Cue Usage in Conscious and Unconscious Thought

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Abstract:

According to the capacity principle of Unconscious Thought Theory (UTT), unconscious thought should outperform conscious thought on complex decision making tasks due to its larger capacity for information (Dijksterhuis & Nordgren, 2006). In this study, participants were asked to complete a prediction task using up to two cues after a period of unconscious thought or deliberation. Some subjects were presented with an intuitive prediction task; others were presented with a non-intuitive one. Contrary to UTT, it was found that unconscious thinkers used fewer cues to make decisions, and they performed worse than conscious thinkers on both intuitive and non-intuitive prediction tasks.

Cue Usage in Conscious and Unconscious Thought

When making a decision, the goal of any decision maker is to utilize a strategy that will lead to the best results while requiring the least amount of effort. There are a number of different decision making strategies that one might use, and some require more attention, deliberation, or cognitive capacity than others. The results of each strategy will vary, depending on the conditions under which a decision is made. For example, any decision that requires a great deal of attention will not produce very good results for someone who is distracted with another task. However, it may prove very effective for someone who has attention to spare. Several theories have developed to determine which decision making strategies will produce optimal results under different circumstances.

One of these theories, Unconscious Thought Theory (UTT) (Dijksterhuis & Nordgren, 2006), proposes that there are two modes of thought, conscious thought and unconscious thought, which differ according to their amounts of task-relevant attention. During conscious thought, attention is directed toward the task at hand, and the problem is thoroughly considered before making a decision. In contrast, unconscious thought is characterized by attention that is directed elsewhere, and the problem is considered through processes outside of conscious awareness (Dijksterhuis & Nordgren, 2006). In other words, conscious thought is what many of us consider to be classical “thought,” while unconscious thought can be equated with “sleeping on” a problem, or what Dijksterhuis terms “deliberation-without-attention” (Dijksterhuis, Bos, Nordgren & van Baaren, 2006). Unconscious thought should be distinguished from lack of thought, as experiments have shown a difference between those who are distracted for a period of

time before making a decision, and those who make the decision automatically without any thought at all (Dijksterhuis, 2004, Experiment 1). This result has been interpreted to support the idea that distraction leads to unconscious processing of the problem (Dijksterhuis, 2004).

UTT encompasses six major principles that distinguish unconscious thought from conscious thought. One of these principles, the capacity principle, states that conscious thought is constrained by a very small capacity, which makes it difficult to work out complex decisions consciously (Dijksterhuis & Nordgren, 2006). This principle is based on studies done by Miller (1956), which proposed that conscious thought is limited to a capacity of about seven items at a time. Some have argued that low capacity is responsible for poor conscious decisions (Wilson & Schooler, 1991). According to UTT, unconscious thought may be better than conscious thought at attending to problems that are very complex because the unconscious has a larger capacity than does conscious thought.

How does one prove that there is a difference between conscious and unconscious thought in attending to complex problems? A typical UTT experiment generally consists of presenting subjects with a complex problem, such as choosing between four apartments with a number of attributes described for each (Dijksterhuis, 2004, Experiment 1). All of the options have both positive and negative features, with the best apartment being defined as the one with predominantly positive features and the worst apartment being defined as the one with predominantly negative features. All subjects are presented with this information. Then, subjects in the conscious thought condition are asked to carefully consider each apartment for a certain amount of time,

normally two to four minutes, after which they rate each apartment on a scale. Meanwhile, subjects in the unconscious thought condition are distracted with a separate task for the same amount of time and then are asked to make the same ratings. Some experiments include a condition in which subjects are asked to make the decision immediately after being presented with the information without the chance to process the information consciously or unconsciously. UTT is supported in that unconscious thought sometimes outperforms both conscious thought and immediate decision making in these types of tasks.

However the assertion that unconscious thought is able to consider more task-relevant information due to its larger capacity may be unsubstantiated. This concept is based on the results of one study in which subjects participated in a typical UTT experiment as described above and then were asked to report whether they made more "global" or "specific" decisions. Unconscious thinkers reported making "global" judgments more frequently than conscious thinkers. This was taken as evidence that unconscious thinkers were better able to attend to all the information provided, while conscious thinkers were forced to use only the information they could consciously process (Dijksterhuis, 2004, Experiment 2). However, the term "global" judgment is subjective, and does not indicate the actual number of cues used. In addition, as Waroquier, Marchiori, Klein, and Cleeremans (2009) point out, it is possible that self-report data such as this may not be valid because participants, particularly those who were processing information outside of conscious awareness, may not have been fully aware of their own decision making process at the time. Self-reported "global

judgments" alone are not sufficient evidence that unconscious thinkers actually used more information to make their decisions.

