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Think, blink or sleep on it? The impact of modes of thought on complex decision making

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Think, blink or sleep on it? The impact of modes of thought on complex decision making

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This paper examines controversial claims about the merit of "unconscious thought" for making complex decisions. In four experiments, participants were presented with complex decisions and were asked to choose the best option immediately, after a period of conscious deliberation, or after a period of distraction (said to encourage "unconscious thought processes"). In all experiments the majority of participants chose the option predicted by their own subjective attribute weighting scores, regardless of the mode of thought employed. There was little evidence for the superiority of choices made "unconsciously", but some evidence that conscious deliberation can lead to better choices. The final experiment suggested that the task is best conceptualized as one involving "online judgement" rather than one in which decisions are made after periods of deliberation or distraction. The results suggest that we should be cautious in accepting the advice to "stop thinking" about complex decisions.

Keywords: Decision making; Unconscious thought; Online judgement; Deliberation.

In order to "get over" the "uncertainty that perplexes us" when we are faced with important, complex decisions, Benjamin Franklin advised the British scientist Joseph Priestly thus:

> My way is to divide half a sheet of paper by a line into two columns; writing over the one Pro, and over the other Con. Then, during the three or four days consideration, I put down under the different heads short hints of the different motives, that at different times occur to me, for or against the measure. . . . I find at length where the balance lies; and if, after a day or two of further consideration, nothing new that is of importance occurs on either side, I come to a determination accordingly. . . . And, though the weight of reasons cannot be taken with the precision of algebraic quantities, yet when each is thus considered, separately and comparatively, and the whole lies before me, I think I can judge better, and am less liable to make a rash step. (Franklin, 1772, cited in Goodman, 1931)

Wilson and Schooler (1991) noted that the essence of what Franklin called his "moral algebra" is found in many of the formal descriptive

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and prescriptive approaches to decision making. For example, techniques such as decision analysis advocate careful consideration of all options and their attributes prior to choice (e.g., Edwards & Fasolo, 2001; Keeney & Raiffa, 1976; von Winterfeldt & Edwards, 1986; see Newell, Lagnado, & Shanks, 2007a, for an overview).

In contrast to this intuitively sensible advice, a recent high-profile book (Gladwell, 2005) and several articles (Dijsksterhuis, 2004; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis & Nordgren, 2006) have questioned the use of conscious analytic thought for complex decisions. Decision makers have been encouraged to make "snap" decisions ("blink", Gladwell, 2005) or to leave complex choices to the powers of unconscious thought ("sleep on it", Dijksterhuis et al., 2006). Such claims are seductive and appealing and have received a great deal of attention in the media, giving rise to such headlines as "Want to make a complicated decision? Just stop thinking" (Jha, 2006) and "Sleep on it, decision makers told" (*BBC News Online*, 2006). This paper examines these important and rather surprising claims and attempts to map out some of the boundary conditions of the power of unconscious thinking.

Not thinking versus thinking too much

The idea that thinking too much can sometimes lead to poorer choices is not new. Wilson and Schooler (1991) demonstrated that students who analysed their reasons for preferring particular brands of strawberry jam revealed preferences that were less consistent with those of experts than participants who did not analyse their reasons. A similar effect was found for preferences for college courses. Wilson and Schooler explained these effects by arguing that introspection causes a departure from an initial adaptive preference when that initial preference is inaccessible to conscious report. Wilson and Schooler suggest that although decision makers are in general able to weight relevant information appropriately, when they are asked to think about their reasons during the decision process it leads to a selective focus on a subset of reasons that are accessible or plausible. As a result, this subset of reasons may receive greater (inappropriate) weight than other possible unarticulated reasons, diminishing the quality of the final preference or choice.

The data from the Wilson and Schooler (1991; see also Wilson et al., 1993) studies suggest that "at least at times, the unexamined choice is worth making" (p. 192). This general conclusion is echoed in work by Levine, Halberstadt, and Goldstone (1996) in evaluations of the likability of cartoon faces, Simonson and Nowlis (2000) in consumer choices, and Tordesillas and Chaiken (1999) in a follow-up of Wilson and Schooler's (1991) study on university course selection. However, more recent work, in particular that of Dijksterhuis and colleagues, has made stronger and more controversial claims on the merits or otherwise of conscious thought. While agreeing that conscious thought may be detrimental for complex decisions, this recent work argues that a period of *unconscious* thought prior to making a decision confers benefits over decisions made immediately (Dijksterhuis, 2004; Dijksterhuis et al., 2006; Dijksterhuis & Nordgren, 2006). These researchers suggest that when decision makers are forced *not* to think about a decision problem (by being made to solve anagrams for example), simultaneous "unconscious" processing occurs during the distraction period that improves subsequent choices.

Unconscious thought is defined as "object-relevant or task-relevant cognitive or affective thought processes that occur while conscious attention is directed elsewhere" (Dijksterhuis & Nordgren, 2006, p. 96). It is explicitly distinguished from ideas popular in research on incubation in which a period of distraction is said to allow problem solvers to return to a problem with "fresh eyes" or to forget inappropriate strategies (e.g., Smith & Blankenship, 1989). Unconscious thought is said to be an active process during which information is organized, weighted, and integrated in an optimal fashion. The benefits of this process are argued to be strongest when a decision problem is complex—those with multiple options and attributes—because unconscious thought does not suffer from the capacity limitations that hobble conscious thought (Dijksterhuis, 2004).

This notion of the "intelligent unconscious" stems partly from work claiming to demonstrate the ability to learn complex information in the absence of awareness (e.g., D. C. Berry & Broadbent, 1984; Knowlton, Squire, & Gluck, 1994; Lewicki, Hill, & Czyzewska, 1992; Reber, 1992). This literature on "implicit" learning phenomena attributes considerable analytic skill to the unconscious: an idea that meshes neatly with the claim that complex decisions are best left to these capacity-unlimited powerful processes. Such conclusions are, however, not without strong critics. In many demonstrations of implicit learning, cogent and compelling alternative explanations that do not require recourse to intelligent unconscious processing have been proposed (e.g., Dienes & Fahey, 1998; Lagnado, Newell, Kahan, & Shanks, 2006; Newell & Bright, 2002; Newell, Lagnado, & Shanks, 2007b; see Shanks & St. John, 1994, for a review of earlier work). In spite of these alternative and often far less startling interpretations, proponents have drawn strong and very general conclusions about the benefits of unconscious thought:

> The current work demonstrates one thing the unconscious is good at: making complex decisions. When faced with complex decisions such as where to work or where to live, do not think too much consciously. Instead after a little conscious information acquisition, avoid thinking about it consciously. Take your time and let the unconscious deal with it. (Dijksterhuis, 2004, p. 596)

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Evidence for the superiority of unconscious thought in complex decision making

What is the evidence for these bold claims? The experimental paradigm used by Dijksterhuis and colleagues is one in which participants are presented with information about three or four objects (cars, apartments, potential room-mates) described by 10 or more attributes (e.g., mileage, building security, tidiness) and are asked to choose the "best" object. In most cases "best" is determined normatively by the experimenter assigning different numbers of positive and negative attributes to each option. For example, the best apartment might have 8 (normatively defined) positive attributes and 4 negative attributes, while the "worst" apartment has the opposite arrangement (e.g., Dijksterhuis, 2004).

In the initial phase of the experiment attribute information is presented sequentially and typically in random order, about the four options. Thus for a choice set in which there are four options each described by 10 attributes, participants will see 40 statements of the type "Apartment A is spacious" presented individually on a screen over a period of a few minutes. Participants are told at the beginning of the presentation phase that at a later stage in the experiment they will be asked to choose their favoured option. Following presentation of the attributes, participants are assigned to one of three (or sometimes only two) conditions. In the unconscious thought condition participants are distracted from the task at hand (thinking about the best option) by being asked to solve a succession of anagrams. In the conscious thought condition participants are asked, in contrast, to think carefully about their choice for a few minutes, and in the immediate thought condition participants are simply asked to decide as soon as the presentation phase has finished. This last condition is a necessary "baseline" (Dijksterhuis, 2004, p. 589) if one wants to draw any conclusions about the relative merits of unconscious thought (as opposed to the possible deleterious effects of conscious thought).

The take-home message from studies using this paradigm is that "unconscious thought improved the quality of decisions" (Dijksterhuis, 2004, p. 596). Proponents argue that participants make better choices, show better differentiation of good and bad options and display more "organized" memories for material following periods of unconscious thought. Later we investigate some of these claims in more detail, but first taking the claims at face value we examine the boundary conditions of such effects and attempt to discover why and indeed whether we really should let the unconscious "do the work" when faced with a complex decision (cf. Bekker, 2006).

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In the first two experiments we investigate how unconscious thought might work in two ways. In Experiment 1 we examine the claim that unconscious thought is beneficial because of its superior ability to weight multiple pieces of information. In Experiment 2, we ask whether benefits that have been observed are due to the *superiority* of unconscious thought or the *inferiority* of conscious thought. We argue that the standard paradigm presents an unrepresentative analogue of the way in which people typically deliberate about complex decisions, which may disadvantage conscious thinkers unfairly.

Weighting information in complex decisions

When faced with a multi-option, multi-attribute decision the acknowledged "gold standard" method is to use some form of weighted-additive model (WADD; Dawes & Corrigan, 1974; Gigerenzer & Goldstein, 1996; Payne, Bettman, & Johnson, 1993). Such models consider each attribute, assign it some "weight" (degree of importance), and then sum the weights of the attributes for each option. The option with the highest overall summed weighting is then chosen. In such situations individuals may assign attributes different weights. Thus the idiosyncratic nature of an individual's weighting scheme is an important factor to consider when determining the quality of an individual's decision. Knowing the subjective attribute weights assigned by an individual allows the experimenter to compare the congruency of objective choices (the option chosen by an individual) with the option predicted by elicited subjective weights (the option with the highest summed subjective weighting score for that individual). Without this knowledge, one does not know whether a choice is "congruent"—in the sense that it is the choice predicted by that particular individual's weighting scheme—or a random/unpredicted choice.

The unconscious thought theory (UTT; Dijksterhuis & Nordgren, 2006) states that optimal weighting of attributes occurs naturally during periods of unconscious thought and that this optimal weighting leads to a closer connection between idiosyncratic preferences and objective choices for unconscious than for conscious or immediate thinkers. Conscious processing is claimed to be limited in capacity, leading people to focus only on a subset of available information, which may misrepresent true underlying preferences. To date, however, the evidence for this "closer connection" is rather limited. Dijksterhuis (2004) reported that the correlation between the difference in attitude towards the "best" and "worst" options in a choice set and the difference in subjective importance ratings of the attributes of these options was higher for unconscious thinkers than for conscious or immediate thinkers. But differences between conditions were not statistically significant.

