Research Article

Boundary Conditions on Unconscious Thought in Complex Decision Making

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ABSTRACT—*Should individuals delegate thinking about complex choice problems to the unconscious? We tested two boundary conditions on this suggestion. First, we found that in a decision environment similar to those studied previously, self-paced conscious thought and unconscious thought had similar advantages over conscious thought constrained to a long fixed time interval in terms of identifying the option with the highest number of positive outcomes. Second, we found that self-paced conscious thought performed better than unconscious thought in a second decision environment where performance depended to a greater extent on magnitudes of the attributes. Thus, we argue that it is critical to take into account the interaction of forms of processing with task demands (choice environments) when considering how to approach complex choice problems.*

When faced with a complex decision, how should one decide? Conventional wisdom is that one should consciously process value information for each available alternative on all relevant dimensions, make trade-offs across dimensions, and then select the alternative with the best overall value. If the decision involves uncertainties, beliefs about event likelihoods should also be considered. This type of conscious, deliberate decision strategy has been referred to as the weighted additive (WADD) model or the expected-value (EV) model and its variants.

In contrast, Dijksterhuis and his colleagues (Dijksterhuis, Bos, Nordgren, & Baaren, 2006; Dijksterhuis & Nordgren, 2006) have argued that unconscious thought may be better than conscious thought in some decision situations. Dijksterhuis and Nordgren (2006) defined unconscious thought as "object-relevant or task-relevant cognitive or affective thought processes that occur while conscious attention is directed elsewhere" (p. 96), and conscious thought as deliberation with attention focused on the problem. According to Dijksterhuis and his colleagues, unconscious thought (a) is good at forming global or holistic impressions of alternatives (Dijksterhuis, 2004), (b) weights "the relative importance of different attributes of objects in a relatively objective and 'natural' way" (Dijksterhuis & van Olden, 2006, p. 628), and (c) is less capacity constrained than conscious thought. Consequently, "one thing the unconscious is good at [is] making complex decisions" (Dijksterhuis, 2004, p. 597). Dijksterhuis and his colleagues noted that conscious thought may be better for making simple decisions or strictly following a single rule, such as applying a lexicographic rule or judging whether something meets a predetermined standard (Dijksterhuis & Nordgren, 2006). However, they advised, "when matters become more complicated and weighting is called for (as in WADD), use unconscious thought" (Dijksterhuis & Nordgren, 2006, p. 105). This idea has provoked debate (e.g., Shanks, 2006); hence, it is important to review the evidence for this advice and to explore possible boundary conditions that may limit its applicability.

In two of the experiments reported by Dijksterhuis (2004) and Dijksterhuis et al. (2006), they operationalized a complex decision problem as involving four alternatives and 12 binary attributes. Experiment 2 in Dijksterhuis (2004) found that the option characterized by more positive attributes was chosen significantly more often in an unconscious-thought condition (59%) than when participants responded immediately (36%) and was chosen more often, though not significantly so, in the unconscious-thought condition than in a conscious-thought condition (47%). In the first study in Dijksterhuis et al. (2006), the option characterized by more positive attributes was chosen significantly more often under unconscious thought (60%) than under conscious thought (22%).

Although these results are noteworthy, we tested two important boundary conditions. First, we found that conscious thought

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performed similarly to unconscious thought in a choice task similar to that used by Dijksterhuis and his colleagues (e.g., Dijksterhuis et al., 2006; Dijksterhuis & Nordgren, 2006) when conscious thought was self-paced rather than performed under task constraints requiring persistence for an artificially long time. When conscious thought was constrained to persist, we replicated the finding that unconscious thought performs better than conscious thought. We interpret this combination of findings as evidence for poor performance of constrained conscious thought, rather than for superiority of unconscious thought.

Second, we found that self-paced conscious thought can outperform unconscious thought in a choice environment where performance depends to a greater extent on magnitude information. In particular, unconscious thought displays limited sensitivity to differences in magnitude information, such as winning $14 rather than $3, performing less well when magnitudes matter more.

