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Unconscious intuition or conscious analysis? Critical questions for the Deliberation-Without-Attention paradigm

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Abstract

The Deliberation without Attention (DWA) effect refers to apparent improvements in decision-making following a period of distraction. It has been presented as evidence for beneficial unconscious cognitive processes. We identify two major concerns with this claim: first, as these demonstrations typically involve subjective preferences, the effects of distraction cannot be objectively assessed as beneficial; second, there is no direct evidence that the DWA manipulation promotes unconscious decision processes. We describe two tasks based on the DWA paradigm in which we found no evidence that the distraction manipulation led to decision processes that are subjectively unconscious, nor that it reduced the influence of presentation order upon performance. Crucially, we found that a lack of awareness of decision process was associated with poorer performance, both in terms of subjective preference measures used in traditional DWA paradigm and in an equivalent task where performance can be objectively assessed. Therefore, we argue that reliance on conscious memory itself can explain the data. Thus the DWA paradigm is not an adequate method of assessing beneficial unconscious thought.

Keywords: unconscious thought, intuition, deliberation.

1 Introduction

Decision theorists have long distinguished between analytical and intuitive decision making (e.g., Brunswik, 1956; Simon, 1955), often attributing them with different processing modes (e.g., Epstein, 1994; Evans, 2008; Stanovich & West, 2001). Despite the flourishing theoretical literature supporting this dichotomous view, the number of empirical attempts to contrast the effects of intuition and deliberation is limited. One reason for this lack of research is the difficulty of assessing the goodness of any particular decision (Wilson & Schooler, 1991). Another reason could originate from the traditional assumption that reasoning and analysis always lead to better outcomes (e.g., Koriat, Lichtenstein, & Fischhoff, 1980). Nevertheless, some of the theories subscribing to this dichotomous view assume that under certain circumstances intuitive decisions can bring more optimal results than rational thinking.

A number of empirical studies have given support to this notion, suggesting that for some tasks we are really better off without conscious thinking (e.g., emotion recognition: Halberstadt, 2005; basketball prediction: Halberstadt & Levine, 1999; prediction at the stock market: Harteis & Gruber, 2008; perceptual training: Melcher & Schooler, 2004; product choice: Wilson & Schooler, 1991). These results were often explained by the hypothesis that reasoning can lead people to use non-optimal criteria and consequently to make worse decisions (Wilson, Dunn, Kraft, & Lisle, 1989), or that intuitive decisions can benefit from the use of *"smart heuristics"* (Gigerenzer, 2007).

Dijksterhuis and his colleagues, however, propose an alternative explanation for superior performance when analytic strategies are not used. According to Unconscious Thought Theory (UTT; Dijksterhuis & Nordgren, 2006) intuitive decisions may benefit from *unconscious thought*: a high capacity process which can weight numerous pieces of information and integrate them into decisions automatically and via distributed, bottom-up processing. They argue that this "smart" unconscious process is more capable in complex, information-dense decision situations than conscious thought, which is limited by working memory capacity.

Empirical support for UTT comes primarily from the Deliberation-without-Attention (DWA) paradigm (e.g., Dijksterhuis, 2004; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006) in which participants are presented with a list of positive and negative attributes describing a variety of possible choices within a particular category (e.g., apartments). The opportunity for thinking before choosing is manipulated across three conditions: participants in the Immediate Decision condition make their decision

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at once; those in the Conscious Thought condition have four minutes to think; those in the Unconscious Thought condition make a choice after four minutes performance on an irrelevant task. According to UTT, the best choices will be made by participants in the Unconscious Thought condition, because the irrelevant task interval provides an opportunity for unconscious processing of information. By contrast, the Conscious Thought condition is assumed to promote choices based on limited-capacity, conscious processing. As has been noted previously (Shanks, 2006), it is also possible that a *forced* delay between evaluation (which may be completed early in the four minute interval) and response in the Conscious Thought condition may somehow (e.g., by self-generated interference) reduce performance; the Immediate Decision condition acts as a baseline, providing control for this counterintuitive effect of forced delay.

