

Running head: CREATIVE COGNITION AND SCHIZOTYPY

The Contributions of Creative Cognition and Schizotypal Symptoms to  
Creative Achievement

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Thesis

Submitted to the Department of Psychology

in partial fulfillment of the requirements

for the Master of Arts degree

Lakehead University

2004

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*Your file* *Votre référence*

*ISBN: 0-494-00480-0*

*Our file* *Notre référence*

*ISBN: 0-494-00480-0*

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Abstract

While previous research suggests people with sub-clinical levels of schizophrenic symptoms achieve a greater number of creative accomplishments, the cognitive reasons for higher proportions of creativity in this population are poorly understood. The contention that there is a creative cognitive advantage in schizotypy has received mixed support. It was hypothesized that accounting for complex relationships between (1) creative cognition abilities (moderated relationships), and (2) creative cognition and schizotypy variables (mediated, moderated, and curvilinear relationships) would significantly increase the ability to predict creative accomplishment and provide a more accurate survey of the schizotypic creative cognitive advantage. One hundred and fourteen participants completed a creative problem solving measure, measures of cognitive creative abilities (Remote Associates Test, a divergent thinking task, and a deductive reasoning task) and measures of positive and negative symptoms of schizotypy (Perceptual Aberration, Magical Ideation, Social Anhedonia and Physical Anhedonia). Regression analyses supported the conception of a multi-stage process in which creative cognition variables interact with each other to predict creative accomplishment. There was no evidence of a creative cognitive advantage in schizotypy: people high in schizotypy performing the same or worse than people reporting few schizotypic symptoms on measures of creative cognition and accomplishment. As no mediator or moderator effects were observed, the independence of cognitive creativity and schizotypy suggests that if schizotypics are indeed more creative than normal controls it is because of factors other than the cognitive ones surveyed in this investigation.

### Acknowledgements

I would like to thank my advisors on this project: Dr. Jamieson for keeping me on track, on time, and taking a chance on a rather confused young graduate student; and Dr. O'Connor for his assistance with various computer programs and valuable feedback at many different stages of the process. I would also like to thank Dr. Katz and Dr. Hayman for taking the time to provide guidance in the study of cognition. I thank Chris Mushquash for being so generous with his assistance at all stages of the thesis. And finally, I wish to thank two of the most important people in the process: Stephanie, for having the patience and fortitude to tolerate a creativity researcher and for valuable support and assistance throughout; and to Lauren whom, although only picking me up as a student partway through the process, has been one of the greatest teachers I have ever had.

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Observers throughout history have written about the link between mental illness and creativity, from Aristotle (as cited in Jamison, 1993) to Galton (1871) and it is still engaging researchers to this day. Modern investigations into this relationship suggest that people who have mild or sub-syndromal levels of mental illness are significantly more creative than people with severe mental illness or healthy controls (e.g. Jamison, 1993; Kinney et al., 2000-2001; Prentky, 2000-2001; Richards, Kinney, Benet, & Merzel, 1988b). Research into the schizophrenic spectrum in particular (Heston, 1966; Karlsson, 1970; Kauffman, Grunebaum, Cohler & Gamer, 1979; Kinney et al., 2000-2001; Richards, 1981) provides evidence for higher levels of creativity among healthier relatives of schizophrenics. Rado (1953) first recognized exceptionalities in the relatives of schizophrenics, which he described as schizotypy - a genetic predisposition to schizophrenia and associated sub-syndromal levels of schizophrenic symptoms. Researchers have subsequently expanded the purely genetic definition of schizotypy to include clinical signs and symptoms of schizotypal personality (the behavioural definition), and neurocognitive performance deficits (e.g. Nuechterlein et al., 2002).

Although studies are suggestive that schizotypics have a greater number of creative accomplishments (Heston, 1966, 1970; Juda, 1949-1950; Karlsson, 1984; Kinney et al., 2000-2001), the mechanism of heightened creativity levels in this population is poorly understood. Schizotypics perform inconsistently on differing psychometric tests of creativity purported to measure cognitive creative mechanisms (e.g. Cox & Leon, 1999; Schulberg, 1990, 2000-2001; Weinstein & Graves, 2001; Wuthrich & Bates, 2001). Recent theories of creativity question the validity of employing only one or two traditionally used tests as a creativity criterion, suggesting instead that multiple

cognitive abilities interact to influence the creative product (Runco, 1991, 1994; Mumford, Baughman & Sager, 2003; Ward, Smith, & Finke, 1999). It follows that investigating the interaction of multiple creative cognitive abilities and symptoms of schizotypy would provide a more accurate understanding of schizotypal creativity. This more accurate understanding might then inform investigations into compensatory mechanisms in mental illness (Richards, 2000-2001), and the actualization of creative potential for preventive gain and in strength-based psycho-social rehabilitation as a means to promote physical and psychological health (Bloom, 2001; Eisenman, 1991; Mraz & Runco, 1994; Runco & Richards, 1997).

### Schizotypy

Schizotypy was a concept formulated by Rado (1953), and later elaborated by Meehl (1962, 1990), to denote a genetically determined disposition to schizophrenia. This predisposition for schizophrenia was evident in traits such as: (a) anhedonia; (b) proprioceptive diathesis (i.e. aberrant perceptions, especially of one's body); (c) motivational deficit; and (d) the inability to organize goal-oriented activities (or 'cognitive slippage,' a mild form of thought disorder).

Subsequently researchers have expanded the purely genetic definition to include behavioural signs and symptoms of schizotypal personality. Research documenting the behavioural characteristics of the relatives of schizophrenic patients (e.g. Nuechterlein et al., 2002) and people reporting sub-clinical psychotic experiences with no family history of schizophrenia (e.g. Kendlar, 1985) were responsible for the operative description of schizotypal personality disorder that appeared in the DSM-IV. This medical formulation included ideas of reference, odd beliefs, unusual perceptual experiences, odd thinking and

speech, suspiciousness, inappropriate or constricted affect, odd behaviour, lack of close friends, and social anxiety (American Psychiatric Association, 1994).

The dimensional or psychological perspective (as opposed to the categorical/medical perspective) describes schizotypy on a continuum with normal functioning, and that psychosis represents extremes of normal variation in the healthy personality (Meehl, 1962; Eysenck & Eysenck, 1975; Claridge, 1985; Prentky, 2000-2001). There is mounting evidence for a dimensional perspective from various research arenas documenting behavioural (symptom), and brain structural/functional similarities between schizotypy and schizophrenia (e.g. Arndt, Alliger & Andreasen, 1991; Green, Nuechterlein & Breitmeyer, 1997; Kendler, McGuire, Gruenberg, & Walsh, 1995), which is discussed subsequently.

Behavioural or symptom research suggests that like schizophrenia, schizotypy is not a unitary entity, but a multifaceted one. Factor analysis of behavioural symptoms of schizotypy, self-report and neuro-psychological measures consistently identify three general factors: positive symptoms (or distortion of reality), negative symptoms (anhedonia), and disorganization (Bentall, Claridge, & Slade, 1989; Claridge et al., 1996, Kendler & Hewitt, 1992; Kendler et al., 1995; Liddle & Morris, 1991; Nuechterlein et al., 2002). Thus, the factors of schizotypy are to some extent in parallel with the three recognized subgroups of schizophrenic symptoms (Arndt et al., 1991).

Significant deficits in performance in various neurocognitive measures have been recently reported for even the healthiest non-psychotic first-degree relatives of schizophrenics (Gooding, Kwapil, & Tallent, 1999; Green et al., 1997). In particular, strong relationships have been identified between symptoms of schizotypy and deficits in

pre-frontal executive functions (Seidman et al., 1995). This hypofrontality in schizotypics is evident in performance on tests of cognitive inhibition (sustained attention, priming tasks), and learning tasks (latent inhibition and inhibition of a cognitive set; i.e. perseveration) (Lencz, Raine, Benishay, Mills & Bird, 1995; Seidman et al., 1995). Similarities have also been shown at the psychophysiological level between schizophrenia and schizotypy, particularly in functional hemispheric asymmetry (Gruzelier, 2003).

Studies on behavioural and neurocognitive/neurophysiological correlates support conceptualizing schizotypy and schizotypal personality disorder as occurring at lower thresholds on a dimension of schizophrenic symptomology than schizophrenia itself (e.g. Kendler et al., 1995; Maier, Falkai & Wagner, 1999, Siever et al., 2002). Schizotypy can thus serve as a dispositional description to individuals who fall below the threshold of schizophrenia but continue to show the behavioural, neurocognitive, or neurophysiological abnormalities as described. Included are those who do and do not meet the criteria for schizotypal personality disorder; the difference being that while individuals without the personality disorder do share similar symptoms, these symptoms are not severe enough to lead to the “distress or impairment” necessary for a psychiatric diagnosis (American Psychiatric Association, 1994).

Recently researchers aligning themselves with the dimensional view of schizotypy have investigated correlates of the schizophrenic spectrum (e.g. Claridge & Beech, 1995; O’Flynn, Gruzelier, Bergman, & Siever, 2003) such as creativity (Cox & Leon, 1999; Schuldberg, 1990, 2000-2001; Tien, Costa & Eaton, 1992; Weinstein & Graves, 2001; Wuthrich & Bates, 2001). Conducting research along a spectrum of illness

is being recognized in both the areas of abnormal psychology and psychological medicine as a useful strategy to shed light on the schizophrenic process as it circumvents many methodological problems involved in studying patients (Gruzelier, 2003). Research on sub-syndromal mental disorders has drawn concern by some researchers when used to address conceptual questions that focus on factors associated with a disorder itself in samples that have few or no symptoms (that is, answering questions about schizophrenia from schizotypics), but is generally accepted when this research is used to address the experience and correlates of different degrees of symptomology (Ingram & Siegle, 2002).

#### Methods of Studying Creativity and Schizotypy and Associated Findings

Creativity is generally defined as an idea or product that is (1) novel; and (2) useful (Amabile, 1983). Like other high-order constructs such as intelligence or personality, there are many differing opinions on the composition of creativity and hence how to measure it. The popularity of studies examining eminent individuals who have produced works that most experts and laypeople broadly assess as creative may be attributed to the intuitive appeal of the criterion. Studying those few artists or scientists that most people agree are in the extremes of a construct alleviates the problem of having a clear operational definition. Following it was comparative studies examining mental illness in groups defined as creative or non-creative (e.g. Juda, 1949-1950; Andreasen & Canter, 1974) that drew the attention of modern researchers to schizotypal creatives. Creativity was judged on the basis of having accomplishments recognized as 'creative' by peers, experts in the field, or the author of the study. These early investigations paved the way for similar investigations into specifically the schizophrenic spectrum (Heston, 1966; Kauffman et al., 1979; Kinney et al., 2000-2001). Studies in which creative

accomplishments are assigned to either creative or non-creative groups have proved useful for informing broad questions between mental illness and creativity, but are limited in their ability to inform questions regarding the process or specific cognitive mechanisms of increased creativity.

Creative process research, as opposed to accomplishment (product) research, involves investigation into the behaviours and abilities that are associated with creativity (Rhodes, 1961/1987). The results of these process studies have been slow to influence the creative personality/cognitive ability research. Many of the later still employ only one traditionally used measure as a global creativity criterion. The obtained results are then interpreted as “creativity levels”. The results of such studies may then conflict with the results of other studies using other creativity measures to infer a “creativity level”. These conflicted findings may not reflect the limitations of a creative process approach, but rather early attempts devoid of the benefit of recent insights into normative information processing. The results from both creative accomplishment and creative process studies on the schizophrenic spectrum are reviewed below to provide a more detailed understanding of the discrepancies fueling the present investigation.

### Creative Accomplishments

The earliest convincing attempt to research schizophrenia and creativity using non-eminent samples might be attributed to Juda (1949-1959). Juda conducted a survey of 19,000 people over a 26-year period, and found artists displayed three times the population prevalence of schizophrenia. He reported prevalence rates of 5.3% in artists and 6.1% in scientists (two professions he considered creativity to be essential for) of psychotic symptoms, compared to 0.85% prevalence of schizophrenic symptoms in the

larger population. More recent evidence (e.g. Andreasen, 1987; Andreasen & Canter, 1974) has failed to replicate the finding of increased rates of schizophrenia in those with high levels of creative accomplishments. Kinney and colleagues (2000-2001) found no difference between healthy controls and those with diagnoses of schizophrenia or schizotypal personality disorder using researcher-rated 'everyday' creative accomplishments. However, they did find a significantly higher number of creative accomplishments among those with only one or two symptoms of schizophrenia. This is consistent with other research demonstrating an inverted U relationship between creativity and mental health (Jamison, 1993; Prentky, 2000-2001; Richards et al., 1988). Kinney and colleagues (2000-2001) suggested that this partial expression of schizophrenic symptoms were consistent with the clinical presentation of those who carried schizophrenic genes, and were likely relatives of people with fully expressed schizophrenia.

Some researchers have also reported greater amounts of creative accomplishment and giftedness among relatives of schizophrenics. Heston (1966, 1970) examined adoptees with and without a schizophrenic parent, observing that while 10% of adoptees did develop schizophrenia, the remainder were more gifted, creative, imaginative and musically gifted when compared with control adoptees. Kaufman and colleagues (1979) also examined a sample of the highest and lowest functioning children of psychotic mothers, and noted greater-than-expected levels of talent, giftedness, and creativity in the high functioning 'schizotypic' children. A study of 9,379 first-degree relatives of hospitalized psychiatric patients using membership on a "Who's who" list, book

authorship, and college graduation, concluded that relatives of psychotic patients benefit intellectually from possession of a schizophrenia gene (Karlsson, 1984).

One wonders why heightened creativity would be evident in only those with muted symptoms, and yet not evident in the full expression of these symptoms or those without symptoms. It has been suggested (Gruzelier, 2003; Kinney et al., 2000-2001), that there may be a compensatory advantage associated with the schizophrenic genotype that helps to maintain the putative gene or genes in the population, despite the low fertility of schizophrenics themselves (Kinney & Matthysse, 1978). Analogous is the heterozygote advantage, a resistance to malaria, conferred on carriers of the sickle-cell gene. Thus, heightened creativity may be explained in family members but not schizophrenics themselves by virtue of a 'heterozygote advantage' that increases cognitive functions that can include creativity, but when environmental and biological factors converge enabling the full expression of all schizophrenic genes, there is a detrimental effect on executive cognitive functioning.

Eminent creative product studies do somewhat avoid the pitfalls of not having a clear operational definition of schizotypy. However, one could argue that their high criteria sacrifice sensitivity for specificity and that this limits the inferences one can make about cognition and creativity as the subjects for such studies are from such a restricted population. Recent research is beginning to address this problem. In studies conducted on the link between mental illness and creativity, Richards, Kinney and colleagues (Kinney et al., 2000-2001; Richards et al., 1988b; Richards, Kinney, Benet & Merzel, 1988a; Schuldberg, 2000-2001) have increased sensitivity for creativity while still maintaining a creative accomplishment approach by studying 'everyday creativity'.

Everyday creativity comes from the belief that every person is seen as possessing 'creativity' to a greater or lesser degree, and it is manifested through a wide variety of outcomes that need not be constrained to specific fields of endeavour (Richards et al., 1988a). Beyond this, certain field-specific skills or special abilities – as, for instance, in art, music or mathematics (Barron & Harrington, 1981; Gardner, 1983; Romaniuk & Romaniuk, 1981) – or broader abilities, as involved in the construct of “general intelligence” (Barron, 1969; Richards 1976, 1981), may also play a role in creative outcomes. The results of studies on domain specificity in creativity testing suggest that although there does seem to be specific domain-related creativeness (Baer, 1996), creativity does have a general component to it. Thus creative accomplishment is generally seen as an interaction between domain specificity and generality (Diakidoy & Spanoudis, 2002). Further studies that have found similar personality traits among “creative people” also lend support to the idea of a general creativity factor (see Barron & Harrington, 1981; Eysenck, 1997; Feist, 1999). The Lifetime Creativity Scale (LCS; Richards et al., 1988) assesses creative accomplishment while increasing sensitivity by rating on a five-point Likert scale the degree to which something is creative (verses the yes/no stance of other studies), and assesses creativity in both vocational and avocational domains.

Although the LCS does attempt to control for biases in self-appraisal by attempting to conceal the purpose of the interview and providing trained interviewers with scoring anchors, studies of this kind that ask participants to report on their own creative accomplishments can be prone to biased self reporting. Discrepancies have been found between self-report and observer rated data in the schizophrenic spectrum for

quality of life reports (Khatri, Romney, & Pelletier, 2001) and negative symptoms (Selten, Wiersma, & van den Bosch, 2000), and it is therefore feasible that skewed self-reporting may influence the outcome of studies using self-report creativity data.

This review of the creative accomplishment literature suggests significantly higher levels of creativity for those in the middle of the schizotypic spectrum (referred to as schizotypics), when compared to those on either end of the spectrum. Due to construct definition problems, lack of generalizability or sensitivity, and self-reporting biases, these studies are limited in their ability to inform questions regarding the process or mechanism of heightened creativity in schizotypy. Research into the cognitive creative process, or creative ability, seeks to address these problems.

### Creative Ability

Those studying creative cognition believe that the hallmark of normative human cognition is its generative capacity to move beyond discrete stored experiences, and that creative accomplishments, from the most mundane to the most extraordinary, are based on those ordinary mental processes that are open to empirical investigation (Ward, Smith, & Finke, 1999). The expression of the normative process of creativity can be conceived to be the same as everyday creativity: an interaction between specific and general domain abilities that is adaptive and can be evident in multiple areas of endeavour.

Creative cognition researchers believe that the process of producing creative accomplishments can be reduced into detectable constituent components. Researchers often investigate this process by using judge rated performance on a creative problem solving test as a dependent measure since success in problem solving is relatively easy to operationalize (Runco & Sakamoto, 1999). Creative problem solving, problem solving in

which the product is novel and useful, is most likely when the task is open ended and allows for originality. Mumford, Baughman and Sager (2003) argue the validity of creative problem solving literature by saying that all forms of creativity involve problem solving. They suggest if one accepts the proposition that creative thought involves not only the generation of alternative solutions but also the identification of viable, new, alternative solutions, then one must also grant the proposition that creative thought represents a form of creative problem solving.

The contention that creative accomplishments result from detectable mental processes has lead researchers to develop many different kinds of psychometric tests in an attempt to measure this normally distributed ability. Three popular types of tests of the components of creative cognition - divergent thinking, information exposure, and convergent thinking - all reflect the authors' own definitions of creativity.