A more direct way to investigate this optimal weighting hypothesis is to examine the congruency of objective choices and subjective weightings: Do participants choose the option predicted by their own (idiosyncratic) subjective weighting schemes? A clear prediction of the theory is that there should be a higher proportion of congruent choices following unconscious thought than following conscious or immediate thought.

We also tested a slightly more subtle prediction of UTT. The theory states that when faced with multiple pieces of attribute information, conscious thought is overwhelmed because of its capacity-limited nature. Unconscious thought on the other hand has unlimited capacity. This characterization suggests that participants in a conscious (and presumably immediate) thought condition might more readily adopt a simpler "heuristic" way of integrating information (cf. Gigerenzer & Goldstein, 1996) than do those in the unconscious thought conditions. To examine this possibility we constructed a choice set in which the "best" option could be calculated in one of two ways. The "simple" method, following Dijsksterhuis, was to count up the number of positive attributes and choose the option with the highest number; the more complex method was to use a WADD algorithm in which not only the *number* of attributes was important, but also the *weight* assigned to those attributes. Application of these two rules, "TALLY" and "WADD", leads to different

Table 1. *Distribution of positive and negative attributes and total weightings of the four apartments in Experiment 1*

Attributes	*Weighting (out of 10)*	*Apartment* *A*	*B*	*C*	*D*
Security of the building	8.95	−	+	−	+
Rent	8.60	−	+	−	+
Crime rate of the area	8.36	+	+	−	−
Flatmate (friend or not)	7.91	−	+	−	+
Size of the apartment	7.56	−	−	+	+
Kindness of neighbours	5.41	+	+	−	−
View	5.18	+	−	+	−
Built-in wardrobe	4.70	+	−	+	−
Direction	4.61	+	−	+	−
Leisure facilities	4.59	+	−	+	−
Frequency of positive attributes		6	5	5	4
Frequency of negative attributes		4	5	5	6
Total weighting[a]		− 0.17	12.59	− 12.59	0.17

[a]Sum of positive minus sum of negative attributes.

options being selected as the "best" (see Table 1 and Method for more details). UTT predicts a higher percentage of choices of the WADD option following unconscious thought than following immediate or conscious thought (Dijksterhuis & Nordgren, 2006).

EXPERIMENT 1

Method

Participants

The sample consisted of 44 female and 27 male ($M = 19.56$ years, $SD = 1.73$ years) undergraduates from the University of New South Wales. They either participated voluntarily or received course credits for an introductory psychology course.

Design

Experiment 1 was a 3 (mode of thought) × 4 (apartment) factorial design. The mode of thought (immediate judgement, conscious deliberation, unconscious thought) was between subjects, with random allocation of participants into conditions. The apartment variable was manipulated within subjects (all participants viewed information about all four apartments).

Materials

The decision problem was to choose an apartment to rent near the university. This is a real problem faced by many undergraduate students, and was modelled closely on the materials used by Dijksterhuis (2004). A set of pilot ratings on the importance of 16 relevant attributes was obtained from the same pool of Year 1 psychology students ($N = 44$). For the purpose of Experiment 1, only the five dimensions with the highest ratings and the five with the lowest were used. These dimensions were selected to allow for the construction of options that could be differentiated both in terms of the number of positive and negative attributes they possessed and in terms of their overall weighted sums. Table 1 shows the set of options constructed. The overall weighting of each apartment was computed by adding the individual positive attribute weightings and then subtracting the negative attribute weightings. For example, Apartment B has five positive attributes (i.e., security of building, rent, crime rate, flatmate, and neighbours), which sum to 39.3 (i.e., $9.0 + 8.6 + 8.4 + 7.9 + 5.4 = 39.3$); it also has five negative attributes, which sum to 26.71, thus its overall weighted sum is $(39.3 - 26.7) = 12.6$. In this choice set the TALLY rule predicts an $A > B = C > D$ order of preference; in contrast the WADD rule predicts $B > D > A > C$.

Procedure

Participants sat at individual computer terminals in a single testing cubicle. The experiment began with the following information:

> Imagine you are planning to rent an apartment near university because you have been living in a faraway suburb. You are also interested in sharing the place with some

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> other students. After some initial house-hunting effort, there are 4 apartments remaining in your list (Apartment A, B, C, & D). Since the semester will begin very soon, you'll have to make the decision as soon as possible.

Following Dijksterhuis (2004), participants were informed that after the presentation of the information they would be asked to choose the apartment they perceived to be the "best". The presentation phase followed in which the 40 attributes were shown individually in a random order, with each attribute appearing for 4 seconds.

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After this information presentation stage, participants in the *immediate judgement* group were asked directly to choose their preferred apartment. After choosing, participants were given a 100-point scale (1 very unattractive to 100 very attractive) to indicate their attitude toward each of the four apartments in a fixed order (i.e., A, B, C, D). After making the ratings, participants were asked to recall the apartment attributes presented earlier. The memory test was included to examine the possibility that poor performance in the conscious thought condition in previous demonstrations (e.g., Dijksterhuis, 2004; Dijksterhuis et al., 2006) was caused by self-generated memory interference (Shanks, 2006). In the test, participants typed the attributes that they could remember for each apartment and stated whether the attribute was present/absent or good/bad (e.g., low security–bad). The memory recall task was displayed on a single screen with Apartment A on the left, B and C in the middle, and D on the right. Finally, participants rated the subjective importance of each of the 10 dimensions using a 10-point Likert scale, ranging from 1 "very unimportant" to 10 "very important".

The only differences in procedure for the remaining two groups were the following: The *conscious deliberation* group was given 4 minutes to think consciously about which apartment to decide upon in between the presentation phase and the choice task. In this period, a white screen appeared, and participants were reminded of the elapsed time after every minute that passed. The *unconscious thought* group was given a distraction task (i.e., solving simple 4–6-letter anagrams) for the same 4-minute period.

Results

Frequency of choice

The percentage of participants choosing each apartment in the three conditions is shown in Figure 1. The figure shows that Apartment B, the apartment with the highest weighted sum, was preferred by approximately equal numbers of participants in each condition. Collapsed across all conditions, 15% of participants chose Apartment A, 65% chose Apartment B, 3% chose Apartment C, and 17% chose Apartment D. A chi-square test demonstrated that there was a significant difference in the percentage of participants picking each apartment, $\chi^2(3, N = 71) = 63.37$, $p < .001$. This difference was also found in each of the experimental conditions: immediate condition, $\chi^2(3, N = 24) = 23.00$, $p < .001$; conscious condition: $\chi^2(3, N = 24) = 19.33$, $p < .001$; unconscious condition: $\chi^2(3, N = 23) = 25.87$, $p < .001$. Follow up tests indicated that Apartment B was chosen by significantly more participants than the next most preferred apartment in all conditions: immediate, $\chi^2(1) = 7.20$, $p < .008$; conscious, $\chi^2(1) = 5.00$, $p < .025$; unconscious, $\chi^2(1) = 7.20$, $p < .008$. Thus in all conditions the preferred choice was the apartment

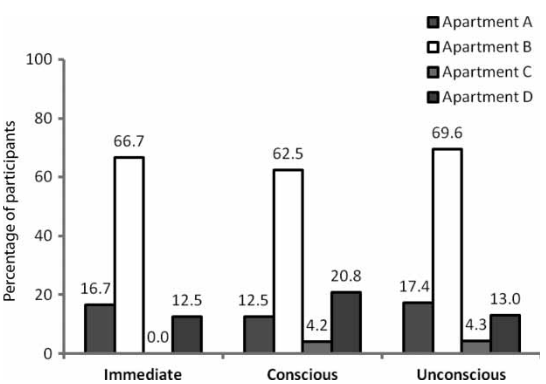

Figure 1. *Percentage of participants choosing each apartment in Experiment 1.*

predicted by the WADD strategy. However, in contrast to the predictions of UTT there was no difference in the choice of Apartment B, or any of the other apartments, as a function of condition: χ^2s < 1, ps $> .607$.

Attitude ratings

Figure 2 displays the attitude ratings toward each apartment on a 1–100 scale (with higher numbers indicating a more positive attitude). The attitude ratings mirror the choice data: Apartment B is clearly favoured in all conditions, and the order of preference is very similar across conditions (B > A > D $\ngtr$ C). This ordering is closer to that predicted by the WADD rule than that predicted by the TALLY rule. Collapsed across conditions, Apartment B was rated as the most attractive ($M = 73.4$, $SD = 18.8$). In the immediate and the unconscious conditions Apartment B was rated as significantly more attractive than each of the other three apartments (individual contrasts, Fs > 10.15, $p < .01$).[1] However, for the conscious condition the comparison of the attitude rating for B ($M = 69.3$) did not differ significantly from that given for A ($M = 65.2$), $F < 1$. This result provides some support for the notion that effortful deliberation can lead to "poorer" differentiation between alternatives (Wilson & Schooler, 1991).

Recall of attributes

Table 2 displays the percentages of correctly recalled attributes collapsed across options. Only the difference between the immediate and unconscious conditions was significant, $F(1, 46) = 11.26$, $p < .01$. This pattern contrasts with the prediction that conscious deliberation would induce self-generated interference and impair memory. If anything, it appears that distracting participants with anagrams led them to forget some of the attributes.

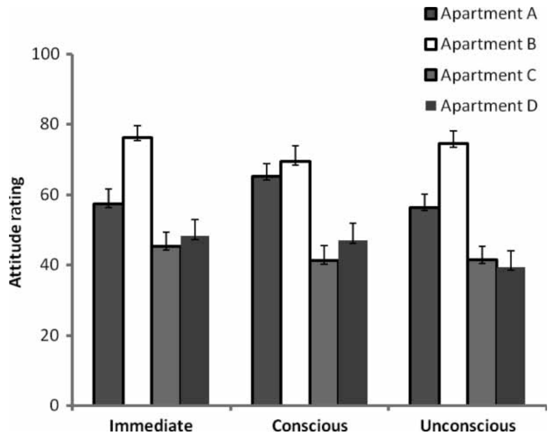

Figure 2. *Attitude rating (0–100; higher numbers indicate more positive attitude) towards each apartment in Experiment 1.*

Attribute weightings and congruency with choices

The correlation between the average weighting for each attribute collected in pilot testing and those elicited in Experiment 1 was .94, allowing us to be confident that our experimental participants had very similar views to our pilot participants about the attributes that are important when renting an apartment. For each participant, preferences for each apartment were computed using the WADD rule. Our measure of congruency in choice is the proportion of participants who chose the apartment predicted by the WADD rule. According to UTT, unconscious thought is better than conscious or immediate thought at weighting attribute information optimally. If this is the case the highest proportion of congruent choices should be in the unconscious thought condition. Table 3 displays the percentages of choices congruent with the first and second highest weighted alternatives. The difference in summed totals between the two highest weighted alternatives was often very small (e.g., one or two points) so we present congruency with both. The pattern provides no support for the prediction of

[1] In the analysis of attitude ratings and memory recall data a set of planned contrasts were conducted using PSY (Bird, 2004) for examining main effects, simple effects, and interactions. They were done by controlling the per-contrast error rate (PCER), thus constructing adjusted 99.74% confidence intervals. The $F_{critical}(1, 68)$ for this analysis was 9.75 with significance set at the alpha level of .05.

