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# Four empirical tests of Unconscious Thought Theory

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ABSTRACT

According to Unconscious Thought Theory, people make better decisions after unconscious than after conscious thought (Dijksterhuis, Bos, Nordgren, & van Baaren, 2006a). Unconscious Thought Theory yields four specific predictions. First, an exact replication of Dijksterhuis et al. (2006a) study should indicate that unconscious decisions are superior to conscious decisions. Second, decisions should improve with duration of conscious thought. Third, unconscious decisions should be superior to conscious decisions, even if unconscious decisions are deliberated while having access to information. Fourth, unconscious decisions should be based on a weighting strategy. We report results of four studies, featuring 480 participants, that yield no evidence in favor of these predictions. Therefore our findings cast doubt on Unconscious Thought Theory and its advice to base decisions on unconscious thought. The results of our studies suggest that it is better to base decisions on conscious thought while having access to information.



## Introduction

It may seem self-evident that the best way for people to solve a complex decision problem is to carefully and *consciously* weigh the pros and cons of each choice alternative. However, this view has been challenged by an influential study on *unconscious* decision making (Dijksterhuis et al., 2006a). This study formed the empirical basis of Unconscious Thought Theory (Dijksterhuis & Nordgren, 2006) and prompted the advice that complex decision problems are best addressed not by conscious deliberation but by unconscious thought, that is, by sleeping on them. This counterintuitive claim received a lot of positive attention in the popular media,[1] yet also raised skeptical comments from within the scientific community (e.g., González-Vallejo, Lassiter, Bellezza, & Lindberg, 2008; Shanks, 2006). In this article, we first summarize Unconscious Thought Theory, we then derive four predictions from this theory and test these predictions in four studies featuring a total of 480 participants. Finally, we integrate our results with previous results and discuss implications for Unconscious Thought Theory.

## Unconscious Thought Theory

The key assumption of Unconscious Thought Theory (UTT, Dijksterhuis & Nordgren, 2006) is that unconscious thought and conscious thought are characterized by different processes. That is, "unconscious thought" processes have a relatively large capacity – hence, they allow for an optimal decision strategy in which all attributes of choice alternatives are weighted according to their importance. These unconscious processes require time, therefore the quality of decisions increases with the duration of unconscious thought (Dijksterhuis & Nordgren, 2006, p. 99; see also Dijksterhuis, 2004). "Conscious thought" processes on the other hand, have a small capacity and therefore only allow for simplified decision making strategies. As summarized by Dijksterhuis and Nordgren (2006, p. 105): "When a decision strategy warrants the careful and strict application of one specific rule, as in a lexicographic strategy, use conscious thought. When matters become more complicated and weighting is called for, as in the weighting strategy, use unconscious thought".

Dijksterhuis et al. (2006a) tested one of the main predictions derived from UTT, namely that in complex situations, decisions should be better after unconscious than after conscious thought. A complex decision making situation was operationalized as a situation in which participants had to choose between four options (cars) defined by 12 attributes each (e.g. mileage, service, legroom). The attributes were presented verbally, one attribute at a time. Following an interval of 4 min, participants had to indicate which car they thought was best. In this 4 min interval, participants either deliberated their decisions (an operationalization of "conscious thought") or performed a secondary task in which they had to

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[1] A select subset of the many online references: http://news.bbc.co.uk/1/hi/health/4723216.stm, http://americanscientist.org/template/Newsletter?memberid=null&issueid=7262, http://www.washingtonpost.com/wpdyn/content/article/2006/02/19/AR2006021901108.html, http://www.newscientist.com/article.ns?id=dn8732, http://www.nytimes.com/2006/02/21/health/psychology/21deci.html?ei=5088&en=94fce15a93b5dd86&ex=129,81,78,000&adxnnl=1&partner=rssnyt&emc=rss&adxnnlx=1182113728-IcgxwPfeyZCsn9oZYxTrMA.

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solve anagrams and thus were not able to deliberate their decisions consciously (an operationalization of "unconscious thought"). The results showed that about 25% of the participants in the conscious condition chose the best car, whereas about 60% did so in the unconscious condition. This superiority of unconscious over conscious decisions was replicated by Strick, Dijksterhuis, and Van Baaren (2010). Moreover, Dijksterhuis (2004) reported a tendency, although not significant, towards superior unconscious performance (see also Lassiter, Lindberg, Gonzalez-Vallejo, Bellezza, & Phillips, 2009 for a similar tendency in one condition, the "form impression" condition).

Therefore, two studies provide evidence for UTT and two studies tend to do so. If a more extensive assessment of UTT would also support this theory, this would have profound implications, both for decision making theory as well as for real life decision making. In the next section we therefore review the possibilities for such a more extensive assessment of UTT, where we show that not all tests of UTT yield such favorable outcomes.

## Four predictions from Unconscious Thought Theory

In this section, we show that a general assessment of Unconscious Thought Theory involves a test of four predictions derived from this theory. We review studies that tested these predictions, show that the evidence is still subject to debate, and indicate how additional evidence can be obtained.

