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FlashReport

Diversifying experiences enhance cognitive flexibility☆

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ABSTRACT

Past research has linked creativity to unusual and unexpected experiences, such as early parental loss or living abroad. However, few studies have investigated the underlying cognitive processes. We propose that these experiences have in common a "diversifying" aspect and an active involvement, which together enhance cognitive flexibility (i.e., creative cognitive processing). In the first experiment, participants experienced complex unusual and unexpected events happening in a virtual reality. In the second experiment, participants were confronted with schema-violations. In both experiments, comparisons with various control groups showed that a diversifying experience – defined as the active (but not vicarious) involvement in an unusual event – increased cognitive flexibility more than active (or vicarious) involvement in normal experiences. Our findings bridge several lines of research and shed light on a basic cognitive mechanism responsible for creativity.

Compared to the general population, highly creative individuals often experience a disproportionate number of unusual and unexpected events, such as early parental loss (Martindale, 1972) or having an immigrant status (Goertzel, Goertzel, & Goertzel, 1978). Furthermore, living abroad is linked to creativity in the general population (Leung, Maddux, Galinsky, & Chiu, 2008). Why are such experiences linked to creativity?

We propose that events like those above are similar in that they are unusual and unexpected, and that the "actor" actively (as opposed to vicariously) experiences the events. We define such experiences as *diversifying experiences*. That is, diversifying experiences are *highly unusual and unexpected events* or situations that are actively experienced and that push individuals outside the realm of "normality." In this paper, we test the prediction that diversifying experiences help people break their cognitive patterns and thus lead them to think more flexibly and creatively.

This prediction is supported by research on multicultural experiences (which represent a specific subset of diversifying experiences). Priming multicultural experiences, or being exposed to multicultural symbols, enhanced creative thinking (Cheng, Leung, & Wu, 2011; Maddux, Adam, & Galinsky, 2010; Maddux & Galinsky, 2009). There are two explanations for these effects. First, multicultural experiences may impact creativity via cognitive expansion (broadening people's knowledge pool). Indeed, studies found that openness to experience and need for cognitive closure moderate the multiculturalism-creativity link (Leung & Chiu, 2008, 2010). Second, multicultural experiences may enhance creativity because they emphasize cultural incongruities. Cultural incongruities lead to negative affect, thereby increasing processing depth (Cheng et al., 2011). We propose a more general cognitive mechanism to be also responsible for enhanced creativity. We hypothesize that *any* unusual and unexpected experience in itself, not necessarily related to cultural experiences or personal identity, can enhance flexible and creative thinking. Importantly, we propose that merely being confronted with something unusual is not enough. Instead, as alluded to above, active engagement is needed, for an unusual event to become a diversifying experience that facilitates creativity.

Because we propose that actively experiencing diversifying events enhances creativity due to improved flexibility, the present studies focus on *cognitive flexibility*. Cognitive flexibility is the ability to break old cognitive patterns, overcome functional fixedness, and thus, make novel (creative) associations between concepts (Guilford, 1967). Researchers conceptualize cognitive flexibility as the cognitive core of creativity, and a necessary (albeit not sufficient) component of "real-life" creativity (Baghetto & Kaufman, 2007; Hennessey & Amabile, 2010). Studies have shown that cognitive flexibility, measured with Guilford's Unusual Uses Task (1967), relates positively to exceptional creative achievement (Carson, Peterson, & Higgins, 2005). As a result, researchers have long used measures of cognitive flexibility as a way to investigate the cognitive styles underlying creativity (see Baas, De Dreu, & Nijstad, 2008).

We conducted two experiments to test the hypothesis that diversifying experiences increase cognitive flexibility. In Experiment 1, we immersed people in a virtual reality environment where we exposed

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them to a series of complex, unusual and unexpected events. Previous studies have shown that, when participants are immersed in virtual reality, they perceive themselves as active agents in that environment (Blascovich et al., 2002). We used regular film clips to have the participants vicariously experience the same highly unusual and unexpected events. In Experiment 2, our manipulation of a diversifying experience is more simple. We produced schema-violations, by changing the sequence of actions of a simple and well-rehearsed schematic activity that participants experienced either actively, or vicariously via a film clip.

Experiment 1

Method

Participants

Sixty-one students (46 female, $M_{Age}=22.21$, $SD_{Age}=5.38$) from Radboud University Nijmegen participated in this experiment for course credit or money (4 Euros).

Design and procedure

Participants were randomly assigned to one of three experimental conditions: *Active-Unexpected-Events* ($N=22$), *Active-Normal-Events* ($N=18$), and *Vicarious-Unexpected-Events* ($N=21$).