In the next section, we review the typical experimental task and instructions used by Dijksterhuis and his colleagues. We then introduce a new instruction for conscious thought and a new choice task that allowed us to systematically control and alter the magnitudes of attribute values. Then, we present data placing boundary conditions on the advice to use unconscious thinking for complex decisions.

THE TASK IN DIJKSTERHUIS'S STUDIES

Dijksterhuis and his colleagues typically utilize a decision-making task in which individuals are presented attribute information on options such as cars or apartments (Dijksterhuis, 2004; Dijksterhuis et al., 2006) and are instructed to form an impression of each option with the explicit goal of later making a choice. Each alternative's value on each attribute is presented on a computer screen, one piece of information at a time, for 4 to 8 s. The information usually is presented in a random order, but sometimes is presented in a fixed order (by alternative; Dijksterhuis et al., 2006; Dijksterhuis & Nordgren, 2006). It is important to note that the attribute values are generally binary (i.e., positive or negative). Several studies used four options described by 12 attributes (a total of 48 pieces of information), requiring what were viewed as complex decisions. In these studies, information acquisition, always conscious, is separated from choice.

Options differ in the number of positive attributes possessed. The "best" option typically is defined as the alternative that has more positive attributes than the other options. For instance, it might have 9 of 12 positive attributes, two of the remaining alternatives might have only 6 of 12, and a final, clearly inferior option might have just 3 positive attributes. Thus, in this paradigm, the best option is defined by a simple strategy of counting positive attributes. Following presentation of the attributes, participants are assigned to different thought conditions. Generally, the focus is on choice following a fixed time (e.g., 3 or 4 min) of deliberation in conscious thought versus choice following unconscious thought (i.e., participants complete a cognitive distraction task, such as solving anagrams) during the same amount of time (Dijksterhuis et al., 2006). We maintained the key features of this task, adding a different conscious-thought instruction and a new choice task to examine boundary conditions.

OVERVIEW OF THE STUDY AND HYPOTHESES

We compared performance in three thought conditions: conscious thought for a fixed time (CT-FT), self-paced conscious thought (CT-SP), and unconscious thought (UCT). Constraining thought time (i.e., CT-FT condition) is perhaps a deficient instantiation of conscious thought if there is too much time to think, so that attention shifts to information of lesser relevance (dilution). For example, in the first study in Dijksterhuis et al. (2006), the fixed-time condition yielded 22% correct responses, essentially chance performance. To create a more realistic choice environment and test whether artificially long deliberation time negatively influences performance, we added the CT-SP condition, in which participants were allowed as much time as they liked to decide.

We tested the three conditions in two choice environments. In one environment, we replicated the finding that the option with the largest number of positive attributes is selected more often in the UCT condition than in the CT-FT condition. However, in a second choice environment, where the magnitudes of the attributes were altered to create a more substantial dissociation between the number of positive attributes and the highest expected value, we found that the option with the highest expected value was selected more often in the CT-SP condition than in both the UCT and the CT-FT conditions.

Task

Participants selected their preferred lottery from four different options, a classic choice task (see Wu, Zhang, & Gonzalez, 2004, for a review). Options were defined by payoffs for 12 equiprobable events defined by drawing 1 of 12 numbered balls from a bingo cage (see Table 1). This task shares the same basic structure used by Dijksterhuis and his colleagues: four options, 12 attributes (or events), and positive and nonpositive outcomes (money won vs. no money won). However, we varied the magnitude of the positive outcomes (e.g., $2 vs. $13 won). If one assumes more money is preferred to less, the preference ordering over the attribute values is clear; this task allows attribute magnitudes to vary while other factors that might influence weighting are held constant (as opposed, e.g., to the automobile-choice task used by Dijksterhuis et al., 2006, in which the global importance of "safety" vs. "cup holders" attributes might differ). We made decisions "real" for our participants by drawing a numbered ball from the bingo cage and providing them with the monetary payoff corresponding to the option they chose. Two types of options are focal: options with the largest number of