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Table 2. *Percentage of correctly recalled attributes in Experiments 1, 2, and 4*

	Mean	*SD*
Experiment 1		
Immediate	50.2	17.4
Conscious	43.6	15.4
Unconscious	34.7	14.5
Experiment 2		
Immediate	60.0	18.4
Conscious	63.7	18.2
Unconscious	62.7	17.7
Conscious & information	72.8	16.8
Experiment 4		
Immediate	47.3	19.6
Conscious	42.3	18.2
Unconscious	36.3	15.7

UTT. There are small differences between conditions (in the opposite direction to the prediction of the theory) but the overwhelming finding is that the majority of participants in all conditions chose the apartment predicted by their idiosyncratic subjective weighting profiles.

Table 3. *Percentage of participants choosing the apartment or car congruent with their subjective weighting schemes*

	Highest score[a]	*Second highest score*[b]	*Total*[c]
Experiment 1			
Immediate	83	17	100
Conscious	75	12.5	87.5
Unconscious	73	9	82
Experiment 2			
Immediate	74	17	91
Conscious	74	26	100
Unconscious	61	39	100
Conscious & information	78	18	96
Experiment 3			
Immediate	57	23	80
Conscious	60	13	73
Unconscious	47	30	77

Note: Apartment: Experiments 1 and 2. Car: Experiment 3.
[a]Chose option with highest summed subjective weighting score. [b]Chose option with second highest summed subjective weighting score. [c]Total choices congruent with first and second highest scores.

Discussion

Experiment 1 demonstrated that, regardless of the mode of thought that participants engaged in, the majority chose the apartment predicted by a WADD rule. Moreover, the clear majority of participants chose the apartment predicted by their idiosyncratic attribute weightings. In previous experiments it has not been possible to investigate this issue because typically only the choice of the objectively best alternative has been reported, and the congruency of actual choices and those predicted by attribute weightings has not been examined. There was very little evidence to suggest that the opportunity to engage in unconscious thought improved choices or led to more optimal weighting of attributes. There was some evidence from the attitude ratings that conscious deliberation led to poorer differentiation between Apartment A (the apartment with the highest number of positive attributes) and Apartment B (the apartment with the highest objective weighted sum; cf. Levine et al., 1996; Wilson & Schooler, 1991).

An important consideration, given the choice pattern, is whether the choice set made it too easy to identify the "best" option and that this ease masked possible differences between conditions. We suggest that this is not the case. Although Apartment B was the preferred option it did not completely dominate choices—it accounted for 65% of choices on average (a figure that is consistent with previous research, e.g., Dijksterhuis, 2004; Dijksterhuis et al., 2006). Moreover, according to UTT if the best option had been "obvious" due, for example, to the inclusion of one attribute that overshadowed all others, then those in the conscious thought condition should have performed best (Dijksterhuis & Nordgren, 2006).

A second consideration is whether the failure to find a difference between conditions is due to insufficient statistical power. Our sample sizes of 23 or 24 participants per condition are consistent with previous research (e.g., Dijksterhuis, 2004; Dijksterhuis et al., 2006), and thus we had no reason to suspect a priori that our samples were too small. Post hoc power calculations using G-Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) indicated achieved power to detect significant differences between conditions (*df* 1) of .92 for a large effect, .53 for a medium effect (.30), and .10 for a small effect (using the definitions of Cohen, 1992). The difference between conscious and unconscious thought for "complex" choices that Dijksterhuis et al. (2006) report corresponds to an effect size of $\phi = 0.35$ (estimated from their Figure 1), which corresponds to an effect that is slightly greater than medium in size (Cohen, 1992). Similarly, in Dijksterhuis (2004, Exp. 2) the difference in "processing style" (global vs. specific) between conscious and unconscious thought was also moderate ($\phi = 0.33$), though the differences in choice between conditions were smaller in this study. Therefore, given our power analysis reported above, we might reasonably have expected to have power in excess of .6 to detect the kinds of effects that Dijksterhuis' data suggest are there.

EXPERIMENT 2

Experiment 1 found little evidence for the superiority of unconscious thought using a choice paradigm closely modelled on the work of Dijksterhuis (2004). However, the results also appear to provide little solace to advocates of a decision analytic approach. Why, when given the opportunity to deliberate about a decision, do participants not perform better than those who make an instant "blink" decision or than those who are distracted prior to making a choice? One possibility is that the type of deliberation that conscious thinkers are able to engage in is unrepresentative of the methods advocated by decision analysts and indeed the nature of conscious thinking that decision makers often engage in when faced with a complex choice (Payne, 2007; Shanks, 2006). How often in a consumer choice situation are we faced with the problems of (a) having all information about objects in the choice set presented briefly and randomly, and (b) having to rely on memory when considering the attributes of the alternatives under consideration? More typically we would have the objects in front of us, or at the very least we would consult websites or magazines that displayed the information we sought. Recall Franklin's advice to Priestly: "when each is thus considered, separately and comparatively, and the whole lies before me, I think I can judge better, and am less liable to make a rash step" (Franklin, 1772, cited in Goodman, 1931)—in other words, have all the information present when making a decision.

Experiment 2 examined these issues by varying the way in which information was presented to participants and whether they had access to it during the deliberation process. Specifically, in three conditions the presentation phase was changed so that now all information about the four options was presented on an "information board" (Payne, 1976; see Figure 3) rather than being presented discretely and randomly. The aim of this manipulation was to ensure that participants in all conditions had sufficient time to encode the necessary information before entering into the different modes of thought (conscious, unconscious, immediate). Interestingly, Dijksterhuis and Nordgren (2006) argue that, "Complex decisions are best when the information is encoded thoroughly and consciously, and the later thought process is delegated to the unconscious. . . . One should look at the list, stop conscious thought for a while, and then wait for the unconscious to deliver the decision in the form of an intuitive feeling" (p. 107). Thus UTT predicts that the unconscious thought condition has even greater potential to shine in Experiment 2 than it did in Experiment 1 because now participants have a much better chance of "thoroughly and consciously" encoding information. In the fourth condition of Experiment 2, labelled "conscious & information", participants were presented with the information in the standard way—randomly and discretely—but during the deliberation period the information board was provided. The experiment thus tests whether (a) unconscious thought improves choices when encoding is facilitated; and (b) unconscious thought is better than conscious thought when information is provided (see Dijksterhuis, 2004).

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Apartment:	A	B	C	D
Size of apartment	small	small	spacious	spacious
Balcony	facing the sun	not facing the sun	facing the sun	not facing the sun
Security of the building	low	high	low	high
Rent	expensive	cheap	expensive	cheap
Built-in wardrobe	present	absent	present	absent
Flatmate	not your friend	close friend	not your friend	close friend
Neighbours	kind	kind	unkind	unkind
View	yes	no	yes	no
Leisure facilities	present	absent	present	absent
Crime rate in the area	low	low	high	high

Figure 3. *Example of the information board used in Experiment 2.*

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A second change in the procedure of Experiment 2 was the time allowed for deliberation or unconscious thought. Dijksterhuis and Nordgren (2006) state that, "longer unconscious thought should lead to even better decisions than brief unconscious thought" (p. 99). In unpublished data (cited in Dijksterhuis & Nordgren, 2006), Dijksterhuis found that unconscious thinkers made better decisions when given 7 minutes of unconscious thought instead of 2 minutes. To test this prediction, and to provide potentially more favourable conditions for unconscious thought, the deliberation/distraction period was extended from 4 to 8 minutes.

Method

Participants

The sample consisted of 92 undergraduate students (65 female and 27 male; $M = 19.42$ years, $SD = 4.34$ years) from the University of New South Wales. They either received course credits or participated voluntarily.

Design

The simplest way to describe the design of Experiment 2 is a 3 (mode of thought) $\times$ 4 (apartment) between by within experiment, but with one additional condition: conscious & information. Due to the nature of the unconscious and immediate conditions it was not possible to run these two as "& information" conditions. (In the unconscious condition participants cannot be given the information whilst also being distracted and encouraged *not* to think about the choice; those in the immediate condition do not have the opportunity to consult the material prior to choice.) Participants were randomly allocated to the standard mode of thought conditions; the conscious & information condition used new participants from the same student population but was run after the completion of the first three conditions.

Materials

An information board was prepared to display all the attributes used in Experiment 1(see Figure 3).[2] The order of attributes, which was always shown on the left column, was randomized

[2] One of the attributes (i.e., direction) used in Experiment 1 was changed to "whether the balcony is facing the sun"; this did not change positive–negative weighting pattern for the four apartments. This change was made because some participants thought north-facing as a better direction while some thought south-facing as better—presumably reflecting a mixture of northern and southern hemisphere natives in our sample.

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for each participant. The information board was displayed on the computer screen either during the presentation phase (conscious, immediate, and unconscious conditions) or during the deliberation period (conscious & information condition).

Procedure
Participants in the immediate, conscious, and unconscious conditions were given a compulsory 3 minutes to read the information on the information board, and then they could decide to proceed directly to the next phase or obtain more time to encode the information; 3 minutes were allocated because the information presentation stage in Experiment 1 lasted for 3 minutes. Participants in the conscious condition were asked to think thoroughly about the apartments throughout an 8-minute period (with reminders at the 2nd, 4th, 6th, & 7th minutes). Those in the unconscious condition solved anagrams for 8 minutes, and those in the immediate condition made their choice as soon as they had decided to proceed to the next phase. Participants in the conscious & information condition were presented with the attributes one by one (as in Experiment 1) and were then shown an information board to study for the 8-minute deliberation period. Other measures (memory, attitudes, and attribute weightings) were elicited in the same manner as in Experiment 1.