Divergent Thinking and Ideation Fluency. Much of the research in creative processes has focused on how ideas are generated; so much so that Runco (1993, May) identified divergent thinking as the most influential theory in the creativity literature. Based on factor analytic studies, Guilford (1956, 1959) presented a model of intellectual processes that distinguished between convergent and divergent thinking, arguing that divergent thinking was critical to creativity. Convergent thinking is a process that results in the identification of one correct solution through deductive reasoning. Divergent thinking, alternatively, refers to the capacity to generate multiple alternative solutions to a novel, open-ended problem. This emphasis of fluency of ideas is seen as a key component of creative processes (Plucker & Renzulli, 1999).

Among the first tests of divergent thinking were Guilford's Structure of Intellect (SOI) divergent production (Guilford, 1967) and Alternate Uses (Guilford, Christensen, Merrifield, & Wilson, 1978) tests, Torrance's (1962, 1974) Tests of Creative Thinking (TTCT), and those by Wallach and Kogan (1965) and Getzels and Jackson (1962).

Divergent thinking has been argued to be a useful estimate of the potential for creative thinking because predictive validities are similar to those obtained by creative achievement (Runco, 1991; Runco & Albert, 1985) and other kinds of creativity assessments (Milgram, 1990; Mraz & Runco, 1994; Torrance, 1968).

Turning to the relationship between ideation fluency and schizotypy, the existing literature suggests a positive relationship between positive schizotypic traits, such as aberrant perceptions or beliefs and impulsive non-conformity. Chadwick (1997) observed a strong correlation between the Alternate Uses test of creativity and scores on Claridge's STA scale (measuring positive schizotypal personality disorder traits, Claridge & Broks, 1984), while Fisher and colleagues (2004) reported positive schizotypal traits significantly predicting scores on a figural fluency task ( $N = 36$ ). Wuthrich & Bates (2001) reported non-significant moderate correlations between verbal and figural forms of divergent thinking (TTCT) and the Schizotypal Personality Questionnaire (SPQ; Raine, 1991),  $r(52) = .19$  and  $.28$  respectively, and Weinstein and Graves (2001) obtained a significant correlation between verbal fluency and positive schizotypal symptoms,  $r(58) = .22$ . Another study (O'Reilly, Dunbar & Bentall, 2001) also reported a relationship between the verbal fluency score on the TTCT and the positive schizotypal dimensions of unusual experiences and impulsive nonconformity,  $r(98) = .20$  and  $.18$  respectively. A positive relationship between psychoticism (a purported dispositional

trait that indicates a susceptibility to the development of psychotic symptoms, see Eysenck & Eysenck, 1975) and divergent thinking that has also been demonstrated (see Eysenck, 1993, 1994b, and 1997 for a review). However, using psychoticism as a measure of schizotypy has been criticized for focusing largely upon the social non-conformity components of schizotypy (Claridge et al., 1996) and criminality (Chapman, Chapman, & Kwapil, 1995).

Research is also conflicted in the way negative schizotypal symptoms are related to ideation fluency. Cox and Leon (1999) found a positive relationship between social anhedonia and divergent thinking as measured by the Alternate Uses test,  $r(114) = .24$ , while Schuldberg (1990) found a negative relationship with physical anhedonia and the Alternate Uses,  $r(623) = -.17$ . Schuldberg's (1990) finding is consistent with fluency research on schizophrenia that suggests negative schizophrenic symptoms impair fluency for both letter and category tests (Maron, Carlson, Minassian, & Perry, 2004). Meta-analysis of studies on letter and category fluency indicates a fluency impairment in schizophrenia (Bokat & Goldberg, 2003), which suggests ideation fluency may share the same inverted-U relationship with positive schizophrenic symptomology as creative accomplishment. This would help to explain Schuldberg and colleagues' (1990; Schuldberg, French, Stone & Herberle, 1988) finding that ideational fluency scores of controls were no different than those scoring above the 95<sup>th</sup> percentile on measures of schizotypy, as using high schizotypy cut-off scores may not capture the part of the spectrum that is associated with high fluency scores.

While most research has been conducted using a fluency scoring system (the total number of appropriate answers) to assess divergent thinking, researchers note that scoring

for originality (uncommon answers) and flexibility (the number of different categories of responses used) increases validity of divergent thinking tests as a measure of creative ability (Hocevar & Michael, 1979; Runco & Mraz, 1992; Runco, Okuda & Thurston, 1987). Hence, the terms fluency, referring to an ability to generate multiple responses (in this case, ideas) to a given prompt, and divergent thinking, referring to the results of divergent thinking tests with validated scoring procedures, should be used conscientiously. Some research on schizotypy has used these more complex scoring systems. O'Reilly and colleagues (2001) reported a relationship between unusual experiences and verbal and figural originality,  $r(98) = .28$  and  $.26$ , correlations higher than those reported for fluency. Green and Williams (1999) reported a similar strength correlation between positive symptoms and originality,  $r(70) = .27$ , while fluency was non-significant. High originality scores and unremarkable fluency scores have also been observed for other verbal fluency tests with schizotypics, such as letter and semantic fluency (e.g. Duchene, Graves, & Brugger, 1998). High originality scores in schizotypics have been attributed by the authors of such studies to be the effect of cognitive disinhibition (e.g. Duchene et al., 1998; Green & Williams, 1999), that is conceptually different than the fluency of ideas. Cognitive inhibition refers to the process of inhibiting irrelevant stimuli that is a concomitant of selective attention (Neill & Westberry, 1987). Research on originality therefore suggests the importance of attention deployment.

Attention Deployment. Several different researchers have proposed different ways in which attention influences exposure to information specific to the creative process. One of the first researchers to examine this was Kris (1952), who proposed that creative individuals are better able to alternate between primary process and secondary process

modes of thought than are uncreative people. Primary process thought (found in states like dreaming, reverie, hypnosis and psychosis) is free-associative, analogical, and characterized by concrete images rather than abstract concepts. Secondary process cognition is abstract, logical, reality-orientated thought. Because primary process cognition is associative, it facilitates the discovery of new combinations of mental elements. Kris hypothesized that creative elaboration involves a return to the secondary process state, so that the creative person is able to alternate between the two. For a review of the literature between creativity and primary process thinking, see Suler (1980).

Having loose conceptual boundaries, so that one has access to more information and therefore potential solutions, has also been hypothesized as a contributor to heightened creativity. According to Mednick (1962), the differences in accessibility to varied mental concepts in creative and noncreative individuals are due to differences in 'associative hierarchies' (i.e. the probability of associating two concepts). People with weaker connections between close concepts and stronger connections between more remote concepts are able to make remote or creative associations more easily. Based on this theory, Mednick developed the Remote Associates Test (Mednick & Mednick, 1967). The Remote Associations Test has been found to correlate significantly with independent estimates of the subjects' creativity (Eysenk, 1994b), and research has shown that creative individuals make broader and more unusual categorizations than less creative individuals (Dykes & McGhie, 1976; Pettigrew, 1982).

In addition to loose conceptual boundaries, it has been proposed that creative individuals have a greater attentional capacity and are more prone to states of defocused attention than noncreative individuals (Mendelsohn, 1976; Wallach, 1970). Defocused

attention is the ability to combine many different elements in the focus of attention at the same time, thus increasing the chance one becomes aware of a creative idea (both in the reception and retrieval of information). Several studies have shown that the attention of less creative individuals is more narrowly focused than that of creative individuals (Dewing & Battye, 1971; Dykes & McGhie, 1976; Martindale & Greenough, 1973; Mendelsohn & Griswold, 1966; Smith, Michael, & Hovecar, 1990).

Martindale (1981; 1999) has suggested that these three ideas, defocused attention, primary process thinking, and remote associations, are essentially expressing the same concepts in different language. Defocused attention is a trait of primary process thinking, which facilitates making remote associations. Martindale (1981) hypothesizes that it is the resulting exposure to diverse information that fosters creativity. Research does indicate that presenting diverse stimuli and instructing participants to observe those stimuli can increase performance on measures of creativity (Clapham, 2000-2001; Feldhusen, Hobson, & Treffinger, 1975; Friedman, Raymond, & Feldhusen, 1978, Ward, 1969), providing empirical support for Martindale's theory of attention deployment.

Referring back to schizotypy, researchers as early as Bleuler (1911/1950) spoke of a 'loosening of associations' in schizophrenic speech and cognition. Cameron (1947) believed that schizophrenic's concepts are overgeneralized: schizophrenics are unable to maintain the normal conceptual boundaries, and incorporate into their concepts elements, some of them personal, which are merely associated with the concept, but are not an essential part of it. In a review of this schizophrenic 'overgeneralization' phenomena, Payne, Matusek and George (1959) suggested it was an inability to focus out extraneous stimuli (or to 'focus' on a specific problem) that prompted overgeneralization. This fits

with the current conception of schizophrenia which many authors characterize as an attention dysfunction, with factor analysis of schizophrenic symptoms purporting a similar view (Peralta & Cuesta, 2001; Wuthrich & Bates, 2001). In particular, deficits in latent inhibition, which have been demonstrated in schizophrenia (Baruch, Hemsley & Gray, 1988; Gray, Hemsley & Gray, 1992), and schizotypy (Lubow, Ingengberg-Sachs, Zalstein-Orda, & Gewirtz, 1992; Alan et al., 1995; Williams et al., 1998) have been argued to account for higher levels of creativity in the schizophrenic spectrum (Eysenck, 2003; Green & Williams, 1999; Prentky, 2000-2001; Wuthrich & Bates, 2001). Latent inhibition is an inhibitory function reflected in the reduced ability of a pre-exposed stimulus to subsequently enter into associations that would otherwise have been readily accessible (Wuthrich & Bates, 2001). Latent inhibition that is normally adaptive for reducing working memory load (Lubow & Gewirtz, 1995) can thus inhibit associations by restricting attentional focus (Martindale, 1981) and the spreading of semantic networks (Spitzer, 1997). Hence, deficits in latent inhibition are adaptive to this part of creative problem solving.

Research on creativity levels and schizotypy at this stage of processing is limited. Weinstein and Graves (2001) reported moderate positive correlations between the Magic Ideation Scale (a measure of schizotypy) and the remote associations test,  $r(58) = .3$ , which is consistent with Cameron's (1938) observations of over-inclusion by schizophrenics on sentence completion tests. Eysenck (1994) also reported moderate relationships between psychoticism and a word association task scored on infrequency of responses (or originality),  $r(98) = .27$ . Theoretical support for defocused attention contributing to creativity comes from Mohr and colleagues' (2001) demonstration of a

greater appreciation for further semantic associations for people high in magical ideation, and from studies showing above average originality scores on divergent thinking tests (Duchene et al., 1998; Green & Williams, 1999; O’Riely et al., 2001). Schuldberg (1990) however, found no relationship between measures of positive symptoms of schizotypy and Remote Associations Tests (RAT), whereas measures of negative symptoms showed a positive, but non-significant relationship to scores on the RAT. Results of studies may be confounded by not distinguishing between positive and negative symptoms of schizotypy, and the possibility of a non-linear interaction between latent inhibition and schizotypy as has been suggested by multiple authors (James & Asmus, 2000-2001; Prentky, 2000-2001; Wuthrich & Bates, 2001).

The use of divergent thinking (DT) tests (scored for originality) as a broad measure of the type of attention deployment related to the creative process warrants further discussion. The RAT has been used in the past as a way to measure the appreciation of semantic distances, which have implications for exposure to diverse information as a result of attention deployment. Theoretically, one can see DT Originality scores as the result of an ability to use this diffused attention to produce unusual or infrequent ideas. However, it does not seem that DT Originality would be a pure measure of an ability to utilize inhibition deficits/diffused attention. The originality of ideas is first dependent on the generation of ideas and it is feasible that the larger number of ideas one produces, the greater the chance one of those ideas will be considered original. Further investigations are needed to examine the validity of using either test to measure this stage of creative information processing.

As mentioned before, various authors have noted that the creative process field has tended to focus on the crucial issue of how new ideas are generated, yet creative achievement depends more on the generation of a single high-quality alternative than on the number of alternatives (Baer, 2003; Mumford, Bughman & Sager, 2003; Runco, 1993 May). Runco (1991) echoed the view of a number of different researchers (see Runco, 2004) by expressing that the evaluative component of the creative process has received very little attention.

Convergent Thinking and Evaluative Processes. Researchers are beginning to step away from the traditional view of divergent thinking as the primary mechanism of creativity and now hypothesize how both divergent and convergent thinking interact in creative problem solving (Baer, 2003; Runco, 1993 May). Guilford (1956, 1959) defined convergent thinking as a process that results in the identification of one correct solution through deductive reasoning. Baer (2003) states that evaluative, critical and convergent thinking all refer to the same process by which solutions are selected based upon their merit. Although researchers generally agree that convergent thinking is essential to the creative process (Okuda, Runco, & Berger, 1991; Runco, 1991; Runco & Chand, 1994), there is debate about the constituent processes of 'creative' evaluative thinking (Halpern, 2003; see Runco, 2003b) and thus how to investigate this ability. Sand (2003) used Guilford's Structure of Intellect (SOI) test to achieve a score for convergent thinking, but the validity and reliability of this measure has often been criticized (e.g. Clarizio & Mehrens, 1985; Cooper, 1991). Some researchers have also used domain knowledge tests (Diakiday & Spanoudis, 2002) as a measure of convergent thought, but this suffers from obvious validity concerns, such as the difference between analytic ability and

crystallized knowledge. Baer (2003) separates convergent thinking from intelligence, saying that convergent thinking has been closely associated with the kind of “right answer” thinking that leads to high scores on IQ tests, which is not the same as the thinking needed to guide and constrain divergent thinking or to judge among its products. Other researchers have used tests more consistent with Guilford’s (1956, 1959) original conception, such as the Employee Aptitudes Survey (Vincent, Decker, & Mumford, 2002) and deductive reasoning problems.

There is little research on the relationship between schizotypy and the type of convergent thinking valuable for creativity. Factor analysis of schizotypic symptoms reveals ‘cognitive disorganization’ to be a major part of the disorder (Claridge et al., 1996), and while deficits in cognitive inhibition make unusual associations more likely and increase the originality of ideas, it would almost certainly hinder the evaluation of ideas. Such controlled-processing tasks require attentive, effortful, and capacity-limited processing which is especially problematic for schizophrenic patients (Serper & Harvey, 1994). Although the creativity related convergent thinking research in schizotypy is sparse, research does exist on related executive (or ‘higher-order’) cognitive functioning. Reviewing the literature on cognition and schizophrenia, Barch (2003) states that the executive control deficits associated with schizophrenia influence many cognitive domains including working memory, inhibition, selective attention, and episodic memory, all of which may then contribute to disturbances in higher cognitive processes such as problem solving, reasoning, and language production. The brain’s prefrontal cortex (PFC) is critical to the aforementioned executive cognitive functioning (Miller & Cohen, 2001), and is thought to be heavily involved in neuropsychological tests that

schizophrenics (see Crider, 1997 for a review), and schizotypics (Farmer et al., 2000; Gooding, Kwapil & Tallent, 1999; Park, Holzman, & Goldman-Rakic, 1995) do poorly on. Waltz and colleagues (1999) present evidence suggesting hypoactivation of the PFC is associated with deficits in relational reasoning (including deductive and inductive reasoning). Thus, available literature suggests schizotypics may score below healthy controls on tests of convergent thinking.

#### Discrepancies in the Literature

From a survey on creative accomplishments, cognition, and schizotypy, one can see that there is obvious discrepancy. While most research documents increased creative accomplishments for people with low to moderate levels of schizophrenic symptomology, research into creative cognitive abilities are mixed. One naturally expects that one must have the cognitive capacity to be creative before one acts in a creative way, making this discrepancy between ability and achievement puzzling. While it has been suggested that creative achievement is the result many different and independent sub-processes (e.g. Albert & Runco, 1989; Mumford et al., 1991), many creativity researchers continue to generalize performance on only one measure of cognitive creative potential as a participants' entire creative capacity. Furthermore, if the success of an individual's efforts in the later phases of a creative problem solving process depends upon the quality of the material provided by prior processing operations, a comprehensive and interactional view of creativity assessment is crucial for returning consistent and valid results on the link between mental illness and creativity. Existing literature that purports mixed performance of schizotypics on psychometric tests of

creativity despite their significantly greater number of creative accomplishments might be the result of insufficient assessment of the complex cognitive creative process.

Other researchers have focused not on the relationship between sub-skills of creativity, but the relationship between personality or psychopathology and creative cognition. If cognitive creative skills vary in the nature of their relationship to schizotypy, research examining samples containing differing levels of symptom severity would also produce inconsistency. Thus, two areas of research may account for the existing heterogeneous findings in creativity and schizotypy: interactions between cognitive creative abilities themselves, and interactions between these abilities and personality. Both of these possibilities will be explored.

#### Information Processing Models of Creative Problem Solving

Creativity and its component skills vary widely not only between individuals, but also within individuals (Baer, 2003). These different creativity skills are independent of each other, following their own developmental trajectories (Baer, 2003). Differing creativity skills also have differing relationships to other variables such as intelligence or memory, which further emphasize the independence of such variables. Mednick and Andrews (1967) reported correlations between .20 to .55 between the RAT and intelligence, whereas Torrance (1975) surveyed 178 correlations from many different studies and found a range of correlations between .06 and .21. Thus, arguments suggesting mixed research findings are due to the unmeasured moderating effect of intelligence no longer have strong support. In the Annual Review of Psychology, Runco (2004) reported the concern that creativity was simply an expression of general intelligence raised in the last general review of creativity (Barron & Harrington, 1981),

was no longer prevalent. Consistent with the conception of multiple independent creative cognitive abilities, Runco and Albert (1987) suggest the relationship between creativity and intelligence is a function of the particular measure employed and the heterogeneity of subjects in the sample.

Researchers have suggested an information-processing model to explain how we can solve problems that require novel solutions. Mumford and colleagues (1991) have proposed a model whereby people generate novel information by combining and reorganizing their existing knowledge structures to come up with a new knowledge structure from which they generate creative solutions (illustrated in Appendix A).

There has been little research linking information-processing theories of creativity and popular creativity tests in use today. Since most popular psychometric tests of creativity were written between 1950 and 1980, and this model was proposed in the early 1990s, there is uncertainty on how these tests of creativity fit into the current information-processing model. It is important to consider the three areas of creative cognition research and theory: ideation fluency, attention deployment, and evaluative thinking with the current model and how they affect creative accomplishment.