In the Active-Unexpected-Events condition, participants encountered three highly unusual and unexpected events, each of them violating the laws of physics (perspective, velocity, and gravity). Participants actively experienced these events in a virtual reality environment by taking 3-minute walks through a virtual replica of the university cafeteria. In the first event, participants walked towards a suitcase that was standing on a table. While approaching, its size decreased, and while moving away, its size increased. In the second event, participants felt they were walking faster than they actually were, as each step led to a larger (1.5 times actual movement) corresponding movement in the virtual environment. In the third event, participants walked towards a table with a toy car in the middle of the table, and a bottle at its edge. While participants walked to the table, the toy car moved towards the bottle. However, upon being hit by the car, the bottle did not fall on the ground, as naturally expected, but slowly moved upwards.

In the Active-Normal-Events condition, we employed the same procedure as in the Active-Unexpected-Events condition, except that we used the corresponding normal events. Events happened as the participants expected them to happen, following the laws of physics.

In the Vicarious-Unexpected-Events condition, participants were not immersed into a virtual reality world but watched a film that was made by recording the three diversifying events of the Active-Unexpected-Events condition.

Measures

After the manipulation, all participants completed a version of the Unusual Uses Task (Guilford, 1967), which is a widely used and well-validated measure of creativity, including cognitive flexibility (see Baas et al., 2008; Carson et al., 2005). Participants were given two minutes to generate and list as many ideas as they could, answering the question "What makes sound?" (Charles & Runco, 2001). Using Guilford's (1967) original coding scheme, two raters measured cognitive flexibility by counting the total number of different categories that the participants' ideas belonged to (e.g., "dog, cat, horse," would lead to a score of one as they are all animals, whereas "dog, car, ocean," would lead to a score of three). The raters showed a high inter-rater reliability (Cronbach's *alpha* = .89), so throughout the analyses we used averaged scores. A high cognitive flexibility score indicates an ability to switch between categories, overcome fixedness, and thus, think more creatively.

To rule out the possibility that affect drives the current effects (see Baas et al., 2008, for effects of affect on creativity), participants completed a shortened version of the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) upon finishing the creativity task.

Results and discussion

We conducted an ANCOVA with cognitive flexibility as the dependent variable, and condition as the between-subjects factor. Because cognitive flexibility was correlated with verbal fluency, that is, the total number of ideas participants generated ($r=.62$), and we wanted to investigate the effect of condition on people's *pure* cognitive flexibility, we entered verbal fluency as a covariate. The analysis revealed a main effect of condition, $F(2, 57)=3.31$, $p<.05$, $\eta^2=.10$. As can be seen in Fig. 1, simple contrasts (between covariate-ajusted means) showed that participants in the Active-Unexpected-Events condition were more cognitively flexible than participants in the Active-Normal-Events condition, $t(38)=2.18$, $p<.05$, and than participants in the Vicarious-Unexpected-Events condition, $t(41)=2.21$, $p<.05$.

Furthermore, we found no difference between the conditions in positive, $F(1,58)=.37$, $p=.60$, or negative affect, $F(1,58)=1.69$, $p=.19$, and the same results on cognitive flexibility were obtained after controlling for positive, $F(2,56)=3.24$, $p<.05$, or negative affect, $F(2,56)=4.26$, $p<.05$.

To conclude, Experiment 1 showed that actively (but not vicariously) experiencing unusual and unexpected events enhances people's cognitive flexibility. These effects were not due to changes in affect. To conceptually replicate and extend these findings, we conducted a second experiment. In Experiment 2, we reduced the complexity of our manipulation to what Simonton (2000) points to be the essential cognitive core of all diversifying experiences; that is, "schema-violations." Unusual and unexpected events, such as early parental death, living abroad, or violations of the laws of physics have in common the fact that they violate well-established schemas of the world. However, because these schema-violations are embedded in complex social contexts and are highly relevant to people, one question remains: Could a minimal schema-violation enhance cognitive flexibility as well? To address this question, we conducted Experiment 2.

Experiment 2

Method

Participants

Eighty-one students (68 female, $M_{Age}=22.07$, $SD_{Age}=3.04$) from Radboud University Nijmegen received course credit or money (4 Euros) for participation.

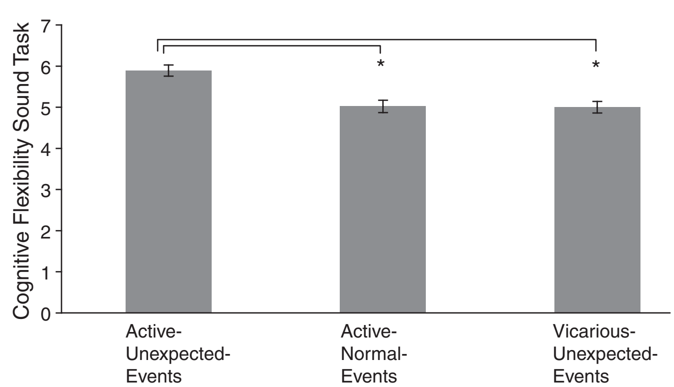

Fig. 1. Cognitive flexibility (covariate-adjusted) on the "sound task," depending on condition. Error bars represent standard errors. *$p<.05$.

