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THE ROLES OF NOVELTY AND THE ORGANIZATION OF STIMULUS MATERIAL IN DIVERGENT THINKING

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This study examines the effects of the novelty and organization of stimulus material on divergent thinking. Participants were 129 undergraduate students of (84 male and 45 female) aged between 17 and 20. Divergent thinking was assessed by the Unusual Uses test, in which participants had to generate as many uses as possible for a wooden ruler. Participants were primed with either rare or common ideas which were presented either in three sets or simultaneously in one set. We found a significant effect of novelty on originality. Participants primed with rare stimuli significantly outperformed those primed with common stimuli on originality. We also found a significant effect of organization on fluency. Participants primed with the discrete stimulus set significantly outperformed those primed with the concurrent stimulus set on fluency. Finally, we found a marginally significant interactive effect of novelty and organization on fluency and originality. Participants who were primed with rare stimuli in discrete sets tended to obtain higher fluency and originality scores than participants in other groups. This means that the discrete organization of stimuli presentation can serve as a means to strengthen the positive effect of novel stimuli exposure. The results of the study can be applied to procedures and techniques for the stimulation of creativity.

Keywords: divergent thinking, creativity, idea generation, stimulus material

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Introduction

The importance of introducing creativity to the school curriculum has long been recognized by the academic community (e.g., Beghetto, 2010; Runco, 2004; Torrance, 1968; Vygotsky, 1967/2004). Since Guilford's (1950) presidential address to the American Psychological Association, numerous studies have been aimed at identifying and studying creativity. Their primary concern are the methods and techniques enhancing creativity in young children, adolescents and adults. Many models developed in the creative education paradigm look at the specific factors stimulating an individual's creative performance. The present study focuses on two of them, the novelty and organization of stimulus material.

In the psychometric tradition, creative thinking is perceived as the ability to initiate multiple cycles of divergent and convergent thinking (Guilford, 1967). The combined effort of these two types of thinking creates an active, attention-demanding process which allows the generation of ideas satisfying the defining characteristics of a creative product: novelty (i.e., original or unexpected) and utility (i.e., useful or meeting task constraints) (see Sternberg, 1999, for an overview[4]). Over the last half century, numerous studies have provided evidence for the ability of divergent thinking tests to predict certain aspects of creative problem-solving performance and real world creative achievement. Although as Runco (1991) argued, "Divergent thinking is not synonymous with creative thinking" (p. ix), many researchers believe that divergent thinking is a defining component of the creative process (Lubart, 2000). Guilford associated the properties of divergent thinking with four main characteristics: fluency (the ability to rapidly produce a large number of ideas or solutions to a problem); flexibility (the capacity to consider a variety of approaches to a problem simultaneously); elaboration (the ability to think through the details of an idea and carry it out); and originality (the tendency to produce ideas different from those of most other people).

In the present study, the organization of stimulus material is presented in terms of the structure of the stimulus set. Studies investigating the effect of task composition on creative performance favoured discrete presentation. Dennis, Valacich, Connolly, and Wynne (1996) reported that individuals who brainstormed on a problem that was presented to them in three discrete sets generated more ideas then those who brainstormed on the same problem presented in one set. Similarly, Coskun, Paulus, Brown, and Sherwood (2000) showed in one of their experiments that discrete presentation of stimuli leads to higher creative performance. In this

[4] Kharkhurin (2014) challenged this definition as being biased by a Western perception of creativity. He proposed an alternative four-criterion construct of creativity, which in addition to novelty and utility considers two other characteristics typical for Eastern perception of creativity: aesthetics and authenticity.

experiment, participants were required to produce ideas on how to improve their university life in 10 categories. Participants in the discrete group had to generate ideas in one category after another. Participants in concurrent group had to generate ideas in all ten categories simultaneously. The first group produced a significantly higher number of ideas. The positive effect of discrete presentation of stimulus material can be explained in terms of the reduction of attentional demands:

> presenting the primes sequentially throughout the session helps to compensate for the limitations of short-term memory, which might be particularly noticeable under highly attention-demanding conditions. Simultaneous (i.e., rapid sequential) presentation may overwhelm the participants and prevent them from focusing their attention adequately on each of the primes presented (Coskun et al., 2000, p. 318).

However, this conclusion was not supported in other studies. For example, Rastogi and Sharma (2010) reported that participants involved in a concurrent task revealed significantly higher creative performance than their counterparts involved in a discrete task.

