

Selective Information Processing Advantages in Creative Cognition as a Function of Schizotypy

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Schizotypy has been consistently associated with an enhanced capacity for creative thinking, but the specificity of this cognitive advantage is, as yet, unclear. Different facets of creative cognition were assessed in the present study by contrasting groups based on the degree of extreme schizotypy personality scores. The high schizotypy group exhibited a selective advantage with better performance relative to a low schizotypy group in overcoming the constraining influence of examples when trying to generate original responses. The results are contrasted with previous findings on a related construct of psychoticism and are interpreted with reference to inhibitory control and other executive functions.

In an effort to characterize potential markers of enhanced creative abilities, numerous personality-based studies have identified the presence of certain psychopathological traits to be promising indicators. Schizotypy is currently one of the most widely investigated constructs in this regard. The term *schizotypy* was first proposed by Meehl (1962) to describe the phenotype of schizophrenia. Schizotypy is defined and recognized by non-dysfunctional personality characteristics that correspond to diminished levels of psychotic symptoms that are typically associated with schizophrenia. The Schizotypal Personality Questionnaire (SPQ; Raine, 1991) is among the most extensively used contemporary schizotypy scales. It was developed with reference to the nine

cognitive and behavioral indices of schizophrenia-prone personality disorder in the *Diagnostic and Statistic Manual of Mental Disorders* (DSM III-R; American Psychiatric Association, 1987) to provide an overall schizotypy index.

A number of studies have found a positive correlation between non-clinical schizotypal traits and tasks requiring creative or unconventional thinking (e.g., Folley & Park, 2005; Green & Williams, 1999; Mohr, Graves, Gianotti, Pizzagalli, & Brugger, 2001; Schuldberg, 2001). Green and Williams (1999), for instance, reported a positive correlation between the degree of schizotypy and the number of unique responses generated on the *instances* and *uses* divergent thinking measures according to Wallach and Kogan (1965). In another study, when judging the semantic distance between stimulus words, loosely associated words were judged to be more closely related by a high magical ideation schizotypy group (Mohr et al., 2001).

The rationale commonly employed to explain enhanced creative abilities in schizotypy is the propensity for poorer cognitive inhibitory control in high

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schizotypy subjects relative to low schizotypy subjects, a finding that has received some support using different methods (e.g., Beech & Claridge, 1987; Burch, Hemsley, & Joseph, 2004; Lubow & De la Casa, 2002). This reduced ability to adequately inhibit irrelevant information is held to result in the influx of more irrelevant or distantly associated concepts into the information processing stream and therefore, by extension, the heightened potential to form unusual or unique conceptual associations. In support for this idea, highly creative individuals have also been found to demonstrate decreased attentional control over different methods (Dykes & McGhie, 1976; Martindale, 1999; Mendelsohn & Griswold, 1964).

This idea parallels Eysenck's (1995) conception of "overinclusive thinking" as a marker of greater creative ability. Overinclusive thinking refers to the cognitive style that is characterized by a wider conception of relevance than usual, and this thinking style is held to characterize high psychoticism (Eysenck, 1992), a related personality construct to schizotypy that also stems from a normalcy-psychosis dimensional approach. Both constructs, however, try to account for different facets of mental illness. Whereas Eysenck's psychoticism dimension stems from an *Einheitspsychose* view that relates to psychosis in general, schizotypy relates specifically to schizophrenic function.

Just as in the case of schizotypy, there is also extensive support for enhanced creativity in relation to psychoticism (e.g., Abraham, Windmann, Daum, & Güntürkün, 2005; Eysenck, 1994; Merten, 1995; Woody & Claridge, 1977). What is a matter of considerable contention, however, is the extent and manner in which these two personality constructs are related to one another, given the commonly found relatively low correlation between them (e.g., Claridge, 1993; Kendler & Hewitt, 1992). How can the parallel findings between such theoretically similar yet experimentally weakly related constructs fit in the same framework? Perhaps part of the answer can be gleaned from a finer understanding of the kind of operations that are employed in different creativity tasks.

Guilford (1950, 1956, 1967) was among the earliest researchers who theorized about and experimentally investigated creativity. Creative or *divergent thinking* was assessed primarily by the level of fluency, flexibility, and novelty of generated ideas and secondarily by the elaboration and redefinition of ideas. Most studies on creative thinking and personality employ divergent thinking measures, the results of which are held to be insightful of creative potential in general. Creativity thus tends to be conceptualized as a fairly unitary construct. However, in the Geneplore model of creativity (Finke, Ward, & Smith, 1992; Smith, Ward, & Finke, 1995), many different cognitive processes are held to underlie

the ability to produce an original response, which means that it is possible to investigate several discrete mental operations that comprise different elements of creative cognition. The various processes underlying creative thinking are advocated as having two components in common, which were in some ways similar to those proposed by Guilford (1967). All involve the initial generation of potential ideas or *preinventive* structures, such as the transfer of information from one domain to another. This phase is followed by extensive exploration and interpretation of these ideas by, for instance, searching for the conceptual limitations of the elicited structures and the assessment of the structures from different perspectives.