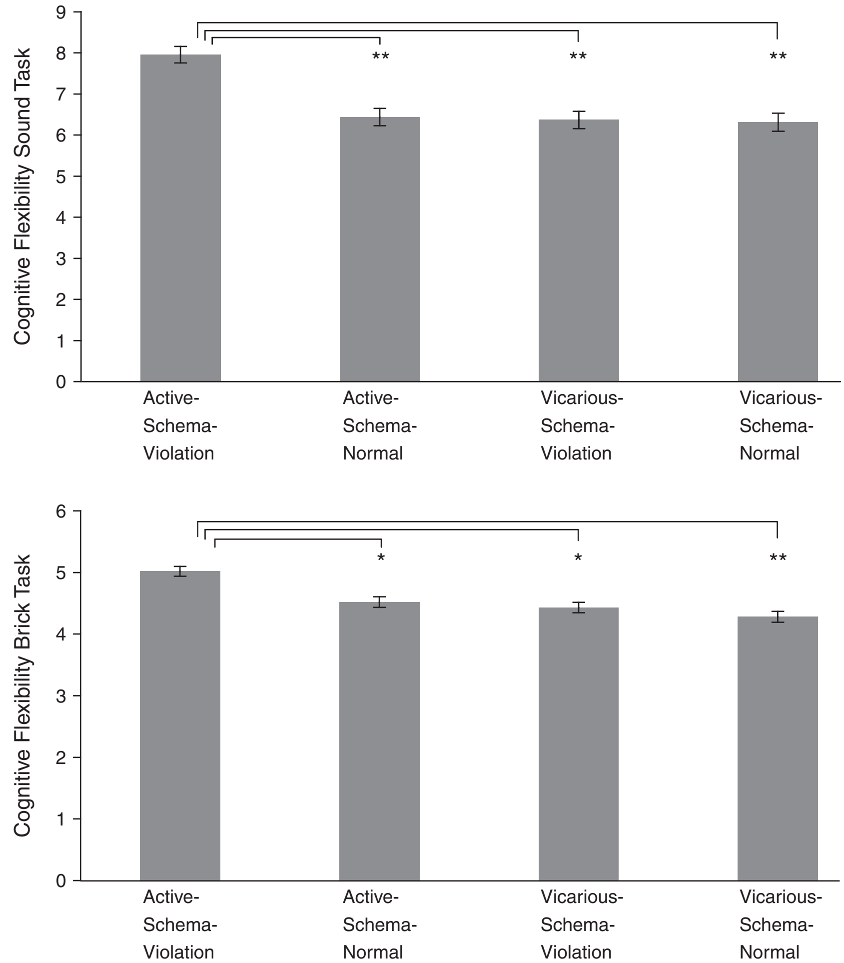

Fig. 2. Cognitive flexibility (covariate-adjusted) on the "sound task" and "brick task," depending on condition. Error bars represent standard errors. *$p<.05$, **$p<.01$.

Design and procedure

Participants were randomly assigned to one of four experimental conditions: *Active-Schema-Violation* ($N=23$), *Active-Schema-Normal* ($N=20$), *Vicarious-Schema-Violation* ($N=20$), and *Vicarious-Schema-Normal* ($N=18$). All participants encountered an everyday activity, that is, the preparation of a sandwich with butter and chocolate chips (a popular breakfast in the Netherlands), which consists of a simple and well-known sequence of actions. Participants in the active conditions had to execute the activity themselves by following several actions. Each action appeared as a written prompt on a computer screen. In the Active-Schema-Violation condition, the usual order of actions was changed. Participants first put chocolate chips on a dish, buttered the bread, and then placed the bread buttered-side-down on the dish with the chocolate chips. In the Active-Schema-Normal condition, the sequence of actions was in accordance with how participants usually perform the activity. Participants first put a slice of bread on a dish, buttered the bread and then placed chocolate chips on top. In the vicarious experience conditions, participants watched a film showing an actor making the sandwich. The way the actor made the sandwich followed either the schema-violation (in the Vicarious-Schema-Violation condition), or the normal schema (in the Vicarious-Schema-Normal condition).[1]

[1] Participants in the Active-Schema-Violation condition (vs. all other conditions) scored significantly higher on questions concerning schema-violations (e.g., "How similar was the way you made the sandwich to regular sandwich-making?") and unexpected experiences (e.g., "Did you experience anything unexpected while making the sandwich?").

