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Research Report

Unconscious creativity: When can unconscious thought outperform conscious thought?☆

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Abstract

Recent research suggests that unconscious thought is superior to conscious thought in many cognitive domains. In this article, we show that the duration of unconscious thought has an inverted-U shaped relationship with creativity performance. Unconscious thought is, thus, unlikely to provide creative advantage over conscious thought when deliberation duration is either short or long. However, when deliberation duration is of a moderate length, the creative output of unconscious thought surpasses that of conscious thought. Furthermore, the superiority of unconscious thought pertains only to the novelty dimension of creativity, but not the appropriateness dimension. These findings not only shed light on the powers and limits of unconscious thought but also illuminate the importance of calibration in utilizing unconscious thought to boost creativity.

Keywords: Creativity; Product ideation; Unconscious thought; Deliberation-without-attention

From the zealous adoption of innovative products such as the iPad or Wii, to the widespread passion for do-it-yourself goods, consumers not only value creative aspects of the goods they consume (Hirschman, 1980) but also enjoy engaging in creative activities (Dahl & Moreau, 2007). Creativity is thus an important aspect of consumer psychology that impacts both consumer satisfaction and corporate success (e.g., Burroughs, Dahl, Moreau, Chattopadhyay, & Gorn, 2011; Dahl & Moreau, 2002; Moreau & Dahl, 2005; see Burroughs, Moreau, & Mick, 2008 for a review). Though a burgeoning number of studies have shed light on the different factors influencing creativity in consumer domains (e.g., Burroughs & Mick, 2004; Moldovan, Goldenberg, & Chattopadhyay, 2011; Sellier & Dahl, 2011), the current understanding of how to unleash and boost creative ingenuity is relatively limited (Hauser, Tellis, & Griffin, 2006).

Given the recent findings on the superior capabilities of unconscious thought (i.e., "deliberation in the absence of conscious attention directed at the problem," Dijksterhuis, Bos, Nordgren, & van Baaren, 2006, p.1005) in processing complex information and decision making (e.g., Bos, Dijksterhuis, & Van Baaren, 2011; Dijksterhuis, 2004; Messner & Wänke, 2011), it is reasonable to suggest that unconscious deliberation can be leveraged to improve creativity in consumer domains. While two pioneering studies (Dijksterhuis & Meurs, 2006; Zhong, Dijksterhuis, & Galinsky, 2008) have provided encouraging initial evidence, their findings are mixed and important research questions remain unanswered. First, it is unclear from the current literature under what conditions can unconscious thought outperform conscious thought on creativity tasks. Second, prior studies have not explored whether and how *different durations* of unconscious versus conscious deliberation impact creativity.

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Third, the extent to which unconscious thought affects the two dimensions of creativity (i.e., novelty and appropriateness, Amabile, 1983) is unknown.

The current research seeks to answer these important consumer psychology questions. In two experimental studies, we show that the duration of unconscious deliberation has an inverted-U shaped relationship with creativity performance; only when deliberation duration is of a moderate length, does the creative output of unconscious thought surpass that of conscious thought. We also show that unconscious thought impacts the two dimensions of creativity differently—whereas unconscious thought can facilitate generation of *novel* ideas, it does not necessarily boost the *appropriateness* dimension of the ideas generated.

The remainder of the paper is organized as follows. We first briefly review the pertinent literature on unconscious thought and creativity, and develop our hypotheses. We then report two experiments that test our hypotheses. We conclude with a discussion of the theoretical contributions and substantive implications of our findings, and potential future research directions.

Theoretical underpinnings

Can unconscious thought improve creativity?

Research on unconscious mental processes (e.g., Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006; Dijksterhuis et al., 2006) suggests that conscious thought is more adept at analytical processing that involves a relatively limited number of attributes, whereas unconscious thought excels at integrating massive quantities of complex information (see, e.g., Payne, Samper, Bettman, & Luce, 2008; Smith, Dijksterhuis, & Wigboldus, 2008 for boundary conditions). Further, unconscious deliberation has been conceptualized as a proactive and goal-driven process (Bos, Dijksterhuis, & van Baaren, 2008; Dijksterhuis & Nordgren, 2006). These qualities suggest that thinking unconsciously may help people boost creative performance.