In fact, attempted replications of this research have indicated no relationship between decision mode, conscious or unconscious, and information usage. Waroquier et al. (2009) performed a very similar experiment to the one described previously, using cars instead of apartments. After subjects rated each car, they were asked to indicate the number of attributes that they took into account. This was designed to be a more direct and quantifiable test of the capacity principle than asking if decisions were "global" or "specific." Subjects in the unconscious thought condition did not indicate using a significantly different number of attributes than subjects in the conscious thought condition. However, this is subject to the same critique as the Dijksterhuis experiment, due to the fact that self-report measures may not be valid indicators of the actual amount of information used by each subject.

There are additional theoretical issues with the capacity principle of UTT. UTT relies on a definition of capacity as the amount of information that is transmitted from one location to another in bits per second. Dijksterhuis and Nordgren (2006) use previous studies based on information theory as a basis for their assertion that conscious thought has a capacity of 10 to 60 bits, compared with the capacity of the entire system, which is 11.2 million bits. However, as Gonzalez-Vallejo, Lassiter, Bellezza, and Lindberg (2008) have pointed out, this requires a strict dichotomy between conscious and unconscious thought, so that the capacity of unconscious thought could be determined by subtracting the capacity of conscious thought from the capacity of the entire system. More contemporary views suggest that there may not be

such a strict dichotomy between these two thought processes (Shiffrin & Nosofsky, 1994). In addition, the primary evidence for capacity differences in the two modes of thought comes from interference tasks. Shiffrin (1997) also points out that these interference tasks rely on the assumption that a stimulus requiring attention must interfere with the processing of other stimuli. However, this assumption does not always hold true, as there are some stimuli whose processing does not detract from the processing of other stimuli.

In addition to the theoretical issues underlying UTT, there are also some methodological issues. One particularly important issue is the failure of UTT to consider weights when determining decision quality. In most UTT tasks, such as the one described previously, the best decision is defined as the one with the most positive attributes and the least negative attributes. The problem with the concept is that while one might be able to determine with relative objectivity which attributes are positive and which are negative, the magnitudes of their positivity or negativity may not match. For example, when choosing a car, a single important negative attribute (such as a bad safety rating) may outweigh several unimportant positive attributes (such as a nice paint color and cup holders). UTT does not account for the differences in these weights in its definition of the “best” choice. Some studies have found that conscious thought outperformed unconscious thought on tasks in which performance depended on the magnitudes of each of the attributes rather than the relative number of positive and negative attributes. This would lead one to believe that unconscious thought may not be as adept at complex tasks that require weighting the attributes (Payne, Samper, Bettman & Luce, 2008).

Other studies have had problems replicating the results of previous UTT experiments, even when using very similar experimental setups. Acker (2008) attempted a functional replication of Dijksterhuis et al. (2006) and found that unconscious thought did not necessarily outperform conscious thought on that decision making task. Rey, Goldstein, and Perruchet (2009) found that an immediate decision condition performed as well as the unconscious condition on a similar task. Both conditions outperformed the conscious thought condition, indicating that the Dijksterhuis et al. (2006) results may be due to a disadvantage of too much conscious processing, rather than an advantage of powerful unconscious processing. Along those lines, Payne et al. (2008) found that self-paced conscious thought did just as well as unconscious thought in a rating task, and both outperformed conscious thought that was fixed to artificially long time intervals. This suggests that the disadvantage of conscious thought in some UTT experiments may be due to having too much time to process information, rather than due to limited capacity. Payne et al. (2008) suggest that having an artificially long time period to think may lead participants to shift attention to less relevant information, an effect that they call dilution (p. 1119).

Finally, there are some statistical concerns regarding UTT that cast some doubt upon its claims. Chief among them is that, in the initial UTT studies, while unconscious thought did outperform conscious thought on a rating task, the difference between the two was not statistically significant (Dijksterhuis, 2004). In fact, a meta-analysis done by Acker (2008) found no evidence of a consistent advantage of unconscious thought over conscious thought, though it did suggest that there may be situations in which unconscious processing is more helpful, and those in which is it not.