Results

Frequency of choice
The percentage of participants choosing each apartment in the four conditions is shown in Figure 4. The figure shows that Apartment B, the apartment with the highest weighted sum, was still preferred by the majority of participants in each condition, but there was more variability in choice in comparison to Experiment 1. Collapsed across all conditions, 9% of participants chose Apartment A, 71% chose Apartment B, 2% chose Apartment C, and 18% chose Apartment D. A chi-square test demonstrated that there was a significant difference in the percentage of participants picking each

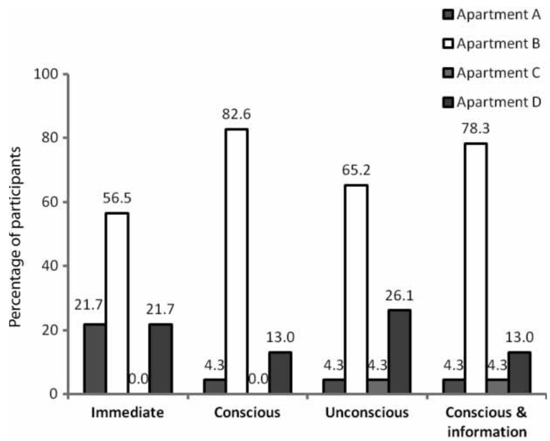

Figure 4. *Percentage of participants choosing each apartment in Experiment 2.*

apartment, $\chi^2(3, N = 92) = 101.83$, $p < .001$. This difference was also found in each of the four conditions: immediate condition, $\chi^2(3, N = 23) = 15.09$, $p < .01$; conscious condition, $\chi^2(3, N = 23) = 41.52$, $p < .001$; unconscious condition, $\chi^2(3, N = 23) = 22.74$, $p < .001$; conscious & information condition, $\chi^2(3, N = 23) = 35.25$, $p < .001$. Follow-up tests indicated that Apartment B was chosen by significantly more participants than the next most preferred apartment in all conditions, though the effect was marginal for the immediate and unconscious conditions: immediate, $\chi^2(1) = 3.55$, $p < .059$; conscious, $\chi^2(1) = 11.63$, $p < .001$; unconscious, $\chi^2(1) = 3.86$, $p = .05$; conscious & information, $\chi^2(1) = 10.71$, $p < .001$. Consistent with the findings of Experiment 1, the differences in the proportion of choices of Apartment B, or any of the other apartments, across conditions, failed to reach significance: $\chi^2 < 6.01$, $p\text{s} > .11$. (The largest χ^2 value was for the comparison of Apartment A choices across conditions; this marginal effect was driven by the relatively high proportion of choices of A in the immediate condition compared to that in the other three conditions.)

Figure 4 shows that the highest proportions of choices for Apartment B are in the two conscious thought conditions. To explore the choice pattern further a chi-square analysis compared the percentage of participants choosing Apartment B in the two conscious conditions combined with the two other conditions. The comparison allowed us to examine whether some form of conscious deliberation—either after information has been effectively encoded or when the information is provided—can improve choices relative to immediate or unconscious thought conditions. The analysis revealed a significant difference between these combined conditions when compared to immediate thought: $\chi^2(1, N = 92) = 4.39$, $p < .05$, but not when compared to unconscious thought: $\chi^2(1, N = 92) = 3.05$, $p > .05$. The results suggest that conscious deliberation can sometimes be beneficial for decisions made in this choice task.

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Attitude ratings

The attitude ratings for each apartment are shown in Figure 5. The general pattern of attitudes was similar across the four groups, with all showing an ordering of B > A > D > C (closest to that predicted by the WADD rule). In every condition the ratings of Apartment B were significantly higher than the average of other apartments, Fs(1, 91) > 23.0, ps < .001, and in every condition Apartment C was rated significantly lower than the average of the other apartments, Fs(1, 91) > 29.5, ps < .001. The failure to differentiate Apartments A and B found in the conscious group of Experiment 1 was not apparent in either of the conscious conditions of Experiment 2.

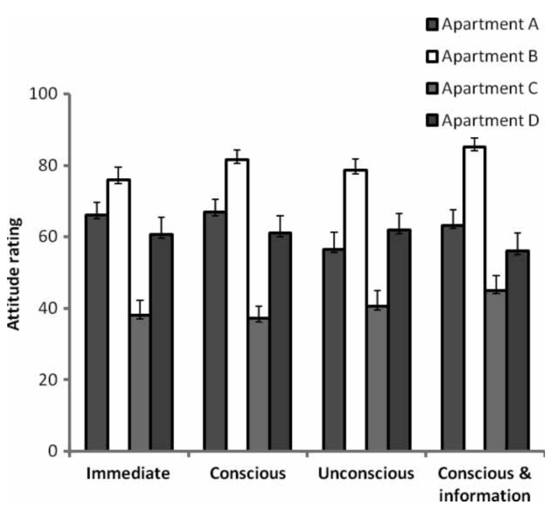

Figure 5. *Attitude rating (0–100; higher numbers indicate more positive attitude) towards each apartment in Experiment 2.*

Recall of attributes

The percentages of correctly recalled attributes are displayed in Table 2. In the three conditions in which the attributes were present on an information board throughout the study phase, performance was very similar and above the average exhibited in Experiment 1 (62.2% compared to 42.9%). In the conscious & information condition performance was better again, presumably reflecting the greater amount of time for examining the attribute information in this group. However, no significant differences in recall were found among the four conditions (largest $F = 6.05$ for immediate versus conscious & information comparison, $F_{\text{critical}} = 9.75$—see Footnote 1).

Attribute weightings and congruency with choices

For each participant, preferences for each apartment were computed according to the WADD rule. Table 3 displays the percentages of participants whose choices were congruent with the first and second highest weighted alternatives. Two aspects of the results are of interest: (a) At least descriptively, more participants choose congruently with their highest weighted option in the three conditions that do not involve unconscious thought; (b) when both first and second highest weighted options are taken into account, the clear majority of participants across all conditions chose the apartment predicted by their subjective weighting profile.

Discussion

The majority choice across conditions was again the option favoured by the WADD rule (Apartment B) although there was more variability in choice patterns—especially in the immediate condition. This variability lends weight to the argument that the choice set is not simply dominated by an obvious best alternative that masks potential

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differences in choice across conditions. The congruency data again emphasize that the variability in choice is not random noise—the clear majority of participants in all conditions chose the option predicted by their subjective weighting profiles (or their second highest option). The data from the two conscious conditions provided an important insight: When participants either have the opportunity to encode information thoroughly or have the information in front of them, some period of conscious deliberation can benefit choice (at least as measured by the objective best option). Despite attempting to improve the conditions for unconscious thought (thorough encoding and extended period of distraction) there was again very little to suggest that unconscious thought improved choice or led to better differentiation between options.

EXPERIMENT 3

In Experiments 1 and 2 we took the claims about unconscious thought at face value and attempted to explore the boundary conditions of the effects. The findings thus far present an unexplained contradiction: Although we tried to follow the procedures used in previous studies and modelled our stimuli closely on those used before, we were unable to replicate the finding of unconscious thought leading to superior choices. However, there is always a possibility that idiosyncrasies in procedures or the particular choice set that we used in Experiments 1 and 2 masked potential differences between the thought conditions. Thus in Experiment 3 we attempted a direct replication of the result that provides the most compelling evidence to date of the benefits of unconscious thought: Dijksterhuis et al. (2006, Exp. 1). In the study participants ($N = 40$) were presented with a choice between four fictional cars described by 12 attributes each. The approximate percentages of participants choosing the best car were 60% following unconscious thought but only 25% (i.e., chance level) following conscious thought—a significant difference (an immediate group was not included). Experiment 3 attempted to replicate this result, and, following the principle that a replication should be more likely if sample sizes are increased, we used 50% more participants per condition. We also included an immediate thought group as a baseline.

Method

Participants

The sample consisted of 90 undergraduate students (56 female and 34 male; $M = 19.3$ years, $SD = 2.02$) from the University of New South Wales. They received course credit for participation. None of the participants had taken part in Experiments 1 or 2.

Design

Experiment 3 was a 3 (mode of thought) × 4 (car) factorial design. The mode of thought (immediate judgement, conscious deliberation, unconscious thought) was between subjects, with random allocation of participants into conditions (ns = 30). The car variable was manipulated within subjects (all participants viewed information about all four fictitious cars).

Materials

The materials were obtained from the supplementary information document downloaded from the *Science* website (Dijksterhuis et al., 2006). The choice set consisted of four fictitious cars each with 12 attributes. The attributes were either positive (for example, "The *Hatsdun* has good mileage") or negative (for example, "The *Dasuka* has poor mileage"). *Hatsdun* was depicted with 75% positive attributes, *Kaiwa* was depicted with 58% positive attributes, *Dasuka* was depicted with 50% positive attributes, and *Nabusi* was depicted with 25% positive attributes (see Appendix A for the attribute list).

Procedure

The procedure was identical to that of Experiment 1, with the exception that participants were told to choose the best car from the set rather than the best apartment. Up to the choice phase the procedure matched that of Dijksterhuis et al. (2006) as closely as possible; following the choice, attitude ratings, recall measures, and attribute ratings were completed.

Results

Frequency and congruency of choice

Figure 6 shows the percentage of participants choosing each car in the three conditions. The figure shows that the *Hatsdun*, the car with 75% positive attributes, was chosen by the majority of participants in each condition. Chi-square analyses showed there was a significant difference in the percentage of participants picking each car, in each of the three conditions: immediate condition, $\chi^2(3, N = 30) = 19.87, p < .01$; conscious condition, $\chi^2(3, N = 30) = 22.00, p < .01$; unconscious condition, $\chi^2(3, N = 30) = 9.73, p < .05$. In the immediate and conscious conditions *Hatsdun* was chosen by significantly more participants than the next most popular option: immediate, $\chi^2(1) = 4.17, p < .05$; conscious, $\chi^2(1) = 4.84, p < .05$; in the unconscious condition only the comparison with the least popular option was significant, $\chi^2(1) = 10.28, p < .001$. Importantly, there was no significant difference in the percentage of participants choosing the *Hatsdun* in the three conditions, $\chi^2(2, N = 90) = 1.67, p > .05$.

The congruency data are displayed in Table 3. Two aspects of the data are noteworthy: First, in line with the findings of Experiments 1 and 2, the lowest percentage of choices congruent with the highest weighted option is in the *unconscious* thought condition; second the overall levels of congruence are slightly lower than those in the first two experiments. This latter pattern might be due to our student participants having somewhat less clearly defined preferences about car attributes than apartment attributes.