Examining normative cognitive processes under various explicitly generative conditions is held to allow for a more thorough understanding of how creative thought can emerge in all its diversity. This approach is employed in the present study, where three experimental tasks are employed to tap conceptual expansion, the constraining effect of examples, and creative imagery in an effort to assess differing creative mental processes. These include conceptual expansion or the ability to broaden the boundaries of established concepts (Ward, 1994), creative imagery or the ability to create novel and usable combinations from a set of simple geometrical elements (Finke, 1990), and the ability to surpass the restrictive effect of pertinent examples in creative idea generation (Marsh, Landau, & Hicks, 1996; Smith, Ward, & Schumacher, 1993).

Differential performance of schizotypy groups across these tasks would enable the identification of the specificity of the associated advantages in creative thinking to this personality construct. In addition, in a previous study (Abraham et al., 2005) we investigated some of these creative cognition tasks in relation to psychoticism where we found that high levels of psychoticism were associated with better performance on the conceptual expansion task and the originality measure of the imagery task. It would, thus, also be possible to draw inferences about the extent of similarity in performance profile as a function of schizotypy in relation to that of psychoticism.

METHOD

Sample Description

The German version of the SPQ (Klein, Andresen, & Jahn, 1997) was completed by 160 psychology undergraduates. Forty of these whose SPQ total scores (range 0–67) were either in the top or bottom 10% of the distribution were invited to participate in the study. The first experimental session with the subjects involved solving

analytical problems (the results of which are reported in Karimi, Windmann, Gunturkun, & Abraham, 2007), prior to which they completed the short form of the German Eysenck Personality Questionnaire (EPQ-RK; Ruch, 1999). The participants were invited for another experimental session for the current study. The final sample included 31 individuals (17 women; M age = 24.19), of which 15 formed the low schizotypy (SPQ total score range: 0–8, M = 4.73; 8 women) and 16 formed the high schizotypy (SPQ total score range: 32–51, M = 40.13; 8 women). All participants received payment for their participation.

Materials and Procedure

Conceptual expansion. Conceptual expansion was assessed with the use of the Ward (1994) animal task. In this task, participants were required to imagine and draw animals that lived on another planet that was very different to those on Earth. The duration for the completion of the task was 5 min. Each drawing was subsequently scored in accordance with the procedures described previously (Abraham et al., 2005; Abraham, Windmann, Siefen, Daum, & Güntürkün, 2006; Ward, 1994) with the help of two independent scorers who had to note the presence or absence of the following features: bilateral symmetry of form, appendages (legs, arms, wings, tail), sense organs (eyes, mouth, nose, ears), atypical appendages, and atypical sense organs. The scoring was deemed valid when both scorers were in agreement. On the occasional situation when scorers were not in agreement (less than 2% of all observations), a third scorer was consulted and the majority result accepted.

These data were then further processed by the experimenter by extracting 5 elements from the coded data: (a) bilateral asymmetry, (b) lack of appendages, (c) lack of sense organs, (d) unusual appendages, and (e) unusual sense organs. In the case of elements (b) and (c), when one or more of the four customary appendages or sense organs were present in a drawing it would qualify as a presence of an appendage or sense organ. Only a complete absence of all customary appendages and sense organs would be scored as lack of appendages or a lack of sense organs. The presence or absence of an element gave rise to a score of 1 or 0. The total expansion score for a drawing thus ranged from 0–5.

Constraints of examples. In this task, subjects were asked to imagine that they were employed by a toy company that is in need of new ideas for toys. The subject's task was to imagine and draw a new and different toy of his or her own creative design within an allotted period of 5 min. Duplication of toys that currently exist or

previously existed was not allowed. Prior to the drawing of the toys, the subject is exposed to exemplars of three examples of toys (for stimuli, refer to Smith, Ward, & Schumacher, 1993) that have 3 fundamental elements in common: the (a) presence of a ball, (b) the presence of high physical activity, and (c) the presence of electronics. Two independent scorers were required to note whether the subjects' drawings contained any of these three elements. There was complete agreement between both scorers on all counts. The total score on this task ranged from 0 (none of the three common elements of the toy examples were present in the subject's drawing) to 3 (all three elements of the toy examples were present). The greater the constraining effect of the examples, the greater degree of similarity of the toy generated of the subject to that of the previously presented toy examples.