The novelty of the stimulus material is also hypothesized to have a positive impact on an individual's creative performance. When people try to come up with a novel idea, their imagination is generally limited by the particular set of properties characterizing the category to which this innovation should belong (Ward, 1994). They tend to select the most common set of properties of the category as the starting point for their creations (Ward, Smith, & Vaid, 1997). A number of studies in various domains of creative production show that the semantic structure of a category has a substantial influence on what people produce (Ward, Patterson, Sifonis, Dodds, & Saunders, 2002). 'Structured imagination' (cf. Ward, 1994) limits individuals from thinking outside the box; that is, people have difficulties violating the conceptual boundaries of a standard category when creating a new exemplar of that category. The novelty of stimulus material may prompt people to overcome these boundaries and demonstrate non-standard thinking. A few studies have tapped into this problem. For example, Dugosh and Paulus (2005) asked participants to list advantages and disadvantages of having an extra thumb on a hand. Participants generated a larger number of unique ideas when primed by a set of rare ideas than when primed by a set of common ideas. However, the effect was found only for a small set of stimuli (eight ideas). When primed with a large set (40 ideas), the common group generated a larger number of unique ideas than the rare group. Similar findings were obtained by Connolly, Routhieaux, and Schneider (1993) who presented participants with either common or rare ideas for balancing a college budget. Rare ideas were those proposed only once by participants in a preliminary study. Common ideas were those generated by at least

five different participants in that preliminary study. Both the rare and common groups were found to produce a comparable number of solutions to the problem. Moreover, the common group produced more unique ideas than the rare group.

The present study investigates the influence of organization and the novelty of the stimulus material on divergent thinking performance. We hypothesize that (a) priming with rare stimulus material improves divergent thinking, and (b) priming with discrete stimulus material improves divergent thinking. In this respect, we anticipate that participants who were stimulated with rare ideas in discrete units would demonstrate greater divergent thinking than their counterparts.

Method

Participants

The participants were 129 undergraduate students of the Higher School of Economics (84 male and 45 female) aged between 17 and 20 (M=18.13, SD=.59).

Divergent thinking assessment

Divergent thinking was assessed using Guilford's Unusual Uses test adopted by Averina and Shcheblanova (1996) for Russian speakers. The standard verbal procedure involves generating as many uses as possible for a common object (in this case, a wooden ruler). It was scored for fluency (the total number of uses generated for the object), flexibility (the total number of categories from which the uses were drawn), and originality (the statistical rarity of the uses). The fluency score was obtained by counting the number of relevant responses. The flexibility score was obtained by counting the number of categories of relevant responses identified by Averina and Scheblanova. The originality score was obtained by comparing participant responses with a list of responses generated by 500 participants in Averina and Scheblanova's sample. This list consists of the response and its frequency. If the response was produces by more than 10% of participants, the originality score is 1; 6-10% scores 2; 3-6% scores 3; 1-3% scores 4; less than 1% scores 5. That is, the more original a response, the higher the score. The average originality score was calculated for each participant.

Procedure

The stimuli were selected from the list of original responses in Averina and Shcheblanova (1996). Fifteen applications of a wooden ruler which received a score of 5 (the most uncommon; e.g., to make a sole for an old shoe) were selected as rare stimuli; 15 applications of a wooden ruler which received a score of 1 (the most common; e.g. make a cross) were selected as common stimuli

(see Appendix). All the stimuli were printed on sheets of paper and presented to subjects as ideas produced by other participants of the experiment.

Participants were randomly divided in five groups. Two discrete stimulation groups received stimuli in three consequent sets (5 stimuli in each set). They had 20 seconds to familiarize themselves with each set. Then, they were given two minutes to produce their own ideas. The procedure was repeated for each set. The first set of stimuli was presented to participants at the very beginning of the experiment just before they started to produce their own uses for a wooden ruler. The discrete-rare stimulation group received rare stimuli, whereas discrete-common stimulation group received common stimuli. Two concurrent stimulation groups received all 15 stimuli at once. They had one minute to familiarize themselves with the stimuli. Then, they were given six minutes to produce their own ideas. Participants were allowed to use the stimuli presented to them in their own response. The concurrent-rare stimulation group received rare stimuli, whereas concurrent-common stimulation group received common stimuli. Control group received no stimulation. Participants were given six minutes to produce their own ideas.

The test was preceded by the instructions, which explicitly prompted participants from all groups to produce as many uncommon uses of the wooden ruler as they could. It also explicitly stated that these uses should have some practical value.

Results and Discussion

The means and standard deviations of the originality, flexibility, and fluency scores for each group (discrete-rare stimulation, concurrent-rare stimulation, discrete-common stimulation, concurrent-common stimulation, and control) are reported in Table 1.