Given that Dijksterhuis' findings may not fully support the capacity principle of UTT, the process by which unconscious thought sometimes leads to different decisions than conscious thought is open to alternative explanations. One alternative explanation is that unconscious thinkers operate not by using more information than conscious thinkers, but by utilizing a heuristic, or mental rule-of-thumb. One heuristic, Take-the-Best (TTB), operates by basing ones' decision on the single best cue available, rather than attempting to integrate a large number of cues. There is some evidence that use of this heuristic can be as effective as, if not better than, consciously rationalizing ones' way through a decision (Gigerenzer & Goldstein, 1996). It is possible that unconscious thinkers are using a heuristic similar to TTB in making their decisions, and that would account for differences between their performance and that of conscious thinkers, who might be using more effortful but less effective strategies.

In fact, some previous studies have suggested that people are more likely to rely on heuristics when their cognitive capacity is limited (Gigerenzer & Selten, 2001). Dijksterhuis et al. (2006) suggest that making subjects complete a cognitively demanding task is a way to promote unconscious thought; however it is also likely to limit cognitive capacity. In this sense, the conditions under which subjects are made to process information may actually encourage heuristic thinking (Waroquier et al., 2009). Using a heuristic similar to Take-the-Best might allow subjects in the unconscious thought condition to outperform subjects in the conscious thought conditions while using less information.

If this shown to be true, however, it would run directly counter to Dijksterhuis' capacity principle, which states that unconscious thinkers use *more* information to make

their decisions. One could test this theory by determining whether unconscious thinkers use more or less cues in rendering their decisions compared to conscious thinkers. In the current study, participants were presented with a situation in which they could use up to two cues of varying quality in order to make a series of predictions. Decision quality was defined as the number of correct predictions. Using regression analysis, we could determine the average number of cues being used by both conscious and unconscious thinkers. We predict that unconscious thinkers will differ significantly from conscious thinkers in the number of cues used to render a decision. If unconscious decision makers use more cues, it will support the capacity principle of UTT. However, if unconscious decision makers use less cues, this result would be consistent with the theory that the unconscious thought operates using a take-the-best-type heuristic which would allow the participant to render a better decision while using less information. Furthermore, by manipulating the validities of the cues given to participants, we can determine under what circumstances use of more or less cues will lead to better results. We predict that usage of a single good cue will prove to be the better method when the best cue is intuitively correct, and that usage of more than one cue will be the better method when the “best” cue is not easily discernible.

Method

Participants

The participants in this experiment were 87 undergraduate students at The Ohio State University. Participation was in exchange for research credit, used to fulfill a class requirement.

Procedure

Participants were seated at a computer and told by the experimenter that they would be “making predictions about what other people believe”. After this, all instructions were presented on the computer. Participants were asked to imagine they were in the following scenario, adapted from Sieck and Arkes (2005):

> *“In this experiment, you are to assume the role of a new attorney in a law firm, Brown & Black. Brown & Black does a lot of jury trial work. Thus, an important skill every attorney must have or acquire is the ability to anticipate how potential jurors would feel about a given issue. The supervising partner to whom you report, Philip Elkin, has prepared a test of your juror judgment skills. If Mr. Elkin concludes that your skills are just too weak, he will have to let you go. All the prospective jurors in the given jurisdiction completed a general questionnaire concerning several personal characteristics as well as their opinions about various miscellaneous issues. Those prospective jurors also responded ‘‘yes’’ or ‘‘no’’ to the question of whether a terminally ill patient should be allowed to end his or her own life. Your job is to decide how the jurors responded.”*

After these instructions, participants were taken to a new screen which gave them specific instructions regarding the task that they were about to complete. All participants were presented with two pieces of information for each prospective juror: their political party affiliation (Republican or Democrat) and their alcohol consumption habits (consume or abstain from alcohol). They were also shown a picture of each hypothetical juror, which was designed to serve as a non-cue and prevent the information provided from becoming too repetitive. Participants in the conscious

thought conditions were presented with this information, then given 30 seconds during which they could write their thoughts about the prediction. Unconscious thought participants were presented with the same information, then given 30 seconds during which they were distracted by a math task. This task required subjects to memorize three numbers, presented one at a time, with the first number labeled A, the second labeled B, and the third labeled C. After the numbers were presented, participants were given a screen that required them to type in the answers to simple math problems, using the letters they memorized. For example, a problem might ask the participant to subtract C from A. The student would have to remember which number corresponded to C, and which corresponded to A, and to subject them mentally within a given time frame. The math task was designed to be cognitively demanding enough to prevent conscious processing of the information in the previous screen, and to occupy the 30 seconds that elapsed between the presentation of each prospective juror's data. Both conscious and unconscious thinkers were then asked to make their prediction, by indicating whether they thought that juror was "in favor of" or "opposed to" physician assisted suicide in a multiple choice format.