The first prediction derived from UTT is that in complex situations, decisions after unconscious thought should outperform decisions after conscious thought. Several studies provide support for this prediction (Dijksterhuis et al., 2006a; Strick et al., 2010; and a tendency in Dijksterhuis, 2004 and in Lassiter et al., 2009), but other studies do not (Lassiter et al., 2009, "memorize" condition; Acker, 2008; Calvillo & Penaloza, 2009; González-Vallejo, Lassiter, Bellezza, & Lindberg, 2008; Mamede et al., 2010; Newell, Wong, Cheung, & Rakow, 2009; Payne, Samper, Bettman, & Luce, 2008; Rey, Goldstein, & Perruchet, 2009; Thornsteinson & Withrow, 2009; Waroquier, Marchiori, Klein, & Cleeremans, 2009). However, it might be argued that the latter studies (i.e., those that failed to replicate Dijksterhuis et al., 2006a) did not reveal superiority of unconscious thought because they were not designed to provide an *exact* replication of the experimental conditions in Dijksterhuis et al. (2006a). Specifically, the Dijksterhuis et al. (2006a) study differed from the others in four aspects. First, the Dijksterhuis et al. (2006a) study concerned choice whereas other studies concerned judgment (Acker, 2008; Calvillo & Penaloza, 2009; Lassiter et al., 2009, study 2; Thornsteinson & Withrow, 2009, study 1; Waroquier et al., 2009, studies 1–3). These two situations, choice vs. judgment, may trigger different decision strategies (Billings & Scherer, 1988). Second, in the Dijksterhuis et al. (2006a) study participants did not receive a decision instruction prior to the presentation of attributes, whereas this instruction was provided in some other studies (Acker, 2008; Newell et al., 2009, study 3; Payne et al., 2008). Third, not all studies incorporated the original stimulus material (Calvillo & Penaloza, 2009, studies 1 and 2; González-Vallejo, Lassiter, Bellezza, & Lindberg, 2008; Mamede et al., 2010; Newell et al., 2009, studies 1 and 4; Payne et al., 2008; Thornsteinson & Withrow, 2009, studies 1 and 2; Waroquier et al., 2009, studies 1 and 3). Finally, not all studies operationalized conscious thought as Dijksterhuis et al. did (Rey et al., 2009). For these reasons we performed a study in which we tried to replicate the Dijksterhuis et al. (2006a) study as closely as possible. That is, our replication study concerned choice, participants did not receive a decision goal before viewing stimulus materials, we used the same stimulus materials and incorporated the same operationalization of conscious thought, we even sampled from the same Dutch subpopulation as Dijksterhuis et al. did. According to UTT, this exact replication should show that unconscious decisions are superior to conscious decisions.

The second prediction derived from UTT is that the quality of unconscious decisions should increase with the duration of unconscious thought. This also means that unconscious decisions should be superior to immediate decisions. However, several studies comparing unconscious to immediate decisions did not find evidence in favor of this prediction: instead, unconscious and immediate decisions were shown to be equivalent (Acker, 2008; Dijksterhuis, 2004; Newell et al., 2009, study 3). Newell et al. explained this result by arguing that participants who are instructed to perform a judgment already form this judgment online, that is, during attribute presentation. This online judgment is then used to arrive at a decision immediately after attributes have been presented (Hastie & Park, 1986), where the decision is not changed by either conscious nor unconscious thought (cf. Lassiter, Lindberg, Gonzalez-Vallejo, Bellezza, & Phillips, 2009 for a similar interpretation). However, Strick et al. (2010) recently showed that decisions after unconscious thought are superior to online decisions. Therefore, the evidence for the second UTT prediction is inconclusive. In order to study this second prediction further, we compared immediate, conscious and unconscious decisions, where the duration of unconscious thought was varied. UTT predicts that unconscious decisions outperform immediate decisions, and that the quality of unconscious decisions increases with the duration of unconscious thought.

The third prediction derived from UTT is that the superiority of unconscious over conscious thought is a general phenomenon that is not related to a particular operationalization of (un)conscious thought (Dijksterhuis, Bos, Nordgren, & Van Baaren, 2006b; Dijksterhuis & van Olden, 2006; Dijksterhuis et al., 2006a). Dijksterhuis et al. (2006a) operationalized conscious thought in a way that is arguably not very representative of realistic decision making situations (González-Vallejo et al., 2008; Shanks, 2006; Thornsteinson & Withrow, 2009). That is, in the Dijksterhuis study there was no opportunity for participants to inspect information during deliberation; whereas in real life people often do have access to this information. In order to test this third UTT prediction, we designed a study in which unconscious thought was compared to more realistic operationalizations of conscious thought which offer participants access to information while they deliberate their decisions. UTT predicts that even in this situation unconscious thought should be superior to conscious thought.

The fourth prediction derived from UTT is that unconscious thought is associated with an optimal decision strategy, the weighting strategy, whereas conscious thought is associated with suboptimal strategies, such as the lexicographic strategy. In the weighting strategy, people derive for each choice alternative an importance-weighted sum of attributes and subsequently prefer the alternative with the highest weighted sum (see Brandstätter, Gigerenzer, & Hertwig, 2006, for a review). In the lexicographic strategy (Luce, 1978), people prefer the alternative with the highest score on the most important attribute. When two or more alternatives are tied, people compare the tied alternatives on the next most important attribute. This procedure continues until all ties are broken and only a single alternative is left. Note that there exist other suboptimal strategies, such as Dawes strategy (e.g. Brandstätter et al., 2006; Bröder & Schiffer, 2003). People using the Dawes strategy choose the alternative with the highest number of positive attributes (Bröder & Schiffer, 2003; Dawes & Corrigan, 1974, see also Payne et al., 2008). The weighting and Dawes strategy are prime examples of a compensatory strategy: negative values on some attributes can be compensated by positive values on other attributes. In contrast, the lexicographic strategy is a non-compensatory strategy: if one choice option scores suboptimal on the most important attribute, this cannot be compensated by other positive attributes.

Thus, UTT predicts that unconscious decisions are based on an optimal weighting strategy and not on the suboptimal lexicographic strategy. To our knowledge there are no studies that actually investigated this prediction. However, there is independent evidence to suggest that it is likely that unconscious decisions are based on the lexicographic instead of the weighting strategy. That is, decision making situations differ in the extent to which they encourage the use of the lexicographic strategy over the weighting strategy. For instance, people use the lexicographic strategy more often in decision making as opposed to judgment situations (Billings & Scherer, 1988). People also use the lexicographic strategy more often when information is presented in words instead of pictures (Bröder & Schiffer, 2006), and when the number of options and attributes is relatively high (cf. Bröder, 2003; Hunt, 2000; for a review see Ford, Schmitt, Schechtman, Hults, & Doherty, 1989). In addition, people use the lexicographic strategy more often when information has to be retrieved from memory than when there is full access to information (Slegers, Brake, & Doherty, 2000, see also Schooler & Hertwig, 2005). Finally, people use the lexicographic strategy more often when a decision making task has to be performed simultaneously with another task (Bröder & Schiffer, 2006; Hunt, 2000). In sum, people tend to use the lexicographic strategy instead of the weighting strategy when they are in a decision making situation, where information is presented in words, with a high information load that has to be retrieved from memory while performing another task. These are exactly the features associated with the unconscious thought condition of the Dijksterhuis et al. study: the study concerns decision making, information is presented in words, the information load is high, information has to be retrieved from memory, and participants perform another task (i.e. have to solve anagrams). In sum, UTT predicts that unconscious decisions are based on a weighting strategy, but general considerations suggest it is likely that unconscious decisions are based on a lexicographic strategy. Therefore, we designed a study to determine whether unconscious decision making relies on a weighting or a lexicographic strategy.