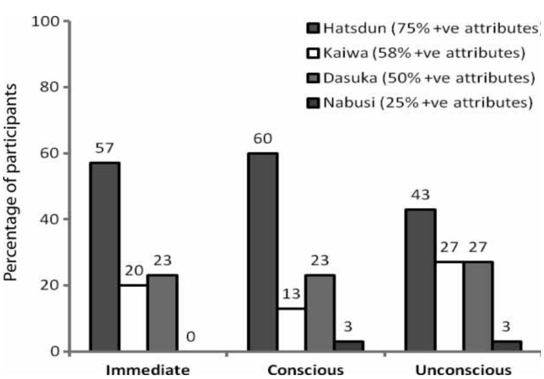

Figure 6. *Percentage of participants choosing each car in Experiment 3.*

Our primary interest in Experiment 3 was the choice data; thus in the interests of space we do not report a full analysis of the attitude and memory data. To summarize: The attitude data showed a clear preference for the best car in all conditions but no suggestion that unconscious thought improved differentiation of options relative to the other two modes of thought (consistent with Experiments 1 and 2). There were no significant differences in the amount of information recalled across conditions, with all groups recalling approximately the same number of attributes (average of 4 collapsed across options), a pattern that is comparable to the recall data of Experiment 1 (see Table 2).

Discussion

Experiment 3 attempted to replicate the clearest finding in the literature of the superiority of unconscious thought for complex decisions. Despite using the same stimulus materials, following procedures as closely as possible, and increasing the sample size we were unable to find an advantage for the unconscious thought condition. It is not clear why we were unable to replicate the pattern reported by Dijksterhuis et al. (2006). At this stage, perhaps the best that can be said is that the stark contradiction in the data remains to be solved through further theoretical understanding of how and why the unconscious thought effect arises. What is clear from Experiment 3 is that adopting the same materials and procedures but using a different sample population does not guarantee that the unconscious thought effect will be observed (see also Acker, 2008).

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EXPERIMENT 4

Our initial aim in this set of experiments was to replicate the unconscious thought effect and then to examine boundary conditions in an attempt to elucidate possible underlying mechanisms. Our inability to replicate the effect is to our minds important to document in its own right; however, it would be more satisfying to provide some explanation for the similarity in choice following immediate, conscious, or unconscious thought that we observed in all three experiments. Although such an approach may not directly resolve the contradiction between our findings and those of Dijksterhuis and colleagues it has the potential to shed light on why our participants showed consistent choice behaviour across thought conditions.

Rethinking the choice task

Participants in the standard choice task are told prior to the presentation of attribute information that at a later stage in the experiment they will be expected to choose the "best" option. Attribute information is then presented discretely and sequentially about each option. Setting up the task in this way invites participants to treat it as an "online judgement task" (Hastie & Park, 1986)—one in which a participant forms, and possibly updates, a judgement as attribute information is encountered. This contrasts with end-of-sequence judgements (Hogarth & Einhorn, 1992), or judgements or decisions from memory (see Bröder & Schiffer, 2003) where a judgement is made after the relevant information has been encoded. Given that a choice is expected, it is likely that a participant sequentially updates impressions of each option as more evidence is encountered (Edwards, 1968; Hogarth & Einhorn, 1992). The judgement reached at the end of the presentation phase is then the one relied upon when the decision is asked for (e.g., after the period of deliberation or distraction). Hastie and Park (1986) argue that "so many judgements are made online (spontaneously) because when a new judgement must be made *in the absence of perceptually available evidence*, subjects rely on previous judgements rather than remembered evidence" (p. 263, emphasis added). Self-report data obtained in Experiment 2 are consistent with this interpretation: In all but the conscious & information condition (in which evidence was available during deliberation) the majority of participants indicated that they had arrived at their decision prior to engaging in deliberation or distraction.

If participants approach the experiment as an online judgement task, then two predictions follow: First, there should be little difference in choice between modes of thought—this prediction flies in the face of unconscious thought theory (Dijksterhuis & Nordgren, 2006) but is consistent with the pattern in Experiments 1–3, and second, that choices should be affected by the order in which attribute information is encountered (Hogarth & Einhorn, 1992). This latter prediction is yet to be investigated because in previous experiments care has been taken to randomize the order of attribute presentation. In Experiment 4 attribute order was manipulated to investigate this prediction.

Several investigations of impression formation have documented *recency effects* in which pieces of evidence encountered later are given more weight than those encountered earlier (Denrell, 2005; Dreben, Fiske, & Hastie, 1979; Hogarth & Einhorn, 1992). Typically recency effects are found when judgements are required after each piece of information is presented, although that is not the case with the current choice paradigm (a judgement is only required at the end); because participants need to update their impressions of four separate options the processing required is perhaps akin to deciding which of the four is "ahead" after each attribute is presented. In standard impression formation tasks participants evaluate only a single option (e.g., a person) for, for example, likeability (Dreben et al., 1979) or suitability for a job (Hastie & Park, 1986).

To examine whether recency effects could be found in a more complex choice task we adapted the task used in Experiment 3 to one involving two cars each described by 20 attributes (10 positive and 10 negative; the names *Hatsdun* and *Nabusi* were used and were counterbalanced across conditions; for ease of explanation we use the generic terms Car 1 and Car 2). (Two cars were used rather than four to enable a more straightforward manipulation of attribute ordering—see Method.) On a simple tally rule the two cars were "balanced" in terms of their "goodness" as choices because they had equal numbers of positive and negative attributes. The key question of interest was whether this overall balance was affected by the order in which attribute information was encountered. If order does have an effect then we would have evidence to support the claim that participants treat this task as an online judgement task. This in turn could explain why we found little difference in the choices made across modes of thought in Experiments 1 to 3. If participants are making their choice at the end of the presentation phase and then retrieving that decision when asked, one would expect choices to be similar regardless of the mode of thought subsequently engaged in.

A second question is whether the mode of thought interacts with any biases induced by attribute ordering. Arguably, proponents of unconscious thought theory would predict that because unconscious thought is capable of more optimal weighting of information than conscious thought then it should be least susceptible to ordering biases (Dijksterhuis & Nordgren, 2006). That is, after a period of distraction (unconscious thought) any bias to choose one option should be counteracted by the optimal restructuring of information in memory. In direct contrast to this prediction, some experiments on impression formation have found evidence that recency effects are stronger when presentation of attributes and judgements are interpolated with distraction tasks (Dreben et al., 1979).

The presentation order of attributes of the cars was manipulated in an ascending (predominantly negative attributes presented first followed by predominantly positive attributes) or descending order (predominantly positive attributes followed by predominantly negative attributes; see McAndrew, 1981). The presentation order was counterbalanced for the two cars. In the "Car 1 +ve last" condition attributes of Car 1 were presented in ascending order, and Car 2 attributes were presented in descending order. In the "Car 1 +ve first" condition attributes of Car 1 were presented in descending order, and Car 2 attributes were presented in ascending order. Recency effects would be indicated by the tendency to choose the car about which a participant has recently encountered positive information: Car 1 in the "Car 1 +ve last" condition and Car 2 in the "Car 1 +ve first" condition.[3]

Method

Participants

The sample consisted of 119 undergraduate students (86 female and 33 male; $M = 19.7$ years, $SD = 3.4$) from the University of New South Wales. They received course credit for participation. None of the participants had taken part in Experiments 1, 2, or 3.

Design

Experiment 4 was a 3 (mode of thought) $\times$ 2(order) $\times$ 2(car) with the first two factors manipulated between subjects and the third within subjects. Participants were randomly assigned to the six conditions resulting from crossing mode of thought (immediate, conscious, unconscious) with order (Car 1 +ve last, Car 1 +ve first). There was an n of 20 in each condition except the "unconscious, Car 1 +ve first" condition, which had 19.

Materials

Appendix B contains a complete list of the attributes used and the order in which they were presented. The 12 attributes used in Experiment 3 were supplemented with 8 new attributes (e.g., has a parking sensor) to construct the lists. List A in Appendix B shows the ascending pattern used in the "Car 1 +ve last" condition in which

[3] The alternative prediction—that information encountered first will have a greater influence (i.e., primacy)—could also be made, but previous research led us to predict that recency effects would be more likely in this paradigm (e.g., Denrell, 2005, p. 962), hence our framing of the hypothesis with respect to recency.

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predominantly positive attributes about Car 1 are shown later in the list. List B shows the descending pattern used in the "Car 1 −ve last" condition in which predominantly negative attributes about Car 1 are shown later in the list.

Procedure
The procedure was identical to that of Experiment 3. Memory recall, attitude ratings, and attribute ratings were all elicited in the same manner.

Results

Frequency of choice
Figure 7 displays the percentage of participants choosing Car 1 in the six conditions. It is important to note that because there are only two alternatives in this experiment the percentage of participants choosing Car 2 in each condition is simply 100 minus each of the values displayed in Figure 7. The overall pattern suggests an effect of recency. This is evidenced by the left-hand bar (Car 1 +ve last) being higher than the right-hand bar (Car 1 +ve first) in each mode of thought condition—indicating that more people chose Car 1 when they had recently seen positive information about it than when they had seen positive information about it at the start of the presentation phase. This pattern is clearly most evident in the unconscious thought condition.

Hierarchical log-linear analysis was used to examine the interaction between mode of thought and sequence order for the choice data. Thought condition (immediate vs. conscious vs. unconscious), order (Car 1 +ve last vs. Car 1 +ve first), and choice (Car 1 vs. Car 2) were entered as factors. The three-way effect (Thought Condition × Order × Choice) was not statistically significant, $\chi^2(2) = 3.37$, $p = .186$. The two-way order-by-choice effect was

