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FlashReport

Shedding light on insight: Priming bright ideas

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ABSTRACT

Previous research has characterized insight as the product of internal processes, and has thus investigated the cognitive and motivational processes that immediately precede it. In this research, however, we investigate whether insight can be catalyzed by a cultural artifact, an external object imbued with learned meaning. Specifically, we exposed participants to an illuminating lightbulb – an iconic image of insight – prior to or during insight problem-solving. Across four studies, exposing participants to an illuminating lightbulb primed concepts associated with achieving an insight, and enhanced insight problem-solving in three different domains (spatial, verbal, and mathematical), but did not enhance general (non-insight) problem-solving.

Shedding light on insight: priming bright ideas

Many are familiar with the "Aha!" experience that accompanies a solution to a vexing problem. After working on a problem to no avail, an insight may suddenly appear and voilà: problem solved. Insight is often described as central to creativity (Mednick, 1962; Taylor, 1988) and many of history's great ideas are said to be products of insight (see Gruber, 1981). Unsurprisingly, then, a great deal of research has investigated the cognitive and motivational processes that immediately precede insight (Bowden & Jung-Beeman, 2003a; Friedman & Förster, 2000; Friedman & Förster, 2001; Isen, Daubman, & Nowicki, 1987; Siegler, 2000) and the dispositions and abilities that support insight (Aguilar-Alonso, 1996; McCrae, 1987; Soldz & Vaillant, 1999). As cognitive processes and dispositions reside within people, insight has been characterized as the product of cognitive processes relatively insulated from perception (but see Grant & Spivey, 2003). More generally, creativity is commonly regarded as a prototypically personal process. In contrast to this account, we examine whether insight in three domains (spatial, verbal, and mathematical) can be catalyzed by cultural artifacts.

A great deal of research has shown that behavior can be automatically activated (Bargh, 2006). In a classic study, participants subtly exposed to words related to the elderly subsequently walked more slowly down a hallway after leaving the experiment (Bargh, Chen, & Burrows, 1996). In a study more germane to the current research, two-word primes separated by "and" rather than "of" enhanced problem-solving in the Duncker Candle Problem, which requires separating an object (a box *of* tacks) into two entities (a box *and* tacks; Higgins & Chaires, 1980). Additionally, a variety of trait (Dijksterhuis & van Knippenberg, 1998; Dijksterhuis et al., 1998), mindset (Sassenberg & Moskowitz, 2005), and motivational (Friedman & Förster, 2000; Friedman & Förster, 2001) primes influence mental performance and behavior.

In addition to the many experiments that show priming by exposure to words and images, a growing body of research shows that cultural artifacts – objects imbued with learned meaning tangential to their utilitarian purpose – can produce surprising behavioral effects. For instance, exposure to artifacts from the business world (briefcases, executive-style pens) induces individuals to play an economic game more competitively (Kay, Wheeler, Bargh, & Ross, 2004). Also, exposure to the American flag initiates aggressive behavioral tendencies among regular news watchers (Ferguson & Hassin, 2007). Such effects are thought to occur via the activation of concepts associated with the object. For example, exposure to the American flag causes activation of concepts associated with aggression and thus motivates aggressive behavior. Similarly, we hypothesize that cultural artifacts can activate cognitive representations associated with achieving insight and thus motivate insightful problem-solving.

To examine this hypothesis, we relied on an ancient yet still popular metaphor for insight: the shining of light on a previously darkened area of the mind (cf. Plato ca 375 BCE/1991). This metaphor is illustrated by scholarly descriptions of insight (e.g., Baars, 1988; Crick, 1984; Dijksterhuis & Meurs, 2006), by language ("shedding light on"), and by the iconic image of insight: the lightbulb. Such metaphorical descriptions of insight suggest an abstract conceptual relationship between illumination and insight that may have an experiential origin (see Lakoff & Johnson, 1980, 1999). The

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current research goes beyond previous research (cf. Higgins & Chaires, 1980) by examining how a cultural artifact might prime insight in general, rather than priming a particular procedure for achieving insight. Study 1 examined if exposure to a lightbulb activates concepts associated with achieving insight. Studies 2–4 examined if exposure to a lightbulb would enhance performance on spatial, verbal, and mathematical insight problems. In all studies, insight problems met criteria used in previous research: the problems were ultimately soluble, and were likely to lead to an impasse followed by reinterpretation and an immediate solution (Schooler, Ohlsson, & Brooks, 1993).