Initial studies using this paradigm provided many illustrations of this "DWA effect", supporting for UTT (e.g., Dijksterhuis, 2004; Dijksterhuis, Bos, van der Leij, & van Baaren, 2009; Dijksterhuis & van Olden, 2006). However, several recent papers have challenged this interpretation and questioned the degree of support the original paradigm offers for UTT.

A series of studies has reported a failure to replicate the original results (e.g., Calvillo & Penaloza, 2009; Lassiter, Lindberg, Gonzalez-Vallejo, Bellezza, & Phillips, 2009; Newell, Wong, Cheung, & Rakow, 2009; Thorsteinson & Withrow, 2009; Waroquier, Marchiori, Klein, & Cleeremans, 2009). Others have found that the effect may only occur under specific circumstances (e.g., Lerouge, 2009; Payne, Samper, Bettman, & Luce, 2008).

Acker (2008) used a meta-analysis to determine that the benefit for choices following unconscious thought in the first 17 studies published was modest (mean effect size $g = .251$). A more recent meta-analysis of 37 studies (Strick et al., n.d.) reported a similar effect size ($g = .244$), which the authors propose as evidence for important moderators of the effect in the different designs of the task.

Notwithstanding any controversy regarding the magnitude or reliability of the DWA effect, we believe that there are two more fundamental criticisms that must be addressed before the effect can be interpreted as evidence for beneficial unconscious processing.

1.1 Preferences between objects of choice (e.g., persons, cars etc.) are difficult to assess in terms of decision quality

The original interpretation of the DWA effect is based on a view that the preferences of the unconscious thought condition are not only different from, but *better than,* the decisions made in other conditions. This is generally defined as a stronger preference for the item with the highest proportion of positive attributes, or the highest sum of attributes weighted according to their importance. However, these approaches may fail to capture true optimal preference, as combinations of attributes, such as a potential housemate who is both *very tidy* or *is often in her room* (examples from Dijksterhuis, 2004), may influence the evaluation in complex ways (Waroquier et al., 2009). In general, the lack of an *objective* scale on which to rate the choices presents a challenge for a claim concerning that benefits of a particular decision strategy, especially a claim that a decision is superior to that made by participants who are free to reflect upon their choice.

Furthermore, even if one accepts that one option is objectively better than another, a stronger preference for the "good" item may not always represent a *better* decision than a weak preference, if a strong preference *overestimates* the relative difference in quality. Rey and colleagues (Rey, Goldstein, & Perruchet, 2009) analyzed decision strategies on a standard DWA task involving choosing between cars. Using independent ratings of attribute importance they found that a comparison of the cars on a subset of between two and five of the most important attributes produced the largest apparent quality difference between the "best" car and the others, with a steep decrease in this difference when more attributes are included in the consideration. For difficult decisions, the combination of all relevant attributes may be such that the values of the two options are closely matched. In such a case, a stronger preference may represent a reduction in performance, due to recollection of fewer attributes (a consequence of the distraction manipulation reported by Newell et al., 2009).

1.2 The DWA effect may be due to influences on explicit processing

The DWA effect provides support for UTT only insofar as the key manipulation may be assumed to alter the amount of "unconscious thinking" between the groups. However, performance is likely to be sensitive to explicit cognitive processes: on-line judgments and recollection. As participants are typically aware of the choice requirement before the presentation of the attributes, they may treat the task as a form of on-line judgment. A judgment is on-line if based on the immediate experience of the subject (Hastie & Park (1986).[1] Empirical support

[1] Hastie and Park (1986, p. 261) differentiated memory-based and on-line judgment tasks: "In many judgment tasks, information for the operator follows a path from the stimulus environment external to the subject into working memory and directly to the judgment operator. We call tasks of this type on-line judgment tasks because the subject is forming the judgment 'on-line' as evidence information is encountered."

for this type of bias comes from observations that manipulation of the presentation order influences final ratings (e.g., Calvillo & Penaloza, 2009; Lassiter et al., 2009; Newell et al., 2009), and the finding that initial instructions to simply memorize the attributes, rather than to form an impression of the alternatives, reverse the DWA effect (Lassiter et al., 2009). Evidently, differences in online judgment cannot be the source of the original DWA effect, as the key manipulation occurs after such opinions would be formed; however, the distraction manipulation might influence conscious memory retrieval for the attributes or opinions (Shanks, 2006). Recent evidence that mnemonic aids removes the DWA effect, producing superior performance for the Conscious Thought group (Thorsteinson & Withrow, 2009), and replications in which only immediate deciders performed better than chance (Calvillo & Penaloza, 2009) confirm that conscious memory is an important factor in this type of task.