According to Mumford and colleagues (1991), after people define or construct the nature of the problem at hand they then identify multiple categories, or schema, which might be used to account for the available information bearing on the nature of the problem. The number and variety of categories that can be identified as relevant to the problem influence the originality and utility of the final solution, as these categories are used to generate potential solutions. Martindale's (1981) unifying theory of attention deployment and creativity is echoed by Mumford et al. (1991) who express that the

development of novel combinations can be facilitated by the “activation of atypical category exemplars of associated multiple categories” (p. 107). These best categories are combined and reorganized to form a base from which new solutions can be generated. Thus, according to the information-processing model, factors such as diffused attention resulting from deficits in latent inhibition that affect the number and types of categories or nodes activated will have a strong effect on creative performance. As such, it seems this stage of processing involves the same abilities used to complete the RAT or DT Originality.

Once a person has identified multiple categories that might be used to account for available information bearing on the nature of the problem, Mumford and colleagues (1991) propose people then engage in the combination-and-reorganization stage that provides new knowledge structures and thus a basis for the generation of new alternative solutions. The individual forms pre-inventive structures, which are internal precursors to the final product and can range from a mental blend of basic concepts to mental models representing physical or conceptual systems (Ward, Smith, & Finke, 1999). The ability to generate new alternative solutions is measured by performance on tests of ideation fluency (e.g. Alternate Uses - Guilford 1956, 1959; TTCT - Torrance, 1962).

From the multiple solutions (or “pre-inventive structures”) generated in the previous stage, one examines the emergent properties and their implications and then evaluates each to select a solution to the problem (Mumford et al., 1991). Baer (2003) states that evaluative, critical and convergent thinking all refer to the same process by which solutions are selected based upon their merit. As Guilford (1956, 1959) originally defined convergent thinking as a process that results in the identification of one correct

solution through deductive reasoning, it logically follows that tests measuring deductive reasoning ability would aptly capture adeptness in the end phase of the creative process.

Mumford and colleagues (1991) then state the results of gathering information to solve the problem, generating the solutions, and examining the solutions for the best one are then implemented and monitored for its effectiveness. The effective execution of all these processes is required for the generation of successful solution. As the success of an individual's efforts in the later phases of this cycle will depend upon the quality of material provided by prior processing operations, one expects early phase abilities to moderate the relationship between late phase abilities and creative accomplishment. Given the similarities between popular tests of creativity and Mumford and colleagues (1991) stages, one expects a two way interaction between performance on the RAT/DT Originality and ideation fluency tests, and then a three way interaction between deductive reasoning, ideation fluency, and performance on the RAT/DT Originality.

There is a paucity of research that applies existing measures of creative cognition to this information processing theory. Vincent and colleagues (2002) conducted a path analysis to predict performance on a creative problem from a test of divergent thinking, a verbal reasoning test, and a test requiring participants to provide a title and description to a group of loosely related tasks (which would conceivably require similar skills that are needed to do well on the RAT). As Mumford and colleagues' (1999) model suggests, the RAT-like measure correlated strongly by itself with creative performance, and also interacted with divergent thinking to affect creative performance. The reasoning and divergent thinking tasks were also related to creative performance, but contrary to Mumford's model, there was not evidence of a three-way interaction. This is not entirely

surprising, given the relatively small number of participants in the study and that convergent thinking is more related to editing the product of divergent thinking than with attention deployment. So although there is support for every stage of Mumford and colleagues' (1999) information processing model of creativity, and there are suggestions that this model can also be used with popular measures of creativity, further research is required to confirm the utility of such a model in interpreting popular creativity measures.

#### Nature of the Personality/Creative Ability Relationship

Not only is there debate on how different creative cognition abilities interact with each other, but also the nature of the relationship between cognition and personality. The mechanism by which schizotypy influences creativity has been referred to as a "cognitive set". A cognitive set can be defined as creative ability and personality interacting to result in a person's (creative) behaviour (Richards, 1981). This interaction is the focus of the present investigation. However, there seems to be no overall consensus on how creative cognition and schizotypy interact. In reviewing the literature on schizotypics' performance on measures of creativity, almost all of the results have been reported in correlations which assume a linear relationship between schizotypy and creativity (e.g. Sand, 2003; Schulberg, 1990, 2000-2001). However, it has already been stated that Kinney et al. (2000-2001) found a curvilinear relationship between number of schizophrenic symptoms and scores on creativity measures. Other researchers have found this pattern in the interaction of performance on tests measuring creative cognition and personality variables (James & Asmus, 2000-2001; Prentky, 2000-2001; Wuthrich & Bates, 2001; see also Cox & Leon, 1999 and Bokart & Goldberg, 2002), a subject Richards (1981, 2000-2001) has repeatedly called for more research on. Richards (1981,

2000-2001) and Runco (1993) also state that the direction of the relationship, whether personality mediates creative cognition and accomplishment or vice versa, has also not been resolved. Thus researchers should keep in mind the possibility of curvilinear relationships as well as mediated/moderated relationships between cognitive and personality variables.

### The Current Investigation

There is a discrepancy between creative accomplishment studies, that suggest schizotypics have a greater number of creative accomplishments when compared to controls, and creative ability studies, that suggest while some measures of creativity are positively related to positive schizotypic symptoms, results are largely mixed. It is hypothesized that this discrepancy is a result of researchers failing to assess separate creative cognition skills and account for their interaction. Also, as pathology and creativity have been shown in some cases to share curvilinear relationships, mixed findings may represent differences in sampling. This study addresses apparently conflicting research results by addressing three questions: (1) Can one use Mumford and colleagues' (1991) model to predict creative accomplishments from the results of popular creative cognition measures; (2) is there evidence for a linear or curvilinear creative cognitive advantage in schizotypy; and (3) what is the nature of the relationship between measures of creativity and positive and negative symptoms of schizotypy (independent, mediated, or moderated)?

Inherent in Mumford and colleagues' information processing model is that the success of an individual's efforts in the later phases of the process is influenced by the quality of material provided by prior processing operations. As such, sequential

regression will be employed to determine if addition of ability interactions between 'early' (RAT, Ideation Originality) and 'later' (Ideation Fluency, Deductive Reasoning) phase abilities improved prediction of creative problem solving beyond that afforded by the independent contributions of tests. Two separate multiple regressions will be conducted, the first to test the predicted interactions between the RAT, Ideation Fluency and Deductive Reasoning, and a second exploratory regression to examine the utility of including Ideation Originality when predicting creative problem solving. To test simple interactions between early and late phase abilities, two-way interaction terms of theoretical importance will be entered in the second block: interactions between hypothesized early phase abilities (RAT and Ideation Originality) and Ideational Fluency (as inferred by Mumford et al., 1991) and Deductive Reasoning (as demonstrated by Vincent et al., 2002). If the ability of ideational fluency as a predictor of creative accomplishment is influenced by on the success of the success of previous (early phase) processing of information, the interaction term is expected to account for additional variance in creative accomplishment. Similarly, the success of the last hypothesized phase involving evaluative thinking (measured by Deductive Reasoning) will be affected by processing in phases going before it (RAT or Ideation Originality; Ideation Fluency), and thus a three way interaction involving all of these variables should again add to the prediction of creative accomplishment.

This research question also involves the selection of a representative measure of creative accomplishment resulting from the cognitive creative process. While Mumford and colleagues' (1991) creative process research has focused on creative problem solving as a measure of creative achievement, much of the literature investigating mental illness

and creativity has used self-report data. The value of using self-reported creative accomplishment with creative cognitive process research will be examined.

The second research question asks if there is evidence for a creative cognitive advantage in schizotypy. Correlations between creative cognition and symptoms of schizotypy will determine the creative cognitive profile associated with different symptoms of schizotypy. Since researchers have suggested the possibility of curvilinear relationships between personality and creative cognition variables (e.g. James & Asmus, 2000-2001; Prentky, 2000-2001), regression analyses will be used to detect the presence of quadratic relationships.

Thirdly, this study examines the nature of the relationship between measures of creativity and positive and negative symptoms of schizotypy. Again, both linear (as suggested by Sand, 2003; Schulberg, 1990, 2000-2001) and quadratic relationships (as suggested by James & Asmus, 2000-2001; Kinney et al., 2000-2001; Prentky 2000-2001; Wuthrich & Bates, 2001) will be examined to interpret the nature of the relationship. Through analyses of mediator and moderator effects, the independence of these variables in their prediction of creative accomplishment will also be assessed. For example, it could be that symptoms of schizophrenia, such as the neuro-psychological symptom of deficits in latent inhibition, cause the loosening of associations important for creative thought, which in turn predicts creative accomplishment (creative cognition mediating the relationship of schizotypy and creative accomplishment). It seems equally as plausible that an introverted, socially anhedonic lifestyle contributes to creative accomplishment only when people are high in cognitive creative abilities (creative cognition moderating the relationship of schizotypy and creative accomplishment). As

the direction of the mediated relationship is not known (schizotypy might mediate the relationship of creative cognition and schizotypy, see Richards, 1981, 2000-2001), both possibilities will be explored.

## Method

### Participants

A total of 114 Lakehead University undergraduate students, 80 female and 34 male participants (median years of age = 22) completed the questionnaires. All participants received partial course credit for their participation. The study was approved by Lakehead University Research Ethics Committee.

### Measures

Schizotypy. The Chapman scales of schizotypic symptoms (see Appendix B) were used as it has been demonstrated that they are less affected by acquiescence and negative response styles (Chapman, Chapman & Kwapil, 1995) and have high loadings on their respective symptom factors (Bental et al., 1989). Six participants did not complete three of the scales, and they were thus excluded from analyses involving schizotypy variables.

The Perceptual Aberration Scale (PA; Chapman, Chapman, & Raulin, 1978) and Magical Ideation Scale (MI; Eckblad & Chapman, 1983) were used as measures of the positive schizotypic symptomology. The PA scale consists of 28 items to tap grossly schizophrenic-like distortions in the perception of one's own body and 7 items for other perceptual distortions, and has an internal consistency as assessed by Cronbach's alpha of 0.89. The MI scale contains 30 items that are purported to measure belief in forms of causation that by conventional standards of our dominant culture are regarded as invalid

or magical (e.g. common superstitions, thought transmission, precognition, transfer of psychic energy and other schizophrenic-like deviant beliefs), and has a Cronbach's alpha of .85. The PA and MI scales have been found to highly correlate with each other ( $r = .68-.70$ ) (Chapman et al., 1982), and high-scoring subjects on the two scales are typically combined into a single group referred to as the Perceptual Aberration-Magical Ideation (Per-Mag) group, regarded as a measure of positive schizotypal symptoms.

The 40-item Revised Social Anhedonia Scale (SoA) was used to measure schizoid indifference to other people, and has an internal consistency as assessed by Cronbach's alpha of 0.79. Eckblad and colleagues (1982) revised this scale eliminating items reflecting social anxiety to add new items tapping schizoid asociality. The Physical Anhedonia scale (Chapman et al., 1976) is purported to measure a deficiency in experiencing pleasure, and has a Cronbach's alpha of .82. The last 21 (of 61 questions) were discarded to shorten the length of the study questionnaire. These discarded questions contained an equal number of normal and reverse scored items, and had essentially the same point-biserial correlation of item score with total score as the questions that were kept,  $r(59) = .29$  and  $.26$  respectively. Claridge and Breech (1995) reviewed several meta-analysis on schizophrenic symptoms suggesting PhA and SoA generally comprised the anhedonic or negative schizotypic symptoms.

The Mood Disorder Questionnaire (Appendix C) screens for lifetime history of a manic or hypomanic syndrome (Hirschfeld, Williams, & Spitzer, 2000). The authors report a sensitivity of 0.73 and a specificity of 0.90 for this screening measure. This score was used to screen for hypomanic episodes as creativity is also associated with hypomanic episodes (e.g. Jamieson, 1993) and creativity researchers are often concerned

with differentiating the two exceptionalities when interpreting results (e.g. Richards, 2000-2001).

Creativity. The Product Improvement subtest from the Torrance Test of Creative Thinking (TTCT) was used as a measure of ideation and originality. Participants are shown a picture of a stuffed doll and asked to think of as many ways as they can to change the product to make it better. Torrance suggests the use of this specific subtest if time is limited (Torrance, 1984). Ideation fluency is scored by summing the number of relevant responses (responses are judged relevant if they are related to the instructions). Ideation originality is scored by summing the number of responses that are not on a list of common responses provided by Torrance (1984).

Twelve participants did not complete the divergent thinking task, and were thus excluded from analyses involving this measure. To ensure a minimal amount of effort from participants on the divergent thinking measure, fluency scores were discarded if participants could not think of more than two ways to improve upon the product. Another nine participants were thus excluded from fluency analyses.

Because some of the vocabulary from Mednick's (1962) original Remote Associations Test (RAT) has become unfamiliar, an updated RAT (Appendix D) was used as one measure of information exposure (e.g. Ansburg & Hill, 2003; Smith & Blakensip, 1991). The RAT problems require solvers to find a connection between three seemingly unrelated words. A total score was obtained by summing all of the correct answers. Ansburg and Hill (2003) reported an internal consistency as assessed by Cronbach's alpha was 0.74.

As a measure of convergent thinking, six deductive reasoning problems developed by Ansburg were used (Ansburg & Hill, 2003, Appendix E). A total score was obtained by summing the number of correct responses. The reported internal consistency measured by Cronbach's alpha, was 0.62.

Creative accomplishment was measured through solving a creative problem (CPS) drawn from Redmond et al. (1993), in which subjects are asked to develop an advertising campaign for a new product. It was believed that by giving participants a highly structured creative problem, any variation between individuals at the problem finding stage (the first stage in the current model; Mumford et al., 1991) would be minimized. Two trained judges with at least an undergraduate degree in psychology and a familiarity with creativity research were recruited for scoring the responses. These judges were blind to the participants' score on any other measure, and used the original benchmark rating scales from Redmond and colleagues (1993) developed using Hennessey and Amabile's (1988) consensual rating technique. Scale anchors consisted of illustrations of products reflecting varying levels of quality and originality based on a consensus of the advertising executives. Judges were presented with a sample of responses, and was asked to rate each question on the quality (CPS Quality) and originality (CPS Originality) of the response, as indicated by the rating scales. After judges completed their initial ratings, they were convened for a second meeting where they were to discuss their ratings in relation to the provided rating scales, and reach a consensus on any discrepancies. CPS Quality and CPS Originality were then summed to provide the overall score, CPS Total. Twelve participants failed to provide an acceptable response and were excluded from analyses involving creative problem solving.

As some creative accomplishment research relies on the self reporting of creative accomplishments (e.g. Kinney et al., 2000-2001; Schulberg 2000-2001), and self-report data in schizophrenic patients is different than observer rated data for some tests (e.g. Khatri et al., 2001; Selten et al., 2000), it was hypothesized that studies reporting heightened creative accomplishments may reflect a schizotypic bias involving the over-reporting of creative accomplishments. In order to test this hypothesis, participants in the study were asked to assess their own creative abilities using the domains of the Lifetime Creativity Scales (LCS) (Richards et al., 1988), a common instrument in the creative accomplishment literature. Participants rated on a 5 point Likert scale the extent and peak amount they were creative in vocational, avocational domains, and overall level of creativity (see Appendix F). Although only the overall domain (Reported Peak Overall and Reported Extent Overall) was included in the analyses (a practice consistent with other researchers, see Kinney et al., 2000-2001; and Schulberg 2000-2001), requiring participants to first assess their vocational and avocational creativity was thought to stimulate participants to make a more accurate global assessment (overall domain). The vocational and avocational questions were thus retained in the research procedure.

### Procedure

Participants were recruited through announcements in class or posted on course web-sites, being told they were signing up for a study on problem solving and personality. The participants completed the questionnaires posted on the creativity lab web-site on their own time. Upon clicking on the link, respondents were directed to the consent form (Appendix G). Upon consenting to participate, respondents were instructed to click on "I wish to participate" and were redirected to the questionnaire that took

approximately 90 minutes to complete. Participants were administered the creativity measures first (as they were hypothesized to be more demanding) and the personality measures second, to minimize the effects of fatigue on demanding tasks. Responses were sent directly to a database that could be accessed by SPSS. After completing the questionnaire, participants were then directed to the debriefing form (Appendix H). Because of missing values on some of the variables, analyses were conducted using pair-wise deletion to maximize the inclusion of all valid data.

Internet-based data collection is an area new to creativity research, and as such there is little evidence for the validity of such measures over the Internet. Research suggests that results obtained from measures completed over the Internet are consistent with measures completed in the lab (see Birnhabum, 2004 for a review).

### Results

Five participants met the threshold criteria for a lifetime prevalence of a hypomanic or manic episode on the MDQ. An independent samples t-test revealed no significant differences in personality or creativity variables between the hypomanic group and the rest of the participants in the study, and these participants were included in subsequent analyses.

#### Creativity Variables

The means, standard deviations, number of participants, and correlation coefficients were computed among the nine measures of creativity. Results are presented in Table 1. There was little relationship evident between the two measures of creative accomplishment: Creative Problem Solving (CPS Quality, CPS Originality, and CPS Total), and Self-Assessed Creativity (Reported Peak Overall and Reported Extent

Overall). CPS Total was significantly correlated with three of the four cognitive creative ability variables (the exception being Ideation Fluency), and thus was a good empirical and theoretical candidate for being used as a measure of creative accomplishment resulting from a creative cognition process. In terms of a factor structure (disregarding the redundant information contained in CPS Total) RAT, Deductive Reasoning and CPS Quality were correlated together, whereas Ideational Fluency, Ideation Originality and CPS Originality (and less so CPS Quality) were also interrelated.

The finding that Ideation Fluency was not directly and linearly related to any measure of creative accomplishment is consistent with Ideational Fluency being conceived as a later phase ability, mediated by Ideation Originality or the RAT. The relationship between the RAT, Ideation Originality, and creative problem solving is consistent with the conception of these two variables as an early phase ability. The direct linear relationship between Deductive Reasoning and Creative Problem Solving however, suggests that Deductive Reasoning abilities may play a larger role earlier in the process than was originally hypothesized.

As there were few significant correlations between self-reported creativity and the creative cognition variables, the Reported Peak Overall and Reported Extent Overall were dropped as dependent measures for subsequent regression analyses involving the prediction of creative accomplishment from creative cognitive ability variables. As the CPS Quality and Originality scores were highly correlated and shared similar relationships with creative cognition variables as CPS Total, CPS Total was chosen as the dependent variable for all subsequent regression analyses.