Study 1

Immediately before participants began working on a lexical decision task (LDT), the experimenter either turned on a lamp (with an unshaded 25-W lightbulb) visible to the participant or an overhead fluorescent light. We hypothesized that exposure to an illuminating lightbulb would result in facilitated reaction times (RTs) to words associated with achieving insight.

Method

Participants

Seventy-three college students (61% female) from a private university in the northeastern United States participated in exchange for partial course credit. All participants indicated in prescreening that they were native English speakers.

Procedure

Participants were first seated at a computer with instructions for the LDT. In this study and in all subsequent studies, participants were told that the study was concerned with the problem-solving strategies of college students. Before leaving the room the experimenter said, "I just noticed it's a little dark in here; let me turn this on for you," and turned on either the lightbulb or an overhead fluorescent light (based on random assignment), which stayed on for the remainder of the experiment. After turning on the light, the experimenter walked out of the room and the participant began the LDT.

The LDT presented 10 words associated with insight (e.g., create, conceive, and envision), 10 control words (matched for word-length, valence and abstractness), and 20 non-words. All stimuli were randomly presented via DirectRT™ software. Participants were asked to indicate as quickly and as accurately as possible if each stimulus was a word or non-word. No participants in this study (or any of the four studies) indicated suspicion of the experimental manipulation during debriefing.

Results and discussion

Incorrect responses, responses faster than 200 ms, and responses exceeding personal average RT by 2.5 standard deviations were excluded. After these exclusions, three individuals had average RT's that exceeded the grand mean by more than 2.5 standard deviations. These individuals were excluded from analyses.

A 2 (lighting) $\times$ 2 (word-type) mixed-model analysis of variance (ANOVA) was conducted with repeated measures on the second factor. Participants responded faster to insight words ($M = 588$ ms) than control words ($M = 614$), $F(1, 68) = 25.30$, $p < .001$ and participants in the lightbulb condition responded faster ($M = 583$) than participants in the control condition ($M = 619$), $F(1, 68) = 4.29$, $p = .042$. Crucially, these effects were qualified by the predicted word-type by lighting interaction, $F(1, 68) = 5.37$, $p = .024$, $\eta^2 = .07$. Compared to participants in the control group, participants exposed to the lightbulb responded quicker to words that were means to achieve insight, $t(68) = 2.90$, $p = .005$, Cohen's $d = 0.70$, but not to control words, $t(68) = 1.23$, $p = .22$ (see Fig. 1). This study thus suggests that an illuminating lightbulb activates concepts associated with achieving an insight.

Study 2

An illuminated lightbulb activated concepts associated with achieving insight. Such activation might reasonably promote insightful thought processes; this question was addressed by Study 2. While participants were working on a spatial insight problem, the experimenter turned on either a lamp (with a visible lightbulb) or an overhead fluorescent light. We hypothesized that exposure to an illuminating lightbulb would lead participants to solve the spatial insight problem more often than those exposed to the fluorescent light.

Method

Participants

Seventy-nine college students (61% female and 11% unreported) from a private university in the northeastern United States participated in the study in exchange for monetary reimbursement.

Procedure

After finishing a simple non-insight algebra problem, participants received the insight problem and were informed that they would have 3 min to solve it. For the insight problem, participants were asked to connect four dots arranged in a square by drawing three connected straight lines without either lifting the pencil from the page or retracing a line, and while ending the drawing at the same dot it was begun (see Fig. 2; for a similar problem, see Maier, 1930). Fifty-five seconds after the participant began working on the problem, either the lamp with a visible lightbulb or an overhead fluorescent light was turned on (with the same explanation used in Study 1), based on random assignment, and remained on for the remainder of the experiment.

If participants had not solved the problem after 3 min they were shown the solution. Participants were then asked if they were familiar with the problem or its solution.