Pioneering research on this possibility (Dijksterhuis & Meurs, 2006; Zhong et al., 2008) yielded encouraging but mixed evidence. Dijksterhuis and Meurs (2006) asked participants to list Dutch place names starting with the letter "A" (Experiment 2a) or letter "H" (Experiment 2b). Whereas those who deliberated consciously generated more names of large cities and towns, those who deliberated unconsciously reported more names of small villages, suggesting that unconscious thought may provide better access to unusual, pre-stored information, which could enhance creativity. Further, Zhong et al. (2008) found that for difficult remote association test (RAT) items, a short period of unconscious thought, as opposed to an equal duration of conscious thought, increased the *speed* at which participants were able to respond to the RAT items correctly. This also suggests that unconscious thought provides superior access to pre-stored information. However, in the study by Zhong and colleagues, unconscious thought did not increase the number of correct answers provided by participants. This suggests that the correct responses may not be successfully transferred to consciousness and outputted, potentially attenuating the gains in creativity that may have resulted from unconscious mental activation. Thus, despite encouraging initial findings, it is unclear how the power of unconscious thought can be adequately harnessed to improve creative outcomes in the consumer context.

Under what conditions can unconscious thought outperform conscious thought?

Unconscious creativity

Extant research suggests that unconscious thought may benefit creative ingenuity through a two-stage process (Zhong et al., 2008): in the first phase, unconscious deliberation generates creative ideas through the "deep activation" of mental constructs associated with the target task (Wegner & Smart, 1997; Zhong et al., 2008), and in the second phase, the fruits of the unconscious labor are outputted (Dijksterhuis & Meurs, 2006). The impairment of either step would attenuate the impact of unconscious thought on creativity.

Research on unconscious thought in decision making indicates that unconscious deliberation is a goal-driven process (Bos et al., 2008). This suggests that the initial generation phase in unconscious creativity can also be a goal-driven process that is monitored unconsciously. Research on consumer information processing (Alba & Chattopadhyay, 1985; 1986) has argued that retrieval of information from memory is monitored, and efforts at retrieving from memory are terminated, once it is deemed that sufficient effort has been expended or that further effort is unlikely to lead to the retrieval of additional information. While this research focused on conscious deliberation, we suggest that this termination process is likely to occur for unconscious deliberation as well; once the goal of generating creative ideas is deemed completed, the unconscious should cease to deliberate about the task. Thus, even if an individual is allotted ample time for unconscious deliberation, that person might not deliberate unconsciously for the entire duration, and could stop generating creative ideas early on.

The second phase, the output phase, is typically a conscious process (e.g., writing down ideas) where the activated constructs need to emerge from the unconscious to the conscious, to be successfully realized. However, because the activation of mental constructs decays rapidly (Baddeley & Scott, 1971; Kiefer & Spitzer, 2000), fewer and fewer of the constructs activated during active unconscious deliberation would continue to remain sufficiently activated to be transferred, as time passes. This would particularly be the case when the goal driving the activation—generating creative solutions—is deemed completed (Cesario, Plaks, & Higgins, 2006).

Considering the combined outcome of the goal directed generation phase of unconscious deliberation and the decay of unconsciously activated mental constructs together, we are likely to observe an inverted-U shaped relationship between duration of unconscious thought and creativity performance. When the duration of unconscious thought is short, few constructs are likely to be generated and, thus, be available to be outputted. When the duration is too long, the found

constructs may no longer be sufficiently activated to be consciously realized. Thus, creative output is maximized when the duration of unconscious thought is moderate. Admittedly, the appropriate amount of duration depends on the specific creativity task (Weisberg, 1999), as different tasks require different amounts of minimum mental effort.

Our conceptualization suggests that the mixed results of initial research on unconscious thought and creativity could be because these studies did not specifically search for the optimal duration of unconscious thought for the creativity tasks that they used. We investigate this possibility here.

Conscious creativity

Like unconscious thought, conscious deliberation is a goal-driven process. However, for conscious thought the fruits of its labor are, by definition, consciously available for output. It is thus not affected by deliberation duration in the same manner as unconscious thought. In fact, because conscious thought is inferior in processing capability (Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006) and thus operates at a slower speed than unconscious thought, longer duration of deliberation may help improve the creativity performance of conscious thought. Taken together, these characteristics of unconscious and conscious thought suggest that we should only observe superior creative output of unconscious over conscious thought when the deliberation duration is moderate, but not when deliberation duration is too short or long.

Does unconscious thought affect different dimensions of creativity equally?