Table 1

Intercorrelations Between Creativity Measures

| Measure                    | 1    | 2     | 3     | 4    | 5     | 6     | 7    | 8     | 9     |
|----------------------------|------|-------|-------|------|-------|-------|------|-------|-------|
| 1. CPS Quality             | --   | .75** | .94** | .21* | .18   | .28** | .19  | .29** | .28** |
| 2. CPS Originality         |      | --    | .94** | .16  | .08   | .19   | .17  | .37** | .15   |
| 3. CPS Total               |      |       | --    | .18  | .13   | .25*  | .19  | .35** | .22*  |
| 4. Reported Peak Overall   |      |       |       | --   | .62** | .17   | .23* | .13   | .09   |
| 5. Reported Extent Overall |      |       |       |      | --    | .09   | .11  | .02   | .02   |
| 6. RAT                     |      |       |       |      |       | --    | .12  | .13   | .41** |
| 7. Ideation Fluency        |      |       |       |      |       |       | --   | .68** | .10   |
| 8. Ideation Originality    |      |       |       |      |       |       |      | --    | .06   |
| 9. Deductive Reasoning     |      |       |       |      |       |       |      |       | --    |
| <u>M</u>                   | 2.78 | 2.63  | 5.41  | 3.19 | 2.46  | 8.16  | 7.21 | 2.17  | 2.65  |
| <u>SD</u>                  | .99  | .96   | 1.81  | 1.08 | 1.11  | 3.75  | 3.36 | 1.87  | 1.23  |
| <u>N</u>                   | 102  | 102   | 102   | 111  | 114   | 114   | 93   | 102   | 114   |

Note. \*\* Correlation significant at the .01 level. \* Correlation significant at the .05 level.

CPS = Creative Problem Solving, RAT = Remote Associates Test. Numbers 1 – 5 represent creative achievement variables, where as 6 – 9 represent creative cognitive abilities.

Examining the Interactional Process Model of Creative Cognition

One of the purposes of this study was to determine if one can use Mumford and colleagues' (1991) model to predict creative accomplishment from the results of popular

tests of creative cognition. The first multiple regression analysis was conducted with the RAT, Ideation Fluency (IF), and Deductive Reasoning (DR) entered as the first block, to examine the contribution of the tests alone. Significance at the first step was taken to mean a direct, unmediated relationship with creative problem solving suggestive of an early phase ability. To test simple interactions between early and late phase abilities, two way interaction terms were entered in the second block: RAT and Ideation Fluency; and RAT and Deductive Reasoning. Finally, it was hypothesized that the final phase of the creative process would have to also account for all stages that have gone before it, and as such a three-way interaction was entered in the third step: RAT, Ideation Fluency, and Deductive Reasoning combined. The tests of creative ability entered in the first block significantly predicted creative problem solving,  $R^2 = .10$ ,  $F(3, 86) = 3.28$ ,  $p < .05$ . The addition of the two way interaction terms significantly improved the prediction of creativity problem solving scores,  $R^2 = .17$ ;  $R^2$  change = .07,  $F$  change (2, 84) = 3.56,  $p < .05$ . Contrary to the current conception of Mumford and colleagues' (1991) model, the addition of the last stage of the last later phase interactions (RAT\*IF\*DR) did not significantly improve prediction of creative problem solving,  $R^2 = .17$ ;  $R^2$  change < .01,  $F$  change (1, 83) = .01, n.s. The summary of how each variable influence the prediction is presented in Table 2.

As predicted, the RAT shares the strongest correlation with, and predicts, creative problem solving scores (see Table 1). However, neither RAT nor Deductive Reasoning accounts for a unique amount of variation despite their correlation with CPS Total. This may be due to the high correlation of RAT with deductive reasoning scores ( $r = .41$ ,  $p < .01$ ). As both RAT and Deductive Reasoning directly predict creative problem solving,

Table 2

Summary of Hierarchical Regression Analysis for Creative Cognition Variables

| Variable                     | $\beta$ | SE B | p    |
|------------------------------|---------|------|------|
| Step 1*                      |         |      |      |
| Remote Associates Test (RAT) | .17     | .06  | .14  |
| Ideation Fluency (IF)        | .15     | .05  | .13  |
| Deductive Reasoning (DR)     | .14     | .17  | .22  |
| Step 2*                      |         |      |      |
| RAT*IF                       | -.93    | .02  | .02* |
| RAT*DR                       | .56     | .04  | .11  |
| Step 3                       |         |      |      |
| RAT*IF*DR                    | .05     | .01  | .91  |

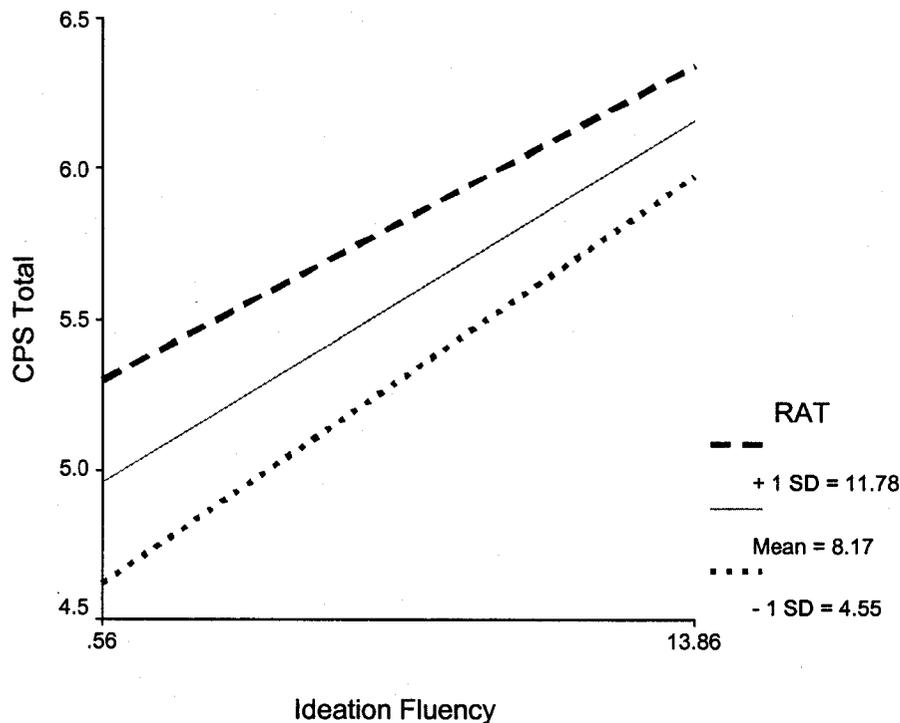
Note. \* $p \leq .05$ , Dependent Variable = CPS Total

they act like early phase abilities in the cognitive creative process.

Also consistent with the hypothesis that later stage creative abilities (e.g. ideation fluency) are dependent on the material provided by earlier stage abilities (e.g. attention deployment), adding the RAT\*IF interaction in the second step significantly improved prediction of creative problem solving scores. To discover the nature of the interaction, the regression lines between Ideation Fluency and CPS Total were plotted for different levels of the RAT (the mean, and one standard deviation above and below the mean as suggested by Cohen & Cohen, 1983). The moderated regression plot is presented in Figure 1.

Examination of the regression plot confirms the hypothesized direction of the

Figure 1

Regression of CPS Total on Ideation Fluency as a Function of Three Values of RAT

interaction. As scores on both the RAT and Ideation Fluency increase, scores on CPS Total also increase. Participants with lower performance on the RAT (an early stage ability) also had lower CPS Total scores compared with participants with equivalent scores on Ideation Fluency. As these regression lines converge however, it seems that poor RAT performance may not always be associated with poor CPS Total (accomplishment) at very high levels of Ideation Fluency.

The hypothesis that the contribution of evaluative thinking (measured in this case by deductive reasoning) to creative problem solving scores would be affected by preceding abilities was not supported in the present analysis. It is plausible that the predictive variance RAT and DR share important to the prediction of interactions was already accounted for by the previous interaction with IF. However, it also may be that

the ability required to do well on the Deductive Reasoning test plays a larger role early in the cognitive creative process than was hypothesized.

A second sequential multiple regression was used to explore the utility of including Ideation Originality when predicting creative problem solving. Analysis was conducted to evaluate the hypothesis that Ideation Originality (IO) scores are also related to Mumford and colleagues' (1991) "search for categories" stage, and may account for a unique amount of variance at this early stage, and with interactions with other variables at subsequent stages. Ideation Originality was therefore placed in the first block of the regression analyses, while the relevant interactions: Ideation Originality and Ideation Fluency, and Ideation Originality and Deductive Reasoning, were added to the second block. A three way interaction, IO\*IF\*DR was added to the third block to see if deductive reasoning's interaction with this new variable that is theoretically representative of the 'search for categories' phase (as RAT was theorized to be), but is unrelated to Deductive Reasoning. The first block again significantly predicted creative problem solving,  $R^2 = .19$ ,  $F(4, 85) = 4.90$ ,  $p = .001$ , with the addition of Ideation Originality resulting in predicting an additional nine percent of the variation in CPS Total. In contrast to the previous analysis, addition of the second interaction terms failed to account for a significant amount of new variation,  $R^2 = .24$ ,  $R^2$  change = .05,  $F$  change (4, 81) = 1.44, n.s. However, the third step in which the three way interactions were added significantly better predict creative problem solving scores,  $R^2 = .35$ ;  $R^2$  change = .11,  $F$  change (2, 79) = 3.56,  $p < .01$ . The summary of the variables in the equation is presented in Table 3.

Table 3

Summary of Hierarchical Regression Analysis for Creative Cognition Variables WithIdeation Originality

| Variable                     | $\beta$ | SE B | p   |
|------------------------------|---------|------|-----|
| Step 1***                    |         |      |     |
| Remote Associates Test (RAT) | .15     | .05  | .39 |
| Ideation Fluency (IF)        | -.12    | .07  | .17 |
| Deductive Reasoning (DR)     | .15     | .16  | .17 |
| Ideation Originality (IO)    | .40**   | .13  | .00 |
| Step 2                       |         |      |     |
| RAT*IF                       | -.69    | .02  | .09 |
| RAT*DR                       | .55     | .04  | .11 |
| IO*IF                        | -.15    | .02  | .64 |
| IO*DR                        | -.21    | .10  | .52 |
| Step 3**                     |         |      |     |
| RAT*IF*DR                    | .57     | .01  | .31 |
| IO*IF*DR                     | 2.00**  | .02  | .00 |

Note. \*p  $\leq$ .05, \*\*p  $\leq$ .01, \*\*\*p  $\leq$ .001; Dependent variable = CPS Total

Consistent with the hypothesis that Ideation Originality scores have a direct relationship with creative problem solving and thus act like an early stage process in Mumford and colleagues' (1991) model (as the RAT does), Ideation Originality significantly predicted creative problem solving. Although not uniquely significant, predictive variance common to the RAT and DR was likely not accounted for by IO, as these variables were unrelated in the correlation matrix (see Table 1).

As already reported, addition of two-way interactions failed to support the hypothesis that the results of the first stage (measured in this case by Ideation Originality and the RAT) interacts with another single later phase ability (such as Ideation Fluency or Deductive Reasoning) to account for a significant amount of additional variation in creative problem solving. This is in contrast to the first analyses in which Ideation Fluency interacted with the RAT to predict creativity scores in the second step. Due to the large correlation between Ideation Fluency and Ideation Originality ( $r = .68, p < .01$ ), the unique variation that the RAT and Ideation Fluency added to the prediction was likely already accounted for by Ideation Originality in Step 1. Unlike Ideation Fluency, Ideation Originality has a direct relationship with CPS Total, and unlike the RAT and Deductive Reasoning it shares variance with Ideation Fluency. Therefore, Ideation Originality may be representative of a combination of creative cognitive abilities early in the creative problem solving process and not a pure measure of the “search for categories” stage.

In step three, both tests theorized to be later stage abilities (Ideation Fluency and Deductive Reasoning) interact together with Ideation Originality to significantly account for an additional amount of variation in creative problem solving (16% more than Step 1). This is in contrast to RAT\*DF\*DR being non significant. As the two-way interactions in Step 2 were non-significant, it is apparent that despite the shared relationship between Ideation Fluency and Ideation Originality the interaction of all three variables is necessary. This is suggestive that Deductive Reasoning is important as a later phase ability (as well as in the earlier phase with the RAT) in the context of Ideational Originality. To discover the nature of the interaction, the regression lines

between Deductive Reasoning and CPS Total were plotted for different levels of the RAT and Ideation Fluency (one standard deviation above and below the mean as suggested by Cohen & Cohen, 1983). The moderated regression plot is presented in Figure 2.

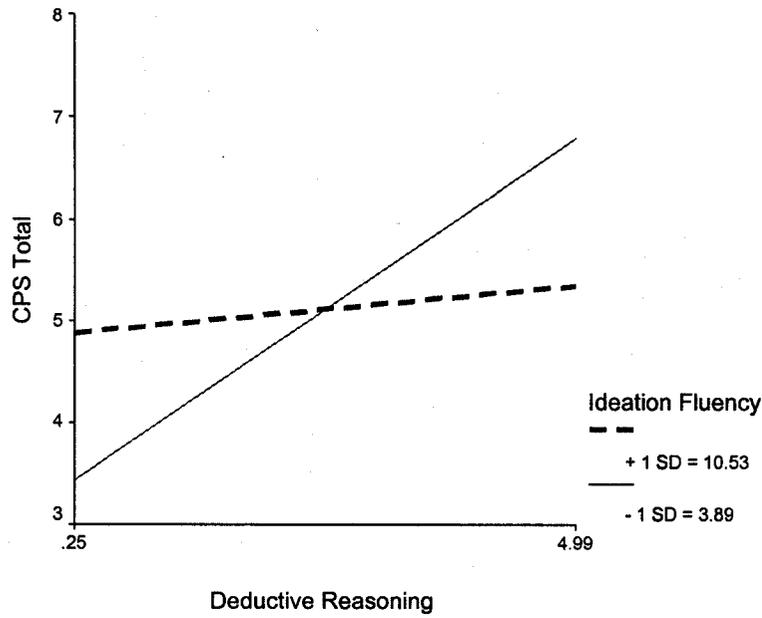
Generally, the current findings are consistent with the direction of the hypothesized interaction. When all three creative cognitive abilities (IO, IF, DR) were low, CPS Total was also low. Conversely, when all three creative cognitive abilities were high, CPS Total was also high. For the most part, combinations of low and high creative cognition variables fell somewhere within the range between all low and all high abilities as expected. Also, Ideation Originality appears to have a large influence on the relationship between Ideation Fluency and CPS Total when also considering Deductive Reasoning. This results in two paradoxical findings. First, the highest CPS Total scores were actually those who were high in Ideation Originality, but low in Fluency and Deductive Reasoning. Secondly, those high in Ideation Originality and Deductive Reasoning had low creative accomplishment scores (CPS Total) if they were low in Ideation Fluency.

The results of the previous analyses are somewhat consistent with the current conception of Mumford and colleagues' (1991) model. The results are first suggestive of a direct predictive relationship between an ability common to performance on the RAT and Deductive Reasoning to creative accomplishment (as measured by performance on a creative problem solving measure). Secondly, the results are also suggestive of the two measures related to attention deployment (RAT and Ideation Originality) moderating the relationship between ideation fluency and creative problem solving, consistent with the

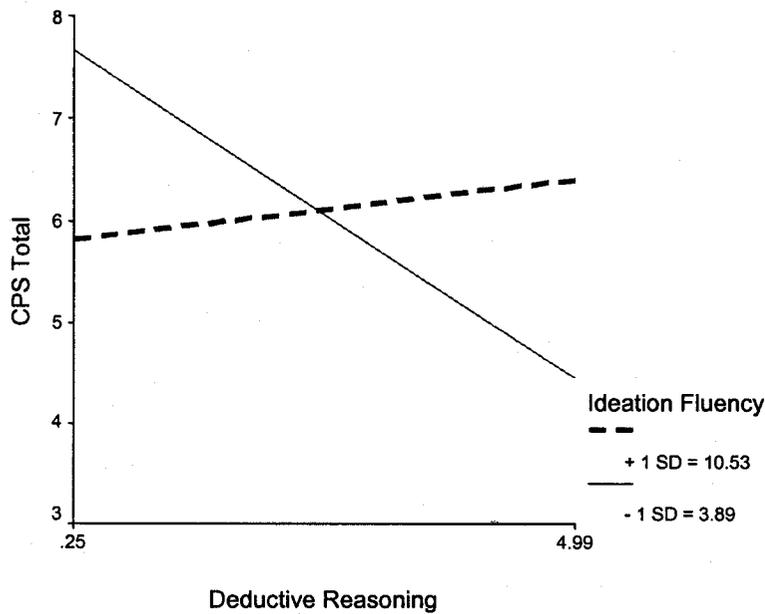
Figure 2

Regression of CPS Total on Deductive Reasoning as a Function of High and Low Values on the RAT and Ideation Fluency

Ideation Originality Low.



Ideation Originality High.



present conception of Mumford and colleagues' (1991) model. The interaction of RAT and Ideational Fluency significantly added to the ability to predict creative problem solving scores. Ideation Originality also accounts for a similar amount of variation in creative problem solving (17% after RAT\*IF entered, 19% after IO entered), consistent with the current conception of IO as tapping some early and later phase abilities. The direct relationship between Ideation Originality and creative problem solving suggests it is one of the first stages in the creative problem solving process (Mumford's "search for categories" stage), as theory suggests it should be. Ideation Originality is also empirically related to ideation fluency (Mumford's and colleagues "generation of alternative solutions" phase, see Table 1. Therefore, while Ideation Originality accounts for a similar amount of variation in creative problem solving as RAT\*IF does, and this variation is accounted for by Ideation Originality when it is entered into the regression equation before RAT\*IF, there is evidence to suggest that Ideation Originality reflects an interaction between the attention deployment and ideation fluency stages. Lastly, there was a significant three-way interaction between Ideation Originality and Fluency and Deductive Reasoning, as was predicted. Success in all three creative cognitive abilities generally resulted in high creative achievement scores (CPS Total).

While the inclusion of Ideation Originality makes interpretation more difficult as it may overlap a few steps of Mumford and colleague's model, the amount of additional variance IO and its interactions accounted for warranted its retention in subsequent analyses involving schizotypy. Interaction effects that did not make a significant contribution to the prediction of creative problem solving were discarded in future analyses. The variables retained (the Remote Associates Test, Ideation Fluency,

Deductive Reasoning, Ideation Originality, RAT\*IF, and IO\*IF\*DR) all significantly predicted creative problem solving, with the exception of Ideational Fluency.

### Schizotypy

Correlation coefficients among the four measures of schizotypy are presented in Table 4.