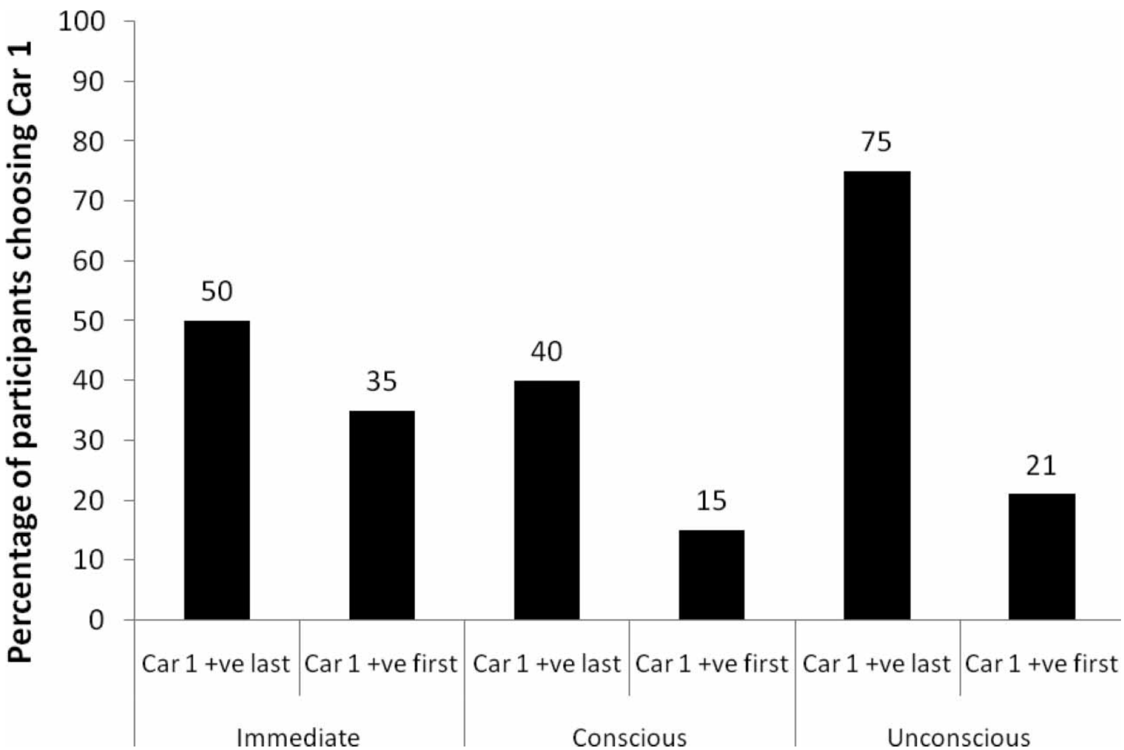

Figure 7. *Percentage of participants choosing Car 1 in Experiment 4.*

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significant, $\chi^2(2) = 12.45$, $p < .001$—the proportion choosing Car 1 was significantly higher when participants encountered its positive attributes later. As order effects were a key concern in this experiment, we used three separate chi-square tests to perform planned comparisons of this effect of order upon choice separately for each thought condition. There was a large and statistically significant effect in the unconscious condition, $\chi^2(1) = 11.35$, $p = .001$, $\phi = 0.54$, consistent with a greater influence of recently viewed material. This effect was small and nonsignificant in the immediate condition, $\chi^2(1) = 0.92$, $p = .337$, $\phi = 0.15$. In the conscious thought condition the effect was moderate and approached significance, $\chi^2(1) = 3.14$, $p = .077$, $\phi = 0.28$.

Attitude ratings

The attitude ratings revealed a similar picture to the choice data. Analyses of variance (ANOVAs) found no main effects of conditions but a significant interaction between order and car, $F(1, 113) = 5.86$, $p < .02$, arising because on average Car 1 was rated higher than Car 2 in the "Car 1 +ve last" condition (Car 1 = 60.5, Car 2 = 57.7; 1–100 scale), with the reverse being true in the "Car 1 +ve first" condition (Car 1 = 55.9, Car 2 = 63.3). The interaction between order and thought condition was also significant, $F(2, 113) = 4.70$, $p < .02$, because the mean difference in attitude ratings for the two cars was higher in the unconscious (mean difference of 8.7) and the conscious (mean difference of 7.7) than in the immediate condition (mean difference of 2.0). The three-way interaction between car, order, and thought condition was not significant ($F < 1$).

Recall of attributes

The primary interest in the recall data was to examine whether mode of thought had an overall effect on the proportion of correctly recalled attributes. Table 2 shows the percentage of correctly recalled attribute rates collapsed across order and the two cars. A main effect for mode of thought was found, $F(2, 118) = 3.77$, $p < .03$, with the difference between immediate and unconscious being the only significant contrast (95% CI: .013–.21). This pattern is consistent with that found in Experiment 1 and demonstrates that participants in the unconscious thought condition exhibited the poorest memory. In a secondary analysis we examined the effects of order on recall of information about the two alternatives separately. This revealed a marginal but reliable advantage for recall of attributes of Car 1 (42.9% vs. 41.2% for Car 2), $F(1, 113) = 4.96$, $p < .03$, and an effect of order indicating that participants in the "Car 1 +ve first" conditions recalled more correct attributes overall (47.8%) than those in the "Car 1 +ve last" conditions (36.4%), $F(1, 113) = 13.05$, $p < .001$. The reason for this latter effect is unclear, but its presence does not impact the interpretation of the choice data. There were no significant interactions between order, car, and condition.

Attribute weightings and congruency with choices

Participants provided ratings for each of the 20 attributes used to describe Cars 1 and 2. From these ratings preferences for each car were computed according to a WADD rule. The percentages of participants whose choices were congruent with that predicted by WADD were 57.5%, 55%, and 53.8% in the immediate, conscious, and unconscious groups, respectively. These percentages are lower than those seen in the earlier experiments; however, it is important to note that with only two alternatives both with 20 attributes ("balanced" in terms of the number of positive and negative) one would only predict subtle differences in overall weightings. Indeed the mean absolute difference in weightings between Car 1 and Car 2 was only 5.85 points on a possible range of 0–100 (i.e., a difference of 5.8%). This finding of overall ambivalence between the two cars (in terms of attribute weightings) makes the recency data more compelling as it demonstrates that order of information rather than idiosyncratic weighting schemes was primarily responsible for choices.

Discussion

Experiment 4 found evidence of recency effects on the choices made in a two-alternative choice task.

The effect was present in all three modes of thought condition but was strongest in the unconscious thought condition. The pattern of data supports the claim that participants engage in online updating of the options, a process that is affected by the order in which pieces of information are encountered. Finding that participants appear to treat the task as an online updating task provides a plausible explanation for why we found similar patterns of choice across modes of thought in Experiments 1 to 3. If, as Hastie and Park (1986) suggested, participants retrieve judgements made online when subsequently asked for a decision in this type of task, we would expect little difference between conditions when the order of information is randomized. Such an explanation begs the question why Dijksterhuis and colleagues find differences between modes of thought when randomized lists are used, but at this stage, as noted earlier, the theoretical basis for the unconscious thought effect is not yet sufficiently understood to resolve such contradictions.[4]

An important contribution of Experiment 4 is the finding that when the order of attributes is manipulated participants in the unconscious thought condition appear to be most affected (though the data are suggestive, rather than definitive, with respect to this). This effect is contrary to the prediction of unconscious thought theory and suggests that a period of distraction can enhance recency effects (cf. Dreben et al., 1979) and, in this case, lead to poorer choices. This conclusion is reinforced by the attribute rating data, which showed that participants were largely ambivalent between the two options and yet were influenced—heavily in the case of the unconscious thought condition—by the order in which attributes were encountered.

GENERAL DISCUSSION

In contrast to the advice of decision analysts, recent claims in the media have urged people to "Leave big decisions to your unconscious" (Munro, 2006). In four experiments we examined the techniques on which these claims were based. All four experiments showed that when the congruency of choices was examined—by comparing the choice predicted by the sum of weighted attributes with the actual choice—the majority of participants chose options congruent with their highest or second highest weighted option. This effect held regardless of the mode of thought engaged in but, if anything, was clearer in the conditions that did not involve unconscious thought. This finding is both novel and important as previous investigations of this choice paradigm have not reported sufficiently detailed data to examine congruency of choice. Experiment 4 investigated the idea that the choice task involves the online updating of options throughout the presentation phase. We found evidence—in the form of recency effects—to support this claim and argued that framing the task in this way provides a plausible explanation for why we found little difference between the modes of thought in Experiments 1 and 3. In stark contrast to claims in the literature and the media we found very little evidence of the superiority of unconscious thought for complex decisions.

[4] We believe that there is some reason to be cautious in interpreting some of the differences between thought conditions reported in previous studies. For example in Dijksterhuis, 2004, Experiment 2 (one of the few studies to report choice proportions as opposed to attitude differences) the percentage of participants choosing the "best" apartment was 59.3%, 47.1%, and 36.4% in the unconscious, conscious, and immediate groups respectively. The comparison between the unconscious and the immediate group was significant on a chi-square test but only using a one-tailed test with a p value of .04 (it is questionable whether one-tailed tests of significance are suitable in this instance given that a number of alternative theories that would predict effects in the opposite direction: Kimell, 1957; Howell, 2002). The crucial comparison between the conscious and unconscious groups was not statistically significant. In the same paper in Study 1 the difference in attitude towards the "best" and "worst" options between the unconscious and immediate conditions was significant only for males in the sample (15 out of a total of 63 participants); there was no significant difference between the conscious and the unconscious condition. In Study 3 the difference between the conscious and unconscious conditions was significant but only for the males in the sample (38 out of 145).

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Resolving a contradiction

Caution should always be taken when interpreting failures to replicate. Although the experiments reported here provide important insights into the congruency of judgements, the role of online updating, and the effect of providing attribute information, it is the absence of significant differences between the modes of thought that is perhaps most contentious. One reaction to this null result is to dismiss it (e.g., "the experimenters must have done something wrong"). We used four different choice tasks, including a direct replication of the Dijksterhuis et al. (2006) study, and even altered some conditions in an attempt to facilitate unconscious thought (e.g., extending the period of distraction, providing information for thorough encoding) but could not find an unconscious thought effect. If we did "do something wrong" it is not clear to us what that "something" was. This is not to deny outright the existence of the effect, rather it is to suggest that the appropriate reaction to these findings is to acknowledge that sometimes contradictory patterns appear in the literature and that their presence forces further theoretical and empirical development (e.g., see C. J. Berry, Shanks, & Henson's, 2006, reexamination of Merikle & Reingold's, 1991, unconscious memory effects). The direction that this development will take is not yet clear, but we speculate, along with other recent investigations (e.g., Acker, 2008; Payne, Samper, Bettman, & Luce, in press) that it might result in a need to temper some of the bold and general claims made about the benefits of unconscious thought. For researchers familiar with the trajectory of research on related topics such as implicit learning, in which initial claims about the sophistication of unconscious processes were subsequently unsupported, such tempering of conclusions and reconsideration of the evidence will not come as a surprise (e.g., Lagnado et al., 2006; Shanks, 2005).

Other indices of unconscious thought

Proponents of UTT could argue that other indices of behaviour may have greater potential to reveal the benefits of unconscious thought for decision making. We suggest that the choice data from controlled, laboratory experiments are the most compelling and important (it is after all what the person ultimately chooses to do that is of most consequence); nonetheless it is possible that the benefits can be more clearly seen in other dependent measures such as attitude ratings, memory for attributes, or postchoice regret (Dijksterhuis & Nordgren, 2006; Dijksterhuis & van Olden, 2006; Wilson et al., 1993)—or indeed from studies performed outside the laboratory (e.g., Dijksterhuis et al., 2006, Studies 3 and 4). Our preference is to obtain clear demonstrations of the phenomena of interest in the laboratory before speculating on what might or might not be underlying effects seen in people's recollections of consumer choices (for example); nevertheless we can examine some of the other dependent measures that we collected in our experiments to look for evidence of the effects of unconscious thought.