Psychological (e.g., Amabile, 1983; Gardner, 1993; Sternberg & Lubart, 1999) and consumer research (e.g., Burroughs & Mick, 2004; Burroughs et al., 2011; Moreau & Dahl, 2005) has established that creativity has two distinct dimensions: novelty (i.e., the extent to which a solution/idea is original and novel) and appropriateness (i.e., the extent to which a solution/idea is useful and fits the situation). While prior research on unconscious creativity has focused on the novelty dimension (Dijksterhuis & Meurs, 2006), the appropriateness dimension of creativity has not been investigated, although it is an important aspect of creativity for both consumer satisfaction and corporate success (e.g., Burroughs et al., 2011; Dahl, Chattopadhyay, & Gorn, 1999). The current research investigates the impact of unconscious thought on both dimensions of creativity.

Given its superior capabilities in processing, searching, and associating complex knowledge bases (Dijksterhuis et al., 2006; Zhong et al., 2008), unconscious thought is likely to excel on divergent processes—accessing a wide spectrum of pre-stored information to produce more novel ideas. However, whereas conscious thought is proficient in precision processing following specific rules, unconscious thought operates at the gist level and produces approximate estimates (Dijksterhuis & Nordgren, 2006). Thus, unconscious thought is not necessarily superior to conscious thought on the appropriateness dimension of creativity—producing appropriate solutions that meets the exact constraints of the situation and resolves the issue at hand (e.g., Guilford, 1968; Runco, 1991).

More formally, we propose the following three hypotheses:

H1. There is an inverted-U shaped relationship between the duration of unconscious thought and the novelty of the creative output.

H2. Unconscious thought is likely to outperform conscious thought on the novelty dimension of creativity only when the duration of deliberation is moderate.

H3. Unconscious thought is unlikely to outperform conscious thought on the appropriateness dimension, regardless of deliberation duration.

We next report two experimental studies. Experiment 1 investigates the first two hypotheses in the context of consumers generating product use ideas. Experiment 2 tests all three hypotheses in a product idea generation context.

Experiment 1

Design and participants

The experiment utilized a 2 (thought type: unconscious vs. conscious) × 3 (deliberation duration: 1, 3, 5 min) between-participants design. Because Zhong et al. (2008) gave 5 min for their creativity task and found differences in activation but not in output, we used 5 min for the long duration. Given that 3 min of deliberation duration has been used in a large number of studies (e.g., Dijksterhuis, 2004; Dijksterhuis & Meurs, 2006) demonstrating the superior capability of unconscious thought on tasks similar, in terms of difficulty, to the ones in this research, we selected 3 min as the moderate duration.[1] To keep the interval between the durations constant, we used 1 min for the short duration.

One hundred and fifty-five undergraduate students participated in the study in exchange for a voucher for a sandwich. Participants were randomly assigned to the experimental conditions, and completed their session alone in a sound-proof cubicle.

Procedure

Participants in all conditions were informed that they were to work on a creativity task and then shown the instructions ("What are the things one can do with a paperclip? Please list everything you can think of.") along with an image of a standard paperclip (adapted from Dijksterhuis & Meurs, 2006, Study 3; see also Sternberg & Lubart, 1996). Information about the task remained on the computer screen for 30 s before the next set of instructions was shown.

[1] To ensure that 3 min is within the optimal deliberation duration range, we ran a pretest with 56 participants drawn from the same population as the main study, which revealed that those in the unconscious thought condition performed better than those in the conscious thought condition when the deliberation duration was 3 min, but not when it was shorter (i.e., 2 min).

Participants in the conscious-thought conditions were then asked to spend 1 min (vs. 3 vs. 5 min) thinking about their answers to the creativity task. Those in the unconscious-thought conditions, however, were told that we would like them to complete a memory assessment task before they began working on the creativity task. These participants then engaged in a 2-back lexical task that eliminates conscious thought by severely impacting executive functioning, but still allows for unconscious deliberation (Dijksterhuis, 2004; Jonides et al., 1997). After deliberating for the assigned amount of time, participants in both the conscious and unconscious conditions were shown the instructions for the creativity task again and given 2 min to write down their answers.

Given that affect has been shown to impact creative ingenuity (see Hennessey & Amabile, 2010 for a recent review) and that completing vs. not completing the 2-back lexical task—a fairly demanding undertaking—may result in affective differences between the two thought conditions, we asked participants to complete the PANAS scale (Watson, Clark, & Tellegen, 1988). Participants were then debriefed and dismissed. No participant correctly identified the purpose of the study in the debriefing, and thus all responses were included in subsequent analyses.