Table 4

#### Intercorrelations Between Schizotypy Measures

| Measure                       | MI   | PA    | SA   | PhA   |
|-------------------------------|------|-------|------|-------|
| 1. Magical Ideation (MI)      | --   | .75** | .11  | -.07  |
| 2. Perceptual Aberration (PA) |      | --    | .21* | -.02  |
| 3. Social Anhedonia (SA)      |      |       | --   | .31** |
| 4. Physical Anhedonia (PhA)   |      |       |      | --    |
| <u>M</u>                      | 8.79 | 5.82  | 9.69 | 7.15  |
| <u>SD</u>                     | 5.14 | 5.72  | 6.00 | 4.14  |

Note. \*\* $p < .01$ , \* $p < .05$ ,  $N = 108$

As expected, both measures of positive schizotypic symptoms (PA and MI) correlated strongly. Social anhedonia correlated moderately with the other negative symptom scale (PhA), and a positive symptoms scale (PA). The means and standard deviations and intercorrelations for the schizotypy measures are similar to those obtained by researchers sampling a university undergraduate population (Kwapil, Crump, and Pickup, in press), and by the authors (Chapman, February 2004, personal communication).

Creativity and Schizotypy

To explore the nature of the relationship between measures of creativity and positive and negative symptoms of schizotypy, bivariate correlations were calculated between the personality and creativity test scores. The self-assessed creativity variables (Reported Peak Overall and Reported Extent Overall) were included in this analysis to test the hypotheses that creative accomplishment may be a result of a biased self-assessment in schizotypy. The results are displayed in Table 5.

Table 5

Correlations Between Schizotypy and Creativity Variables

|                              | SA   | PhA   | MI   | PA    | <u>N</u> |
|------------------------------|------|-------|------|-------|----------|
| CPS Total                    | .08  | -.25* | .12  | -.01  | 98       |
| Reported Peak Overall        | -.05 | -.07  | .10  | .03   | 105      |
| Reported Extent Overall      | -.04 | -.17  | .19* | .15   | 108      |
| Remote Associates Test (RAT) | .04  | -.14  | .06  | .08   | 98       |
| Ideation Fluency (IF)        | -.14 | .00   | .06  | .08   | 108      |
| Deductive Reasoning (DR)     | -.05 | -.24* | -.17 | -.23* | 108      |
| Ideation Originality (IO)    | -.16 | -.10  | -.08 | -.09  | 89       |

Note. \*  $p < .05$ . SA = Social Anhedonia; PhA = Physical Anhedonia; MI = Magical Ideation; PA = Perceptual Aberration; CPS = Creative Problem Solving

The only creative cognitive ability associated with schizotypy was deductive reasoning, individuals with both positive and negative symptom profiles doing poorly on

this test. People scoring high on Physical Anhedonia also did poorly on creative problem solving. Related to the research question of a biased self-assessment of creativity in schizotypy, people high in Magical Ideation reported themselves as involved in creative activities to a greater extent, while there was no relationship between Magical Ideation and any other creative accomplishment or creative cognition variable.

The correlation matrix between creative cognition and schizotypy provided little evidence for a cognitive creative advantage in schizotypy. However, the correlation matrix does not reflect the possibility of non-linear relationships between creative cognition and schizotypy. To test for quadratic relationships, schizotypy variables were entered into the first block an omnibus multiple regression analyses predicting creative problem solving to test the linear relationship, while the squared schizotypy variables were added into the second step to determine if the quadratic relationship accounted for any additional variance. In the first step, schizotypy symptoms significantly (but negatively) predicted creative problem solving,  $R^2 = .12$ ,  $F(4, 93) = 3.13$ ,  $p < .05$ . In the second step, the squared schizotypy variables did not significantly account for any more variation, indicating a lack of strong quadratic relationships,  $R^2 = .18$ ,  $R^2$  change = .06,  $F$  change (4, 89) = 1.63, n.s. The summary of how each variable influenced the prediction is presented in Table 6.

Consistent with the results of Table 6, PhA was the only schizotypic symptom variable that predicted creative problem solving. Although the overall test for the quadratic effects was non-significant, the quadratic term involving Perceptual Aberration accounted for significantly more variation than the linear effect accounted for. As this quadratic effect was not powerful enough to make the overall test significant, it is quite possible

Table 6

Summary of Hierarchical Regression Analysis for Detection of Quadratic Relationships of Schizotypy Variables in the Prediction of Creative Problem Solving

| Variable                   | $\beta$ | SE B | p     |
|----------------------------|---------|------|-------|
| <b>Step 1*</b>             |         |      |       |
| Magical Ideation (MI)      | -.29    | .05  | .09   |
| Perceptual Aberration (PA) | -.23    | .05  | .13   |
| Social Anhedonia (SA)      | .18     | .03  | .09   |
| Physical Anhedonia (PhA)   | -.29    | .05  | .01** |
| <b>Step 2</b>              |         |      |       |
| MI*MI                      | .22     | .01  | .61   |
| PA*PA                      | -.65    | .00  | .02*  |
| SA*SA                      | -.07    | .00  | .83   |
| PhA*PhA                    | -.21    | .01  | .50   |

Note. \*p < .05, Dependent Variable = CPS Total

significance at this stage represents a Type I error, thus it will not be considered further.

As relationships between cognitive creativity variables and symptoms of schizotypy were of interest, exploratory multiple regression analyses were also conducted to test for linear and quadratic effects of schizotypy in predicting creative cognition.

Again, schizotypy measures were entered in the first step, and their squared products were entered in the second step for the dependent variables of the RAT, Ideation Fluency, Ideation Originality, and Deductive Reasoning. The addition of the quadratic schizotypy terms to the regression equation did not significantly add to the prediction of any of the

dependent variables, and will not be given further consideration in the current analysis. Future research, however, may examine those individual quadratic effects that were significant but not powerful enough to significantly influence overall prediction. A curvilinear relationship may exist between: Perceptual Aberration and Ideation Originality; and Social Anhedonia and Deductive Reasoning.

A sequential multiple regression was then employed to investigate the predictive relationship between schizotypal symptoms (MI, PA, PhA, SA) and creative problem solving. Specifically, this analysis addressed the possibility of mediating effects of schizotypy on the creative cognition/creative problem solving relationship (i.e. creative cognition causes schizotypic symptoms). Evidence for a mediated relationship would be provided if the addition of schizotypy symptoms before creative cognition measures in the regression equation causes the relationship between creative cognition and creative problem solving to disappear. It was anticipated that the shared variance between Magical Ideation and Perceptual Aberration might hide any significant effects on the prediction of creative problem solving if entered in the same step as other schizotypy symptoms, and as such they were entered in the first step alone. The negative symptoms, Social Anhedonia and Physical Anhedonia were next entered into the regression equation. Creative cognition variables that significantly predicted creative problem solving in previous analyses were entered in the third step (RAT, IO, IF, DR, RAT\*IF, IO\*IF\*DR). In the first step of the regression equation, the two positive schizotypy symptom variables (MI and PA) did not predict creative problem solving scores,  $R^2 = .05$ ,  $F(2, 83) = 2.12$ , *n.s.* In Step 2, the addition of the negative schizotypy symptom variables (SA and PhA) significantly improved prediction of creative problem solving

scores,  $R^2 = .14$ ,  $R^2$  change = .09,  $F$  change (2, 81) = 4.45,  $p \leq .01$ . While the positive symptoms of schizotypy were not related to creative accomplishment as measured by creative problem solving scores, a negative symptom profile did predict accomplishment. Taken together, however, positive and negative symptoms of schizotypy accounted for 14% of the variance in creative problem solving. For Step 3, the addition of the creative cognition variables added to the prediction of creative problem solving scores,  $R^2 = .31$ ,  $R^2$  change = .16,  $F$  change (6, 75) = 2.94,  $p \leq .01$ , and as such the hypothesis that schizotypy mediates the relationship between creative cognition and creative problem solving was not supported. In fact, since the variance accounted for by the creative cognition variables remained virtually the same when schizotypy scores were taken into account, this finding suggests that while schizotypy and creative cognition both significantly predict creative problem solving, they are largely independent. The summary of how each variable influenced the prediction is presented in Table 7.

Physical anhedonia contributed to the prediction of creative problem solving, sharing a negative relationship with it. As physical anhedonia also had a significant relationship with deductive reasoning, and deductive reasoning predicts creative problem solving, it might be hypothesized that people with high physical anhedonia do poorly on creative processes involving deductive reasoning and hence poorly in creative accomplishments. In this case, creative cognition would mediate the relationship between schizotypy and creativity. This possibility is tested in the subsequent analyses. When entered into the same block, there was no one test of creativity that accounted for a significant amount of unique variation. The observation that Ideation Originality is no longer uniquely significant when entered into the same block as the interaction

Table 7

Summary of Hierarchical Regression Analysis for Schizotypy with Creative CognitionVariables Predicting Creative Problem Solving

| Variable                     | $\beta$ | SE B | p     |
|------------------------------|---------|------|-------|
| <b>Step 1</b>                |         |      |       |
| Magical Ideation             | .22     | .06  | .18   |
| Perceptual Aberration        | -.00    | .06  | .98   |
| <b>Step 2</b>                |         |      |       |
| Social Anhedonia             | .20     | .03  | .07   |
| Physical Anhedonia           | -.28    | .05  | .01** |
| <b>Step 3</b>                |         |      |       |
| Remote Associates Test (RAT) | .13     | .13  | .63   |
| Ideation Fluency (IF)        | .10     | .20  | .79   |
| Deductive Reasoning (DR)     | .22     | .19  | .09   |
| Ideation Originality (IO)    | .16     | .22  | .48   |
| RAT*IF                       | -.25    | .02  | .61   |
| IO*IF*DR                     | .20     | .01  | .41   |

Note. \*\*p < .01, \*p < .05, Dependent variable = CPS Total

effects further suggests that Ideation Originality is representative of a number of different stages in the creative problem solving process. As Ideation Originality shares predictive variance with the RAT and Deductive Reasoning, while co-varying with Ideation Fluency, it is thus interrelated with other ability tests.

Another multiple regression was performed to test the hypothesis that schizotypy might mediate the relationship between creative cognition and creative problem solving (e.g. schizotypic symptoms cause creative problem solving skills and deficits). With the creative cognition variables entered in the first step, there was a significant prediction of creative problem solving scores,  $\underline{R}^2 = .16$ ,  $\underline{F} (6, 79) = 2.59$ ,  $p < .05$ . Creative cognition accounted for the same amount of variance in creative problem solving when it was entered in the third step of the previous analysis, which again confirms the independence of schizotypy and creative cognition in predicting creative problem solving. In contrast to the previous analysis, the addition of positive symptoms of schizotypy (MI and PA) in the second step added to the prediction of creative problem solving scores,  $\underline{R}^2 = .25$ ,  $\underline{R}^2$  change = .08,  $\underline{F}$  change (2, 77) = 4.14,  $p < .05$ . Positive symptoms were likely significant in this analysis because of an increase in power due to the variance already explained by cognitive creative ability. Negative schizotypic symptom scales (SA and PhA) were added to the regression equation in the third step, again significantly predicting creative problem solving scores,  $\underline{R}^2 = .31$ ,  $\underline{R}^2$  change = .06,  $\underline{F}$  change (2, 75) = 3.27,  $p < .05$ . As schizotypy was still significantly related to creative problem solving, the hypothesis that schizotypal symptoms mediate the relationship between cognitive creative ability and creative problem solving was not supported. The summary of how each variable influenced the prediction is presented in Table 8.

Despite the positive symptoms of schizotypy significantly predicting creative problem solving in the presence of creative cognition variables, the large amount of shared variance between the two symptoms resulted in neither one making a unique contribution. Physical Anhedonia continued to make a significant contribution to the

Table 8

Summary of Hierarchical Regression Analysis for Creative Cognition with SchizotypyVariables

| Variable                     | $\beta$ | SE B | p    |
|------------------------------|---------|------|------|
| <b>Step 1</b>                |         |      |      |
| Remote Associates Test (RAT) | .11     | .14  | .69  |
| Ideation Fluency (IF)        | .21     | .03  | .93  |
| Deductive Reasoning (DR)     | .21     | .19  | .12  |
| Ideation Originality (IO)    | .21     | .24  | .38  |
| RAT*IF                       | -.15    | .02  | .77  |
| IO*IF*DR                     | .14     | .01  | .59  |
| <b>Step 2</b>                |         |      |      |
| Magical Ideation             | .22     | .05  | .16  |
| Perceptual Aberration        | .10     | .06  | .52  |
| <b>Step 3</b>                |         |      |      |
| Social Anhedonia             | .20     | .03  | .06  |
| Physical Anhedonia           | -.21    | .05  | .05* |

Note. \* $p \leq .05$ , Dependent variable = CPS Total

prediction of creative problem solving despite rearranging the order of creative cognition and schizotypy variables in the regression equation.

A final sequential regression was performed to investigate whether creative cognition might moderate the relationship between creative cognition and accomplishment (e.g. perhaps social anhedonia predicts creative achievement only when

anhedonics have a high level of ideation fluency). Sixteen interaction variables were computed for four schizotypy symptom measures and the four measures of cognitive creative ability to test for moderating variables. These interactions were entered in the third block after the schizotypy measures in the first block and the creative cognition measures in the second. As it is also possible that creative cognition might also moderate a curvilinear relationship between schizotypy and creative accomplishment (even though no curvilinear relationships were apparent in a previous analysis), the four squared schizotypy variables and the sixteen possible interactions with creative cognition variables were also included. The addition of the linear interaction variables did not significantly improve prediction of creative problem solving ability from schizotypic symptom measures and creative cognitive abilities,  $R^2$  change = .10,  $F$  change (16, 57) = .62, n.s. The addition of interactions between creative cognition and quadratic schizotypy variables also did not significantly improve prediction of creative problem solving ability,  $R^2$  change = .16,  $F$  change (16, 41) = .45, n.s. Therefore, this data does not support creative cognition moderating the relationship between schizotypy and creative cognition.

### Discussion

The ranges, means, standard deviations, and inter-correlations of the four schizotypy scales were similar to those obtained by other researchers examining creativity and schizotypy in a primarily undergraduate population (e.g. Schuldberg, 2000-2001; Weinstein & Graves, 2002). Thus, there is support for comparing the current findings to previous research in the field. Magical Ideation and Perceptual Aberration (referred to as positive symptoms of schizotypy) were more closely related than the negative symptoms of schizotypy (Social Anhedonia and Physical Anhedonia). The

positive relationship between Social Anhedonia (a negative symptom) and Perceptual Abberation (a positive symptom) was similar in size and direction to that reported by Claridge and colleagues (1996) in a large factor analysis of schizotypal symptoms.

The selection of a dependent variable for the regression analyses bears on the interpretation of all of the research questions. Two dependent variables were evaluated as a measure of creative accomplishment. Performance on a creative problem is widely used in creative cognitive process research (see Mumford et al., 2003; Runco & Sakamoto, 1999). The self-report of creative accomplishments is a method used in investigations of mental illness and creativity, and for this study a very obtuse tool (based on a more sophisticated measure) was used to maximize detection of broad biases in the self-appraisal of creativity – specifically, the over-reporting of creative accomplishments in schizotypy. In the current results, there was little to no relationship between self-assessed creativity and creative problem solving. This suggests that broad assessments of the extent and degree one is creative is not related to the kind of creativity measured by creative problem solving, independent of schizotypal symptoms. Tests of creative cognition, that are predictive of real life creative accomplishment (e.g. Eysenck, 1994b; Milgram, 1990; Mraz & Runco, 1994; Runco, 1991; Runco & Albert, 1995; Torrance, 1975), also had little to no relationship with self assessed creativity, but were significantly correlated with creative problem solving scores. Therefore, broad assessments of the extent and degree one is creative are also not related to performance on cognitive creativity variables. However, it could also be argued that the kinds of ‘cognitive’ creativity measures used in this study are measures of creative states, influenced by a host of temporal influences such as motivation or affect (see Runco, 2004

for a review), whereas the self-assessment of creativity reflects their overall creativity traits. Self-assessed creativity may also be related to the creative person (personality styles) more than the creative process (cognitive styles) (e.g. King, Walker & Broyles, 1996). The use of creative problem solving as a dependent measure in this study therefore represents the cognitive approach used to solve these problems that is subject to various temporal influences, and the comparison of results to studies that involve creative personality measures or the self-assessment of creativity over a life-span should be weighted by this qualification.

One of the proposed explanations for a discrepancy between the creative accomplishment and creative cognition literature was that schizotypics might over-report levels of creativity on self-assessment measures as has been observed with other self-report measures (Khatri et al., 2001; Selten et al., 2000). As such, this study compared the results from a measure involving a high-degree of self-assessment, and measures involving no self-assessment of abilities. A positive relationship was found between a positive symptom of schizotypy (Magical Ideation) and the self-reported extent to which one participates in creative activities. This finding should be interpreted with caution since it was observed with 28 other non-significant correlations, and could be a Type 1 error. If one were to compare this finding to research suggesting people with schizotypy are inaccurate in some forms of self-report, one might conclude that schizotypics believe they are more creative when they are not. However, when noting that only one symptom scale was significantly correlated, and that there was no relationship between self-assessed peak creativity levels and schizotypy, one might suggest that people with odd beliefs (MI) actually do engage in more activities that they consider to be inherently

creative (Reported Extent Overall) without actually assessing the products of these activities to be more creative than others (Reported Peak Overall). Support for this viewpoint comes from studies on personality that suggest people open to trying new experiences and beliefs are more typically involved in the creative arts (e.g. Baron & Harrington, 1981; King, Walker & Broyles, 1996; see also McCrae, 1987). Either way, future researchers might do well to note that when conducting research that involves using self-reported creative accomplishments with a schizotypic population, collaborative data on creativity might help to inform the interpretation of the results.

The present study examined the relationship between creative ability, creative cognition, and schizotypy as guided by the questions: (1) Can one use Mumford and colleagues' (1991) model to predict creative accomplishments from the results of popular creative cognition measures; (2) is there evidence for a creative cognitive advantage in schizotypy; and (3) what is the nature of the relationship between measures of creativity and positive and negative symptoms of schizotypy?