Establishing a role for explicit memory in the DWA task does not directly challenge the UTT account, as the theory does not exclude the possibility of conscious processing affecting the decisions. Nevertheless, if the DWA effect is adequately predicted by explicit accounts, it can be accepted as evidence for UTT only if direct evidence is available for the unconscious nature of the thought processes involved (Shanks, 2006).

Despite the importance of this issue, to our knowledge there have been no previous attempts to provide direct evidence for unconscious processing in DWA paradigms, most likely because of the well-known difficulty in establishing the conscious status of processes (e.g., Shanks & St. John, 1994). However, UTT has as a central claim that decisional processes may be unconscious; if this is to be considered a valid scientific claim, it must have empirical consequences. Fortunately, the authors of UTT provide a way by which unconscious thought processes may be empirically identified. UTT states that unconscious thought processes result in intuition, a feeling of preference, and that the agent is *"largely unaware where that feeling came from, or what it is based on"* (Dijksterhuis & Nordgren, 2006, p. 105). The degree to which a preference is based upon a "feeling of intuition", rather than "consciously inferred based on recollections" can be assessed empirically using personal reports.

In this study we present a replication of one of the original examples of the DWA task, as close as possible to the original design, with the addition of a simple question to assess how much the person believed that their decision is based upon a feeling of intuition or recollection, in order to assess whether subjectively intuitive, unconscious decision-making corresponds in general with better performance. In addition, we used a novel variant on the DWA paradigm in which the accuracy of decisions could be assessed objectively.

2 Method

2.1 Participants

72 undergraduate students (41 female) of Eötvös Loránd University, Budapest, Hungary (M = 21.86 years, SD = 3.11 years), native Hungarian speakers, received 1500 HUF (approximately US$ 8) for participation in a 45-minute session of unrelated experiments; this study comprised the second half of the session following an unrelated selective attention task. Each participant attended one of three independent sessions (24 individuals per session). Within each session, individuals were randomly assigned to one of the three conditions, and were in the same condition for both of the tasks.

2.2 Materials and procedure

The experiment consisted of two decision making tests: *Housemate Rating Test* followed by the *Number Mean Estimation Test.*

Housemate Rating Test. Participants were informed that they were taking part in a decision making experiment. They would see descriptions of three potential housemates (*László, István, Zoltán*), after which they would be asked to rate each housemate. Stimuli from Dijksterhuis (2004) Experiment 3, were translated into Hungarian including any necessary cultural adjustments. Prior to the main task, half of the participants in each group were required to rate the subjective importance of twelve attribute dimensions for a housemate (e.g., cooking skills) on a 7-point Likert scale from 1 (very unimportant) to 7 (very important).

36 sentences were used, each describing a single attribute of one housemate on one of the twelve dimensions. Each description was either positive (e.g., *"László is very friendly"*) or negative (e.g., *"István is not very tidy"*). Housemate names and attributes were counterbalanced across participants. The most attractive housemate for each participant (hereafter Housemate A) had 8 positive and 4 negative attributes; the least attractive housemate (Housemate C) had the reverse attribute on each of these dimensions, giving 4 positive and 8 negative attributes. Finally, Housemate B had 6 positive and 6 negative attributes. The sentences were presented in a random order for 3 s each with 0.5 s blank screen between each sentence.