Table 1

Means and standard deviations of fluency, flexibility, and originality scores for all five groups

Stimulus type	common		rare		control
Stimulation manner	concurrent	discrete	concurrent	discrete	
fluency	12.31 (3.04)	12.65 (4.04)	11.54 (2.83)	14.38 (4.12)	10.28 (3.90)
flexibility	10.00 (2.81)	10.31 (3.06)	9.50 (2.34)	11.19 (2.90)	8.48 (2.47)
originality	3.07 (.63)	2.72 (.70)	3.26 (.41)	3.33 (.36)	2.90 (.61)

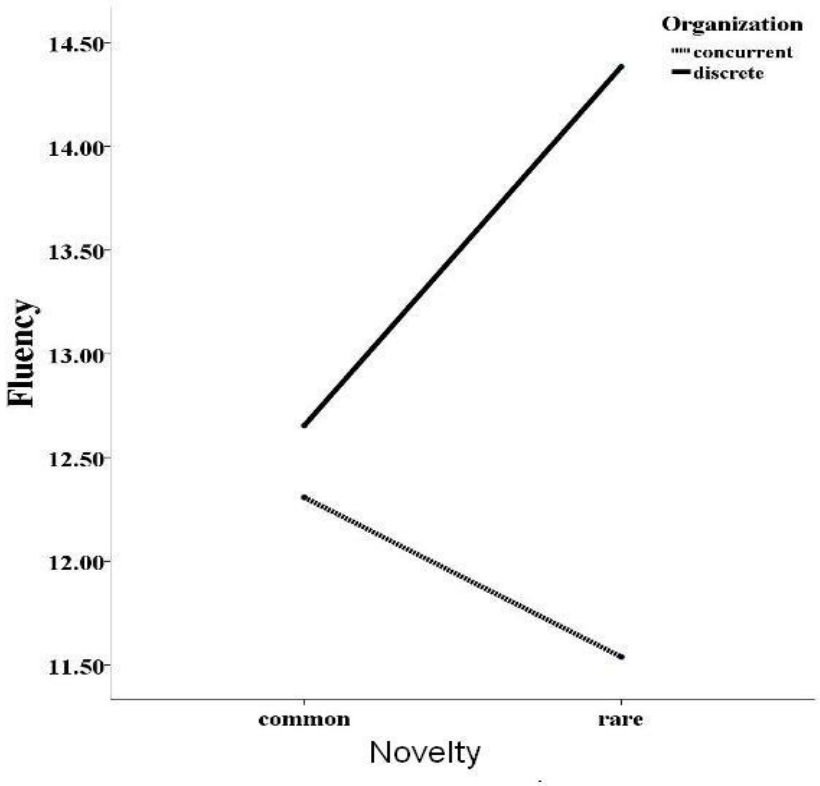
*Note. S*tandard deviations are in parentheses.

We performed a multivariate ANOVA with novelty (rare, common) and organization (discrete, concurrent) as independent factors, and creativity traits (fluency, flexibility, and originality) as dependent variables and found a significant main effect for novelty ($F(3, 98) = 4.61$; $p<.01$; $\eta^2=.12$) and marginally significant effects of organization ($F(3, 98) = 2.56$; $p=.06$; $\eta^2=.07$), and the interaction between novelty and organization ($F(3, 98) = 2.24$; $p=.09$; $\eta^2=.06$).