Here we report four studies – incorporating a total of 480 participants – that allow us to test the four predictions from UTT. In the first study, we investigated whether we could replicate the superiority of unconscious over conscious thought (prediction 1). In this study we also investigated whether the duration of unconscious thought affects the quality of unconscious decisions (prediction 2). In the second study, we investigated whether unconscious thought outperforms conscious thought, even if the latter is operationalized in more realistic ways (prediction 3). In the third study we investigated whether the Dijksterhuis paradigm offers the opportunity to determine whether participants use a weighting or a lexicographic strategy, where the answer turns out to be negative. In the fourth study, we therefore used a modified paradigm to assess different decision making strategies. More specifically, we determined whether unconscious decisions are based on the weighting instead of the lexicographic strategy (prediction 4).

## Study 1: Replication study and duration of Unconscious Thought Study

In this study, we tested two UTT predictions: first, that in complex situations, decisions after unconscious thought should outperform decisions after conscious thought and second, that the quality of decisions should increase with the duration of unconscious thought. We tested the first prediction by trying to replicate all aspects of the seminal work by Dijksterhuis et al. (2006a). We took every effort to maximize the probability of successfully replicating the findings from Dijksterhuis et al. (2006a). More specifically, as in Dijksterhuis et al., participants had to choose an option instead of judging options. In addition, like in Dijksterhuis et al., participants viewed choice attributes without knowing they had to decide at a later stage (i.e., the experiment featured a so-called "no-goal situation"). Moreover, we used the same stimulus materials[2] and the same operationalization of conscious thought as Dijksterhuis et al. did. We also adopted the same criterion for what constitutes the best choice, namely the option with the largest number of positive attributes.[3] Participants in our study were also psychology students from the Netherlands. Finally, we were also careful to use a larger sample size than Dijksterhuis et al. (i.e., 30 instead of 20 participants per cell), thereby increasing the probability of finding differences between conscious and unconscious thought and decreasing the probability that any null findings are due to a lack of power.

In this study, we also investigated the second UTT prediction that the quality of decisions should increase with the duration of unconscious thought. We contrast this with the online judgment account which states that people who know that they have to decide at a later stage (i.e. a "goal situation") base their decisions on an online judgment that is formed during attribute presentation and that remains unaltered by subsequent unconscious or conscious thought. The online judgment account thus predicts that immediate decisions, decisions after various durations of unconscious thought and conscious decisions should not differ.

### *Method*

#### *Participants*

Two hundred and ten psychology students from the University of Amsterdam and the University of Rotterdam in the Netherlands participated for course credit or a small monetary reward.

#### *Design*

Participants were randomly assigned to one of seven conditions, each condition featured 30 participants. Two conditions, that is, 4 min of unconscious thought and 4 min of conscious thought, were included to test the first UTT prediction regarding superiority of unconscious thought. These two conditions mimicked those in Dijksterhuis et al. (2006a): both conditions did not include a decision goal. The other five conditions, immediate decisions, 4 min of conscious thought and 2, 4 or 8 min of unconscious thought, were included to test the second UTT prediction concerning the effects of the duration of unconscious thought. In the latter five conditions participants were informed before attribute presentation that they had to decide at a later stage, that is, in these conditions participants did have a decision goal. In this study we operationalized conscious and unconscious thought as Dijksterhuis et al. (2006a) did: unconscious thought was operationalized by the instruction to deliberate decisions, whereas unconscious thought was operationalized by the instruction to solve anagrams.

#### *Materials*

We used the stimuli from the complex choice condition in Dijksterhuis et al. (2006a), that is, four cars defined by 12 attributes each.[2] We chose these complex stimuli since these stimuli were

[2] Dijksterhuis et al. were not able to provide the program in which the experiment was implemented, yet they did provide a table with car attributes in Dutch. We derived our stimuli from this Dutch table and not from the translated table in the supplementary materials of Dijksterhuis et al. (2006a). There were two reasons to do so. First, this allowed us to use the same wording as Dijksterhuis et al. did. Second, the supplementary materials contained an error: one of the suboptimal cars, the Kaiwa, was defined by 5 out of 12 negative attributes, whereas in the paper it was stated that the Kaiwa was defined by 6 negative attributes.

[3] Note that this definition equals optimality according to the Dawes strategy. It is not necessarily true that it equals optimality according to the weighting strategy. But as we will see in Study 3, the Dijksterhuis et al. (2006a) stimulus material yields one sole option that is optimal according to both the weighting strategy, the Dawes strategy, and the lexicographic strategy.

**Table 1**
The Dijksterhuis et al. (2006a) Material. *Note*: A "+" or "−" indicates that the car has the positive or negative version of the attribute. The average (in parenthesis standard deviation) ratings of attributes were obtained in Study 3. The dominance column contains the percentage of participants that gave the highest rating to a particular attribute.