TABLE 1
Payoffs for the 12 Equiprobable Events and Expected Value for Each Option

Game and option	Event (number rolled) 1	2	3	4	5	6	7	8	9	10	11	12	Expected value
Game A													
HiEV (Wynn)	0	0	0	0	0	0	8	9	10	11	12	13	$5.25
P(win) (Mirage)	0	0	0	2	4	5	6	7	8	9	10	11	$5.17
Decoy (Mandalay)	0	0	0	0	0	0	3	5	6	7	12	13	$3.83
Filler (Venetian)	0	0	0	0	0	0	0	0	0	2	3	4	$0.75
Game B													
HiEV (Luxor)	0	0	0	0	0	0	8	9	10	12	14	16	$5.75
P(win) (Rio)	0	0	0	2	3	4	5	6	7	8	9	10	$4.50
Decoy (Platinum)	0	0	0	0	0	0	3	5	6	7	14	16	$4.25
Filler (Sahara)	0	0	0	0	0	0	0	0	0	2	4	12	$1.50

Note. Outcomes were presented on the screen in a random order. Names of the options are given in parentheses. HiEV = option with the highest expected value; *P*(win) = option with the greatest probability of winning something.

positive outcomes (the accuracy criterion used in prior work by Dijksterhuis and his colleagues) and options with the highest EV (a standard accuracy criterion for risky choice that takes attribute magnitudes into account).

Replicating Dijksterhuis's Environment: *P*(win)

In situations of complex risky choice, people often select options that maximize the overall probability of winning *something*, *P*(win), even at some cost to EV (Payne, 2005). We refer to this as the *P*(win) rule. The highest-*P*(win) option is analogous to the best option in Dijksterhuis's paradigm (i.e., the option with the largest number of positive values). Automatic encoding and recall of the frequency of positive outcomes (Hasher & Zacks, 1984) in the UCT condition would favor choice of the option selected by the *P*(win) rule. Coding of positive versus nonpositive outcomes can be construed as a simplification that responds to the *gist* of the outcome value (Reyna & Brainerd, 1995) or as a response to the importance of achieving an aspiration level (Lopes, 1995). Thus, we believe that the UCT condition is particularly suited to the *P*(win) criterion for accuracy, but performance in this condition may be relatively poor if the environment demands increased sensitivity to magnitude (see Hsee & Rottenstreich, 2004, for differential sensitivity of different modes of thought to magnitudes).

Examining Magnitudes: EV

EV maximization is generally considered to be a normative standard for risky choice with low stakes (see Table 1 for the EVs of the options in our study).

Our choice environments manipulated the trade-off between the *P*(win) rule and the more magnitude-sensitive EV rule, which selects the option with the highest EV (HiEV). By definition, the *P*(win) choice always provided the highest probability of winning a nonzero payout (9 out of 12 payouts were nonzero). Also by definition, the HiEV option had the highest EV, but only 6 of 12 outcomes for this option were positive. We structured the choice environments to make the trade-off between number and magnitude of positive outcomes negligible ($0.08 in the first choice environment, referred to as Game A) or much more significant ($1.25 in the second choice environment, referred to as Game B). Diecidue and van de Ven (2008) viewed this trade-off of EV maximization and *P*(win) maximization within a more general expected utility framework, implying that the larger the EV difference, the more choices should shift toward the HiEV option and away from the *P*(win) option. Note that the negligible EV difference in Game A allowed us to simultaneously preserve the rank ordering of gambles across game environments and maintain the reasonableness of Dijksterhuis and his colleagues' operationalization of accurate choice as the *P*(win) option in the Game A environment.

The HiEV gamble in the Game B environment first-order stochastically dominated the HiEV gamble used in Game A, and the *P*(win) gamble used in Game A first-order stochastically dominated the *P*(win) gamble used in Game B. Therefore, one would expect a shift in preference from the *P*(win) gamble in Game A to the HiEV gamble in Game B, regardless of risk attitudes.