Results

Two coders blind to the experimental conditions identified the most novel idea each participant generated—the one that is most different from the standard use of a paperclip, i.e., clipping two items together. The difference in the selection (3% disagreement) was resolved through discussion between the coders. Each coder then rated the most novel idea generated by each participant on a seven-point scale (1=*not at all novel*; 7=*very novel*).[2] For example, "use the paperclip as a hairpin" would be rated lower than "use it as a weapon to stab someone." The ratings of the coders were averaged to serve as the dependent measure. The correlation between the coders' ratings was positive (.87) and significant ($p<.01$). This measure allowed us to assess novelty, independent of the number of ideas each participant generated. That is, participants who generated one novel idea along with many average ideas would not be penalized because of the less novel ideas. Those who generated one highly novel idea, but few additional ideas, would also not be penalized for coming up with fewer ideas. Similar operationalization of novelty has been used in prior research (e.g., Goncalo & Staw, 2006).

Moreover, as an indirect measure of the proposed process, coders identified the number of ideas each participant outputted. The difference (2% disagreement) in coding was resolved through discussion. Our theorizing suggests that the number of ideas outputted in the unconscious thought conditions should follow an inverted-U shape, while in the conscious deliberation conditions it should follow an increasing function.[3]

Novelty

An ANOVA, with the novelty score as the dependent measure and thought type and deliberation duration as the independent measures, revealed a significant main effect of deliberation duration ($F(2, 149)=5.90$, $p<.005$) and a significant interaction ($F(2, 149)=6.44$, $p<.005$), but no effect of thought type ($F(1, 149)=.08$, $p>.78$). Planned contrasts were conducted to investigate H1. As shown in Fig. 1, participants who deliberated unconsciously for 3 min ($M_{\text{uncon\_3 min}}=5.40$) outperformed those in the one-minute ($M_{\text{uncon\_1 min}}=3.78$, $F(1, 149)=18.24$, $p<.001$) and five-minute ($M_{\text{uncon\_5 min}}=4.19$, $F(1, 149)=10.21$, $p<.005$) conditions.[4] Thus, consistent with H1, we found an inverted-U shaped relationship between the duration of unconscious deliberation and novelty—the novelty score first increased with unconscious deliberation duration, and then decreased.

For participants in the conscious-thought conditions, however, the novelty score increased with deliberation time. Those who deliberated consciously for 5 min ($M_{\text{con\_5 min}}=4.98$) had significantly higher novelty scores than those in the one-minute ($M_{\text{con\_1 min}}=4.19$, $F(1, 149)=4.34$, $p<.05$) condition and marginally higher scores than those in the three-minute condition ($M_{\text{con\_3 min}}=4.37$, $F(1, 149)=2.64$, $p=.1$).

Further, consistent with H2, only when the deliberation duration was 3 min did participants in the unconscious-thought condition outperform those in the conscious-thought condition ($M_{\text{con\_3 min}}=4.37$, $M_{\text{uncon\_3 min}}=5.40$, $F(1, 149)=7.27$, $p<.01$). However, when the deliberation duration was 1 min ($M_{\text{con\_1 min}}=4.19$, $M_{\text{uncon\_1 min}}=3.78$, $F(1, 149)=1.25$, $p=.27$) or 5 min ($M_{\text{con\_5 min}}=4.98$, $M_{\text{uncon\_5 min}}=4.19$, $F(1, 149)=4.50$, $p<.05$), those in the conscious-thought condition performed at least as well as those in the unconscious-thought condition.

Indirect process measure

The number of ideas participants outputted provided an indirect measure of the underlying process we discussed. We expect to find that when the duration of unconscious thought is too short, few ideas are generated and available to be outputted. When the duration is too long, some or all of the unconsciously generated ideas may no longer be sufficiently activated to be outputted consciously. Thus, moderate deliberation duration would allow the largest number of ideas to be outputted. Consistent with this prediction, an ANOVA with the idea output quantity as the dependent measure revealed a significant interaction effect between thought type and deliberation

[2] To ensure that our findings are robust to the operationalization of the novelty construct, we ran two additional analyses using two different coding methods—average novelty of the ideas each participant generated and overall novelty of the entire set of ideas each participant generated. The results of the analyses using these two measures yielded an identical pattern of results as the best-idea measure reported in the body of the paper.

[3] Given sufficient time, under conscious deliberation, the number of thoughts outputted would likely plateau.

[4] When a quadratic regression model was fit to the responses of participants in the unconscious-thought conditions, the model was significant ($F(2, 75)=13.01$, $p<.001$, $R^2=.26$) and greatly improved the goodness of fit compared to a linear model ($p>.27$, $R^2=.02$). The quadratic model did not fit the data of the conscious-thought condition ($F(2, 74)=1.90$, $p>.15$).