| Attributes | Cars | | | | Ratings | Dominance* |
|---|---|---|---|---|---|---|
| | Hatsdun | Kaiwa | Dasuka | Nabusi | | |
| The car has good/poor mileage | + | + | − | − | 8.86(1.41) | 68 |
| The car is relatively good/not so good for the environment | + | + | − | − | 8.30(1.59) | 32 |
| The car has good/poor handling | + | − | + | − | 7.11(2.07) | 15 |
| With the car it is easy/difficult to shift gears | − | − | + | − | 7.04(2.04) | 11 |
| The car has plenty of/poor legroom | − | + | − | + | 6.52(2.42) | 9 |
| The car has a large/small trunk | + | + | − | − | 6.42(1.90) | 1 |
| The car has a good/poor sound system | − | − | + | − | 6.07(2.58) | 7 |
| For this car the service is excellent/poor | + | + | − | − | 6.02(2.36) | 6 |
| The car is very new/old | + | − | + | − | 4.59(2.44) | 2 |
| The car has a/no sunroof | + | − | + | + | 3.99(2.34) | 0 |
| The car is available in many/very few different colors | + | + | − | + | 3.57(2.37) | 0 |
| The car has/ has no cupholders | + | − | + | − | 2.37(2.45) | 1 |
| Total score of weighting strategy | 31.60 | 8.52 | −8.52 | −42.70 | | |

* Percentages do not necessarily sum to 100 since a participant may have given an equal high rating to two attributes.

associated with the superiority of unconscious thought in Dijksterhuis et al. (2006a). The stimuli are presented in Table 1. For example, the Kaiwa car is characterized by "good mileage", "good for the environment", "poor handling", etc. Following Dijksterhuis et al. (2006a), the car with the largest number of positive attributes, the Hatsdun, was defined as the optimal car.[3]

*Procedure*

The attributes were shown in random order on a computer screen for eight seconds each. The total viewing time thus was $4 \times 12 \times 8$ s, that is, 6.4 min. Prior to the presentation of the attributes, instructions appeared on screen. In the no-goal conditions participants did not receive a decision instruction before they viewed the car attributes. More specifically, in the no-goal, unconscious condition the instruction was:[4] "In this task, you will be shown a number of attributes of some cars. After having viewed all the cars attributes, you will be asked to make some anagrams for a while. The time will be indicated with a clock on screen". In the no-goal, conscious condition the instruction was: "In this task, you will be shown a number of attributes of some cars. After having viewed all the cars attributes, you will be asked to think for a while about those attributes, the time will be indicated with a clock on screen".

In the goal conditions participants were given the decision instruction before they viewed the car attributes. More specifically, in the goal and immediate and goal and conscious condition the instruction was: "In this task, you will be shown a number of attributes of some cars. After having viewed all the car attributes, you will be asked to think for a while about those attributes. The time will be indicated with a clock on screen and after a while you will have to decide which car is best. At the end of the experiment you will be asked to pick the best car. Important! At the end of the experiment you will be asked to pick the best car". In the goal and unconscious conditions the instruction was: "In this task, you will be shown a number of attributes of some cars. After having viewed all the cars attributes, you will be asked to make some anagrams for a while. The time will be indicated with a clock on screen and after a while the choice menu will automatically appear on screen. At the end of the experiment you will be asked to pick the best car. Important! At the end of the experiment you will be asked to pick the best car."

In all seven conditions, after making either the anagrams or thinking about the car attributes, participants were prompted to choose the best car with the instruction "You can now make your choice for the best car." Participants indicated their choice by typing a H for the Hatsdun, a K for the Kaiwa, etc.

*Results*

Fig. 1 shows the percentage of participants that chose the optimal car.[5] The first UTT prediction was tested by comparing the two no-goal conditions, one featuring conscious thought and the other featuring unconscious thought. Decisions in the conscious and unconscious conditions did not deviate significantly ($\chi^2(1) = 1.67$, $p = .20$). In the conscious condition 57% of the participants chose the optimal car, a percentage that exceeds the percentage that would be the result of guessing, i.e., chance level responding of 25% (binomial test, $p < .001$). In the unconscious condition 40% chose the optimal car, a percentage that does not exceed chance level responding ($p = .09$).

The second UTT prediction was tested by comparing the five goal conditions. All pairwise comparisons between immediate decisions, decisions after conscious thought and decisions after 2, 4 or 8 min of unconscious thought resulted in non-significant differences ($\chi^2$ tests with $p$ values exceeding .1). In all conditions the optimal car was chosen above chance level: immediate (47%, $p = .01$), conscious (67%, $p < .001$), unconscious 2 min (57%, $p < .001$), unconscious 4 min (63%, $p < .001$), unconscious 8 min (47%, $p = .01$).

*Discussion*

In this study, we tested the first prediction derived from UTT, that in complex situations, unconscious thought is superior to conscious thought. Although we aimed at an exact replication of the experimental conditions in the Dijksterhuis et al. (2006a) study, we failed to replicate the finding that unconscious thought is superior to conscious thought. The number of correct decisions did not differ significantly between the unconscious and conscious conditions. If anything, conscious decisions were slightly better than unconscious decisions: 57% of the conscious and 40% of the unconscious decisions were correct. Note that these percentages were respectively about 25% and about 60% in the Dijksterhuis et al. study.

The question then arises why results differ to such a large extent, since our study was designed to provide an exact replication.

[4] Dijksterhuis et al. (2006a) did not describe the instructions that were given before attribute presentation. Since the authors were not able to provide the program in which the experiment was implemented, we had to formulate our own instructions. Therefore, we cannot guarantee that instructions mimicked those in Dijksterhuis et al. (2006a).

[5] All pair-wise comparisons between the seven conditions indicate non-significant differences, except that 4 min of conscious thought with a goal resulted in better choices than 4 min of unconscious thought without a goal ($\chi^2(1) = 4.29$, $p = 0.04$). Moreover, four minutes of unconscious thought with a goal tended to yield better results than the same duration of unconscious thought without a goal ($\chi^2(1) = 3.27$, $p = 0.07$) (cf. Bos, Dijksterhuis, & van Baaren, 2008).