Creative imagery. In this task (Finke, 1990), the participant was asked to assemble an object that fell into a predetermined category using three figures, which pre-selected from an array of simple 3-dimensional figures that included a sphere, a half-sphere, a cube, a cone, a cylinder, wire, a tube, a flat square, a bracket, a rectangular block, a hook, wheels, a cross, a ring, and a handle (for stimuli, refer to Abraham et al., 2005; Abraham et al., 2006). Except for altering the form of the figures, the participants were allowed to vary the figures provided to them in any way with regard to size, orientation, position, texture, and so on. The participants were required to put the figures together in a meaningful way so as to form a useful object in the category provided. The five categories included furniture, tools and utensils, toys and games, transportation, and weapons. The inventions were rated by two trained scorers along two dimensions: Originality (how unusual and unique the invention is) and Practicality (how functionality and usable the invention is) using a five-point scale. The inter-rater correlations (intra-class correlation coefficient) on the creative imagery measures were significant for both the originality scale, ($r = .43$, $p < .0001$), and the practicality scale ($r = .49$, $p < .0001$). The average of their ratings was taken as the scores for the inventions and each participant consequently obtained an average score of practicality and originality from the five inventions they generated.

In all cases, the scorers were blind to the nature of the experiment and had no information about the participants.

RESULTS

Using a 2-tailed t -test, the high and low schizotypy groups were found to be significant different on the total

TABLE 1
Mean and Standard Deviation Values for the High and Low
Schizotypy Groups on the Dependent Variables

	Low Schizotypy		High Schizotypy	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
SPQ: Total score	4.733	2.344	40.125	6.163
Psychoticism scale: Total score	3.800	2.077	3.563	2.128
Extraversion scale: Total score	8.800	3.550	8.500	3.578
Neuroticism scale: Total score	5.867	3.652	4.813	3.016
Lie scale: Total score	2.333	1.799	2.625	1.025
Conceptual expansion: Total score	1.900	1.242	2.406	1.114
Constraint of examples: Total Score	1.333	0.724	0.750	0.577
Creative imagery: Mean originality	2.253	0.368	2.386	0.510
Creative imagery: Mean practicality	3.040	0.385	3.166	0.400

Note. SPQ = Schizotypal Personality Questionnaire (Raine, 1991).

SPQ score, $t(29) = -20.853$, $p < .0001$, which was to be expected, given that the subjects were recruited for the study on the basis of their extreme schizotypy scores. However, they did not differ significantly on any of the four EPQ dimensions, including psychoticism, $t(29) = 0.314$, $p = .756$, which suggests that schizotypy and psychoticism are not linearly related personality constructs. Table 1 includes the descriptive data on all the experimental variables for both the schizotypy groups. All analyses were two-sided, and nonparametric tests of significance (Mann-Whitney U test) were employed due to the non-continuous nature of the variables. Effect sizes were calculated using Cohen's d to gauge the size of a statistically significant difference. According to the generally adopted guidelines, 0.2 is indicative of a small effect size, 0.5 a medium effect size, and 0.8 a large effect size (Cohen, 1988).

Analyses on the conceptual expansion task revealed no significant difference between the schizotypy groups on the mean total expansion score, $U = 85.5$, $p = .168$. On the constraining examples task, the low schizotypy group generated toys that were significantly more similar to the examples that they were preexposed to, in comparison to the high schizotypy group, $U = 69.5$, $p = .022$ ($d = .89$), indicating lower creative ability on this variable. With regard to the creative imagery task, there were no significant differences between the performances of the high and low schizotypy groups on either the mean originality score, $U = 94$, $p = .301$, or the mean practicality score, $U = 113$, $p = .781$.

To find out whether performance on the different creative cognition variables were interrelated, correlations between mean conceptual expansion score, total constraining examples score, mean originality-imagery score and mean practicality imagery score were carried out using Spearman's rho. A significant positive correlation was found between the mean conceptual expansion score and the mean originality-imagery score,

$r = .383$, $p = .033$, and a significant negative correlation emerged between the mean originality-imagery score and the mean-practicality imagery score, $r = -.461$, $p = .009$. No significant correlations were found in relation to the total degree of similarity to examples measure of the constraints of examples task.

DISCUSSION

The results indicate that significant differences in performance as a function of the degree of schizotypy were found on the constraints of examples task, but not on the conceptual expansion task or the creative imagery task. This implies that the high schizotypy group was more immune to the restraining effect of examples relative to the low schizotypy group but showed no advantages on other tested facets of creative cognition such as the ability to go beyond the framework of established conceptual structures or the ability to imagine and create novel and usable combinations from a set of simple geometrical elements.