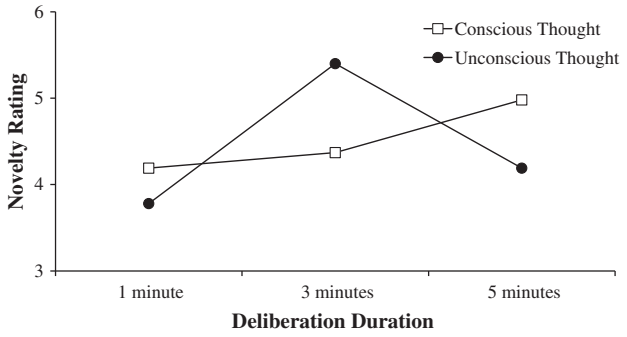

Fig. 1. Experiment 1 result: rating of the most novel idea.

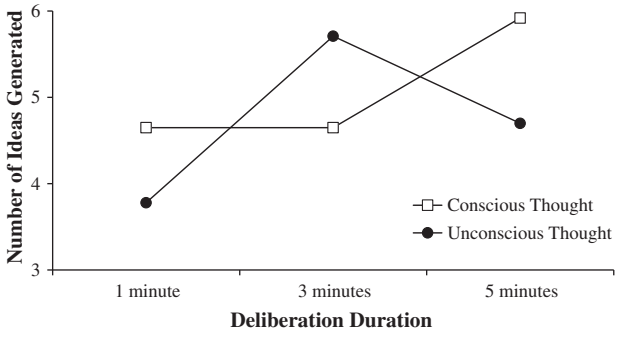

Fig. 2. Experiment 1 result: quantity of product use ideas generated.

duration ($F(2, 149)=4.68$, $p<.02$), in addition to a significant main effect of deliberation duration ($F(2, 149)=4.63$, $p<.02$). The effect of thought type was not significant ($F(1, 149)=1.14$, $p>.20$).

Planned contrasts revealed that participants who deliberated unconsciously for 3 min ($M_{uncon\_3\ min}=5.71$) generated significantly more ideas than those in the one-minute ($M_{uncon\_1\ min}=3.78$, $F(1, 149)=11.67$, $p<.001$) and marginally more ideas than those in the five-minute ($M_{uncon\_5\ min}=4.70$, $F(1, 149)=3.16$, $p<.08$) condition.[5] For participants who deliberated consciously, however, the quantity of product use ideas increased with duration of deliberation. Those who deliberated consciously for 5 min ($M_{con\_5\ min}=5.92$) outperformed those in the one-minute ($M_{con\_1\ min}=4.64$, $F(1, 149)=5.03$, $p<.05$) and three-minute ($M_{con\_3\ min}=4.65$, $F(1, 149)=5.03$, $p<.05$) conditions.[6]

Finally, as shown in Fig. 2, participants in the three-minute condition generated marginally significantly more ideas when they deliberated unconsciously than consciously ($M_{con\_3\ min}=4.65$, $M_{uncon\_3\ min}=5.71$, $F(1, 149)=3.42$, $p<.07$). In the one-minute condition, no significant difference was found between the two thought types ($M_{con\_1\ min}=4.64$, $M_{uncon\_1\ min}=3.78$, $F(1, 149)=2.50$, $p>.10$). In the five-minute condition, participants generated significantly more ideas when they deliberated consciously than unconsciously ($M_{con\_5\ min}=5.92$, $M_{uncon\_5\ min}=4.70$, $F(1, 149)=4.73$, $p=.03$). These results thus provide indirect support to the process we propose.

Affect as an alternative explanation

PANAS measures for positive and negative affect did not differ between the thought conditions (Fs<2.2, ps>.14, see Table 1 for a summary). Adding these measures as covariates did not affect the results reported above. Therefore, an affect-based account cannot explain our findings.

Discussion

The results of Experiment 1 provided support for the first two hypotheses. We found that novelty first increased with the duration of unconscious deliberation, and then decreased (H1). More importantly, participants in the unconscious-thought conditions outperformed those in the conscious-thought conditions, only when the deliberation duration was 3 min, but not 1 or 5 min (H2). Further, the results for the number of ideas generated were consistent with our proposed mechanism. We also found no support for an affect-based, alternative explanation.