#### Process Model of Cognition

Central to our investigation of a process model of creativity is the inter-correlation of tests of creativity. Although there was theoretical reason to suspect the Remote Associates Tests and Ideation Originality would be related as success on each would seem to indicate diffused attention, it was empirically a different story. Instead, the Remote Associates Test was related to Deductive Reasoning and Creative Problem Quality. Conversely, Ideation Originality was related to Creative Problem Solving Originality and Ideation Fluency (and slightly less so to Creative Problem Quality). Thus, the inter-correlations mimic a binary factor structure suggestive of Guilford's

(1956, 1959) convergent-divergent model of creativity. The first “divergent” factor, containing Ideation Originality, Ideation Fluency, and CPS Originality, seems representative of the ability to generate a diverse collection of information in response to the requirements of a prompt. This is not unconstrained fluency as the information must be relevant to the prompt or otherwise hinder the process (as necessary for the single answer required for CPS Originality) and the involvement of wide attentional deployment (as is implicated in originality scores). The “synthesis” factor, containing the RAT, CPS Quality, and Deductive Reasoning, seems indicative of the ability to synthesize multiple pieces of information to meet the requirements of a problem. The synthesis factor is not purely deduction as implied in Guilford’s (1956, 1959) original conception of convergent thinking. Performing well on the RAT involves finding commonality among examples, as is involved in inductive reasoning. Also, all tests in this factor have an emphasis on ensuring the suitability of the problem to the requirements, a process that involves a circular process of checking suitability, making improvements, and checking suitability again (e.g. Baer, 2003).

Therefore, while the RAT and Ideation Originality were proposed to measure attention deployment as related to creative performance, the lack of a relationship between these two abilities suggest a revision is needed. Baer (2003) has recently reviewed models in which divergent and convergent (or synthesis) styles of thinking are necessary for each step of the cognitive creative process. While an ability necessary for good performance on Ideation Originality might be useful at this stage to ‘cast the net widely’ and identify many different categories of information that might be useful in solving the problem, the ability involved in successful RAT performance would then

invariably be needed to synthesize many multiple (and seemingly distinct) categories together so as to provide a manageable amount of information for subsequent steps.

Regression analyses were conducted to determine if one could predict creative accomplishment from multiple popular measures of creative cognition using Mumford and colleague's (1991) model. A direct predictive relationship between a creative cognition variable and creative accomplishment (as measured by performance on a creative problem solving measure) suggests that the cognitive abilities involved in this creativity measure are minimally influenced by the results of previous processing operations and are therefore one of the first stages of the cognitive creative process. There was a direct predictive relationship between an ability common to performance on the RAT and Deductive Reasoning to creative accomplishment. While attention deployment, as measured by the RAT, was hypothesized to have a direct relationship with creative accomplishment as it is early in the creative processing model, a direct relationship with Deductive Reasoning was unexpected. Ideation Originality was also directly predictive of creative accomplishment. These results provide support to the hypothesis that the first stages of the creative process are captured by the RAT (related to Deductive Reasoning), and Ideation Originality. As stated before, abilities associated with Ideation Originality may be indicative of Mumford and colleague's (1991) search for categories phase, in which a person identifies multiple categories that might be used to account for the available information bearing on the nature of the problem. Consistent with Baer (2003), this phase also has a 'synthesis' aspect (involving abilities common to the RAT and Deductive Reasoning) in which these categories are "combined and re-

organized” (Mumford et al., 1991) to form a new knowledge structure for the generation of alternative solutions.

Inherent in Mumford and colleagues’ (1991) model is that the success of an individual’s efforts in the later phases of the process depends upon the quality of material provided by prior processing operations. As such, the success of later efforts is essentially moderated by earlier phases and can therefore be tested with interactions between earlier and later phase variables. Mumford and colleagues’ (1991) specify that after the new knowledge structure is formed, one generates alternative solutions. The ability to generate a large amount of ideas (ideation fluency) was thought to capture this phase. Consistent with the current conception of Mumford and colleague’s (1991) model, the results are also suggestive of the two measures related to attention deployment (RAT and Ideation Originality) moderating the relationship between ideational fluency and creative problem solving. The interaction between the RAT and Ideation Fluency significantly predicted creative problem solving, as did Ideation Originality. Success at the earlier stage of attention deployment affected the amount of ideas one had to generate to achieve a similar creative achievement score. Those with poor attention deployment achieved lower creative accomplishment scores than their counterparts with higher attention deployment scores and an equivalent amount of ideation fluency.

As stated before, the pattern of correlations between Ideation Originality and tests of creativity, and Ideation Originality’s behaviour in regression analyses with other variables suggests that a direct relationship between Ideation Originality and creative problem solving may actually be representative of the interaction of the early phases and the generation of ideas. Therefore, people high in ideation fluency, or the ability to

generate many alternative solutions, are therefore at an advantage in solving creative problems only so far as the influence of previous stages of the cognitive process are facilitative (i.e. good attention deployment).

Mumford and colleagues' (1991) then specify that from these multiple solutions, one examines the emergent properties and their implications and then evaluates each to select a single solution to the problem. Therefore, the last ability investigated was a three way interaction involving attention deployment variables, ideation fluency, and deductive reasoning as the final synthesis process. It was hypothesized that people with high levels of the synthesis factor as measured by Deductive Reasoning would also do well on creative problem solving only if they did well on the previous stages involving attention and fluency. The current findings are generally consistent with this hypothesis: combinations of low and high creative cognitive abilities fell somewhere between the range of consistently low creative cognitive abilities resulting in low creative accomplishment and consistently high creative cognitive abilities resulting in high creative accomplishment scores. The exception was two interactions involving high Ideation Originality. First, those high in Ideation Originality and Deductive Reasoning had low creative accomplishment scores (CPS Total) if they were low in Ideation Fluency. This might suggest that if a person cannot generate a sufficient amount of ideas in the first place, one's ability to come up with novel ideas or evaluate ideas does not assist one with creative accomplishments. Secondly, the highest creative accomplishment scores were actually those who were high in Ideation Originality, but low in Fluency and Deductive Reasoning. This finding again emphasizes the importance of using Ideation Originality scores in the evaluation of creative cognition. This finding

might also suggest a kind of cognitive creative process different than Mumford and colleague's (1991) model that can lead to successful creative problem solving.

In conclusion, the hypothesis that one can use Mumford and colleagues' (1991) model to predict the results of popular creative cognition measures was generally supported, but with qualifications. The moderating effect of the RAT on the Ideation Fluency/creative problem solving relationship does suggest process models of creative cognition add to the accuracy of predicting creative problem solving. However, the significance of Deductive Reasoning and the overlapping nature of Ideation Originality scores suggest that either the model or tests of creativity need to be modified so that future researchers easily investigate specific stages of the process. The results of this study also suggest the importance of both divergent and synthetic (or convergent) processing at various stages in the creative cognition process. As using these tests to measure the various stages of information processing models of creativity is relatively new, future research on the specificity of these tests to each stage will refine prediction. Future investigations into the cognitive creative process would do well to theoretically and empirically examine the cognitive processes involved in tests predictive of creative accomplishment by comparing these tests to the current state of cognitive science research. Revisions of these tests to incorporate current findings in cognitive science would likely increase the psychometric properties of such tests and their use as a research and clinical tool.

#### Evidence of a Cognitive Creative Advantage in Schizotypy

A review of the literature suggested that schizotypics have a higher proportion of creative accomplishments than schizophrenics or healthy controls (e.g. Heston, 1966,

1970; Karlson, 1984; Kaufman et al., 1979; Kinney et al. 2000-2001). It was thus hypothesized that schizotypics are superior in one of the creative abilities predictive of creative accomplishment. In the current investigation, the results of bivariate correlations between schizotypic and creativity variables suggested that schizotypics actually perform worse on creative accomplishment, measured by performance on a creative problem (specifically, there was a negative relationship between Physical Anhedonia and creative problem solving). Consistent with the research on relational reasoning and executive control in schizotypy and schizophrenia (e.g. Barch, 2003; Claridge et al., 1996; Waltz et al., 1999), there was also a negative relationship with deductive reasoning (an ability predictive of success in early and possibly late phases of the creative process) and schizotypic symptoms (Physical Anhedonia and Perceptual Aberration). Contrary to previous research (e.g. Chadwick, 1997; Fisher, 2004; Weinstein & Graves, 2001) there was no evidence for a linear relationship between any other creative cognition ability and schizotypy, suggesting there was no apparent advantage schizotypics possess in relation to the creativity cognition variables studied.

Because there were already conflicting findings between investigations into creative cognition and schizotypy, two explanations were proposed that might account for inconsistent findings in previous research. First, it was proposed that later stage processes in the creative problem solving process were not being adequately measured since these later stage abilities involve material processed by earlier stages and are therefore interrelated. Simple correlations calculated for the interactions of creativity tests that significantly predict creative accomplishment (a measure of later phase abilities) were not related to the creativity variables, and thus did not support this

hypothesis. Secondly, it was proposed that there could be complex relationships between creativity and schizotypy variables as have been suggested by other researchers (James & Asmus, 2000-2001; Kinney et al., 2000-2001; Prentky, 2000-2001; Wuthrich & Bates, 2001). There was weak evidence for quadratic relationships found between two creative cognition variables and two schizotypal symptom variables (specifically Perceptual Aberration and Ideation Originality; and Social Anhedonia and Deductive Reasoning), but the effect was too small to be considered significant. However, this finding when considered against existing theory and research, is suggestive that there may be curvilinear relationships between performance on cognitive creativity measures and personality variables, and future researchers would be wise to note this. This might explain conflicted findings between mental health and some cognitive creativity variables, as the strength and direction of the relationship would then depend on the sampling methods used.

Regression analyses were also conducted to investigate the possibility of the relationship between creative accomplishment and schizotypy being underrepresented in bivariate correlations due to the mediating or moderating effects of creative cognition. These hypotheses were unsupported by the present analyses. In fact, regression analyses indicated an independent relationship between schizotypy and creativity. In sum, there was no cognitive advantage found to explain increased creative accomplishment in schizotypy.

#### Relationship Between Creativity and Symptoms of Schizotypy

The results of regression analyses indicate that positive symptoms of schizotypy have a weak predictive relationship with creative problem solving, while Physical

Anhedonia shares a stronger relationship with creative accomplishment. All significant schizotypy symptoms had a negative relationship with creativity, meaning the higher schizotypal symptoms, the lower the creativity scores. No mediator or moderator effects were observed, suggesting an independent relationship between creative cognition and schizotypy. Schizotypics would therefore have to overcome deficits in cognitive abilities that hinder creative accomplishment in order to be successful.

If existing research suggests schizotypics engage in more creative activities than normal controls or schizophrenics, and with success, why then was there a negative relationship observed between schizotypy and creative problem solving/deductive reasoning? Two explanations are given. First, it may be that this study was limited in its ability to address the qualitative nature of schizotypics' creative work. The structured nature of the creative problem solving measure, with generalized scale anchors and the inability to ask respondents for clarification, may be missing the kind of creativity involved in the abstract and modernist work generally associated with the schizophrenic spectrum (e.g. Richards, 2000-2001). Secondly, it is conceivable that under some circumstances deficits in the factor associated with Deductive Reasoning (convergent thinking) may increase originality. The first part of the current study provided evidence for very high creative accomplishment scores associated with high originality scores, but low deductive reasoning. In the second part of the study, both positive and negative symptoms in schizotypy seemed to interfere in deductive reasoning, one of the 'synthesis' or evaluative thinking tasks. Regardless of whether creativity in schizotypy is related to producing a greater number of original ideas, the filter mechanism that in healthy controls matches ideas to the solution requirements (an ability hypothesized to be

related to the 'synthesis' factor of this study) may be dysfunctional. This hypo-evaluation may thus result in unusual solutions for a problem for which non-schizotypal thinking may have produced a 'better-fitting', yet less 'creative', solution. As these solutions would not be typical of what many people would answer, the judged originality of such a solution would be high.

If this hypothesis is correct, one would also expect to see a decreased sensitivity of schizotypics for matching responses to external demands. Indeed, previous research demonstrates deficits in even high functioning schizotypics on neuro-psychological tests involving matching responses to a shifting requirement (e.g. Gooding, Kwapil, & Tallent, Green et al., 1997; Lencz, Raine, Benishay, Mills & Bird, 1995; Siever et al., 2002). For example, schizotypics have a greater amount of perseverative errors on tests involving cognitive set switching – essentially 'forcing' a response set that no longer matches requirements of the task. More research is needed to test how this might influence creative problem solving, and the circumstances in which being unable to match problem solving efforts to the requirements of the problem actually results in a creative appraisal of the output.

In sum, while research suggests schizotypics are involved to a greater extent in professions for which creativity may be useful, and that they report a greater amount and extent of creativity, they perform the same or worse than others on measures that are more temporal and cognitive in nature. The independence of cognitive creativity and schizotypy suggests that if schizotypics are indeed more creative than normal controls, it is because of factors other than the cognitive ones surveyed in this investigation (e.g. emotion, motivation, personality differences). Future researchers in this area should thus

exercise caution when choosing a “general measure” of creativity. The use of popular cognitive creativity tests to investigate heightened creative accomplishment in schizotypy may not be yielding satisfying results because schizotypics perform the same or worse than controls on those particular measures of creativity. It is also still unclear which stage in the creative process popular measures tap, and the use of just one measure limits the ability of the researcher to draw conclusions about why a group may exhibit creative abilities or deficits. Similarly, as Physical Anhedonia was the strongest symptom in predicting creative accomplishment, the use of just Social Anhedonia as a broad measure of negative symptoms in schizotypy may also miss some of the most meaningful data.

## References

- Alan, W. J. H., Wellman, N. A., Tonin, J., Taylor, E., Feldon, J., & Rawlings, J. N. P. (1995). Effects of tobacco smoking, schizotypy, and number of pre-exposures on latent inhibition in healthy subjects. Personality and Individual Differences, *19*, 893-902.
- Amabile, T. M. (1983). The Social Psychology of Creativity. New York: Springer-Verlag.
- American Psychiatric Association (1994). Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition. Washington, DC: American Psychiatric Association.
- Andreasen, N. C. & Canter, A. (1974). The creative writer: Psychiatric symptoms and family history. Comprehensive Psychiatry, *15*, 123-131.
- Ansburg, P. I., & Hill, K. (2003). Creative and analytic thinkers differ in their use of attentional resources. Personality and Individual Differences, *34*, 1141-1152.
- Arndt, S., Alliger, R. J., & Andreasen, N. C. (1991). The distinction of positive and negative symptoms: The failure of a two-dimensional model. British Journal of Psychiatry, *158*, 317-322.
- Baer, J. (2003). Evaluative thinking, creativity, and task specificity: Separating wheat from chaff is not the same as finding needles in haystacks. In M. A. Runco (Ed.), Critical creative processes (pp. 129-151). Cresskill, NJ: Hampton Press.
- Baer, J. (1996). The effects of task-specific divergent-thinking training. Journal of Creative Behavior, *30*, 183-187.
- Barch, D. M. (2003). Cognition in schizophrenia: Does working memory work? Current Directions in Psychological Science, *12*, 146-150.

- Barron, F. (1969). Creative person and creative process. New York: Holt, Rinehard & Winston.
- Barron, F., & Harrington, D. (1981). Creativity, intelligence, and personality. Annual Review of Psychology, 32, 439-476.
- Baruch, I., Hemsley, D. R., & Gray, J. A. (1988). Differential performance of acute and chronic schizophrenics in a latent inhibition task. The Journal of Nervous and Mental Disease, 176, 598-606.
- Bentall, R. P., Claridge, G. S., & Slade, P. D. (1989). The multidimensional nature of schizotypal traits: A factor analytic study with normal subjects. British Journal of Clinical Psychology, 28, 109-116.
- Birnbaum, M. H. (2004). Human research and data collection via the internet. Annual Review of Psychology, 55, 803-332.
- Bleuler, E. (1911/1950). Dementia praecox or the group of schizophrenias. New York: International Universities Press.
- Bloom, M. (2001). Promoting creativity across the lifespan. Washington, DC: Child Welfare League of America.
- Brod, J. H. (1997). Creativity in schizotypy. In G. Claridge (Ed.), Schizotypy: Implications for illness and health (pp. 274 – 298). London, UK: Guilford Press.
- Cameron, N. (1938). Reasoning, repression, and communication in schizophrenics. Psychological Monographs, 50, 1-33.
- Cameron, N. (1947). The psychology of behaviour disorder. Boston: Houghton Mifflin.

- Chadwick, P. K. (1997). Schizophrenia: A positive perspective. London: Routledge.
- Chapman, J. P., Chapman, L. J., & Kwapil, T. R. (1995). Scales for the measurement of schizotypy. In A. Raine, T. Lencz, & S. A. Mednick (Eds) Schizotypal personality (pp. 79-106). Cambridge, UK: Cambridge University Press.
- Chapman, L. J., Chapman, J. P., & Raulin, M. L. (1976). Scales for physical and social anhedonia. Journal of Abnormal Psychology, *85*, 374-382.
- Chapman, L. J., Chapman, J. P. & Raulin, M. L. (1978). Body image aberration in schizophrenia. Journal of Abnormal Psychology, *87*, 399-407.
- Clapham, M. M. (2000-2001). The effects of affect manipulation and information exposure on divergent thinking. Creativity Research Journal, *13*, 335-350.
- Clapham, M. M. (1998). Structure of figural forms A and B of the Torrance Tests of Creative Thinking. Educational and Psychological Measurement, *58*, 275-283.
- Claridge, G. S. (1985). Origins of Mental Illness. Oxford: Blackwell.
- Claridge, G., & Beech, T. (1995). Fully and quasi-dimensional constructions of schizotypy. In A. Raine, T. Lencz, and S. A. Mednick (Eds.), Schizotypal Personality (pp. 192-216). Cambridge, UK: Cambridge University Press.
- Claridge, G. S., & Broks, P. (1984). Schizotypy and hemisphere function. I: theoretical considerations and the measurement of schizotypy. Personality and Individual Differences, *5*, 633-648.
- Claridge, G., McCreery, C., Mason, O., Bental, R., Boyle, G., Slade, P., & Popplewell, D. (1996). The factor structure of 'schizotypal' traits: A large replication study. British Journal of Clinical Psychology, *35*, 103-115.

Clarizio, H. F., & Mehrens, W. A. (1985). Psychometric limitations of Guilford's Structure-of-Intellect model for identification and programming of the gifted. Gifted Child Quarterly, 29, 113-120.

Cooper, E. (1991). A critique of six measures for assessing creativity. Journal of Creative Behavior, 25, 194-204.

Dewing, K., & Battye, G. (1971). Attention deployment and nonverbal fluency. Journal of Personality and Social Psychology, 17, 214-218.

Diakiday, I. N., & Spanoudis, G. (2002). Domain specificity in creativity testing: A comparison of performance on a general divergent-thinking test and a parallel, content-specific test. Journal of Creative Behavior, 36, 41-61.

Duchene, A., Graves, R. E., & Brugger, P. (1998). Schizotypal thinking and associative processing: A response commonality analysis of verbal fluency. Journal of Psychiatry and Neuroscience, 23, 56-60.