Other Options

In addition to the two crucial options, *P*(win) and HiEV, each game included a decoy option, which had a lower EV than the HiEV option, the same *P*(win) value as the HiEV option (6 out of 12 nonzero payouts), and, most important, the same highest payoff value as the HiEV option ($13 in Game A and $16 in Game B). Such a decoy option might be selected if one simply remembers an option with the highest payoff. In our experiment, the decoy was selected between 15% and 34% of the time. Finally, a filler option (3 positive outcomes) with a much lower EV than the other options was included as a test of attention to the task; few subjects (< 4% across both games) chose it.

Relative Performance: EV Gain

We devised an index to summarize the overall performance level in each condition across all possible choices. Because the filler was chosen so infrequently, the index used choices of the decoy option and choices of the HiEV option as performance extremes. We defined relative EV gain (over the decoy) as follows: EV gain = (EV of the chosen option − EV of the decoy)/(EV of the HiEV option − EV of the decoy). This index equals 1 for choice of the HiEV option, 0 for choice of the decoy, and either .94 (Game A) or .17 (Game B) for choice of the *P*(win) option. We also included in our analyses the few filler choices made by participants, using an index value of 0 for such choices.

Hypotheses

We expected the frequency with which the *P*(win) and HiEV options were chosen to show an interaction of game and condition. For Game A, we expected the frequency of choice of the

P(win) option to be higher in the UCT condition than in the CT-FT condition, which would replicate the findings of Dijksterhuis (2004) and Dijksterhuis et al. (2006). We also predicted that the P(win) option would be chosen more often in the CT-SP condition than in the CT-FT condition, and that the UCT and CT-SP conditions would not differ significantly in choice of that option. We expected across-condition differences in frequency of choice of the P(win) option to be dampened in Game B, in which the P(win) rule was a much less attractive strategy; we also expected CT-SP decision makers to shift to more magnitude-focused strategies in Game B.

In Game B, we put the EV and P(win) rules into greater conflict by increasing the magnitude of several positive outcomes for the HiEV option and decreasing the magnitude of several positive outcomes for the P(win) option (see Table 1). We expected that participants in the UCT condition would perform relatively poorly in this environment because of the greater differences in magnitude of the outcomes. Thus, we expected participants in the CT-SP condition to choose the HiEV option more often than participants in both the UCT and the CT-SP conditions. We did not expect the UCT and CT-FT conditions to differ in the frequency with which the HiEV option was chosen. Note that we expected these differences in choice of the HiEV option only in Game B. In Game A, accuracy was operationalized as choice of the P(win) option, given the negligible EV penalty for choosing that option and the attractiveness of a high probability of winning something (Payne, 2005). This accuracy criterion is consistent with the work of Dijksterhuis (2004; Dijksterhuis et al., 2006).

With respect to EV gain, we expected that participants in the CT-SP condition would perform well in both games, that participants in the CT-FT condition would perform less well in both games, and that participants in the UCT condition would perform well in Game A and less well in Game B. Thus, we expected main effects of game (Game A was a more lenient environment) and condition (with EV gain consistently higher in the CT-SP condition than in the CT-FT condition). On the basis of our reasoning about the relative performance of participants in the UCT condition, we also expected that the complex contrast comparing the CT-SP and UCT conditions across games would be significant, with the difference greater in Game B than in Game A.

METHOD

Procedure

We used computers running MediaLab to present the experiment to participants, who were instructed that they would receive information about the attributes of four different options and should form an impression of these options, to prepare for a later choice. They were told that the option they selected would be played, and that they would receive the amount of money they won.