Experiment 2

Experiment 1 has a number of potential limitations. The target task in Experiment 1 required participants to generate product use ideas, a task more appropriate for assessing the range and the quantity of creative ideas generated, but less so for evaluating the extent to which an idea appropriately meets the needs and constraints of a situation. In Experiment 2, we addressed this issue by utilizing a different target task that involved devising a single solution for a specific context. The task in Experiment 1 involved generating ideas on how to make use of a simple object. However, there are many other types of creativity contexts that are more ecologically valid and important to consumers and firms. In Experiment 2, we utilized a creativity task that allowed us not only to examine creativity in a new context (i.e., product ideation—a task qualitatively different from that used in the prior studies [Dijksterhuis & Meurs, 2006; Zhong et al., 2008]), but also to test the performance of unconscious thought on both the novelty (H1 and H2) and appropriateness dimensions (H3).

Table 1
Experiment 1 PANAS measures.

	Positive affect			Negative affect		
	1 min	3 min	5 min	1 min	3 min	5 min
Conscious thought	26.08	25.77	25.80	13.58	13.23	14.28
Unconscious thought	28.96	29.04	25.44	13.30	12.17	12.81

[5] Fitting a quadratic model on the responses of participants in the unconscious conditions revealed the expected significant pattern ($F(2, 75)=6.80$, $p=.002$, $R^2=.15$) and greatly improved the goodness of fit compared to a linear model ($p>.09$, $R^2=.04$).

[6] Whereas the difference between one- and three-minute conscious conditions was not significant ($p>.30$), the responses of all three conscious-thought conditions could be fit to a linear model ($p<.05$) but not a quadratic one—an overall pattern consistent with our proposition.

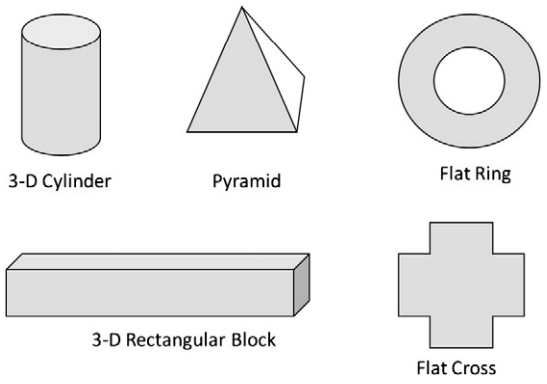

Fig. 3. Experiment 2 stimuli: parts for product design.

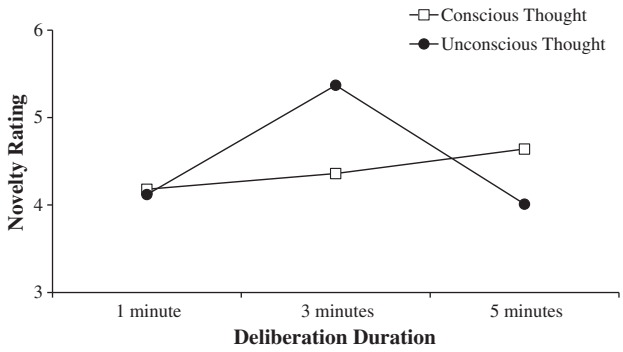

Fig. 4. Experiment 2 result: novelty rating of the product design.

Design and participants

Experiment 2 utilized a 2 (thought type: unconscious vs. conscious)×3 (deliberation duration[7]: 1 vs. 3 vs. 5 min) between-participant design. One hundred and fifty-eight undergraduate students participated in the study in exchange for a sandwich voucher, and completed their session alone in a sound-proof cubicle.

Procedure

Participants in all conditions were first shown a description of the target task—designing a toy for children between ages 5 and 11 years (adapted from Moreau & Dahl, 2005). As shown in Fig. 3, participants were given five component parts that are commonly used to develop new products, and were told that they could use whatever combination of these parts they wanted, to design the toy. The information about the design task remained on the computer screen for 90 s before the next set of instructions was shown. The rest of the procedure was identical to that of Experiment 1. No participant correctly identified the purpose of the study in the debriefing, and thus all responses were included in subsequent analyses.

Results

Using a procedure similar to that of Moreau and Dahl (2005), we asked two independent judges to rate each participant's toy design on three 7-point scales measuring novelty (*not at all original/very original*, *not at all innovative/very innovative*, *not at all novel/very novel*) and three 7-point scales measuring appropriateness (*not at all useful/very useful*, *not at all practical/very practical*, *not at all effective/very effective*). The three items for each dimension were averaged into a single score (αs>.90), and the scores of the two judges were then averaged for subsequent analyses. The correlations between the judges on the scores were positive (.80 for novelty, .74 for appropriateness) and significant (*p*s<.01).