Following presentation of the sentences, participants rated the housemates. Ratings were taken at once, in the Immediate Decision condition, or after four minutes. In the Conscious Thought condition, the names of the three potential housemates were presented on the screen and participants were encouraged to use the four minutes as thinking time. In the Unconscious Thought condition,

participants were required to perform a 1-back task during the four minute interval. A random sequence of the letters A, B, and C appeared on the screen, each letter shown for 1.9 s with a 0.8 s ISI. Participants were instructed to decide if the letter was the same as the previous one, indicating their response by pressing one of two keys on the keyboard ("X" for same, "M" for different).

Participants rated their impression of each potential housemate using three identical on-screen 7-point Likert scales, ranging from 1 (extremely negative) to 7 (extremely positive). For half of the participants the names of the housemates were arranged in A-B-C order (as in Dijksterhuis, 2004); for other participants the names were presented in C-B-A order. Following a four minutes interval, all participants then rated the subjective importance of twelve attribute dimensions for a housemate as described above (half of the participants were re-rating these dimensions).

In the second and third of the three sessions, the participants were asked to report how much they had relied on memories of specific attributes whilst rating the housemates. This was done using a numerical response reported on a scale from 0 (pure intuition/guess) to 10 (pure memory).

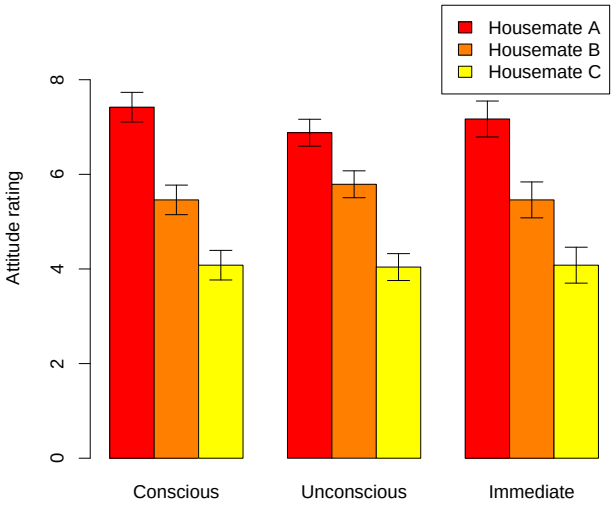
Number Mean Estimation Test. The rating of attribute dimensions within the Housemate Task supposes that, rather than simply regarding each individual attribute as "good" or "bad", the subjective importance and magnitude of these evaluations varies across attributes and across individuals. The second test was designed to be logically equivalent to the *Housemate Rating Task*, but without the subjective variation in the importance or magnitude of preference. Housemates A and C were replaced by different colors, and color descriptive attributes by the magnitudes of presented digits. The instructions ensured that participants attended to the magnitudes and color of each digit.

Participants received the following instructions (in Hungarian):

"In the following task you will be presented with blue and red numbers. During the task you should attend to both the colors and the values of the numbers. After each number presented, press key 'X' if the presented number has different color from the previously presented number. If the two numbers had the same colors and the new number is bigger, then press key 'M', otherwise do not press any keys. Start the task from the second number presented. Later on you will have to evaluate these numbers according to their colors and values."

The digits varied between 0 and 9. Each stayed on the screen for 2.1 s and was followed by a 0.4 s pause. Digit values were taken from two sets (Set 1, M = 3.5; Set 2, M = 5.5), and members of each set were represented by a distinct color (blue or red, balanced across participants). The items were presented in one of two fixed orders. Order A was constructed such that the difference in means was largely due to items early in the presentation order, whereas Order B was the reverse of Order A. A difference in performance between the two list conditions would thus indicate an influence of presentation order.

Figure 1: Mean attitude rating scores of each Housemate per groups. Error bars represent SEMs.



In the final phase, the participants had to estimate the average value of the numbers within each set (i.e., color) by adjusting two sliders on a scale from 0 and 9. During a 2 minute interval between the final digit presentation and this phase, the Conscious Thought group was instructed to consider the mean value of the presented numbers of each color, whereas the Unconscious Thought group was required to perform the n-back task used in the *Housemate Rating Test.* The Immediate Decision group made their decisions immediately after the final digit was presented.