Participants completed 2 practice trials and 62 experimental trials consisting of one prediction each, and received feedback after making each prediction. They were told prior to starting the experimental trials that they could improve their performance if they paid attention to the feedback.

Design

Participants were randomly assigned to either a Conscious Thought (CT) or an Unconscious Thought (UCT) group, with conscious thinkers asked to consciously

deliberate over each prediction and unconscious thinkers being distracted by the math task for the same amount of time. In addition, participants were either in an Intuitive or Non-intuitive Cue condition. Pilot testing was conducted prior to designing the experiment, and it was found that people generally believed political party affiliation to be the more predictive cue, and alcohol consumption habits to be not predictive. For half the subjects (Intuitive), the cue that pilot subjects thought would be the good predictor (political party affiliation) was made to be the more valid cue, while the other cue was not predictive. For the other half of the subjects (Non-intuitive), the cue that pilot subjects thought would be the bad predictor (alcohol consumption habits) was made to be the more valid cue, while the other cue was not predictive. Thus in each condition, there was one very good predictor and one very bad predictor. The good cue was strongly related to whether a prospective juror favored or opposed physician-assisted suicide, phi coefficient = .74, $p < .001$. The weak cue was not, phi coefficient = .07, n.s.

In order to determine which group of subjects used more cues to make their decisions, we ran a regression analysis and, for each participant, counted the number of cues for which there were significant beta weights. In addition, we also looked at the performance of each group on the prediction task, both as a whole and by comparing the first half of the trials (1-31) to the second half of the trials (32-62). The design was thus 2 (Thought: conscious/unconscious) x 2 (Intuitiveness of cues: Intuitive/Non-intuitive) x 2 (Trial Half: First half, Second half) with the latter factor being a within-subjects factor. The dependent variable of performance was determined by the number of correct predictions out of 62.

Results

Prediction Task Performance

Scores on the prediction task were determined by the number of correct predictions out of 62 experimental trials. Correct predictions were counted for each trial, and an analysis of variance (ANOVA) was done to determine which factors significantly affected subject performance.

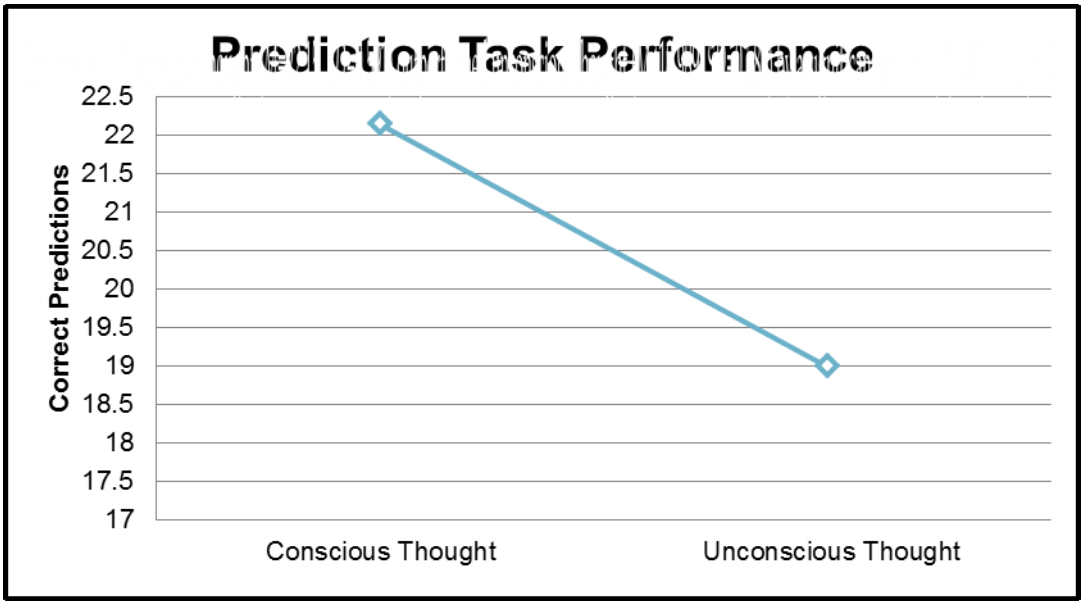

Figure 1: Performance of conscious thought and unconscious thought on the prediction task.