Dykes, M., & McGhie, A. (1976). A comparative study of attentional strategies of schizophrenic and highly creative normal subjects. British Journal of Psychiatry, 128, 50-56.

Eckblad, M., & Chapman, L. J. (1983). Magical ideation as an indicator of schizotypy. Journal of Consulting and Clinical Psychology, 51, 215-225.

Eckblad, M., Chapman, L. J., Chapman, J. P., & Mishlove, M. (1982). The Revised Social Anhedonia Scale. Unpublished test. University of Wisconsin, Madison, WI.

Eisenman, R. (1991). Creativity: Is it disruptive? Creative Child and Adult Quarterly, 16, 223-237.

- Eysenck, H. J. (1993). Creativity and personality: Suggestions for a theory. Psychological Inquiry, 4, 147-178.
- Eysenck, H. J. (1994a). The measurement of creativity. In M. Boden (Ed.) Dimensions of creativity (pp. 199-242). London: MIT Press.
- Eysenck, H. J. (1994b). Creativity and personality: Word association, origence, and psychoticism. Creativity Research Journal, 7, 209-216.
- Eysenck, H. J. (1997). Creativity and personality. In M. A. Runco (Ed.), The creativity research handbook: Volume one (pp. 41-66). Cresskill, NJ: Hampton Press.
- Eysenck, H. J. (2003). Creativity, personality and the convergent-divergent continuum. In M. A. Runco (Ed.), Critical creative processes (pp. 95-114). Cresskill, NJ: Hampton Press.
- Eysenck, H. J. & Eysenck, S. B. G. (1975). Manual of the Eysenck Personality Questionnaire. London: Hodder and Stroughton.
- Feist, G. J. (1999). The influence of personality on artistic and scientific creativity. In R. J. Sternberg (Ed.) Handbook of creativity (pp. 273 - 296).
- Feldhusen, J. F., Hobson, S., & Treffiniger, D. J. (1975). The effects of visual and verbal stimuli on divergent thinking. Gifted Child Quarterly, 19, 205-209, 263.
- Fisher, J. E., Mohanty, A., Herrington, J. D., Koven, N. S., Miller, G. A. & Heller, W. (2004). Neuropsychological evidence for dimensional schizotypy: Implications for creativity and psychopathology. Journal of Research in Personality, 38, 24-31.
- Friedman, F., Raymond, B. A., & Feldhusen, J. F. (1978). The effects of environmental scanning on creativity. Gifted Child Quarterly, 22, 248-251.

- Galton, F. (1871). Hereditary genius: An inquiry into its laws and consequences. New York: D. Appleton & Co.
- Gardner, H. (1983). Frames of mind. New York: Basic Books.
- Getzels, J. E., & Jackson, P. W. (1962). Creativity and intelligence: Explorations with gifted students. New York: Wiley.
- Gooding, D. C., Kwapil, T. R., & Tallent, K. A. (1999). Winsconsin Card Sorting Test deficits in schizotypic individuals. Schizophrenia Research, 40, 201-209.
- Gray, N. S., Hemsley, D. R., & Gray, J. A. (1992). Abolition of latent inhibition in acute, but not chronic schizophrenics. Neurology, Psychiatry, and Brain Research, 1, 83-89.
- Green, M. J., & Williams, L. M. (1999). Schizotypy and creativity as effects of reduced cognitive inhibition. Personality and Individual Differences, 27, 263-276.
- Gruzelier, J. H. (2003). Theory, methods and new directions in the psychophysiology of the schizophrenic process and schizotypy. International Journal of Psychophysiology, 48, 221-245.
- Guilford, J. P. (1956). The structure of intellect. Psychological Bulletin, 53, 267-293.
- Guilford, J. P. (1959). Personality. New York: McGraw-Hill.
- Guilford, J. P. (1967). The nature of human intelligence. New York: McGraw-Hill.
- Guilford, J. P., Christensen, P. R., Merrifield, P. R., & Wilson, R. C. (1978). Alternate uses: Manual of instruction and interpretations. Orance, CA: Sheridan Psychological Services.

Halpern, D. F. (2003). Thinking critically about creative thinking. In M. A. Runco (Ed.) Critical creative processes (pp. 189-208). Cresskill, NJ: Hampton Press Inc.

Hennessey, B. A., & Amabile, T. M. (1988). The conditions of creativity. In R. J. Sternberg (Ed.), The nature of creativity (pp. 11-42). Cambridge, UK: Cambridge University Press.

Heston, L. L. (1966). Psychiatric disorders in foster home reared children of schizophrenic mothers. British Journal of Psychiatry, 112, 819-825.

Heston, L. L. (1970). The genetics of schizophrenia. Science, 167, 249-256.

Hirschfeld, R. M., Williams, J. B., & Spitzer, R. L. (2000). Development and validation of a screening instrument for bipolar spectrum disorder: The Mood Disorder Questionnaire. American Journal of Psychiatry, 157, 1873-1875.

Hocevar, D., & Michael, W. B. (1979). The effects of scoring formulas on the discriminant validity of tests of divergent thinking. Educational and Psychological Measurement, 39, 917 – 921.

Ingram, R. E., & Siegle, G. J. (2002). Contemporary methodological issues in the study of depression: Not your father's Oldsmobile. In I. H. Gotlib and C. L. Hammen (Eds.), Handbook of Depression (pp. 86-114). New York: Guilford Press.

James, K., & Asmus, C. (2000-2001). Personality, cognitive skills, and creativity in different life domains. Creativity Research Journal, 13, 149-159.

Jamison, K. R. (1993). Touched with fire: Manic-depressive illness and the artistic temperament. New York: Simon and Schuster Inc.

Juda, A. (1949-1950). The relationship between highest mental capacity and psychic abnormalities. American Journal of Psychiatry, 106, 296-307.

- Karlsson, J. L. (1970). Genetic association of giftedness and creativity with schizophrenia. Hereditas, *66*, 177-182.
- Karlsson, J. L. (1984). Creative intelligence in relatives of mental patients. Hereditas, *100*, 83-86.
- Kauffman, C., Grunebaum, H., Cohler, B., & Gamer, E. (1979). Superkids: Competent children of psychotic mothers. American Journal of Psychiatry, *136*, 1396-1402.
- Kendler, K. S. & Hewitt, J. (1992). The structure of self-report schizotypy in twins. Journal of Personality Disorders, *6*, 1-17.
- Kendler, K. S., McGuire, M., Gruenberg, A. M., & Walsh, D. (1995). Schizotypal symptoms and signs in the Roscommon Family Study: Their factor structure and familial relationship with psychotic and affective disorders. Archives of General Psychiatry, *52*, 296-303.
- Khatri, N., Romney, D. M., & Pelletier, G. (2001). Validity of self-reports about quality of life among patients with schizophrenia. Psychiatric Services, *52*, 534-535.
- King, L. A., McKee Walker, L., & Broyles, S. J. (1996). Creativity and the five-factor model. Journal of Research in Personality, *30*, 189-203.
- Kinney, D. K., Richards, R., Lowing, P. A., LeBlanc, D., Zimbalist, M. E., & Harlan, P. (2000-2001). Creativity in offspring of schizophrenic and control parents: An adoption study. Creativity Research Journal, *13*, 17-25.
- Kinney, D. K., & Matthyse, S. M. (1978). Genetic factors in the transmission of schizophrenia. Annual Review of Medicine, *29*, 459-473.

- Kris, E. (1952). Psychoanalytic explorations in art. New York: International Universities Press.
- Kwapil, T. R., Crump, R. A., & Pickup, D. (in press). Assessment of psychosis proneness in African-American college students. Journal of Clinical Psychology.
- Lencz, T., Raine, A., Benishay, D. S., Mills, S. & Bird, L. (1995). Neuropsychological abnormalities associated with schizotypal personality. In A. Raine, Lencz, T., and S. A. Mednick (Eds.), Schizotypal personality (pp. 289-328). Cambridge, UK: Cambridge University Press.
- Liddle, P. F. & Morris, D. L. (1991). Schizophrenic syndromes and frontal lobe performance. British Journal of Psychiatry, 158, 340-345.
- Lubow, R. E., & Gewirtz, J. C. (1995). Latent inhibition in humans: data, theory and implications for schizophrenia. Psychology Bulletin, 117, 87-103.
- Lubow, R. E., Ingberg-Sachs, Y., Zalstein-Orda, N., & Gewirtz, J. C. (1992). Latent inhibition in low and high "psychotic-prone" subjects. Personality and Individual Differences, 13, 563-572.
- Maier, W., Falkai, P., & Wagner, M. (1999). Schizophrenia-spectrum disorders. In A. Raine, T. Lencz & S. Mednick (Eds.), Schizotypal personality (pp. 311-371). Cambridge, UK: Cambridge University Press.
- Maron, L. M., Carlson, M. D., Minassian, A. & Perry, W. (2004). A process approach to verbal fluency in patients with schizophrenia. Schizophrenia Research, 68, 105-106.
- Martindale, C. (1999). Biological bases of creativity. In R. J. Sternberg (Ed.) Handbook of creativity (pp. 137-152). Cambridge, UK: Cambridge University Press.

Martindale, C. (1981). Cognition and consciousness. Homewood, IL: Dorsey.

Martindale, C. & Greenough, J. (1973). The differential effect of increased arousal on creative and intellectual performance. Journal of Genetic Psychology, 123, 329-335.

McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. Journal of Personality and Social Psychology, 52, 1258-1265.

Mednick, S. A. (1962). The associative basis of the creative process. Psychological Review, 69, 220-232.

Mednick, M. T. & Andrews, F. M. (1967). Creative thinking and level of intelligence. Journal of Creative Behavior, 1, 428-431.

Mednick, S. A. & Mednick, M. T. (1967). Examiner's manual, Remote Associates Test. Boston: Houghton Mifflin.

Meehl, P. E. (1962). Schizotaxia, schizotypy, and schizophrenia. American Psychologist, 17, 827-833.

Meehl, P. E. (1990). Toward an integrated theory of schizotaxia, schizotypy, and schizophrenia. Journal of Personality Disorders, 4, 1-99.

Mendelsohn, G. A. (1976). Associative and attentional processes in creative performance. Journal of Personality, 39, 391-406.

Mendelsohn, G. A. & Griswold, B. B. (1966). Assessed creative potential, vocabulary level, and sex as predictors of the use of incidental cues in verbal problem solving. Journal of Personality and Social Psychology, 4, 423-431.

Milgram, R. M. (1990). Creativity: An idea whose time has come and gone? In M. A. Runco & R. S. Albert (Eds.), Theories of Creativity (pp. 215-233). Newbury Park, CA: Sage.

Mobley, M. I., Doares, L., & Mumford, M. D. (1992). Process analytic models of creative capacities: Evidence for the combination and reorganization process. Creativity Research Journal, *5*, 125-156.

Mraz, W., & Runco, M. A. (1994). Suicide ideation and creative problem solving. Suicide and Life Threatening Behavior, *24*, 38-47.

Mumford, M. D., Mobley, M. I., Uhiman, C. E., Reiter-Palmon, R., & Doares, L. M. (1991). Process analytic models of creative capacities. Creative Research Journal, *4*, 91-122.

Mumford, M. D., Baughman, W. A., & Sager, C. E. (2003). Picking the right material: Cognitive processing skills and their role in creative thought. In M. A. Runco (Ed.) Critical creative processes (pp. 19-68). Cresskill, NJ: Hampton Press.

Neill, W. T. & Westberry, R. L. (1987). Selective attention and the suppression of cognitive noise. Journal of Experimental Psychology: Learning, Memory, and Cognition, *13*, 327-334.

Nuechterlein, K. H., Asarnow, R. F., Subotnik, K. L., Fogelson, D. L., Payne, D. L., Kendler, K. S., Neale, M. C., Jacobson, K. C. & Mintz, J. (2002). The structure of schizotypy: relationships between neurocognitive and personality disorder features in relatives of schizophrenic patients in the UCLA Family Study. Schizophrenia Research, *54*, 121-130.

O'Flynn, K., Gruzelier, J. H., Bergman, A., & L. J. (2003). The schizophrenic spectrum personality disorders. In S. R. Hirsch and D. Weinberger (Eds.) Schizophrenia (pp. 80-100). Chichester: Blackwell.

Okuda, S. M., Runco, M. A., & Berger, D. E. (1991). Creativity and the finding and solving of real-world problems. Journal of Psychoeducational Assessment, 9, 45-53.

O'Reilly, T., Dunbar, R., & Bentall, R. (2001). Schizotypy and creativity: an evolutionary connection? Personality and Individual Differences, 31, 1067-1078.

Payne, R. W., Matusek, P., & George, E. I. (1959). An experimental study of schizophrenic thought disorder. Journal of Mental Science, 105, 627-652.

Peralta, V. & Cuesta, M. J. (2001). How many and which are the psychopathological dimensions in schizophrenia? Issues influencing their ascertainment. Schizophrenia Research, 49, 269-285.

Petigrew, T. (1982). Cognitive style and social behavior. A review of category width. In L. Wheeler (Ed.), Review of Personality and Social Psychology (Vol. 3, pp. 199-224. Beverly Hills, CA: Sage.

Plucker, J. A. & Renzulli, J. S. (1999). Psychometric approaches to the study of human creativity. In R. J. Sternberg (Ed.) Handbook of creativity (pp. 35 – 61). Cambridge, UK: Cambridge University Press.

Pollert, L. H., Feldhusen, J. F., Van Mondfrans, A. P., & Treffinger, D. J. (1969). Role of memory in divergent thinking. Psychological Reports, 25, 151-156.

Prentky, R. A. (2000-2001). Mental illness and roots of genius. Creativity Research Journal, 13, 95-104.

Rado, S. (1953). Dynamics and classification of disordered behavior. American Journal of Psychiatry, 110, 406-421.

Raine, A. (1991). The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. Schizophrenia Bulletin, 17, 555-564.

Redmond, M. R., Mumford, M. D., & Teach, R. J. (1993). Putting creativity to work: Leader influences on subordinate creativity. Organizational Behaviour and Human Decision Processes, 55, 120-151.

Rhodes, M. (1961/1987). An analysis of creativity. In S. G. Isaksen (Ed.), Frontiers of creativity research: Beyond the basics (pp. 216-222). Buffalo, NY: Bearly.

Richards, R. (1976). A comparison of selected Guilford and Wallach-Kogan creative thinking tests in conjunction with measures of intelligence. Journal of Creative Behavior, 10, 151-164.

Richards, R. (1981). Relationships between creativity and psychopathology. Genetic Psychology Monographs, 103, 261-324.

Richards, R., Kinney, D. K., Benet, M., & Merzel, A. P. L. (1988). Assessing everyday creativity: Characteristics of the lifetime creativity scales and validation with three large samples. Journal of Personality and Social Psychology, 54, 476-485.

Richards, R., Kinney, D. K., Lunde, I., Benet, M., & Merzel, A. P. L. (1988). Creativity in manic-depressives, cyclothymes, their normal relatives and control subjects. Journal of Abnormal Psychology, 97, 281-288.

Romaniuk, J. G., & Romaniuk, M. (1981). Creativity across the life span: A measurement perspective. Human Development, 24, 366-381.

Runco, M. A. (1986). The discriminant validity of gifted children's divergent thinking test scores. Gifted Child Quarterly, 30, 78-82.

Runco, M. A. (1991). The evaluative, valuative, and divergent thinking of children. Journal of Creative Behavior, 25, 311-314.

Runco, M. A. (1993, May). Giftedness as critical and creative thought. Paper presented at the Wallace Symposium on Giftedness and Talent, Iowa City, IA.

Runco, M. A. (1994). Problem finding, evaluative thinking, and creativity. In M. A. Runco (Ed.), Problem finding, problem solving, and creativity (pp. 40-76). Norwood, NJ: Ablex.

Runco, M. A. (2003a). Creativity, cognition, and their educational implications. In J. Houtz (Ed.), The Educational Psychology of Creativity (pp. 25-56). Cresskill, NJ: Hampton Press.

Runco, M. A. (Ed.) (2003b). Critical creative processes. Cresskill, NJ: Hampton Press Inc.

Runco, M. A. (2004). Creativity. Annual Review of Psychology, 55, 657-687.

Runco, M. A. & Albert, R. S. (1985). The reliability and validity of ideational originality in the divergent thinking of academically gifted and non-gifted children. Educational and Psychological Measurement, 45, 483-501.

Runco, M. A. & Chand, I. (1994). Problem finding, evaluative thinking, and creativity. In M. A. Runco (Ed.), Problem finding, problem solving, and creativity (pp. 40-76). Nowrwood, NJ: Ablex.

Runco, M. A. & Mraz, W. (1992). Scoring divergent thinking tests using total ideational output and a creative activity. Educational and Psychological Measurement, 52, 213-221.

Runco, M. A., Okuda, S. M. & Thurston, B. J. (1987). The psychometric properties of four systems for scoring divergent thinking tests. Journal of Psychoeducational Assessment, 2, 149-156.

Runco, M. A. & Richards, R. (Eds.). (1997). Eminent creativity, everyday creativity, and health. Norwood, NJ: Ablex.

Runco, M. A. & Sakamoto, S. O. (1999). Experimental studies of creativity. In R. J. Sternberg (Ed.) Handbook of creativity (pp. 62-92). Cambridge, UK: Cambridge University Press.

Runco, M. A. & Smith, W. R. (1992). Interpersonal and intrapersonal evaluations of creative ideas. Personality and Individual Differences, 13, 295-302.

Sand, B. V. (2003). Toward a definition of creativity: Construct validation of the cognitive components of creativity (Doctoral dissertation, Texas Technical University, 2003). Dissertation Abstracts International, 63, 10-A.

Schuldberg, D. (1990). Schizotypal and hypomanic traits, creativity, and psychological health. Creativity Research Journal, 3, 218-230.

Schuldberg, D. (2000-2001). Six subclinical spectrum traits in normal creativity. Creativity Research Journal, 13, 5-16.

Sculdberg, D., French, C., Stone, B. & Heberle, J. (1988). Creativity and schizotypal traits: Creativity test scores and perceptual abberation, magical ideation, and impulsive non-conformity. Journal of Nervous and Mental Disease, 176, 648-657.

Seidman, L. J., Oscar-Berman, M., Kalinowski, A. G., Ajilore, O., Kremen, W. S., Faraone, S. V., & Tsuang, M. T. (1995). Experimental and clinical neuropsychological measures of prefrontal dysfunction in schizophrenia.

Neuropsychology, *9*, 481-490.