Measures

After the manipulation,[2] participants completed two versions of the Unusual Uses Task (Guilford, 1967). The first task was the same as the one used in Experiment 1. In the second task, participants were given two minutes to generate uses for a brick. Following the same coding procedure used in Experiment 1, we measured people's cognitive flexibility by counting the number of different categories that their responses belonged to. The two raters showed a high inter-rater reliability (Chronbach's *alpha sound task*=.97 and *brick task*=.79), so we used averaged scores throughout the analyses.

As in Experiment 1, participants completed an affect measure upon finishing the creativity task. This time, we used a different affect measure, the Brief Mood Introspection Scale (Mayer & Gaschke, 1988).

Results

To test the hypothesis that actively experiencing schema-violations increases cognitive flexibility, we conducted two ANCOVAs (one for the "sound task" and one for the "brick task") with cognitive flexibility as the dependent variable, and condition as the between-subjects factor.

[2] Immediately after the manipulation, participants performed the Navon Task (1977), which measures global processing. Previous research showed that global processing enhances creativity (Friedman & Förster, 2008), and it seemed possible that diversifying experiences might increase global processing. However, we found no effects of the manipulation on Navon performance, indicating that global processing does not underlie our effect.

As in Experiment 1, cognitive flexibility was highly correlated with verbal fluency, that is, the total number of ideas generated, for both tasks ($r = .78$ and $r = .89$, respectively). Therefore, we included verbal fluency as a covariate in both ANCOVAs, to investigate the effect of condition on pure cognitive flexibility. There was a significant effect of condition on cognitive flexibility for the "sound task," F (3, 74) = 3.68, $p < .02$, $\eta^2 = .13$, as well as for the "brick task," F (3, 76) = 4.01, $p < .02$, $\eta^2 = .14$. To test our hypothesis that participants in the *Active-Schema-Violation* condition have a higher cognitive flexibility than participants in the other three conditions, we conducted simple contrasts. As shown in Fig. 2, for the "sound task", we found that participants in the *Active-Schema-Violation* condition were higher in cognitive flexibility (covariate-adjusted) than participants in the *Active-Schema-Normal* condition, $t(40) = 2.58$, $p < .01$, than participants in the *Vicarious-Schema-Violation* condition, $t(40) = 2.70$, $p < .01$, and than participants in the *Vicarious-Schema-Normal* condition, $t(38) = 2.76$, $p < .01$. Similar effects were found for the "brick task" (all $ps < .05$). In other words, actively participating in a schema-violation increases cognitive flexibility more than vicariously watching a schema-violation and more than participating in or watching a normal schema.

As in Experiment 1, we found no differences between the experimental conditions in positive, $F(3,77) = 1.95$, $p = .13$, or negative affect, $F(3,77) = .47$, $p = .71$, and the same results on cognitive flexibility were obtained after controlling for positive or negative affect in the "sound task", $F(3,73) = 3.63$, $p < .05$, $F(3,73) = 3.85$, $p < .05$ (respectively), as well as in the "brick task", $F(3,75) = 3.94$, $p < .05$, $F(3,75) = 4.05$, $p < .05$ (respectively).

Discussion

Diversifying experiences come in many forms. Whether it is the traumatizing death of a parent or the exciting semester abroad, they all have something in common: They are unusual and unexpected events that are rooted in schema-violations, and that are actively experienced. They violate normality, break cognitive schemas, and promote a thinking style characterized by cognitive flexibility.

In two experiments, we tested the causal role of diversifying experiences in creative cognition. We looked at different levels of complexity of diversifying experiences, going from the more complex, to the more specific. In Experiment 1, we found that actively experiencing complex, unusual and unexpected events in a virtual reality environment increases cognitive flexibility. In Experiment 2, we reduced the complexity of our manipulation to the essential core of diversifying experiences, and we showed that actively experiencing a minimal schema-violation enhances cognitive flexibility. The results remained significant when controlling for affect.

The current findings also have several practical implications. First, they speak to current policies on immigration. Previous research showed that periods of immigration have been historically followed by exceptional creative achievement (Simonton, 1997). Our findings suggest a potential explanation: Immigrants bring the new customs and ideas that may act as "diversifying experiences" for the local population, and thus may enhance creativity via cognitive flexibility. Second, business leaders, politicians, and academics realize that a creative thinking style is crucial in both educational institutions and organizations. The current findings may facilitate the development of behavioral and cognitive strategies meant to enhance cognitive flexibility, and ultimately creativity. As Masaru Ibuka, the co-founder of the *Sony Corporation*, once said—"Creativity comes from looking for the unexpected and stepping outside your own experience."

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