Inspection of the attitude ratings collected in Experiment 1 did indeed provide insight into possible deleterious effects of conscious deliberation, but again no evidence for improved differentiation between the "best" and "worst" options following unconscious thought could be found. In terms of memory, there was no suggestion that overall memory was improved following unconscious thought (it was in fact poorer than that following immediate thought in Experiment 1 and Experiment 4); however, the claims made about the benefits of unconscious thought for memory are slightly more subtle than a simple overall improvement. According to the bottom-up-versus-top-down principle, of UTT, a distinction exists between conscious and unconscious thought in terms of schematic structures. Conscious thought is regarded as being guided by expectancies and schemas, which can lead to distortions in the representation of material (e.g., an overreliance on a subset of plausible or "expected" information, cf. Wilson & Schooler, 1991). Unconscious thought, in contrast, works from the bottom up and delivers an objective summary judgement via the slower process of information integration (Dijksterhuis & Nordgren, 2006). This distinction is demonstrated

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in the "polarization" of memory whereby unconscious thinkers recognize more positive information than negative for desirable options and more negative information than positive for undesirable options. Such polarization is not as apparent following conscious and immediate thought (Dijksterhuis, 2004, Study 4).

We examined the memory data of Experiment 1 (the experiment that most closely resembled that of Dijksterhuis, 2004, Study 4) for possible polarization effects. Figure 8 displays the percentage of accurate recall of positive and negative attributes of the objectively best apartment (Apartment B) and worst apartment (Apartment C). The pattern is very similar to that found by Dijksterhuis (2004). In all conditions there was a tendency to polarize information: Memory for positive attributes of the "best" apartment was better than memory for negative attributes, with the reverse true for the "worst" apartment. A significant apartment by attribute valence interaction supports this interpretation, $F(1, 61) = 10.04$, $p < .003$. This effect appears strongest in the unconscious thought condition but the three-way interaction between mode of thought and memory for positive and negative attributes that UTT predicts was not significant ($p > .60$). Dijksterhuis (2004) also reported a nonsignificant three-way interaction.These data suggest that a period of distraction can lead to subtle changes in the memory for attributes; however, whether this change is due to active and

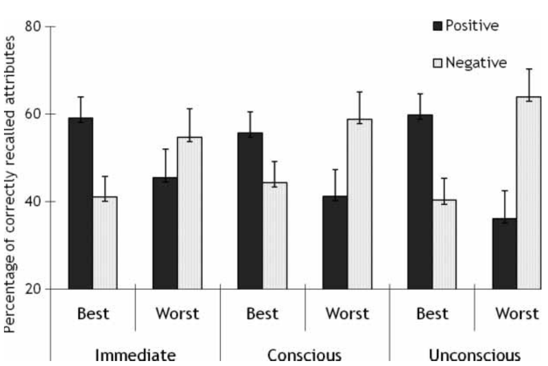

Figure 8. *Percentage of accurate recall of positive and negative attributes of the objectively best apartment (Apartment B) and worst apartment (Apartment C) in Experiment 1.*

qualitatively different processes of consolidation and organization or a reflection of poorer overall memory (see Table 2) is unclear.

This point is worthy of some further consideration. Dijksterhuis (2004) concedes that his test of "memory" for attributes is actually an allocation test—participants were shown attributes and had to identify the source (room-mate A, B, or C). Therefore, from his data on correct "recognition" (allocation) one can infer incorrect recognition/allocation. One can see (Dijsksterhuis, 2004, Fig. 1) that incorrect allocation is high in the case of negative attributes associated with attractive options and positive attributes associated with unattractive options. Therefore, the data that Dijksterhuis presents as evidence of polarization in memory, and discusses as a positive feature of unconscious thought, may simply reflect a rather poor memory for attributes in his unconscious thought conditions. This poor memory is presumably allied to a tendency to misallocate attributes, of which one has little or no memory, on the basis of preferences that one has recently acquired. For this reason, we feel that free recall tests of attributes are much more likely to give genuine insight into the representation of attribute information. Furthermore, there is no reason to suppose that memory polarization precedes or explains patterns of choice. For instance, if, as seems to be the case, the judgements that drive choice are made online, memory for attributes may be influenced by the valence of attitude (rather than attitude being influenced by attribute information stored in memory).

Reliability of ratings

The choice congruency data revealed interesting insights into the relation between actual choices and those predicted by a weighted additive model (WADD). However, their interpretation is not without potential problems. Ratings of attributes were always taken after choices had been made, raising the possibility that there was a demand for participants to appear consistent (i.e., if they had just chosen the apartment without a wardrobe they should not rate "having a wardrobe" as an important

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attribute). Wilson and Schooler (1991) attempted to counter this problem by having participants believe that their reasons for making particular choices in the "jams study" would not be required. There are potential problems with both before and after elicitation methods, but on balance, we felt that eliciting ratings after the choice was less problematic. If the attributes had been prerated this may have increased the potential for all participants to approach the experiment in a more "analytic" (conscious) frame of mind, thus (in the eyes of UTT proponents at least) hampering unconscious thought.

Other decision models

One of our key aims was to examine the claim that unconscious thought is better than conscious thought in weighting attribute information. One test of this prediction was to examine the proportion of choices consistent with a "simple" decision strategy that requires no attribute weighting (TALLY) and a more complex one that does (WADD). It is important to note, however, that there are many more ways in which attribute information can be used to arrive at a decision. We did not attempt to construct a choice set that would allow us to distinguish between other decision models but clearly this is an important goal for future research. For example, the choice set used in Experiments 1 and 2 does not distinguish between the predictions of WADD and a simpler lexicographic model such as "take-the-best" (Gigerenzer & Goldstein, 1996)—both would choose Apartment B. (The latter does so by choosing on the basis of the single "best" attribute that discriminates options in the choice set, when attributes are searched in order of importance.) This is instructive because it means that a participant who chose Apartment B might have arrived at that choice using a weighted sum of all the attributes, or she might have utilized a simpler mechanism like TTB. Given the interest in discovering the conditions under which people adopt such different strategies (see Bröder, in press; Newell, 2005; Newell & Shanks, 2007, for reviews) in future research it would be intriguing to design choice sets in which a lexicographic strategy and WADD make different predictions.

CONCLUSION

Claims about the powers of the unconscious are always appealing and seductive, and the claim that we do not need to think about complex decisions is very tempting. Although proponents of this idea may argue that their original conclusions were not so bold (see, for example, the replies by Dijksterhuis et al. to the letters of Bekker, 2006, and Shanks, 2006, in *Science*), the overwhelming message from these studies was that "choices in complex matters . . . should be left to unconscious thought" (Dijksterhuis et al., 2006). We believe that existing empirical evidence and theoretical understanding is not sufficiently clear to warrant this conclusion. On the contrary, our data suggest that unconscious thought is more susceptible to arbitrary ordering effects, and that if conscious thinkers are given adequate time to encode material, or are allowed to consult material while they deliberate—conditions that reflect Benjamin Franklin's sage advice—their choices are at least as good as those made "unconsciously".

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REFERENCES

Acker, F. (2008). New findings on unconscious versus conscious thought in decision making: Additional empirical data and meta-analysis. *Judgment and Decision Making, 3*, 292–303.

BBC News Online. (2006, February 17). *Sleep on it, decision makers told*. Retrieved May 10, 2007, from http://news.bbc.co.uk/2/hi/health/4723216.stm

Bekker, H. L. (2006). Making choices without deliberating. *Science*, *312*, 1472.

Berry, C. J., Shanks, D. R., & Henson, R. N. A. (2006). On the status of unconscious memory: Merikle and Reingold (1991) re-examined. *Journal of*

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Experimental Psychology: Learning, Memory, and Cognition, *32*, 925–934.

Berry, D. C., & Broadbent, D. E. (1984). On the relationship between task performance and associated verbalisable knowledge. *Quarterly Journal of Experimental Psychology*, *50A*, 1–24.

Bird, K. D. (2004). *Analysis of variance via confidence intervals.* London: Sage Publications.

Bröder, A. (in press). The quest for take the best—insights and outlooks from experimental research. In P. Todd, G. Gigerenzer, & the ABC Research Group (Eds.), *Ecological rationality: Intelligence in the world.* New York: Oxford University Press.

Bröder, A., & Shiffer, S. (2003). Take the best versus simultaneous feature matching: Probabilistic inferences from memory and effects of representation format. *Journal of Experimental Psychology: General*, *132*, 277–293.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 115–159.

Dawes, R. M., & Corrigan, B. (1974). Linear models in decision making. *Psychological Bulletin*, *81*, 95–106.

Denrell, J. (2005). Why most people disapprove of me: Experience sampling in impression formation. *Psychological Review*, *112*, 951–978.

Dienes, Z., & Fahey, R. (1998). The role of implicit memory in controlling a dynamic system. *Quarterly Journal of Experimental Psychology*, *51A*, 593–614.

Dijksterhuis, A. (2004). Think different: The merits of unconscious thought in preference development and decision making. *Journal of Personality and Social Psychology*, *87*, 586–598.

Dijksterhuis, A., Bos, M. W., Nordgren, L. F., & van Baaren, R. B. (2006). On making the right choice: The deliberation-without-attention effect. *Science*, *311*, 1005–1007.

Dijksterhuis, A., & Nordgren, L. F. (2006). A theory of unconscious thought. *Perspectives on Psychological Science*, *1*, 95–109.

Dijksterhuis, A., & van Olden, Z. (2006). On the benefits of thinking unconsciously: Unconscious thought can increase post-choice satisfaction. *Journal of Experimental Social Psychology*, *42*, 627–631.

Dreben, E. K., Fiske, S. T., & Hastie, R. (1979). The independence of evaluative and item information: Impression and recall order effects in behavior-based impression formation. *Journal of Personality and Social Psychology*, *37*, 1758–1768.

Edwards, W. (1968). Conservatism in human information processing. In B. Kleinmuntz (Ed.), *Formal representation of human judgment* (pp. 17–52). New York: Wiley.

Edwards, W., & Fasolo, B. (2001). Decision technology. *Annual Review of Psychology*, *52*, 581–606.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175–191.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review*, *103*, 650–669.

Gladwell, M. (2005). *Blink: The power of thinking without thinking.* London: Penguin.

Goodman, N. G. (1931). *The ingenious Dr. Franklin: Selected scientific letters of Benjamin Franklin.* Philadelphia: University of Pennsylvania Press.

Hastie, R., & Park, B. (1986). The relationship between memory and judgment depends on whether the judgment task is memory-based or on-line. *Psychological Review*, *93*, 258–268.