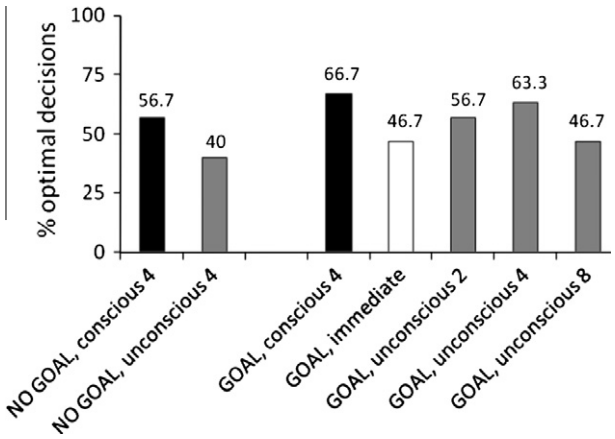


**Fig. 1.** Choice behavior in Study 1. Percentage of participants who chose the optimal car.

A first explanation might be that our stimulus materials did not match those of Dijksterhuis et al. As outlined in footnote 2, we used the stimulus materials kindly provided by Dijksterhuis et al., these stimuli differed slightly from the materials reported in the supplementary materials of Dijksterhuis et al. (2006a). However, Thornsteinson and Withrow (2009) did use the latter stimuli and also failed to observe superiority of unconscious over conscious thought. Therefore, this explanation is not very likely. A second explanation might be that our instructions before attribute presentation differed from those provided by Dijksterhuis et al. Unfortunately, Dijksterhuis et al. did not report their instructions and therefore we cannot determine whether this is a likely explanation.

In this study, we also tested the second UTT prediction that the quality of unconscious decisions should increase with the duration of unconscious thought. The results indicate that immediate decisions are equivalent to decisions after various durations of unconscious thought. Therefore these results do not support the second UTT prediction.[6] Instead, the results support the online judgment prediction, which holds that viewing information with a decision goal in mind results in online judgment which is not changed by various durations of subsequent unconscious thought.

Finally, note that conscious decisions also did not deviate from immediate decisions, although conscious decisions tended to be slightly better than immediate ones. Therefore, we conclude that conscious decisions are also derived from online judgment. This is not to say that future studies with larger sample sizes might find a difference between immediate and conscious decisions, and thus will conclude that conscious decisions are not only derived from online judgment, but also from conscious deliberation.

## Study 2: Access to information study

The aim of this study was to test the third UTT prediction that unconscious thought is superior to conscious thought under conditions that are likely to hold in real-life decision problems. In the Dijksterhuis et al. (2006a) study, the conditions for conscious thought were arguably not very typical of real-life decision making: participants first viewed attributes in random order and then deliberated their decisions while they did not have access to information on these attributes. In real life, people often do have access to information during deliberation. They might deliberate decisions while viewing an unstructured list with notes on choice attributes. Or they might deliberate decisions while they view structured information, for example as presented in tables from consumer guides. In order to test the third UTT prediction, we therefore performed a study in which we compared 4 min of unconscious thought to more real-life operationalizations of conscious thought in which participants did have access to unstructured or structured information while they deliberated their decisions.

### Method

#### Participants

One hundred and eight psychology students of the University of Amsterdam in the Netherlands participated for course credit or a small monetary reward. The students did not participate in Study 1.

#### Design

Participants were randomly assigned to one of three conditions: unconscious thought ($n = 41$), a "structured conscious" condition ($n = 30$) or an "unstructured conscious" condition ($n = 37$). In the unconscious condition, participants first viewed randomly presented attributes for 6.4 min and then solved anagrams for 4 min (cf. Study 1). In the "structured conscious" condition participants first viewed the randomly presented attributes for 6.4 min and then deliberated their choices for 4 min while they had full access to information which was presented in a highly structured way. In the "unstructured conscious" condition participants deliberated their choices for 4 min while they studied a list in which the attributes were presented in random order. Note that the total time in the unconscious and structured conscious condition thus was 10.4 min, whereas it was only 4 min in the "unstructured conscious" condition.

#### Materials

In this study, we again used the Dijksterhuis stimuli (cf Study 1, Table 1).

#### Procedure

The experimental procedure for the unconscious condition was equivalent to the goal and unconscious procedure in Study 1. The experimental procedure for the "structured conscious" condition mimicked the goal and conscious procedure in Study 1, on the understanding that during deliberation participants were able to inspect a sheet of paper on which all the attributes were listed just as they would be presented in consumer guides. The order of attributes and options on this sheet was randomized between participants. In the "unstructured conscious" condition, participants did not view attributes on a computer screen but they deliberated their choices for 4 min while they were provided with a sheet of paper on which the attributes were presented in a random order. For example, the sheet may have started with the statement "The Kaiwa has a large trunk" followed by "The Nabusi has poor handling".

### Results

The percentage of optimal choices was higher in the conscious conditions than in the unconscious condition (unconscious vs. unstructured conscious: $\chi^2 = 4.64$, $df = 1$, $p = .03$; unconscious vs. structured conscious: $\chi^2 = 10.70$, $df = 1$, $p = .001$), but did not differ significantly between the two conscious conditions ($\chi^2 = 2.14$, $df = 1$, $p = .14$). Fig. 2 shows that in the unconscious condition, 58.5% of the participants made the optimal decision, a percentage that exceeds chance responding ($p < .001$). In the conscious conditions the percentage of optimal decisions was even larger (unstructured conscious 81.1%, $p < .001$); structured conscious (93.3%, $p < .001$).

[6] Note that although the duration of unconscious thought did not significantly affect decision quality, performance tended to *de*crease after 8 min of unconscious thought. This finding further challenges UTT, which predicts that performance should *in*crease with the duration of unconscious thought.

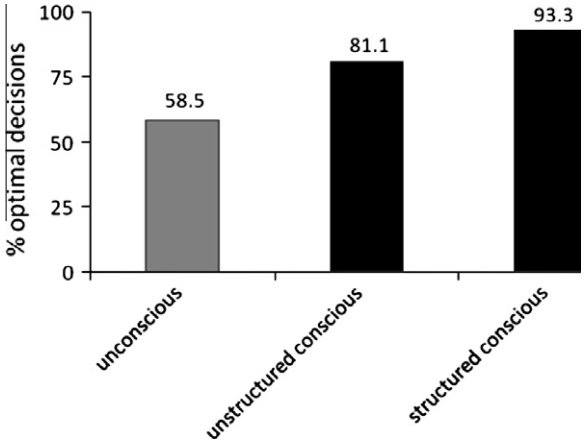


**Fig. 2.** Choice behavior in Study 2. Percentage of participants who chose the optimal car.

Finally, the percentage of optimal choices in the conscious conditions exceeded that of the Study 1 conscious condition where participants did not have access to information during deliberation (unstructured conscious vs. no information conscious: $\chi^2 = 3.98$, $df = 1$, $p = .046$; structured conscious vs. no information conscious: $\chi^2 = 6.67$, $df = 1$, $p = .01$).

