UTT unavoidably has experimental weakness or deficiencies, further research still need more investigation, such as better and more reasonable paradigm, assessment, operation, setting better criteria for participants selection and material editing. In terms of the argument that the power of UT was overstated, future research may put greater emphasis on the interaction between these two modes of thought.

In daily application, unconsciousness indeed plays quite a remarkable role. The idea of "active unconscious processing" of UTT has drawn us to look at the problems via another angle and find an effective way to solve a complex problem or make a complex decision. It has proposed an alternative to make a complex decision --- distracting attention from very complex matters instead of focusing on scrutinizing the factors consciously. It has proved and emphasized that for simple decisions, rational CT indeed plays a much more important role and decision makers can rely on it for making a decision of high quality; for complex decisions, however, the quality

of decision will decrease if decision makers still use the CT approach, but will get improvement if decision makers use the UT approach. The present findings have also contributed to a deeper understanding of the nature of the UTE and its moderators. Merely applying UT when facing a complex decision, simply distracting attention to something else after acquiring some information does not always lead to a stable, good and satisfied decision. Several questions have to be asked before you apply UT in decision making: " Is the decision complex enough to apply your UT?" " Have you acquired expertise or sufficient experience in the field of the decision?" Expertise and experience makes UT and intuition more reliable. " Have you acquired enough basic and important information about the decision?" Sufficient information acquisition is critical. "Have you be given enough time to allow UT be processed?" Time is critical in thought process. We also advised decision maker to repeatedly come-and-go between conscious thinking and unconscious thinking about the decision or problem for several times before making a final decision in order to benefit from a much more reliable UTE. However, if people think in a conscious way on their own pace without thinking too much, and make a choice when they are ready on their own, it is also possible to make a sound decision.

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Appendix

Appendix A Materials used in Experiment 1 & 3

Hati 很节省燃油	Kawa 很节省燃油
Hati 很容易操纵	Kawa 很难操纵
Hati 的车尾厢宽敞	Kawa 的车尾箱宽敞
Hati 有多种颜色可供选择	Kawa 有多种颜色可供选择
Hati 的售后服务很好	Kawa 的售后服务很好
Hati 的放脚空间狭窄	Kawa 的放脚空间宽阔
Hati 换档困难	Kawa 换档容易
Hati 有杯托	Kawa 没有杯托
Hati 有天窗	Kawa 没有天窗
Hati 相对环保	Kawa 相当环保
Hati 的音响系统很差	Kawa 的音响系统很差
Hati 的款式新	Kawa 的款式旧
Das 很消耗燃油	Naki 很消耗燃油
Das 很容易操纵	Naki 很难操纵
Das 的车尾箱狭窄	Naki 的车尾厢狭窄
Das 只有少许颜色可供选择	Naki 有多种颜色可供选择
Das 的售后服务不良	Naki 的售后服务不良
Das 的放脚空间狭窄	Naki 的放脚空间宽阔
Das 换档容易	Naki 换档困难
Das 有杯托	Naki 没有杯托
Das 有天窗	Naki 有天窗
Das 不太环保	Naki 不太环保
Das 的音响系统很好	Naki 的音响系统很差
Das 的款式新	Naki 的款式旧

Appendix B Materials used in Experiment 2

A 很节省燃油	B 很节省燃油
A 很容易操纵	B 很容易操纵
A 的车尾厢很小	B 的车尾厢很小
A 的车厢狭窄	B 的车厢宽敞
A 的售后服务差	B 的售后服务很好
A 的放脚空间宽阔	B 的放脚空间宽阔
A 换档容易	B 换档容易
A 没有杯托	B 没有杯托
A 没有天窗	B 没有天窗
A 的音响系统很好	B 的音响系统较好
A 是旧车	B 是新车
A 没有 GPS 导航系统	B 没有 GPS 导航系统
A 座椅舒适	B 座椅舒适
A 有安全气囊	B 有安全气囊
A 刹车距离短	B 刹车距离短
A 没有空调暖气装置	B 有空调暖气装置
C 很消耗燃油	D 很消耗燃油
C 容易操纵	D 容易操纵
C 的车尾厢很小	D 的车尾厢很小
C 的车厢宽敞	D 的车厢狭窄
C 的售后服务很好	D 的售后服务差
C 的放脚空间狭窄	D 的放脚空间狭窄
C 换档容易	D 换档容易
C 没有杯托	D 没有杯托
C 没有天窗	D 没有天窗
C 的音响系统较好	D 的音响系统较差
C 是新车	D 是旧车
C 有 GPS 导航系统	D 没有 GPS 导航系统
C 座椅不舒适	D 座椅舒适
C 没有安全气囊	D 没有安全气囊
C 刹车距离长	D 刹车距离短
C 有空调暖气装置	D 没有空调暖气装置

Appendix C Materials used in Experiment 4 & 7

E 较消耗燃油	F 很节省燃油
E 很容易操纵	F 很容易操纵
E 的售后服务差	F 的售后服务很好
E 的放脚空间狭窄	F 的放脚空间宽敞
E 换档容易	F 换档容易
E 具备良好的电子智能防盗系统	F 具备良好的电子智能防盗系统
E 的音响系统较差	F 的音响系统较差
E 有 GPS 导航系统	F 没有 GPS 导航系统
E 座椅不舒适	F 座椅不舒适
E 有几个安全气囊	F 有几个安全气囊
E 刹车距离短	F 刹车距离短
E 有较差的空调暖气装置	F 有良好的空调暖气装置
G 很节省燃油	H 很消耗燃油
G 很难操纵	H 很难操纵
G 的售后服务差	H 的售后服务差
G 的放脚空间宽阔	H 的放脚空间狭窄
G 换档容易	H 换档容易
G 具备较差的电子智能防盗系统	H 具备较差的电子智能防盗系统
G 的音响系统很好	H 的音响系统较差
G 没有 GPS 导航系统	H 没有 GPS 导航系统
G 座椅舒适	H 座椅不舒适
G 有几个安全气囊	H 有几个安全气囊
G 刹车距离长	H 刹车距离短
G 的空调暖气装置较差	H 的空调暖气装置较差