As seen in Figure 1, it was found that participants in the conscious thought condition (M=22.51, SD=0.591) outperformed participants in the unconscious thought condition (M=18.99, SD=0.585) in the prediction task. This main effect was significant ($F(1,83)=14.5$, $p<0.01$). However, the main effect for the intuitive cue condition was not significant, nor was the interaction between cue condition and thought condition (p=.437 and p=.859, respectively). Overall, conscious thinkers outperformed unconscious thinkers irrespective of which of the two cues was the better predictor.

By splitting the first half of the experimental trials (1-31) from the second half (32-62), we were also able to determine if subjects in different conditions were more apt to improve their performance with the feedback they were given. There was a significant interaction effect between the trials and the intuitiveness of the cue condition. Subjects in the intuitive cue condition were able to improve their performance from earlier trials (M=20.22, SD=4.88) to later trials (M=21.41, SD=4.64). However, subjects in the non-intuitive cue condition actually got worse from earlier trials (M=21.12, SD=3.94) to later trials (M=19.44, SD=4.35). This interaction effect was significant (F(1,83)=15.93, p<.001).

Cue Usage

In order to determine the average number of cues that subjects in each thought condition used, we counted, for each participant, the number of cues for which there were significant beta weights. An ANOVA showed that subjects in the conscious thought condition used more cues on average (M=0.93, SD=0.07) than participants in the unconscious thought condition (M=0.67, SD=0.07), and that this difference was significant (F(1,81)=6.61, p<.05).

Discussion

The results of the prediction task provide evidence that unconscious thought is not inherently better than conscious thought at utilizing information in order to make a decision. In this case, it was worse. I believe that unconscious thought may have performed worse on this prediction task due to being misled by the presence of less valid information, regardless of how intuitively correct that information may seem. Some

research has questioned whether unconscious thought is capable of weighting information properly (Payne et al. 2008; Gonzalez-Vallejo et al. 2008). If unconscious thought could not properly weigh the value of the cues given, it is possible that it would be more easily misled by an invalid cue. Conscious thought, in contrast, seems to have been able to utilize the information more effectively, leading to better performance. This is directly counter to the results that UTT would have predicted.

The original hypothesis was that unconscious thought may be able to outperform conscious thought when the task was an intuitive one. In this experiment, however, the intuitiveness of the task did not seem to make a difference for participants in the conscious and unconscious thought conditions. It is possible that this finding is a due to the extreme difficulty of the task given to participants. Even in the intuitive cue condition, participants were not told which cue was the better one to use, and had to figure it out on the basis of feedback. In addition, even using the most predictive cue did not lead to the best answer 100% of the time. Because of this, it is possible that participants in both the conscious and unconscious conditions did not find the intuitive condition significantly easier.

Where the intuitiveness of the cues given did make a difference was in task improvement. Participants improved their task performance from earlier to later trials if the task was intuitive, but their performance actually decreased if the task was non-intuitive. This occurred regardless of whether participants thought consciously or unconsciously about their predictions. It suggests that if the task is easier, performance gains are more likely to occur. However, task intuitiveness did not make a difference for conscious versus unconscious thinkers, suggesting that task intuitiveness may not be

the mechanism by which conscious thought outperformed unconscious thought in this experiment. This mechanism is still open for interpretation.

With regards to the amount of information used to make each prediction, our results indicate that conscious thinkers use significantly more information than unconscious thinkers. This suggests that there may be an alternative to the capacity principle, which states that unconscious thought should outperform conscious thought due to its greater capacity for information (Dijksterhuis & Nordgren, 2006). Our results suggest that conscious thought not only outperforms unconscious thought, but does so as a result of increased information usage. If unconscious thought does have vast capacity for information, it may not always be using that capacity to its fullest extent.

Overall, we believe this study demonstrates that conscious thought may outperform unconscious thought in the presence of misleading information. In addition, we take this study as evidence that unconscious thought does not necessarily use more information than conscious thought. Conscious thought may, in fact, utilize more information in making decisions, even if its capacity for information is smaller. We hope that these results will challenge some of the assumptions of Unconscious Thought Theory as a whole, and the capacity principle in particular. We also hope that these results will lead to further questioning of the mechanisms by which conscious and unconscious thought may lead to different decisions, and how the circumstances may interact with this mechanism to affect decision quality.

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