Novelty

An ANOVA, with the novelty score as the dependent measure and thought type and deliberation duration as the independent measures, revealed a significant main effect of deliberation duration ($F(2, 152)=3.55$, $p=.03$), a significant interaction effect ($F(2, 152)=4.46$, $p=.01$), but no main effect of thought type ($F(1, 152)=.21$, $p>.60$). Providing support for H1, planned contrasts revealed that participants who deliberated unconsciously for 3 min ($M_{uncon\_3\ min}=5.37$) outperformed those in the one-minute ($M_{uncon\_1\ min}=4.12$, $F(1, 152)=9.57$, $p<.005$) or five-minute ($M_{uncon\_5\ min}=4.01$, $F(1, 152)=11.64$, $p<.001$; see Fig. 4) conditions.[8] For participants in the conscious-thought conditions, however, the results were different. Though novelty appeared to increase with deliberation duration, the difference between the conditions failed to reach significance (*F*s<1, *p*s>.20).

Providing support for H2, only in the three-minute condition did participants who deliberated unconsciously outperform those who worked on the task consciously ($M_{con\_3\ min}=5.37$, $M_{uncon\_3\ min}=4.36$, $F(1, 152)=6.52$, $p=.01$; other *F*s<3, *p*s>.10).

Appropriateness

Consistent with H3, an ANOVA, with the appropriateness score as the dependent measure and thought type and deliberation duration as the independent measures, revealed no significant main or interaction effects (*F*s<2.2; *p*s>.10).[9]

Affect as an alternative explanation

The negative affect measure differed significantly in the three-minute condition ($M_{con\_3\ min}=17.75$, $M_{uncon\_3\ min}=13.58$, $F(1, 152)=6.03$, $p<.05$) and marginally significantly in the five-minute condition ($M_{con\_5\ min}=16.60$, $M_{uncon\_5\ min}=13.44$, $F(1,$

[7] To ensure that 3 min is within the optimal deliberation duration range for this new creativity task, we ran a pretest with 48 participants, which revealed that those in the unconscious thought condition performed better than those in the conscious thought condition when the deliberation duration was 3 min, but not when it was shorter (i.e., 2 min).

[8] When a quadratic regression model was fit to the responses of participants in the unconscious-thought conditions, the model was significant ($F(2, 74)=7.33$, $p<.001$, $R^2=.17$) and greatly improved the goodness of fit compared to a linear model ($p>.75$, $R^2<.001$). The quadratic model did not fit the data in the conscious-thought conditions ($F(2, 78)=.66$, $p>.50$).

[9] For the sample size we had, the power to detect a medium effect size was .65 for the interaction and .55 for the contrast analyses.

Table 2
Experiment 2 PANAS measures.

	Positive affect			Negative affect		
	1 min	3 min	5 min	1 min	3 min **	5 min *
Conscious thought	25.46	23.46	24.96	14.54	17.75	16.60
Unconscious thought	27.88	25.25	21.81	13.65	13.58	13.44

* $p<.10$.
** $p<.05$.

152)=3.47, $p<.10$; see Table 2 for a summary). However, including the affect measures as covariates did not change the results discussed above.

Discussion

The results of Experiment 2 provided further support for our hypotheses. We found participant's ability to design a novel product first increased with the duration of unconscious deliberation, and then decreased (H1). Importantly, participants in the unconscious-thought conditions outperformed those in the conscious-thought conditions only when the deliberation duration was 3 min, but not 1 or 5 min (H2). Moreover, we found no differences on the appropriateness dimension of creativity between conscious and unconscious thought, for any of the deliberation durations (H3). This suggests that there is no tradeoff: higher novelty does not come at the cost of lower appropriateness. Further, as in Experiment 1, we found no support for an affect-based account of our findings.

General discussion

This paper sheds light on the impact of unconscious thought duration on creativity. In Experiment 1, participants were asked to generate ideas on how to make use of a product. Following conscious or unconscious deliberation, participants in the unconscious-thought conditions outperformed those in the conscious-thought conditions only when the deliberation duration was 3 min, but not 1 or 5 min. This is because participants' creativity performance, in terms of the quantity of ideas outputted and the extent to which the ideas were novel, first increased with the duration of unconscious deliberation, and then decreased. These results are consistent with the theoretical account we proposed, but inconsistent with an affect-based, alternative explanation.