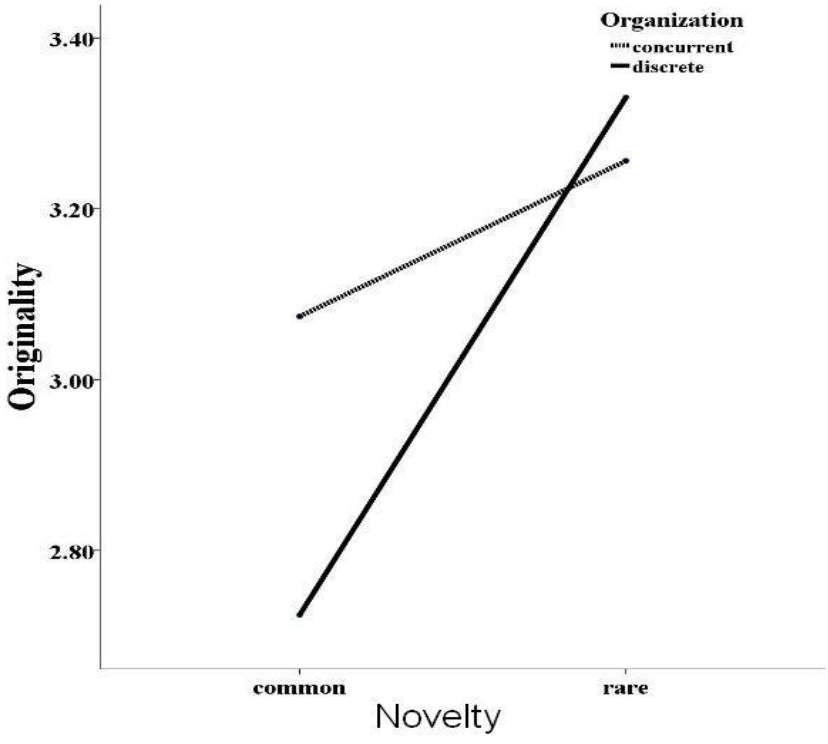
The subsequent univariate ANOVAs revealed that novelty had a significant effect on originality ($F(1, 100) = 13.58$; $p<.001$; $\eta^2=.12$). Participants primed with rare stimuli significantly outperformed their counterparts primed with common stimuli on the originality score ($\Delta M=.39$, $SE=.11$, $p<.01$). This finding confirmed our first hypothesis that priming with rare stimulus material improves divergent thinking. It is also consistent with a simple matching perspective (Dugosh & Paulus, 2005) arguing that exposure to rare stimulus material leads to the generation of rare ideas; and vice versa, exposure to common stimulus material leads to generation of common ideas.

We also found that organization had a significant effect on fluency ($F(1, 100) = 5.24$; $p<.05$; $\eta^2=.05$). Participants primed with the discrete stimulus set significantly outperformed their counterparts primed with the concurrent stimulus set on the fluency score ($\Delta M=1.60$, $SE=.72$, $p<.05$). This finding confirmed our second hypothesis that priming with discrete stimulus material improves divergent thinking. It also overlaps with the findings of Dennis et al. (1996) and Coskun et. al. (2000) discussed earlier. A possible explanation for an increase in fluency when stimulus material is presented in discrete sets is task alternation. This effect occurs when work on the target activity is distracted by an alternative activity. Dijksterhuis and Meurs (2006) demonstrated that a distraction can stimulate individual creativity. In the discrete condition, participants had to switch back and forth between the perception and production of alternative uses of a ruler, being periodically distracted from performing the target task. This task switching may stimulate an individual's production of new ideas.

Finally, we found a marginally significant interactive effect for novelty and organization on fluency ($F(1, 100) = 3.21$; $p=.08$; $\eta^2=.03$) and originality ($F(1, 100) = 3.93$; $p=.05$; $\eta^2=.04$). As Figure 1a illustrates, participants who received rare stimuli in discrete sets tended to obtain higher fluency scores than participants in other groups ($\Delta M=2.85$, $SE=.99$, $p<.01$, with concurrent-rare; $\Delta M=2.08$, $SE=.99$, $p<.05$, with concurrent-common and $\Delta M=1.73$, $SE=.99$, $p=.08$, with discrete-common). Similarly, as Figure 1b illustrates, participants who received rare stimuli in discrete sets tended to obtain higher originality scores than participants in other groups, although this difference reached significance only in comparison with those participants who received common stimuli in discrete sets ($\Delta M=.60$, $SE=.15$, $p<.001$).



1a



1b

Figure 1. The interactive effect of novelty and organization on (a) fluency and (b) originality, N=104.

These results confirm our hypotheses that novelty and organization of stimulus material improves divergent thinking. They are in line with the results of numerous studies revealing the positive influence of stimulus set decomposition on individual creativity (e.g. Coskun et al., 2000). The revealed positive effect of novel stimuli on originality supports the notion that the novelty of others' ideas could be a good example of overcoming barriers and stereotypes in thinking. Each of these effects can serve as a source for the stimulation of individual creativity. At the same time, the results reveal the complexity of the interaction of these factors, which may give a head start to future research in the area. This interaction may strengthen separate effects. The results of the study can be applied to methods and procedures for the stimulation of creativity.

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Appendix A

A list of rare and common stimuli (translated from Russian)

Rare	Common
Ice-cream stick	Cut out shapes
Make a hair rollers	Make a cheat sheet
Ice-hockey stick	Birdcage
Stand for items	Measure length or width
Spatula for applying paint or plaster	A catapult
Make a fan	Draw lines, shapes or select anything
Propeller for a toy airplane	Make a sword
Blinds	A bar to lock the door
A sole for an old shoe	Opener
An electrical insulator	Make a toy raft
Tennis racket	Make a cross
Make a ladle	Material to burn
Make a stretcher	Make a bird cage
Float for fishing rod	Make furniture
Make a water ski	Boomerang

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