12 Irrelevant attributes:

生产这部汽车的工厂为张先生拥有。	汽车销售员很友善。
汽车公司的老板是贝尔先生。	汽车销售员口才很好。
汽车公司的老板很富有。	这部汽车的销售员很丑。
这款汽车昨天出现在北京街头。	这个汽车公司的名称很有趣。
汽车旁边的车模很漂亮。	这个汽车的公司提供很舒适的椅子。
这款车曾经在电影里出现过。	这款汽车的生产商很狡猾。

Note: In the LI condition 1: 12 relevant attributes + 8 irrelevant attributes

In the MI condition 2: 12 relevant attributes +12 irrelevant attributes

Appendix D Materials used in Experiment 5 (Expertise)

Hati 很节省燃油	Kawa 很节省燃油
Hati 很容易操纵	Kawa 很难操纵
Hati 的座椅不舒适	Kawa 的座椅舒适
Hati 的放脚空间狭窄	Kawa 的放脚空间宽阔
Hati 换档容易	Kawa 换档较困难
Hati 的音响系统很差	Kawa 的音响系统很差
Hati 最大马力为 510 马力	Kawa 最大马力为 80 马力
Hati 发动机最大排量为 0.8L	Kawa 发动机最大排量为 0.8L
Hati 最高转速为 12000rpm	Kawa 最高转速为 12000rpm
Hati 发动机最大功率为 380 kW	Kawa 发动机最大功率为 48 kW
Hati 供油方式为直喷	Kawa 供油方式为直喷
Hati 的转向器采用电控动力转向	Kawa 的转向器采用机械转向
Das 很消耗燃油	Naki 很消耗燃油
Das 很容易操纵	Naki 很容易操纵
Das 的座椅不舒适	Naki 的座椅不舒适
Das 的放脚空间狭窄	Naki 的放脚空间狭窄
Das 换档容易	Naki 换档困难
Das 的音响系统很好	Naki 的音响系統很差
Das 最大马力为 500 马力	Naki 最大马力为 510 马力
Das 发动机最大排量为 6.0L	Naki 发动机最大排量为 0.8L
Das 最高转速为 3000rpm	Naki 最高转速为 3000rpm
Das 发动机最大功率为 380 kW	Naki 发动机最大功率为 38 kW
Das 供油方式为单点喷射	Naki 供油方式为单点喷射
Das 的转向器采用电控动力转向	Naki 的转向器采用机械转向

Appendix E Materials in Experiment 6

A 车的汽车底盘方面：	B 车的汽车底盘方面：
A 的转向器采用机械转向	B 的转向器采用电控动力转向
A 采用化油器发动机	B 采用电控发动机
A 采用非独立悬挂	B 采用麦弗逊式独立悬挂
A 的发动机启动时间短	B 的发动机启动时间短
A 车的电气设备方面：	B 车的电气设备方面：
A 有风窗除霜装置	B 没有风窗除霜装置
A 的发动机采用传统机械触点点火	B 的发动机采用电控点火
A 没有自动泊车系统	B 配备自动泊车系统
A 带有 GPS 导航系统	B 不带有 GPS 导航系统
A 车的汽车安全方面 ：	B 车的汽车安全方面 ：
A 的车身设计考虑人的安全性	B 的车身设计考虑人的安全性
A 没有配备多个安全气囊	B 配备多个安全气囊
A 配备智能电子防盗系统	B 配备智能电子防盗系统
A 刹车距离长	B 刹车距离短
A 车的汽车舒适度方面 ：	B 车的汽车舒适度方面 ：
A 配备电动调节真皮加热座椅	B 配备手动调节座椅
A 的车厢空间大	B 的车厢空间小
A 没有配备空气自动净化装置	B 配备空气自动净化装置
A 的音箱系统先进	B 的音箱系统先进
C 车的汽车底盘方面：	D 车的汽车底盘方面：
C 的转向器采用电控动力转向	D 的转向器采用机械转向
C 采用电控发动机	D 采用化油器发动机
C 采用非独立悬挂	D 采用麦弗逊式独立悬挂
C 的发动机启动时间长	D 的发动机启动时间长
C 车的电气设备方面：	D 车的电气设备方面：
C 有风窗除霜装置	D 没有风窗除霜装置
C 的发动机采用传统机械触点点火	D 的发动机采用电控点火
C 有自动泊车系统	D 没有自动泊车系统
C 没有 GPS 导航系统	D 没有 GPS 导航系统
C 车的汽车安全方面 ：	D 车的汽车安全方面 ：
C 的车身设计没有考虑人的安全性	D 的车身设计没有考虑人的安全性
C 配备多个安全气囊	D 没有配备多个安全气囊
C 配备智能电子防盗系统	D 配备智能电子防盗系统
C 刹车距离长	D 刹车距离长
C 车的汽车舒适度方面 ：	D 车的汽车舒适度方面 ：

C 配备电动调节真皮加热座椅	D 配备手动调节座椅
C 的车厢空间小	D 的车厢空间小
C 没有配备空气自动净化装置	D 没有配备空气自动净化装置
C 的音箱系统先进	D 的音箱系统先进