Building on Experiment 1, Experiment 2 focused on the impact of the duration of unconscious thought on the extent to which a single solution for a specific task (i.e., designing a toy for children) is creative. The findings provided further support for our hypotheses, and suggested that the superiority of unconscious thought only pertained to the novelty dimension, but not the appropriateness dimension of creativity.

Our results contribute to the growing research evidence on the boundary conditions of unconscious thought (e.g., Payne et al., 2008; Smith et al., 2008) and, at the same time, help support the existence and capabilities of the unconscious. They show that the power of unconscious thought is realized only when deliberation duration is of a moderate length and, thus, suggests that in order to fully harness the power of unconscious thought, it is important to calibrate the deliberation duration for the task at hand. Our findings also add to consumer psychology research on unconscious cognitive processes (e.g., Bos et al., 2011; Messner & Wänke, 2011), showing that by engaging in unconscious deliberation for an adequate duration, consumers may enhance their creative consumption experiences. Further, our findings challenge managerial intuitions regarding unconscious thought. In a survey of thirty-three corporate executives from a large organization, we provided participants with detailed descriptions of unconscious thought and the product design task we used in this research, and asked them to predict the outcomes. The majority (91%) predicted a linear relationship—having more time for unconscious deliberation would lead to more creative outcomes. Our findings thus can help firms more effectively leverage the powers of the unconscious to develop innovative products and creative marketing programs to better serve consumers.

Our results compliment research findings on incubation in the creativity literature (e.g., Dodds, Ward, & Smith, 2003; Olton, 1979; Sio & Ormerod, 2009). Admittedly, there are procedural differences between the unconscious thought experimental paradigm and the incubation paradigm. For example, whereas the duration of deliberation is exogenously fixed in the unconscious thought paradigm (e.g., Dijksterhuis, 2004), many incubation studies allowed participants to output their creative inspiration whenever an epiphany occurs (e.g., Patrick, 1938). While no task-relevant external cues are presented to participants in the unconscious thought paradigm (e.g., Dijksterhuis, 2004), such cues are sometimes utilized to help boost creative thinking in the incubation paradigm (e.g., Christensen & Schunn, 2005). Nonetheless, incubation may in fact share mental processes with unconscious thought (Dijksterhuis & Meurs, 2006; Zhong et al., 2008). If so, our findings suggest that incubating for a long period of time could be suboptimal and reduce the likelihood of epiphany.

Our research opens up interesting questions for future research. While we observed 3 min as the optimal duration of unconscious thought in the creativity tasks we used, we are not claiming that 3 min of deliberation is appropriate for all creativity tasks. On the contrary, we believe that the optimal duration of unconscious thought is contingent on the task (Weisberg, 1999), as different creativity tasks require different amounts of mental effort (e.g., re-use a soft drink bottle vs. design a skyscraper). Future research could explore methods to estimate the optimal duration as a function of task characteristics.

Further, our studies investigated the impact of unconscious versus conscious thought on the generation of product use ideas (Experiment 1) and product design (Experiment 2). It would be interesting to investigate how deliberation duration interacts with the two thought types to impact (1) identification of the best idea among a pool of self-generated ideas (see Ritter, van Baaren, & Dijksterhuis, 2012), and (2) other types of creative tasks that require different mental processes (Baer, 1998). It would also be interesting to examine whether the pattern of

results we uncovered applies to the 'creativity-during-sleep' phenomenon (Ritter, Strick, Bos, Van Baaren, & Dijksterhuis, forthcoming).

Though the results of our studies are consistent with the theoretical account we offer, our experimental methodology and the scope of this research report, limited our ability to fully test the mechanism we propose. With more sophisticated methods such as neuroimaging, future research could shed more light on the process through which the unconscious affects creativity. For example, in our studies, we found that unconscious thought did not produce more novel output than conscious thought when time is short, suggesting that the relative speed of unconscious versus conscious thought might not be radically different—otherwise we should have detected a significant difference between thought types in the one-minute condition. With more advanced methodologies, future research could perhaps quantify the differences in speed between the operations of conscious and unconscious thought.

Finally, future research could also extend our findings by exploring potential moderators. For example, because experts tend to benefit more from unconscious thought than novices (Dijksterhuis, Bos, van der Leij, & van Baaren, 2009), future research could investigate whether people with high expertise or ample prior knowledge exhibit a different pattern of creativity performance as a result of unconscious deliberation. Exploring important research topics such as these will not only further our theoretical knowledge of unconscious thought, but also offer valuable insights for consumers and managers.

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