3 Results

3.1 Housemate rating task

Attitude rating. The participants showed a clear preference between housemates, relatively uninfluenced by condition. This pattern is generally consistent with participants having reached a judgment by the end of presentation, and this judgment being uninfluenced by a subsequent 4-minute delay (whether distracted or otherwise). The pattern was confirmed by a mixed 3 × 3 (Housemates × Condition) ANOVA revealing that the participants gave higher ratings for housemates with more positive attributes, $F(1.89, 130.44) = 54.09$, $p < .001$, $\eta^2_p = .44$, (*Figure 1*), while there was no evidence of influ-

ence of the different experimental conditions, $F < 1$. Post-hoc analyses confirmed that each group showed independent evidence of differential preference, smallest $F(98.11, 155.89) = 14.48$, $p < .001$, $\eta^2_p = .39$, and rated Housemate A more positively than Housemate B, smallest $t(23) = 2.25$, $p = .034$, $d = 0.46$.

Congruency with personal preference. Following Dijksterhuis's (2004) procedure, a weighted index was calculated from the final ratings of the twelve dimensions for each participant. This is the sum of the ratings of the subjective importance of the eight dimensions on which Housemate A was more attractive than Housemate C, minus the sum of ratings of the four remaining dimensions (where Housemate C was described more positively). This index thus reflects the degree to which Housemate A should be subjectively preferred to Housemate C by that individual, assuming attributes do not interact: a low value indicates a lesser predicted preference because the participant regards the few positive attributes of Housemate C as important.

This index was used by Dijksterhuis (2004) to evaluate the quality of the housemate judgments: insofar as participants rate Housemates A and C according to their subjective preferences, across participants the index should positively correlate with the preference for Housemate A over Housemate C. The Conscious Thought group showed the predicted positive correlation, $r(24) = .364$, $p = .040$ (one-tailed), unlike the Unconscious Thought group $r(24) = .254$, $p = .116$ (one-tailed) and the Immediate Decision group $r(23) = -.090$, $p = .685$ (one-tailed).[2] Although this is no evidence for a difference between the groups, the pattern is dissimilar to the results reported by Dijksterhuis (2004), who found a positive correlation for all groups *other* than the Conscious Thought group.

Presentation order effect. A further analysis was performed to assess the original claim that the diverted attention condition promotes "unconscious thought", and thus produces preferences reflecting an optimal integration of information. A corollary prediction of the optimal use of information is that such ratings would be uninfluenced by irrelevant factors such as the order in which positive and negative attributes were presented.

As this study replicated that of Dijksterhuis (2004), presentation order was randomized. This procedure produces variation across participants in the degree to which the positive attributes of a particular housemate occurred early or late in the sequence. The few negative attributes of Housemate A may occur predominantly in the early or late part of the sequence; a similar pattern may arise for the few positive attributes of Housemate C. For each participant, a measure of this tendency was derived from the slope coefficient of a logistic regression model predicting the valence of the twelve attributes (positive=1 or negative=0) from its position within the 36 item sequence. Positive coefficients thus reflect presentation orders where the positive attributes were predominantly late in the sequence, and whereas a negative coefficient reflects the reverse.

Table 1: Slope-performance correlation coefficients for Housemate A and Housemate C. N = 24.

	Housemate A	Housemate C	Combined
Conscious	$r = -.17$	$r = -.04$	$Z_r = -.69$
Unconscious	$r = -.38$	$r = -.50^*$	$Z_r = -3.08^{**}$
Immediate	$r = -.17$	$r = .16$	$Z_r = -.03$
Combined	$Z_r = -1.97^*$	$Z_r = -1.13$	$Z_r = -2.19^*$

Note. Negative correlations indicate higher ratings when positive attributes occur early in presentation. Z-values represent standardized sums of the Fisher's transformed correlation coefficients (Howell, 2007), and providing for omnibus null hypothesis (zero correlation) significance tests for the row, column, or table; * $p < .05$, ** $p < .01$.