Next, participants were presented with 48 different pieces of information, each specifying the payoff for one option-event combination (e.g., "If ball 1 comes up, the Mandalay option's payout would be $0"). These pieces of information were presented one at a time for 6 s each, in random order. Following this presentation, participants were randomly assigned to conditions. In the UCT condition, participants performed a difficult anagram task (i.e., a distraction task) for 4 min (inclusive of 20 s of instruction; Kee, Morris, Bathurst, & Hellige, 1986). In the CT-FT condition, participants were told, "You will now have four minutes to deliberate and decide which game you think is best." The message remained on the screen, and participants were not allowed to respond until the computer automatically went to the choice screen 4 min later. Finally, in the CT-SP condition, participants were told, "You will now have as much time as you like to deliberate and decide which game you think is best." They proceeded to the choice screen whenever they felt ready. In all conditions, the choice screen reminded participants that they would play their choice for real money and asked: "Based on the information presented to you about the four options, which is the best option?"

Procedures were identical for the two games, except that the outcome values and option names differed (see Table 1). In addition, for Game B, we added a fourth condition in which participants were asked to respond immediately after the presentation of information. We included this condition, sometimes reported by Dijksterhuis and his colleagues, to test our assumption that the CT-SP condition is in fact a new condition.

Participants

Two hundred fifty-three students from a Southeastern university participated in the three main thought conditions of Game A (N = 120) or Game B (N = 133). In addition, 27 students participated in the immediate condition of Game B. Given the variance in participants' age (18 to 60 years, M = 22.9, SD = 6.0) and the gender differences previously observed (see Experiment 3 in Dijksterhuis, 2004), we used both age and gender as covariates in our analyses.

RESULTS

Frequency of *P*(win) and HiEV Choices

First we report overall analyses of the frequency of P(win) and HiEV choices by game and condition for the three main thought conditions. For P(win), logistic regression revealed no main effect of condition, $\chi^2(2, N = 253) = 3.03$, $p < .22$, Cramer's $\varphi = .11$, or game, $\chi^2(2, N = 253) = 0.76$, $p < .38$, Cramer's $\varphi = .05$, but the condition-by-game interaction was significant, $\chi^2(2, N = 253) = 7.55$, $p < .03$, Cramer's $\varphi = .17$. Similarly, for HiEV, there was no main effect of condition, $\chi^2(2, N = 253) = 1.16$, $p < .56$, Cramer's $\varphi = .07$, or game, $\chi^2(2, N = 253) = 0.02$, $p < .90$, Cramer's $\varphi = .01$, but the condition-by-game interaction was significant, $\chi^2(2, N = 253) = 7.21$, $p < .05$, Cramer's $\varphi = .17$. Table 2 provides the percentage of participants who chose each option in each game and thought condition.

TABLE 2
Sample Sizes, Percentage of Participants Choosing Each Option, and EV Gain in Games A and B

Game and condition	n	Percentage choice: HiEV	P(win)	Decoy	Filler	EV gain
Game A						
Conscious thought, fixed time (CT-FT)	38	42	21	32	5	.62
Unconscious thought (UCT)	42	36	45	19	0	.79
Conscious thought, self-paced (CT-SP)	40	28	50	15	8	.75
Game B						
Conscious thought, fixed time (CT-FT)	46	30	37	28	4	.36
Unconscious thought (UCT)	41	27	37	34	2	.33
Conscious thought, self-paced (CT-SP)	46	52	26	17	4	.56
Immediate	27	33	26	41	0	.38

Note. HiEV = option with the highest expected value (EV); P(win) = option with the greatest probability of winning something. EV gain was calculated as follows: (EV of chosen option − EV of decoy)/(EV of HiEV option − EV of decoy); EV gain was equal to 0 for choice of the filler.