Results and discussion

Eight participants solved the insight problem before the experimental manipulation and four participants had previously encountered the problem. These participants were excluded from analyses. As predicted, participants exposed to the illuminating lightbulb solved the insight problem more often (44%) than indi-

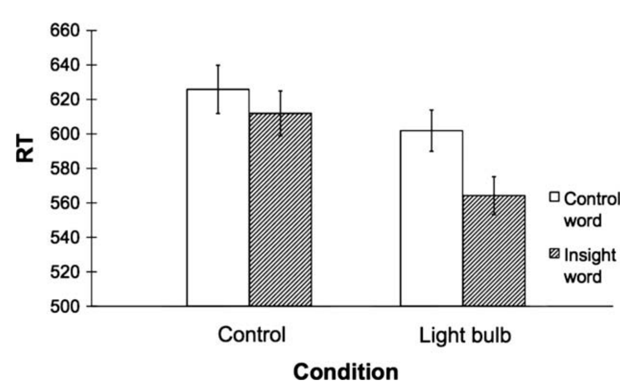

Fig. 1. Mean RTs in Study 1.

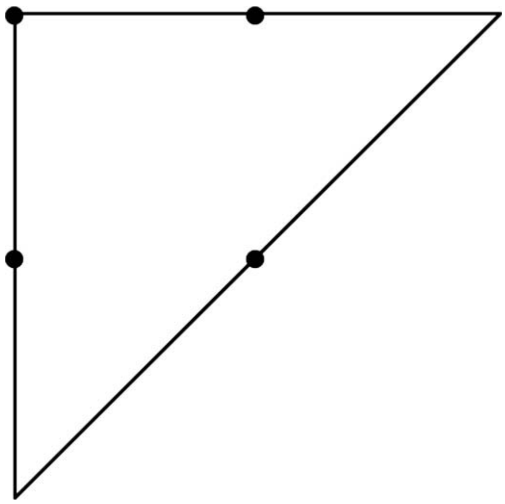

Fig. 2. The problem used in Study 2 with its solution.

viduals exposed to fluorescent lighting (22%), $\chi^2(1, N = 67) = 5.14$, $p = .024$, Cramér's *phi* = .28. Hence, exposure to the illuminating lightbulb enhanced spatial insight problem-solving. An alternative explanation is that the lightbulb emitted pleasant (or different) lighting, relative to the fluorescent light control, and the resulting positive mood led to insight (see Isen et al., 1987). In Study 3a we examined the role of mood in the lightbulb's influence on insight and in Study 3b we used a new control condition that equated the quality and quantity of lighting. In both, we sought converging evidence by utilizing an alternative measure of insight.

Study 3a

This study explored the role of mood in the influence of the lightbulb on insight problem-solving. Immediately before participants began working on a set of verbal insight problems, the experimenter either turned on a lamp (with a visible lightbulb) or an overhead fluorescent light. After turning on the light, but before beginning the insight problems, participants completed a previously-established mood measure. We hypothesized that (a) exposure to an illuminating lightbulb would enhance performance on a verbal insight task (the Remote Associates Test, RAT; Mednick, 1962), and (b) this effect would not depend on mood.

Method

Participants

Thirty-eight college students (63% female) from a private university in the northeastern United States participated in exchange for partial course credit. All participants indicated in prescreening that they were native English speakers.

Procedure

The procedure was identical to Study 2 with two exceptions. First, after the experimental manipulation, participants indicated their overall current mood (How do you feel right now?) on a scale of 1 (very bad) to 9 (very good), and then rated specific feelings (calm, concerned, content, disappointed, nervous, down, happy, joyful, nervous, relaxed, and tense) from 1 (not at all) to 9 (extremely). Second, the dependent measure was changed from a spatial insight problem to a verbal insight problem. The RAT included 15 triads composed of three words. Participants were instructed to generate a word that formed a compound with the other three words (e.g., "common" is the correct response to "sense, courtesy, place"). Triads (selected from Bowden & Jung-Beeman, 2003b) were of moderate difficulty (see Table 1) and were randomly presented via MediaLab™ software. Each triad was on screen for 5 s, followed by a text box asking participants to immediately type in their answer (if they did not have one they typed "no").

Results and discussion

As predicted, participants exposed to the illuminating lightbulb solved more triads correctly ($M = 4.88$) than participants exposed to the overhead fluorescent light ($M = 2.86$), $t(36) = 2.37$, $p = .02$, Cohen's $d = 0.79$. Hence, exposure to an illuminating lightbulb enhanced verbal insight problem-solving.