The statistics in Table 1 shows that the attractiveness ratings of Housemates A and C[3] were negatively correlated with the degree of slope in the attribute sequence, indicating that earlier presentation of the positive attributes produced higher attractiveness ratings. This pattern was observed for both housemates, and the degree of correlation was no smaller for the Unconscious Thought condition. These data provide no support for the claim that the DWA manipulation promotes a more equal weighting of all attributes by participants in the Unconscious Thought condition.

Conscious Status of Decision Knowledge. According to the original description of UTT, preferences that are based upon a greater degree of unconscious processing will be accompanied by reduced access to the source of the preference (structural knowledge). The original interpretation of the DWA effect is based on the assumption that the manipulation will vary the amount of "unconscious thought" that influences decisions. There was no evidence for this assumption, in terms of differences between the groups in the degree of reported reliance on conscious memory, $F(2, 45) < 1$ (Conscious Thought group $M = 7.267$; Unconscious Thought group: $M = 6.688$; Immediate Decision group: $M = 7.059$).

Although the manipulation failed to alter the reported conscious status of decision-making between groups,

[2]One participant accidentally terminated the experiment before reporting the importance of the dimensions after the rating.

[3]Correlations for Housemate B ratings were not computed, as they are not directly comparable: the equal distribution of positive and negative valence attributes for Housemate B would produce a highly restricted range of logistic regression slopes.

there was individual variation in this measure. If the rating reflects the degree to which participants engaged in subjectively unconscious thought, and this type of thought increases the preference for Housemate A, then it follows that participants who report more intuitive decision-making should show a stronger preference for Housemate A over C. Analysis of the correlation between preference and the subjective reliance on intuition (10 = pure memory for specific items, 0 = pure intuition) revealed the opposite effect: $r(48) = .422$, $p = .003$ (within-group correlations: Conscious Thought, $r(15) = .402$, $p = .137$; Unconscious Thought group, $r(16) = .569$, $p = .022$; Immediate Decision, $r(17) = .246$, $p = .341$). The existence of a correlation validates the use of this subjective rating of information awareness as assessing task-relevant differences between individuals' decision-making. However, the result is the reverse of the key theoretical prediction of UTT: those people who rely *less* upon the output of any subjectively unconscious thought are those that show the strongest preference for the "correct" housemate in this task.

3.2 Number mean estimation

The mean value for estimations in the Number Mean Estimation task was analyzed by means of a mixed ANOVA with number set (larger or smaller mean) as a within-subjects factor and Group and presentation order (Order A or Order B) as between-subjects factors. There were no effects or interactions involving presentation order (Fs < 1). Nevertheless, the size of estimated difference varied across groups, group × number set, $F(2,68) = 3.43$, $p = .038$, $\eta^2_p = .09$. Notably, the Conscious Thought group correctly ranked the average of the larger numbers higher than the average of the smaller numbers ($M = 1.29$), $t(23) = 2.57$, $p = .017$. This estimated difference was significantly larger, and closer to the true difference of 2, than that of the Unconscious Thought group $t(46) = 2.66$, $p = .011$, for whom the difference between the two ratings was not reliable ($M = -.50$), $t(23) = 1.12$, $p = .275$.

4 Discussion

The present experiments investigated two assumptions required for the claim that DWA effects provide support for Unconscious Thought Theory. The results provide evidence to reject both assumptions, and thus no reason to accept that existing demonstrations of a DWA effect can be regarded as being in support of UTT.

First, we investigated whether the distraction manipulation produces greater degree of unconscious thought. The Weighting Principle of the UTT claims that processing in the diverted attention condition would help to combine a large amount of information in an unbiased manner. Therefore, UTT predicts that participants in the Unconscious Thought condition would be less influenced by serial position effects in presentation order than those in the other groups. No evidence was found that the effects of serial position were reduced in the Unconscious Thought condition.