For Game A, we expected conditions to differ in the percentage of P(win) choices, but not HiEV choices. Logistic regression revealed a main effect of thought condition on proportion of P(win) choice, $\chi^2(2, N = 120) = 7.12, p < .03$, Cramer's $\varphi = .24$. The pattern of results replicated those of Dijksterhuis and his colleagues (Dijksterhuis, 2004; Dijksterhuis et al., 2006) and supports the use of our lottery choice task. Specifically, there were more choices of the P(win) option (45%) in the UCT condition than in the CT-FT condition (21%), $\chi^2(1, N = 80) = 4.74, p < .03$, Cramer's $\varphi = .24$. The CT-SP condition also led to more choice of the P(win) option (50%) than the CT-FT condition, $\chi^2(1, N = 78) = 6.54$, $p < .02$, Cramer's $\varphi = .29$. There was no significant difference between the CT-SP and UCT conditions in choice of the P(win) option in Game A, $\chi^2(1, N = 82) = 0.2$, $p < .65$, Cramer's $\varphi = .05$, a result reflecting the appeal of the P(win) rule when EV trade-offs are low. The median time taken to reach a decision in the CT-SP condition was 24 s ($M = 49.4$ s, $SD = 71.2$ s), which suggests that the deliberation phase in the CT-FT condition may be artificially extended. Finally, as expected, logistic regression revealed no main effect of thought condition on proportion of HiEV choice in Game A, $\chi^2(2, N = 120) = 1.73$, $p < .42$, Cramer's $\varphi = .12$.

Thus, within the Game A environment, we showed an important boundary condition to Dijksterhuis's conclusions regarding the superiority of unconscious thought: In a complex task, self-paced conscious thought, like unconscious thought, outperformed a fixed period of conscious thought in leading to choice of the option with the largest number of positive outcomes, the P(win) option. Next we considered a second possible boundary condition by examining sensitivity of the thought conditions to the magnitudes of the values defining the options in Game B.

The outcomes in Game B put EV and P(win) into greater conflict. As noted earlier, the HiEV option in Game B stochastically dominated the HiEV option in Game A, and the P(win) option in Game A stochastically dominated the P(win) option in Game B. Thus, in Game B, the EV option became a relatively better choice, and we predicted that participants in the CT-SP condition would be more sensitive to magnitude and would outperform participants in both the CT-FT and the UCT conditions in this environment. We predicted no differences for P(win) choices.

For Game B, logistic regression revealed a main effect of thought condition on proportion of HiEV choice, $\chi^2(2, N = 133) = 6.86$, $p < .04$, Cramer's $\varphi = .23$. As predicted, there was a higher proportion of HiEV choice in the CT-SP condition (52%), compared with both the CT-FT condition (30%), $\chi^2(1, N = 92) = 4.29, p < .04$, Cramer's $\varphi = .22$, and the UCT condition (27%), $\chi^2(1, N = 87) = 5.49$, $p < .02$, Cramer's $\varphi = .25$. Proportion of HiEV choice did not differ between the UCT and CT-FT conditions, $\chi^2(1, N = 87) = 0.13, p < .74$, Cramer's $\varphi = .04$. As expected, there was no effect of thought condition on proportion of P(win) choice, $\chi^2(2, N = 133) = 1.70$, $p < .42$, Cramer's $\varphi = .11$. The median time taken to reach a decision in the CT-SP condition was 18 s in Game B ($M = 33.5$ s, $SD = 44.4$ s).

The two choice environments (Game A and Game B) were designed such that preferences were expected to shift toward the HiEV option from Game A to Game B, given sensitivity to magnitude. Simple-effects tests of a shift in choice across games revealed that only the CT-SP condition showed a shift in the proportion of P(win) choice from Game A (50%) to Game B (26%), $\chi^2(1, N = 84) = 5.44$, $p < .02$, Cramer's $\varphi = .25$, and in the proportion of HiEV choice from Game A (28%) to Game B (52%), $\chi^2(1, N = 84) = 5.14$, $p < .03$, Cramer's $\varphi = .25$.