Conversely, there were was no significant difference in overall mood between the two conditions (lightbulb $M = 6.10$, fluorescent light $M = 6.13$), $t(36) = 0.21$, $p = .83$. Additionally, there was no significant differences between the two conditions in composite (average) scores of positive feelings (lightbulb $M = 5.88$, fluorescent light $M = 5.86$), $t(36) = 0.06$, $p = .95$, nor negative feelings (lightbulb $M = 3.32$, fluorescent light $M = 3.05$), $t(36) = 0.60$, $p = .55$.

These results indicate that the lightbulb enhanced insight problem-solving in a different domain than Study 2, but that this effect was not contingent on mood (the lightbulb did not impact mood). To provide a more controlled test in Study 3b, we equated the experimental and control conditions on amount and type of light.

Study 3b

This study was a replication of Study 3a with the exclusion of the mood measure and a change to the control condition, in which participants were exposed to incandescent light in both conditions.

Method

Participants

Fifty-seven college students (67% female) from a private university in the northeastern United States participated in exchange for partial course credit. All participants indicated in prescreening that they were native English speakers.

Procedure

The procedure was identical to Study 3a, except the mood measure was excluded, and the control condition was changed. Participants were either exposed to the 25-W lightbulb used in the previous experiments or were exposed to a *shaded* 40-W lightbulb. A brighter bulb was used when shaded to equate the two conditions for ambient light. Thus, the only difference between the con-

Table 1
Triads used in the remote associates test.

Triad			Answer
Sense	Courtesy	Place	Common
Print	Berry	Bird	Blue
Horse	Human	Drag	Race
Main	Sweeper	Light	Street
Opera	Hand	Dish	Soap
Dress	Dial	Flower	Sun
Down	Question	Check	Mark
Carpet	Alert	Ink	Red
Flower	Friend	Scout	Girl
Hound	Pressure	Shot	Blood
Mill	Tooth	Dust	Saw
Basket	Eight	Snow	Ball
Sandwich	House	Golf	Club
Pie	Luck	Belly	Pot
Fly	Clip	Wall	Paper

ditions was the sight of an illuminating lightbulb (versus a lamp shade). After the light was turned on, participants completed the RAT.

Results and discussion

As predicted, participants exposed to the illuminating lightbulb solved more triads correctly ($M = 6.08$) than participants exposed to shaded bulb ($M = 4.60$), $t(55) = 1.98$, $p = .05$, Cohen's $d = 0.53$. In Studies 2 and 3, exposure to an illuminating lightbulb enhanced performance on spatial (Study 2) and verbal (Study 3) insight problems, and this effect was not due to incandescent light or mood. Yet another alternative explanation is that exposure to the lightbulb enhanced problem-solving in general. Study 4 addressed this alternative in the context of mathematical problems.

Study 4

Immediately before participants began working on a set of mathematical problems, an experimenter either turned on a lamp (with a visible lightbulb) or an overhead fluorescent light. We hypothesized that an illuminating lightbulb would facilitate performance on an insight problem, but not on non-insight problems.

Method

Participants

Sixty-nine college students (64% male) from a private university in the northeastern United States participated in exchange for partial course credit.

Procedure

The procedure was identical to Study 2, except that the dependent measure in Study 4 consisted of four algebra equations, one of which was an insight problem (see Fig. 3; see Dow & Mayer, 2004 for other mathematical insight problems). The easiest solution to the three non-insight problems involved a multi-step incremental process that did not require any nonobvious approaches (the criterion for non-insight problems; Schooler et al., 1993). This procedure was to combine like terms, put unlike terms on opposing sides of the equation, and solve for *x*. Conversely, the insight problem was easiest to solve in a single step of reinterpretation by recognizing that the terms in the equation could be reinterpreted in a novel way. Novel reinterpretation is the classic criterion for insight problem-solving (Guilford, 1950).

To confirm the insight/non-insight distinction, we identified 16 students who were able to solve both the insight and non-insight problems. The answers were coded by independent raters according to the two definitions noted above. All 16 students solved all three non-insight problems according to the multi-step procedure. Fifteen of 16 students solved the insight problem in a single step and by recognizing that a term could be reinterpreted in a novel way.