*Discussion*

In this study, we tested the third UTT prediction, namely that unconscious thought is superior to conscious thought under conditions that are likely to hold in real-life decision problems. That is, when people have full access to information while they deliberate their decisions. The results of this study do not support this prediction. Instead, our results suggest that people will make better decisions if they are able to inspect information while they are consciously deliberating their decisions (cf. González-Vallejo et al., 2008; Shanks, 2006). Therefore the present results indicate that the advice to sleep on decisions problems warrants reconsideration.

## Study 3: Does the Dijksterhuis paradigm allow for an assessment of strategies?

According to UTT, unconscious decisions outperform conscious decisions because the former rely on an optimal weighting strategy whereas the latter rely on simplified strategies such as the lexicographic strategy (Dijksterhuis & Nordgren, 2006, p. 105). In order to test this prediction, it should first be determined whether the original Dijksterhuis paradigm allows one to determine whether participants use a lexicographic or a weighting strategy. This is the case only if one option is optimal according to a weighting strategy and another is optimal according to a lexicographic strategy (cf. Jansen, van Duijvenvoorde & Huizenga, 2012, for a similar approach). If one choice option is optimal according to several decision strategies, the paradigm does not allow one to test UTT's fourth prediction that unconscious and conscious thought rely on different strategies. In that case, the paradigm should be modified in such a way as to allow for an assessment of strategy use. The aim of the third study therefore was to investigate whether the Dijksterhuis paradigm allows one to identify decision strategies.

In order to address this question, we obtained importance ratings of choice attributes in the Dijksterhuis paradigm. In this manner, we were able to determine whether choice options were optimal according to a weighting strategy, a lexicographic strategy or according to Dawes strategy. The latter strategy was also assessed since Dijksterhuis et al. (2006a) defined the optimal choice option as the option with the highest number of positive attributes.

*Method*

*Participants and materials*

Eighty-seven psychology students of the University of Amsterdam in the Netherlands rated the 12 car attributes in the Dijksterhuis paradigm on a 10-point scale (1 = not important, 10 = very important). The students did not participate in Studies 1 and 2.

*Results*

The ratings column in Table 1 shows the average rating for each attribute. The final row of Table 1 shows the average weighting score for each car. The Hatsdun is optimal according to Dawes strategy since it has the highest number of positive attributes. The Hatsdun is also optimal according to the weighting strategy since it has the highest average weighting score. In addition the Hatsdun is optimal according to a three-step lexicographic strategy, since this is the only car that scores positive on the three most important attributes. This means that a choice for the Hatsdun is optimal according to at least three choice strategies.

*Discussion*

This study indicates that one choice option is optimal according to at least three strategies, the weighting strategy, the lexicographic strategy and Dawes strategy. This implies that the Dijksterhuis paradigm cannot be used to test UTTs fourth prediction that unconscious thought relies on the weighting strategy and that conscious thought relies on the lexicographic strategy. Therefore, in Study 4, we designed new stimulus materials that do allow us to test this prediction.

The present study also generates more insight into the results of the conscious condition in Dijksterhuis et al. (2006a). More specifically, our results indicate that one choice option is optimal according to both the weighting and the lexicographic strategy. Therefore, UTT predicts that this choice option should be chosen by more than 25% of the participants in both the unconscious *and* the conscious condition. Indeed Dijksterhuis et al. (2006a) found that about 60% of the participants in the unconscious condition chose the optimal car, a result far exceeding chance level (binomial test, $p < .001$). However only about 25% of the participants in the conscious condition chose this optimal car out of four cars, a percentage certainly not exceeding chance level responding (binomial test, $p = .59$). This reanalysis of the data reported by Dijksterhuis et al. therefore suggests that participants in their conscious thought condition did not rely on a lexicographic strategy.

The question then arises what kind of decision strategy has been used by participants in the conscious condition of Dijksterhuis et al. (2006a). Shanks (2006) suggested that participants might have been confused and therefore resorted to guessing. Dijksterhuis et al. (2006b) indicated in a rebuttal that this guessing account is not required since "Although conscious deliberation itself cannot be said to be random, the decisions produced by conscious deliberation are under some circumstances not superior to randomly generated decisions". This rebuttal is not supported by our results. Instead, our results indicate that lexicographic decisions do give rise to decisions that are superior to random decisions. Hence, our results may provide support for Shanks (2006) suggestion that participants in the conscious condition of Dijksterhuis et al. (2006a) resorted to guessing.

Alternatively, participants in the Dijksterhuis et al. study may have used a lexicographic strategy but valued attributes differently than participants in our study. For example, cf. Table 1, if they valued "legroom" as more important than "mileage", a lexicographic strategy would result in a choice for the suboptimal Kaiwa instead of the optimal Hatsdun car. Note however that this explanation

requires that the Dijksterhuis et al. sample differed substantially from our sample: Table 1 shows that in our sample 68% of the participants valued mileage as most important and only 9% did so for legroom.

In sum, this study indicates that the Dijksterhuis paradigm does not offer the possibility to assess decision strategies. In addition, the present analysis provides some further insight into the suboptimal conscious decisions reported by Dijksterhuis et al. (2006a). The present analysis indicates that these decisions may be due to guessing. Alternatively, these decisions may be due to a lexicographic strategy, but only if participants weighted attributes differently than participants in our sample.

## Study 4: Assessment of decision strategies in a modified paradigm

Study 4 features a modified paradigm in which attributes are assigned to the choice alternatives in a way that allows us to assess decision strategies. Specifically, the modified paradigm allows us to test the fourth UTT prediction, namely that participants in the unconscious condition used a weighting strategy (Dijksterhuis & Nordgren, 2006, pp. 97, 99, 100, 103), rather than a lexicographic strategy.