EV Gain

We examined relative EV gain in an overall, combined game-by-condition analysis. As predicted, this analysis revealed a main effect of game (Game A: EV gain = .72; Game B: EV gain = .42), $F(1, 245) = 30.3$, $p < .001$, $p_{rep} = 1.00$, and condition (CT-FT: EV gain = .49; UCT: EV gain = .56; CT-SP: EV gain = .66), $F(1, 245) = 3.10, p < .05, p_{rep} = 0.88$. There was no game-by-condition interaction, $F(2, 245) = 2.24, p < .11, p_{rep} = .81$. A planned contrast revealed a higher EV gain for the CT-SP condition than for the CT-FT condition, $t(245) = 2.47, p < .02$, $p_{rep} = .94$, but EV gain did not differ significantly between the UCT and CT-FT conditions, $t(245) = 1.50$, $p < .14$, $p_{rep} = .78$. Finally, the planned complex contrast of the UCT versus CT-SP conditions across Games A and B was significant, $t(245) = 2.06$, $p < .05$, $p_{rep} = .89$, a result supporting our hypothesis that the performance in the UCT condition shifted relative to performance in the CT-SP condition across games. Specifically, when high EV was in conflict with high P(win) (i.e., in Game B), there was a decrease in performance in the UCT condition relative to the CT-SP condition. See Table 2 for overall means of EV gain.

Differentiating Between Immediate and Self-Paced Thought

We collected data for immediate thought in Game B to test our assertion that the CT-SP condition was indeed a new thought condition. The median decision time was significantly lower in the immediate-choice condition (7 s) than in the CT-SP condition (18 s), $\chi^2(1, N = 73) = 12.41, p < .0004$, Cramer's $\varphi = .41$. The proportion of HiEV choice was lower in the immediate-thought condition (33%) than in the CT-SP condition (52%), but this difference was not significant, $\chi^2(1, N = 73) = 2.08$, $p < .15$, Cramer's $\varphi = .17$. However, further analyses suggested that the relationship of time to performance did differ across these conditions. A median split of decision times (range: 2–46 s) in the immediate condition showed 21% correct responses for those participants who responded more quickly, and 46% correct responses for those participants who responded more slowly, $\chi^2(1, N = 27) = 2.45, p < .12$, Cramer's $\varphi = .30$. In contrast, a median split of decision times in the CT-SP condition (range: 8–290 s) showed 74% correct responses for those participants who responded more quickly, and 30% correct responses for those participants who responded more slowly, $\chi^2(1, N = 46) = 8.57, p < .01$, Cramer's $\varphi = .43$. Thus, the CT-SP condition was distinguished from the immediate-choice condition in that performance declined as more time was taken in the CT-SP condition, but improved as more time was taken in the immediate-choice condition, perhaps because of dilution effects as conscious thought proceeded.

GENERAL DISCUSSION

We have demonstrated two significant boundary conditions on the conclusion by Dijksterhuis et al. (2006) that one should delegate thinking about complex decision problems to the unconscious. First, our study shows that self-paced conscious thought is similar in effectiveness to unconscious thought in some conditions, and is superior in others. In Game A, both self-paced conscious thought and unconscious thought, compared with an artificially fixed period of conscious thought, led to more choice of the option with the largest number of positive outcomes. Thus, the comparative results for the UCT and CT-FT conditions reported by Dijksterhuis et al. may demonstrate more that a fixed period of conscious thought is a poor way to structure conscious thought than that unconscious thought is generally better than conscious thought.

Second, the results from Game B suggest that although unconscious thought may be sensitive to the frequency of positive values, it may be less sensitive to magnitude. In Game B, magnitudes of the payoffs—not just whether the values were good or bad—mattered, and in this environment, self-paced conscious thought led to more choice of the highest-EV option than unconscious thought did.

Although more work on underlying processes is needed, the experiment we have reported here suggests that the mechanisms underlying the conscious-/unconscious-thought dichotomy emphasized by Dijksterhuis and his colleagues (e.g., Dijksterhuis & Nordgren, 2006) may be more complex than previously described. These results also show that it is critical to take into account the interaction of forms of processing with task demands (choice environments) when giving prescriptive advice (Payne, Bettman, & Schkade, 1999).

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(Received 10/11/07; Revision accepted 4/20/08)