As has been pointed out previously, the classic DWA effect could be explained by a combination of explicit factors (differential memory for items and previous online judgments) rather than any effects of additional processing during the manipulation. Support for such an account was found in these data by exploring the effect of presentation order on task performance in one of the original DWA designs. The analysis of the effect of serial position in the *Housemate Rating Test* revealed that attributes at the beginning of the presentation had more impact on ratings than those presented later. This primacy effect might seem to be surprising since the Newell et al. (2009) demonstrated a recency effect, whereby the most recent items were more likely to be available to recall at the time of decision. However, this tendency may be offset by primacy effects in judgment formation: forming opinions about persons tends to be biased by a "first impression" effect (Anderson, 1965).

UTT defines unconscious thought processes as resulting in a feeling of preference, such that the decision maker has little access to the source of this feeling. We attempted to measure this directly by asking the participants how much they relied on their intuition (rather than memories for specific features) when providing their evaluation. We found no evidence that the Unconscious Thought group relied more on "intuition" when making their choices than other groups.

Neither the analysis of presentation order, nor the subjective ratings, support the assumption that the distraction manipulation promotes unconscious thought; indeed the *Housemate Rating Test* did not replicate the original effect (Dijksterhuis, 2004), as the groups did not differ reliably in their preference for Housemate A. These results are consistent with meta-analyses (e.g., Acker, 2008) that indicate that any advantage for Unconscious Thought group may be more modest than early studies suggested, and perhaps specific to certain stimulus types and decisions.

However, analysis of individual differences in the self-report measure confirmed that the measure *is* sensitive to task-relevant differences: degree of preference was positively correlated with the reported reliance on specific memories of attributes (i.e., with *less* use of subjectively unconscious thought). In summary we find no evidence that distraction reduces the role of explicit processes (as assumed in the UTT account of DWA). Nevertheless, some aspect of the degree to which decision-making is

based on explicit memory can be measured directly: this reveals that a reduced reliance on explicit processes decreases, rather than increases, preference for the "better" choice option.

The second aspect of the investigation concerned the difficulty of assessing the quality of the decisions in tasks where objective criteria cannot be applied. In a *Number Mean Estimation Test,* the Conscious Thought group performed better than the other two groups, indicating that conscious processing is beneficial, rather than detrimental, to the appropriate averaging of numerical attributes.

It might be argued that a task involving abstract numerical judgment may be inappropriate for assessing unconscious processing, perhaps because such processes rely on some affective, or evaluative, aspect of the stimuli (Damasio, Everitt, & Bishop, 1996). However, one of the properties of unconscious thought proposed by UTT is an ability to weigh attributes of the objects of choice optimally. This implies that unconscious thought must be minimally capable of approximate algebraic averaging. In fact, proponents of this view have described unconscious, or implicit processes as being capable of integrating numerical information into rough estimations, and claimed to demonstrate this capability (Betsch, Plessner, Schwieren, & Gutig, 2001; Dijksterhuis & Nordgren, 2006).

In summary, this paper addresses two key untested assumptions of the claim that the DWA paradigm reveals the benefit of unconscious thought. We found no evidence that the key manipulation alters influences the degree to which participants rely on intuitive, or "unconscious" processes. Furthermore we found evidence that a greater reliance on explicit processing is associated with "better" judgment in the classic task, a pattern that is confirmed in a simple task for which performance can be objectively assessed.

We argue that, by assessing the subjective conscious status of structural knowledge, and using a task where an objectively correct judgment is possible, it should be possible to unambiguously test the predictions of UTT: that (1) the DWA paradigm induces unconscious processing (2) which leads to better performance in complex decisional situation in contrast to conscious thought. However, we find no such evidence and conclude that no previous studies using the DWA paradigm could provide evidence for beneficial unconscious thought, as they have failed to demonstrate that the paradigm actually promotes unconscious decision processes.

Decision-makers often report a robust difference between their personal experiences of analytical and impression-based decisions (Sjoberg, 2003). Whether these subjective experiences reflect truly distinct cognitive processes, and whether any "intuitive" decisional mode serves different adaptive functions, remain open and intriguing questions. The DWA paradigm is a common empirical approach to these questions. However, at present there is no reason to regard any data based on the DWA paradigm as evidence for the existence of, or benefit from, unconscious thought.

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