These results are noteworthy, particularly with reference to a previous study on creative cognition as a function of psychoticism (Abraham et al., 2005), where high psychoticism was associated with better performance on the conceptual expansion task and the originality measure of the creative imagery task. This divergent pattern of results of the personality construct of schizotypy from that of psychoticism across different creative cognition operations may be vital to understanding why these very weakly empirically correlated personality-constructs are both associated with general advantages on creative performance. By exploring the underlying differences between the different tasks, it may be possible to determine the nature of these cognitive processing advantages more clearly. As psychoticism was conceived of as tapping traits of psychoses in general (Eysenck, 1992), which includes both schizophrenic and affective psychoses, although schizotypy is related principally to the former, perhaps the additional affective component is what contributes to the differences between the findings related to each construct.

The conceptual expansion task and the constraints of examples task are similar in that both assess the degree to which people are constrained in their responses when explicitly instructed to create something novel. However, what is essentially different in these tasks is the kind of contextual processing that occurs. By providing examples of novel toys with similar fundamental elements prior to allowing the subject to generate a novel toy, the constraints in the examples task are actively salient and interfere with the ability to generate a new toy, as it is difficult to overcome or inhibit explicitly pertinent information that is directly relevant to the task

at hand. The kind of active inhibition of concrete and relevant information that results in the constraints of examples task gives rise to quite different contextual processing demands compared to that which is necessitated in the conceptual expansion task.

In the case of the conceptual expansion task, the contextual constraints are imposed by the extent to which one's existing knowledge in the form of stored conceptual structures of an "animal" concept influence the capacity to generate a novel kind of animal. So the kind of activation that is implicated here involves the retrieval of long-term memory structures. Although the appropriate stored schemas regulate and delimit the extent to which one can expand concepts, the contextual effects do not actively impinge on one's ability to do so when compared to the processing involved in the constraints of examples task.

The significant positive correlation between performance on the conceptual expansion task, as well as the originality dimension on the creative imagery task, has been reported before (Abraham et al., 2005) and is indicative of the underlying similarity between the cognitive operations that are employed when performing these tasks. In the case of the creative imagery task, the contextual processing is directed by the predetermined categories that limit the nature of the conceptual structures that are activated. Yet, just as in the conceptual expansion task, there is no active intrusion of interfering and relevant representations. Instead, the retrieval processes are targeted at stored semantic structures that are, perhaps, even more widely-defined in the creative imagery task (e.g., concept of *furniture*) relative to the conceptual expansion task (concept of *animal*).

Subtle variations with regard to the form of context then appear to have a significant bearing on whether the high schizotypy group would show an advantage or not. The selective advantage of the high schizotypy group on the constraints of examples task, but not the conceptual expansion or creative imagery tasks, can perhaps be interpreted in light of findings in the neuropsychological literature that suggest not only inadequate cognitive and motor inhibition in association with schizotypy (e.g., Burch, Hemsley, & Joseph, 2004; Holahan & O'Driscoll, 2005; Lubow & De la Casa, 2002; O'Driscoll, Lenzenweger, & Holzman, 1998) but also inadequacies on facets of executive function such as working memory (e.g., Lenzenweger & Gold, 2000; Park & McTigue, 1997) and set-shifting (Gooding, Kwapil, & Tallent, 1999; Lenzenweger & Korfine, 1994).

The constraints of examples task can be likened to the functional opposite of a working memory task where task relevant information needs to be actively maintained in order to reach a goal successfully. The information provided in the constraints of examples task, although relevant to the task, interferes with, rather

than aids, goal-directed thinking. The reduced capacity for high schizotypal individuals to inhibit irrelevant stimuli and/or maintain set would be advantageous on the constraints of examples task as the access to irrelevant stimuli during information processing would diminish the influence of the active context posed by the constraining effect of the examples.

These findings from the present study are novel in that they provide a more precise indication of the nature of the cognitive advantages in creative thinking that are associated with a high degree of schizotypal traits. The results also provide an innovative direction for investigation of this personality construct by having uncovered the specificity of a particular cognitive bias associated with schizotypy, which in turn may have a significant bearing on other facets of information processing. Future research on this issue could be targeted at understanding creative cognitive function not only with reference to individuals with extreme schizotypal personality scores, which is an approach that has also been employed by others (Park & McTigue, 1997; Park & Schoppe, 1997), but additionally with regard to schizotypy as a continuous variable. This would enable a more intricate understanding of the relationship between schizotypy and different facets of creative cognition.

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