Participants were provided with scrap paper and each problem was randomly presented for 1 min via MediaLab™ software. After typing in a response (or after 1 min passed), a bell rang and the next question was presented.

Non-insight mathematical problems

If $2x = 3(x - 2)$, $6x + 3 = ?$

If $x - (2 - x) = 2$, $x = ?$

$x - (4 - x) = 3x + 3$, $x = ?$

Insight mathematical problem

If $x^3 = 12$, $x^6 = ?$

Fig. 3. The mathematical problems used in Study 4. The easiest way to solve the insight mathematical problem is to recognize that an algebraic term can be reinterpreted, and that $x^6 = x^3 \cdot x^3$.

Results and discussion

Two participants were excluded from analyses for not attempting to solve the insight problem. A 2 (lighting) × 2 (problem-type) mixed-model ANOVA was conducted with repeated measures on the second factor. Participants performed better on non-insight problems ($M = 48\%$ correct) than on the insight problem ($M = 18\%$), $F(1, 65) = 16.4$, $p < .001$. Additionally, participants in the lightbulb condition performed better ($M = 37\%$) than participants in the control condition ($M = 24\%$), $F(1, 65) = 4.90$, $p = .03$. However, these effects were qualified by the predicted problem by lighting condition interaction, $F(1, 65) = 4.04$, $p = .049$, $\eta^2 = .06$. Compared to participants exposed to fluorescent light, those exposed to the illuminating lightbulb solved the insight problem more often, $t(65) = 2.43$, $p = .018$, Cohen's $d = 0.60$, but did not solve the non-insight problems more often, $t(65) = .11$, $p = .91$ (see Fig. 4).

Importantly, the insight problem had two interactive properties absent in the non-insight problem—the requirement of reinterpretation and the spontaneity with which the response came to mind. To the extent that these properties are sufficient of insight as argued by other scholars (e.g., Guilford, 1950; Schooler et al., 1993) we believe that the lightbulb's influence was specific to insight problems. Thus, the results of Study 4 suggest that the problem-solving benefits of exposure to an illuminating lightbulb are specific to insight problems.

General discussion

The results of four studies suggest that exposure to an illuminating lightbulb primes bright ideas. Rather than priming a particular procedure for solving a creative task (cf. Higgins & Chaires, 1980), exposure to an illuminating light bulb activates concepts associated with achieving insight and facilitates performance on spatial, verbal and mathematical insight problems, but not non-insight problems. We further demonstrate that such enhanced insight is not due to an induction of positive mood or to exposure to ambient light.

These findings add to the growing body of research showing that perception of objects in our environment can subtly influence our behavior. They demonstrate in particular how visible symbols can influence the generation of insightful solutions to problems; as participants associate an illuminating lightbulb with achieving insight, the mere perception of an actual illuminating lightbulb brought about mental processes that facilitated the insight process.

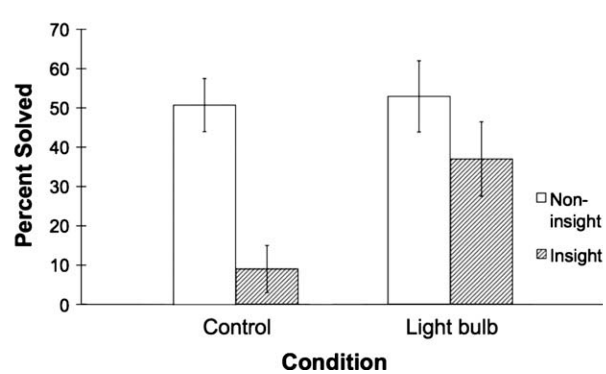

Fig. 4. Mean rates for solving problems in Study 4.

One of the earliest discussions of the insight process described insight as a "flash of illumination" that occurred within the individual (Wallas, 1926). Modern research on creative insight has likewise conceptualized it as highly personal, ultimately based in higher-order thought processes, and has confirmed that a solution to an insight problem may appear suddenly and surprisingly without preview (Metcalfe & Wiebe, 1987). This experience of insight, while highly personal, may follow from cultural events and artifacts. Indeed, the present results show that insight can be facilitated by a cultural artifact – an object that provides an external "flash of illumination."

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