The modified paradigm is based on the results from Study 3. This study had generated importance ratings for the 12 choice attributes. Based on these ratings, we constructed a new choice option that was optimal according to a lexicographic strategy and another new choice option that was optimal according to a weighting strategy,[7] the two remaining options being fillers that were suboptimal according to both strategies. Furthermore, all choice options had the same number of positive and negative attributes, thus precluding the use of Dawes strategy. If our results indicate unconscious decision makers prefer the option that is optimal according to a weighting strategy over the option that is optimal according to the lexicographic strategy, this then supports the fourth UTT prediction.

### Method

#### Participants

Seventy-five psychology students of the University of Amsterdam in the Netherlands participated for course credit or a small monetary reward. The students did not participate in Studies 1, 2 or 3.

#### Design

Participants were randomly assigned to one of two conditions, an unconscious condition ($n = 50$) or an unstructured conscious condition ($n = 25$). The latter condition was included to compare unconscious decision strategies to conscious decision strategies in realistic circumstances where people have access to information when they consciously deliberate their decisions.

#### Materials

In the new stimulus materials, one car that was optimal according to a lexicographic strategy (the Hatsdun), and another car was optimal according to a weighting strategy (the Kaiwa), the two remaining cars being fillers that were sub-optimal according to both strategies (cf. Table 2).

#### Procedure

The experimental procedure for the unconscious condition was equivalent to that of the unconscious goal conditions in Studies 1 and 2.The experimental procedure for the unstructured conscious condition was equivalent to that of the unstructured conscious condition in Study 2.

#### Results

As can be seen in Fig. 3, the unconscious and unstructured conscious conditions did not yield different choices ($\chi^2 = 0.18$, $p = .67$).

In the unconscious condition, the percentage of participants choosing the car that was optimal according to the lexicographic strategy did not differ significantly from the percentage of participants choosing the car that was optimal according to the weighting strategy ($\chi^2 = 1.6$, $p = .21$) (cf. Fig. 3). 48% of the participants chose the car that was most desirable according to the lexicographic strategy (significantly different from chance responding, binomial test, $p < .001$), whereas 32% chose the car that was most desirable according to the weighting strategy (not significantly different from chance responding, binomial test, $p = .16$).

Also, in the unstructured conscious condition, the percentage of participants choosing the car that was optimal according to the lexicographic strategy did not differ from the percentage of participants choosing the car that was optimal according to the weighting strategy ($\chi^2 = 0.18$, $p = .67$). The lexicographic strategy was used above chance level (48%, binomial test, $p = .01$), but this was not the case for the weighting strategy (40%, binomial test, $p = .07$) (cf. Fig. 3).

#### Discussion

The present results do not provide evidence for the fourth UTT prediction: there is no evidence to suggest that unconscious thought relies on the weighting strategy – if anything, the lexicographic strategy is more popular. The same is true for decisions based on conscious thought where people are able to inspect information during deliberation.

The stimulus materials were designed such that each choice option had the same number of positive attributes, therefore Dawes strategy could not be used to arrive at a decision. This of course does not preclude the possibility that unconscious thought does rely on Dawes strategy in case choice options do differ on the number of positive attributes. In fact, Payne et al. (2008) suggested that unconscious thought may rely on Dawes strategy.

It should be noted that we used average ratings of attributes in one group of participants to construct stimulus material that allows for identification of strategies in another group of participants. One might possibly argue that the average ratings in one group do not adequately describe individual ratings in another group. However, the attribute ratings did not show marked variations within a group (cf. Table 1, sixth column), and the two groups were very homogeneous (i.e., students in a similar age range from the same department). This suggests that average ratings indeed provide adequate descriptions of individual ratings. An alternative approach would be to ask each individual participant to rate all attributes, and then construct stimulus materials that allow for the determination of strategies in this individual participant. A disadvantage of the latter approach is that the requirement to rate attributes may bias the process of unconscious and conscious decision making (cf. Park & Lessig, 1981).

[7] It should be acknowledged that this stimulus material is based on average ratings and that ratings of individual participants may differ. For example, a particular participant may judge mileage and the environment as very unimportant. When this participant chooses the Kaiwa (cf. Table 2), this choice reflects the outcome of a lexicographic strategy instead of a weighting strategy. Although it is difficult to completely exclude this interpretation, the results of Study 3 indicate that it is not very likely. First, the standard deviations of the average ratings are small (Table 2, sixth column). More importantly, "mileage" and "environmental friendliness" were rated as the most important attribute by 68% and 32% of the participants, respectively. This makes it unlikely that the Kaiwa, – a car that scores negatively on both of these important attributes – is preferred by an individual participant using a lexicographic strategy.

**Table 2**
The cars and their attributes as constructed for Study 4. According to the lexicographic strategy, the Hatsdun is the best car; according to the weighting strategy, the Kaiwa is the best car. *Note*: A "+" or a "−" indicates that the car has the positive or the negative version of the attribute, respectively.

| Ratings | Attributes | Cars | | | |
|---|---|---|---|---|---|
| | | Hatsdun | Kaiwa | Dasuka | Nabusi |
| 8.86 (1.41) | The car has good/poor mileage | + | − | − | − |
| 8.30 (1.59) | The car is relatively/not so good for the environment | + | − | − | − |
| 7.11 (2.07) | The car has good/poor handling | − | + | − | − |
| 7.04 (2.04) | With the car it is easy/difficult to shift gears | − | + | − | − |
| 6.52 (2.42) | The car has plenty of/poor legroom | − | + | + | − |
| 6.42 (1.90) | The car has a large/small trunk | − | + | − | + |
| 6.07 (2.58) | The car has a good/poor sound system | − | + | + | + |
| 6.02 (2.36) | For this car the service is excellent/poor | + | + | + | + |
| 4.59 (2.44) | The car is very new/old | + | + | + | + |
| 3.99 (2.34) | The car has a/no sunroof | + | − | + | + |
| 3.57 (2.37) | The car is available in many/very few different colors | + | − | + | + |
| 2.37 (2.45) | The car has/ has no cupholders | + | − | + | + |
| Total score of weighting strategy | | 4.54 | 16.68 | −4.60 | −4.80 |