Hogarth, R. M., & Einhorn, H. J. (1992). Order effects in belief updating: The belief adjustment model. *Cognitive Psychology*, *24*, 1–55.

Howell, D. C. (2002). *Statistical methods for psychology* (5th ed.). Belmont, CA: Wadsworth.

Jha, A. (2006, February 17). Want to make a complicated decision? Just stop thinking. *Guardian Online*. Retrieved May 10, 2007, from http://www.guardian.co.uk/science/story/0,,1711859,00.html

Keeney, R. L., & Raiffa, H. (1976). *Decisions with multiple objectives: Preference and value tradeoffs*. New York: Wiley.

Kimmel, H. D. (1957). Three criteria for the use of one-tailed tests. *Psychological Bulletin*, *54*, 351–353.

Knowlton, B. J., Squire, L. R., & Gluck, M. A. (1994). Probabilistic classification learning in amnesia. *Learning & Memory*, *1*, 106–120.

Lagnado, D. A., Newell, B. R., Kahan, S., & Shanks, D. R. (2006). Insight and strategy in multiple cue learning. *Journal of Experimental Psychology: General*, *135*, 162–183.

Levine, G. M., Halberstadt, J. B., & Goldstone, R. L. (1996). Reasoning and the weighting of attributes in attitude judgments. *Journal of Personality and Social Psychology*, *70*, 230–240.

Lewicki, P., Hill, T., & Czyzewska, M. (1992). Nonconscious acquisition of information. *American Psychologist*, *47*, 796–801.

McAndrew, F. T. (1981). Pattern of performance and attributions of ability and gender. *Personality and Social Psychology Bulletin*, *7*, 583–587.

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Merikle, P. M., & Reingold, E. M. (1991). Comparing direct (explicit) and indirect (implicit) measures to study unconscious memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *17*, 224–233.

Munro, A. (2006, February 17). Leave big decisions to your unconscious. *National Post Canada*. Retrieved May 10, 2007, from http://www.canada.com/national/nationalpost/news/cnspolitics/stroy.html?id=28c5ae5c-88a2-4229-962e-f945b670080b.

Newell, B. R. (2005). Re-visions of rationality? *Trends in Cognitive Sciences*, *9*, 11–15.

Newell, B. R., & Bright, J. E. H. (2002). Well past midnight: Calling time on implicit invariant learning? *European Journal of Cognitive Psychology*, *14*, 185–205.

Newell, B. R., Lagnado, D. A., & Shanks, D. R. (2007a). *Straight choices: The psychology of decision making*. Hove, UK: Psychology Press.

Newell, B. R., Lagnado, D. A., & Shanks, D. R. (2007b). Challenging the role of implicit processes in probabilistic category learning. *Psychonomic Bulletin & Review*, *14*, 505–511.

Newell, B. R., & Shanks, D. R. (2007). Perspectives on the tools of decision making. In M. Roberts (Ed.), *Integrating the mind* (pp. 131–151). Hove, UK: Psychology Press.

Payne, J. W. (1976). Task complexity and contingent processing in decision making: An information search and protocol analysis. *Organizational Behavior and Human Performance*, *16*, 366–387.

Payne, J. W. (2007, August). *In a world of constructed preferences, is the decision advice of Benjamin Franklin still valid?* Keynote address to the Subjective Probability, Utility and Decision Making 21st Conference, Warsaw, Poland.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker*. Cambridge, UK: Cambridge University Press.

Payne, J. W., Samper, A., Bettman, J. R., & Luce, M. F. (in press). Boundary conditions on unconscious thought in complex decision making. *Psychological Science*.

Reber, A. S. (1992). The cognitive unconscious: An evolutionary perspective. *Consciousness and Cognition*, *1*, 93–133.

Shanks, D. R. (2005). Implicit learning. In K. Lamberts & R. Goldstone (Eds.), *Handbook of cognition* (pp. 202–220). London: Sage.

Shanks, D. R. (2006). Complex choices better made unconsciously? *Science*, *313*, 760–761.

Shanks, D. R., & St. John, M. F. (1994). Characteristics of dissociable human learning systems. *Behavioral and Brain Sciences*, *17*, 367–447.

Simonson, I., & Nowlis, S. M. (2000). The role of explanations and need for uniqueness in consumer decision making: Unconventional choices based on reasons. *Journal of Consumer Research*, *27*, 49–68.

Smith, S. M., & Blankenship, S. E. (1989). Incubation effects. *Bulletin of the Psychonomic Society*, *27*, 311–314.

Tordesillas, R. S., & Chaiken, S. (1999). Thinking too much of too little? The effects of introspection on the decision-making process. *Personality and Social Psychology Bulletin*, *25*, 623–629.

Von Winterfeldt, D., & Edwards, W. (1986). *Decision analysis and behavioral research*. Cambridge, UK: Cambridge University Press.

Wilson, T. D., Lisle, D., Schooler, J. W., Hodges, S. D., Klaaren, K. J., & LaFleur, S. J. (1993). Introspecting about reasons can reduce post-choice satisfaction. *Personality and Social Psychology Bulletin*, *19*, 331–339.

Wilson, T. D., & Schooler, J. W. (1991). Thinking too much: Introspection can reduce the quality of preferences and decisions. *Journal of Personality and Social Psychology*, *60*, 181–192.

APPENDIX A

Materials used in Experiment 3

This set of attributes was obtained from Dijksterhuis et al.'s (2006) study.

Hatsdun (75% positive attributes)

The Hatsdun is very new
The Hatsdun has good mileage
The Hatsdun has cupholders
The Hatsdun is relatively good for the environment
The Hatsdun has a large boot
The Hatsdun has good handling
The Hatsdun is available in many different colours
The Hatsdun has a sunroof
For the Hatsdun service is excellent
With the Hatsdun it is difficult to change gears
The Hatsdun has poor legroom
The Hatsdun has a poor sound system

Kaiwa (58% positive attributes)

The Kaiwa is fairly good for the environment
With the Kaiwa it is easy to change gears
For the Kaiwa service is excellent
The Kaiwa is available in many different colours
The Kaiwa has plenty of legroom
The Kaiwa has a large boot
The Kaiwa has good mileage
The Kaiwa has poor handling
The Kaiwa has no sunroof
The Kaiwa has no cupholders
The Kaiwa is old
The Kaiwa has a poor sound system

Dasuka (50% positive attributes)

The Dasuka is new
With the Dasuka it is easy to change gears
The Dasuka has cupholders
The Dasuka has a sunroof
The Dasuka has good handling
The Dasuka has a good sound system
For the Dasuka service is poor
The Dasuka is available in very few colours
The Dasuka is not very good for the environment
The Dasuka has little legroom
The Dasuka has a small boot
The Dasuka has poor mileage

Nabusi (25% positive attributes)

The Nabusi has a sunroof
The Nabusi is available in many different colours
The Nabusi is not very good for the environment
For the Nabusi service is poor
With the Nabusi it is difficult to change gears
The Nabusi has poor mileage
The Nabusi is old
The Nabusi has poor handling
The Nabusi has plenty of legroom
The Nabusi has no cupholders
The Nabusi has a poor sound system
The Nabusi has a small boot

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APPENDIX B

Materials used in Experiment 4

The symbols "+" and "−" indicate positive and negative values of the attributes, respectively. The attributes are listed in the orders that they were presented on screen to participants. The names *Hatsdun* and *Nabusi* were counterbalanced as "Car 1" and "Car 2".

Version A

Hatsdun (Car 1) ascending order (negative attributes followed by positive attributes)

− With the Hatsdun the fuel efficiency is low
− The Hatsdun has no power windows
− The Hatsdun has no parking sensor
− The Hatsdun has poor legroom
− The Hatsdun is not very good for the environment
− For the Hatsdun service is poor
− The Hatsdun has no cupholders
− The Hatsdun has a small boot
+ The Nabusi has a sunroof
+ The Nabusi is available in many different colors
+ The Nabusi is new
+ The Nabusi has good mileage
+ With the Nabusi the fuel efficiency is high
+ The Nabusi has power windows
+ The Nabusi has a parking sensor
+ The Nabusi has plenty of legroom
− The Hatsdun has poor handling
− With the Hatsdun it is difficult to change gears
+ The Hatsdun has air-conditioning
+ The Hatsdun has remote central locking system
+ The Nabusi has air-conditioning
+ The Nabusi has good handling
− The Nabusi has no remote central locking system
− With the Nabusi it is difficult to change gears
+ The Hatsdun has a good sound system
+ The Hatsdun has height adjustable seats
+ The Hatsdun has power steering
+ The Hatsdun has fog lamps
+ The Hatsdun has a sunroof
+ The Hatsdun is available in many different colors
+ The Hatsdun is new
+ The Hatsdun has good mileage
− The Nabusi has a small boot
− For the Nabusi service is poor
− The Nabusi has no cupholders
− The Nabusi is not very good for the environment
− The Nabusi has a poor sound system
− The Nabusi has no height adjustable seats
− The Nabusi has no power steering
− The Nabusi has no fog lamps

Version B

Hatsdun (Car 1) descending order (positive attributes followed by negative attributes)

+ The Hatsdun is fairly good for the environment
+ For the Hatsdun service is excellent
+ The Hatsdun has cupholders
+ The Hatsdun has a large boot
+ The Hatsdunhas a sunroof
+ The Hatsdun is available in many different colors
+ The Hatsdun is new
+ The Hatsdun has good mileage
− The Nabusi is not very good for the environment
− For the Nabusi service is poor
− The Nabusi has no cupholders
− The Nabusi has a small boot
− The Nabusi has no sunroof
− The Nabusi is available in very few colors
− The Nabusi is old
− The Nabusi has poor mileage
+ The Hatsdun has air-conditioning
+ The Hatsdun has remote central locking system

− The Hatsdun has poor handling
− With the Hatsdun it is difficult to change gears
− The Nabusi has no air-conditioning
− The Nabusi has no remote central locking system
+ The Nabusi has good handling
+ With the Nabusi it is easy to change gears
− The Hatsdun has a poor sound system
− The Hatsdun has no height adjustable seats
− The Hatsdun has no power steering
− With the Hatsdun the fuel efficiency is low
− The Hatsdun has no power windows
− The Hatsdun has no parking sensor
− The Hatsdun has poor legroom
− The Hatsdun has no fog lamps
+ The Nabusi has a good sound system
+ The Nabusi has height adjustable seats
+ The Nabusi has power steering
+ With the Nabusi the fuel efficiency is high
+ The Nabusi has power windows
+ The Nabusi has a parking sensor
+ The Nabusi has plenty of legroom
+ The Nabusi has fog lamps

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