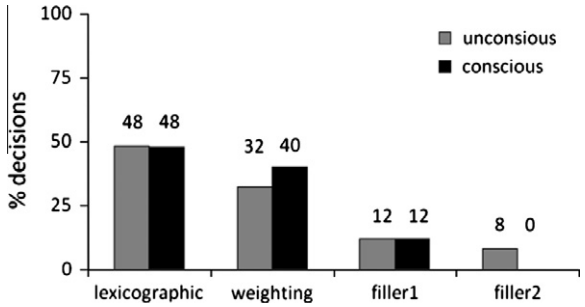


**Fig. 3.** Choice behavior in Study 4. Percentage of participants who chose the lexicographic-optimal car, the weighting-optimal car, or a suboptimal car ("Filler 1" and "Filler 2").

## General discussion

Unconscious Thought Theory (UTT) states that unconscious thought results in better decisions than conscious thought. This counterintuitive claim was supported by an influential study from Dijksterhuis et al. (2006a). If true, UTT has profound scientific and practical ramifications. The importance of the theory and its counterintuitive nature prompted us to test four predictions of UTT. The first and arguably most central prediction is that unconscious thought leads to better decisions than conscious thought. The second prediction is that the quality of unconscious decisions increases with the duration of unconscious thought. The third prediction is that the superiority of unconscious thought remains, even when people have access to all relevant information when they consciously deliberate their decisions. The fourth prediction is that unconscious thought relies on a weighting strategy, whereas conscious thought relies on a lexicographic strategy.

With respect to the first prediction, we showed in an exact experimental replication of the Dijksterhuis et al. (2006a) study, that unconscious thought is not superior to conscious thought. This result strengthens the conclusions of previous studies, not specifically aimed at an exact replication of experimental conditions, that also failed to show the superiority of unconscious thought (Lassiter et al., 2009, "memorize" condition; Acker, 2008; Calvillo & Penaloza, 2009; González-Vallejo, Lassiter, Bellezza, & Lindberg, 2008; Mamede et al., 2010; Newell et al., 2009; Payne et al., 2008; Rey et al., 2009; Thornsteinson & Withrow, 2009; Waroquier et al., 2009). Thus, the first prediction of UTT is not supported by our data.

With respect to the second prediction, we showed that, immediate, unconscious and conscious decisions without access to information are comparable, and that the duration of unconscious thought does not affect the quality of decisions. This suggests that people form an online judgment while they view information, and that subsequent unconscious or conscious thought without access to information have little or no impact on the decision (cf. Lassiter et al., 2009; Newell et al., 2009). Therefore, the second prediction of UTT is not supported by our data.

With respect to the third prediction, we showed that if people have access to information during conscious deliberation, their decisions will be superior to decisions derived from unconscious thought. Our results suggest therefore, that instead of sleeping on a problem, a better advice is to make deliberate decisions with full access to information (González-Vallejo et al., 2008; Shanks, 2006; Thornsteinson & Withrow, 2009). Thus, the third prediction of UTT is not supported by our data.

With respect to the fourth prediction, we showed that unconscious thought is not specifically associated with the optimal weighting strategy. If anything, the lexicographic strategy is more popular. The same was found to be true when people consciously deliberated their decisions while having access to information. Thus, the fourth prediction of UTT is not supported by our data.

In sum, none of the four predictions from UTT was supported by our data. Together with other critical studies, our results therefore cast doubt on the validity of UTT as an adequate description of unconscious and conscious decision making. Interestingly, our analysis in Study 3 also indicated that it is not very likely that UTT provides an adequate explanation for the suboptimality of conscious decisions in the Dijksterhuis et al. (2006a) study. Therefore, further study is needed to determine why conscious decisions were suboptimal in the Dijksterhuis et al. study.

We recommend that, in future studies on this topic, researchers take considerable care when choosing and documenting their experimental procedures. Our review of unconscious thought studies indicates that studies vary in instructions (with or without a decision goal), in whether a judgment or a choice is required, and in the operationalization of conscious thought. All of these factors may affect the comparison between unconscious and conscious thought. In addition, if assessment of decision strategies is important, considerable care should be taken in the design of stimulus materials. More specifically, stimuli should be designed such that strategies are uniquely associated with choices (cf. Payne et al., 2008).

In this article, we concentrated our efforts on variants of the car stimulus materials used by Dijksterhuis et al. (2006a). We focused on the car materials because the study in which these were used has had a large impact in the popular media, and because these materials were made available to us. Although it seems reasonable to assume that similar results will be found for different decision

problems, it might be argued that the present results only apply to the selection of a car (see e.g., Dijksterhuis, 2004; Dijksterhuis & van Olden, 2006; Strick et al., 2010).

In our studies we focused on choice and did not consider post choice satisfaction. Studies in unconscious decision making have found that participants are more satisfied after unconscious than after conscious decisions (Dijksterhuis, 2004; Dijksterhuis & van Olden, 2006; Dijksterhuis et al., 2006a; but see Kmett, Arkes, & Jones, 1999). However, this finding does not necessarily indicate that unconscious decisions are better (Iyengar, Wells, & Schwartz, 2006; Schwartz et al., 2002). The relatively low satisfaction after conscious decisions may be related to unease with the decision process. More specifically, participants may experience a feeling of discomfort if they try to deliberate their choices in a situation where they have to retrieve all information from memory. This explanation is supported by the findings of Kmett et al. (1999), who showed that conscious decisions supported by a decision aid resulted in a higher post choice satisfaction than more intuitive decisions.

To conclude, Unconscious Thought Theory yields four testable predictions, none of which were supported by the present studies. Based on our findings, and those of previous studies, we conclude that Unconscious Thought Theory does not provide an adequate description of unconscious and conscious decision processes. More specifically, the results of our studies do not support UTT's advice to sleep on a problem, instead our results suggest that it is better to consciously deliberate decisions while having access to information.

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