Serper, M. R. & Harvey, P. D. (1994). The need to integrate neuropsychological and experimental schizophrenia research. Schizophrenia Bulletin, *20*, 1-21.

Setlen, J. P., Wiersma, D., & van den Bosch, R. J. (2000). Discrepancy between subjective and objective rating for negative symptoms. Journal of Psychiatric Research, *34*, 11-13.

Siever, L. J., Koenigsberg, H. W., Harvey, P., Mitropoulou, V., Laruelle, M., Abi-Dargham, A., Goodman, M., & Buchsbaum, M. (2002). Cognitive and brain function in schizotypal personality disorder

Simonton, D. K. (1988). Age and outstanding achievement: What do we know after a century of research? Psychological Bulletin, *104*, 251-267.

Smith, K. L. R., Michael, W. B. & Hocevar, D. (1990). Performance on creativity measures with examination-taking instructions intended to induce high or low levels of test anxiety. Creativity Research Journal, *3*, 265-280.

Smith, S. M., & Blankenship, S. E. (1991). Incubation and the persistence of fixation in problem solving. American Journal of Psychology, *104*, 61-87.

Spitzer, M. (1997). A cognitive neuroscience view of schizophrenia thought disorder. Schizophrenia Bulletin, *23*, 29-50.

Sternberg, R. J., & Ohara, L. A. (1999). Creativity and intelligence. In R. J. Sternberg (Ed.), The handbook of creativity (pp. 251-272). Cambridge, UK: Cambridge University Press.

Suler, J. (1980). Primary process thinking and creativity. Psychological Bulletin, 88, 155-165.

Torrance, E. P. (1966). Torrance Tests of Creative Thinking – Figural. Bensenville, IL: Scholastic Testing Services.

Torrance, E. P. (1974). The Torrance Tests of Creative Thinking – Revised. Lexington, MS: Personnel Press.

Torrance, E. P. (1975). Creativity research in education: Still alive. In I. A. Taylor & J. W. Getzels (Eds.), Perspectives in creativity (pp. 278-296). Chicago: Aldine.

Torrance, P. E., & Ball, O. E. (1984). Torrance Tests of Creative Thinking: Streamlined Manual, Figural A and B. Bensenville, IL: Scholastic Testing Services.

Wakefield, J. F. (2003). The development of creative thinking and critical reflection: lessons from everyday problem finding. In M. A. Runco (Ed.) Critical creative processes (pp. 253-274). Cresskill, NJ: Hampton Press.

Wallach, M. A. (1970). Creativity. In P. Mussen (Ed.) Carmichael's handbook of child psychology (pp. 1211-72). New York: Wiley.

Wallach, M. A., & Kogan, N. (1965). Modes of thinking in young children: A study of the creativity-intelligence distinction. New York: Holt, Rinehart, & Winston.

Waltz, J. A., Knowlton, B. J., Holyoak, K. J., Boone, K. B., Mishkin, F. S., de Menezes Santos, M., Thomas, C. R., & Miller, B. L. (1999). A system for relational reasoning in human prefrontal cortex. Psychological Science, 10, 119-125.

Ward, W. C. (1969). Creativity and environmental cues in nursery school children. Developmental Psychology, 1, 543-547.

Ward, T. B., Smith, S. M., & Finke, R. A. (1999). Creative cognition. In R. J. Sternberg (Ed.) Handbook of creativity (pp. 189-212). Cambridge, UK: Cambridge University Press.

Weisberg, R. (1999). Creativity and knowledge: A challenge to theories. In R. J. Sternberg (Ed.) Handbook of creativity (pp. 226-250). Cambridge, UK: Cambridge University Press.

Weinstein, S. & Graves, R. (2001). Are creativity and schizotypy products of a right hemisphere bias? Brain and Cognition, 49, 138-151.

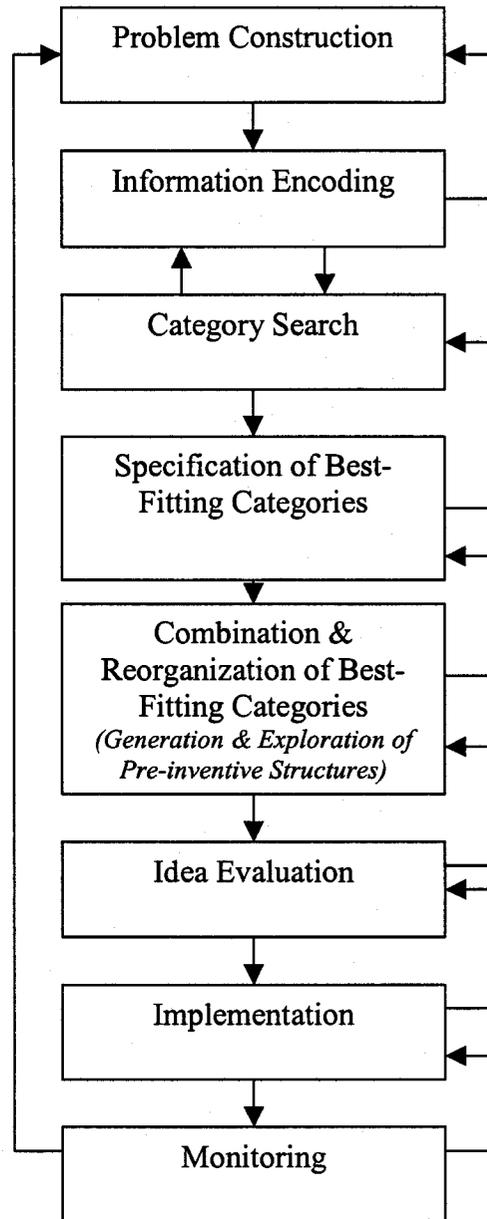
Williams, J. H., Wellman, N. A., Geaney, D. P., Cowen, D. J., Feldon, J., & Rawlins, J. N. P. (1998). Reduced latent inhibition in people with schizophrenia: an effect of psychosis or of its treatment. British Journal of Psychiatry, 172, 243-249.

Wuthrich, V., & Bates, T. C. (2001). Schizotypy and latent inhibition: non-linear linkage between psychometric and cognitive markers. Personality and Individual Differences, 30, 783-798.

Appendix A

Combination and Reorganization Model of Creative Problem Solving

Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991



## Appendix B

Chapman Personality Scales

Please answer each item true or false. Please do not skip any items. It is important that you answer every item, even if you are not quite certain which is the best answer. An occasional item may refer to experiences that you have had only when taking drugs. Unless you have had the experience at other times (when not under the influence of drugs), mark it as if you have not had that experience.

Some items may sound like others, but all of them are slightly different. Answer each item individually, and don't worry about how you answered a somewhat similar previous item.

## The Magical Ideation Scale

1. I have occasionally had the silly feeling that a TV or radio broadcaster knew I was listening to him.
2. I have felt that there were messages for me in the way things were arranged, like in a store window.
3. Things sometimes seem to be in different places when I get home, even though no one has been there.
4. I have never doubted that my dreams are the products of my own mind.
5. I have noticed sounds on my records that are not there at other times.
6. I have had the momentary feeling that someone's place has been taken by a look-alike.
7. I have never had the feeling that certain thoughts of mine really belonged to someone else.
8. I have wondered whether the spirits of the dead can influence the living.
9. At times I perform certain little rituals to ward off negative influences.
10. I have felt that I might cause something to happen just by thinking too much about it.
11. At times, I have felt that a professor's lecture was meant especially for me.
12. I have sometimes felt that strangers were reading my mind.
13. If reincarnation were true, it would explain some unusual experiences I have had.
14. I sometimes have a feeling of gaining or losing energy when certain people look at me or touch me.
15. It is not possible to harm others merely by thinking bad thoughts about them.
16. I have sometimes sensed an evil presence around me, although I could not see it.
17. People often behave so strangely that one wonders if they are part of an experiment.
18. The government refuses to tell us the truth about flying saucers.
19. I almost never dream about things before they happen.
20. I have sometimes had the passing thought that strangers are in love with me.
21. The hand motions that strangers make seem to influence me at times.
22. Good luck charms don't work.
23. I have sometimes been fearful of stepping on sidewalk cracks.
24. Numbers like 13 and 7 have no special powers.
25. I have had the momentary feeling that I might not be human.
26. I think I could learn to read others' minds if I wanted to.
27. Horoscopes are right too often for it to be a coincidence.
28. Some people can make me aware of them just by thinking about me.
29. I have worried that people on other planets may be influencing what happens on Earth.

30. When introduced to strangers, I rarely wonder whether I have known them before.

#### The Revised Physical Anhedonia Scale

1. I have usually found lovemaking to be intensely pleasurable.
2. When eating a favorite food, I have often tried to eat slowly to make it last longer.
3. I have often enjoyed the feel of silk, velvet, or fur.
4. I have sometimes enjoyed feeling the strength in my muscles.
5. Dancing, or the idea of it, has always seemed dull to me.
6. I have always found organ music dull and unexciting.
7. The taste of food has always been important to me.
8. I have had very little fun from physical activities like walking, swimming, or sports.
9. I have seldom enjoyed any kind of sexual experience.
10. On hearing a good song, I have seldom wanted to sing along with it.
11. I have always hated the feeling of exhaustion that comes from vigorous activity.
12. The color that things are painted has seldom mattered to me.
13. The sound of rustling leaves has never much pleased me.
14. Sunbathing isn't really more fun than lying down indoors.
15. There just are not many things that I have ever really enjoyed doing.
16. I don't know why some people are so interested in music.
17. Flowers aren't as beautiful as many people claim.
18. I have always loved having my back massaged.
19. I never wanted to go on any of the rides at an amusement park.
20. Trying new foods is something I have always enjoyed.
21. The warmth of an open fireplace hasn't especially soothed and calmed me.
22. Poets always exaggerate the beauty and joys of nature.
23. When I have seen a statue, I have had the urge to feel it.
24. I have always had a number of favorite foods.
25. I don't understand why people enjoy looking at the stars at night.
26. I have had very little desire to try new kinds of foods.
27. I never have the desire to take off my shoes and walk through a puddle barefoot.
28. I've never cared much about the texture of food.
29. When I have walked by a bakery, the smell of fresh bread has often made me hungry.
30. I have often enjoyed receiving a strong, warm handshake.
31. I have often felt uncomfortable when my friends touch me.
32. I have never found a thunderstorm exhilarating.
33. Standing on a high place and looking out over the view is very exciting.
34. I have often found walks to be relaxing and enjoyable.
35. The sound of the rain falling on the roof has made me feel snug and secure.
36. I like playing with and petting soft little kittens or puppies.
37. The sound of organ music has often thrilled me.
38. Beautiful scenery has been a great delight to me.
39. The first winter snowfall has often looked pretty to me.
40. Sex is okay, but not as much fun as most people claim it is.
41. I have sometimes danced by myself just to feel my body move with the music.
42. I have seldom cared to sing in the shower.
43. One food tastes as good as another to me.
44. On seeing a soft, thick carpet, I have sometimes had the impulse to take off my shoes and walk barefoot on it.
45. After a busy day, a slow walk has often felt relaxing.
46. The bright lights of a city are exciting to look at.

47. The beauty of sunsets is greatly overrated.
  48. It has always made me feel good when someone I care about reaches out to touch me.
  49. I have usually found soft music boring rather than relaxing.
  50. I have usually finished my bath or shower as quickly as possible just to get it over with.
  51. The smell of dinner cooking has hardly ever aroused my appetite.
  52. When I pass by flowers, I have often stopped to smell them.
  53. Sex is the most intensely enjoyable thing in life.
  54. I think that flying a kite is silly.
  55. I've never cared to sunbathe; it just makes me hot.
  56. The sounds of a parade have never excited me.
  57. It has often felt good to massage my muscles when they are tired or sore.
  58. When I'm feeling a little sad, singing has often made me feel happier.
  59. A good soap lather when I'm bathing has sometimes soothed and refreshed me.
  60. A brisk walk has sometimes made me feel good all over.
  61. I have been fascinated with the dancing of flames in a fireplace.
- questions later.

#### The Perceptual Aberration Scale

1. I sometimes have had the feeling that some parts of my body are not attached to the same person.
2. Occasionally I have felt as though my body did not exist.
3. Sometimes people whom I know well begin to look like strangers.
4. My hearing is sometimes so sensitive that ordinary sounds become uncomfortable.
5. Often I have a day when indoor lights seem so bright that they bother my eyes.
6. My hands or feet have never seemed far away.
7. I have sometimes felt confused as to whether my body was really my own.
8. Sometimes I have felt that I could not distinguish my body from other objects around me.
9. I have felt that my body and another person's body were one and the same.
10. I have felt that something outside my body was a part of my body.
11. I sometimes have had the feeling that my body is abnormal.
12. Now and then, when I look in the mirror, my face seems quite different than usual.
13. I have never had the passing feeling that my arms or legs have become longer than usual.
14. I have sometimes felt that some part of my body no longer belongs to me.
15. Sometimes when I look at things like tables and chairs, they seem strange.
16. I have felt as though my head or limbs were somehow not my own.
17. Sometimes part of my body has seemed smaller than it usually is.
18. I have sometimes had the feeling that my body is decaying inside.
19. Occasionally it has seemed as if my body had taken on the appearance of another person's body.
20. Ordinary colors sometimes seem much too bright to me.
21. Sometimes I have had a passing thought that some part of my body was rotting away.
22. I have sometimes had the feeling that one of my arms or legs is disconnected from the rest of my body.
23. It has seemed at times as if my body was melting into my surroundings.
24. I have never felt that my arms or legs have momentarily grown in size.
25. The boundaries of my body always seem clear.
26. Sometimes I have had feelings that I am united with an object near me.
27. Sometimes I have had the feeling that a part of my body is larger than it usually is.
28. I can remember when it seemed as though one of my limbs took on an unusual shape.
29. I have had the momentary feeling that my body has become misshapen.

30. I have had the momentary feeling that the things I touch remain attached to my body.
31. Sometimes I feel like everything around me is tilting.
32. I sometimes have to touch myself to make sure I'm still there.
33. Parts of my body occasionally seem dead or unreal.
34. At times I have wondered if my body was really my own.
35. For several days at a time I have had such a heightened awareness of sights and sounds that I cannot shut them out.

The Revised Social Anhedonia Scale

1. Having close friends is not as important as many people say.
2. I attach very little importance to having close friends.
3. I prefer watching television to going out with other people.
4. A car ride is much more enjoyable if someone is with me.
5. I like to make long distance phone calls to friends and relatives.
6. Playing with children is a real chore.
7. I have always enjoyed looking at photographs of friends.
8. Although there are things that I enjoy doing by myself, I usually seem to have more fun when I do things with other people.
9. I sometimes become deeply attached to people I spend a lot of time with.
10. People sometimes think that I am shy when I really just want to be left alone.
11. When things are going really good for my close friends, it makes me feel good too.
12. When someone close to me is depressed, it brings me down also.
13. My emotional responses seem very different from those of other people.
14. When I am alone, I often resent people telephoning me or knocking on my door.
15. Just being with friends can make me feel really good.
16. When things are bothering me, I like to talk to other people about it.
17. I prefer hobbies and leisure activities that do not involve other people.
18. It's fun to sing with other people.
19. Knowing that I have friends who care about me gives me a sense of security.
20. When I move to a new city, I feel a strong need to make new friends.
21. People are usually better off if they stay aloof from emotional involvements with most others.
22. Although I know I should have affection for certain people, I don't really feel it.
23. People often expect me to spend more time talking with them than I would like.
24. I feel pleased and gratified as I learn more and more about the emotional life of my friends.
25. When others try to tell me about their problems and hang-ups, I usually listen with interest and attention.
26. I never had really close friends in high school.
27. I am usually content to just sit alone, thinking and daydreaming.
28. I'm much too independent to really get involved with other people.
29. There are few things more tiring than to have a long, personal discussion with someone.
30. It made me sad to see all my high school friends go their separate ways when high school was over.
31. I have often found it hard to resist talking to a good friend, even when I have other things to do.
32. Making new friends isn't worth the energy it takes.
31. There are things that are more important to me than privacy.
34. People who try to get to know me better usually give up after awhile.
35. I could be happy living all alone in a cabin in the woods or mountains.

36. If given the choice, I would much rather be with others than be alone.
37. I find that people too often assume that their daily activities and opinions will be interesting to me.
38. I don't really feel very close to my friends.
39. My relationships with other people never get very intense.
40. In many ways, I prefer the company of pets to the company of people.

## Appendix C

Mood Disorders Questionnaire

1. Has there ever been a period of time when you were not your usual self and...
- |   |     |    |
|---|-----|----|
| ...you felt so good or so hyper that other people thought you were not your normal self or you were so hyper that you got into trouble? | Yes | No |
| ...you were so irritable that you shouted at people or started fights or arguments?   | Yes | No |
| ...you felt much more self-confident than usual?  | Yes | No |
| ...you got much less sleep than usual and found you didn't really miss it?  | Yes | No |
| ...you were much more talkative or spoke faster than usual?   | Yes | No |
| ...thoughts raced through your head or you couldn't slow your mind down?  | Yes | No |
| ...you were so easily distracted by things around you that you had trouble concentrating or staying on track?                           | Yes | No |
| ...you had much more energy than usual?   | Yes | No |
| ...you were much more active or did many more things than usual?  | Yes | No |
| ...you were much more social or outgoing than usual; for example, you telephoned friends in the middle of the night?                    | Yes | No |
| ...you were much more interested in sex than usual?   | Yes | No |
| ...you did things that were unusual for you or that other people might have thought were excessive, foolish, or risky?                  | Yes | No |
| ...spending money got you or your family into trouble?  | Yes | No |
2. If you checked YES to more than one of the above, have several of these ever happened during the same period of time?      Yes      No
3. How much of a problem did any of these cause you – like being unable to work; having family, money, or legal troubles; getting into arguments or fights?
- No problem      Minor problem      Moderate problem      Serious problem

## Appendix D

Remote Associates Test

Each problem contains three words. The solution to each problem is a word which is related to each of the three words. For example, find a word that is related to the following three:

WASHER

SHOPPING

PICTURE

The correct answer is WINDOW (window washer, window shopping, picture window).

|     |          |          |          |
|-----|----------|----------|----------|
| 1.  | LICK     | SPRINKLE | MINES    |
| 2.  | WIDOW    | BITE     | MONKEY   |
| 3.  | TYPE     | GHOST    | STORY    |
| 4.  | SURPRISE | LINE     | BIRTHDAY |
| 5.  | WHEEL    | ELECTRIC | HIGH     |
| 6.  | CAT      | SLEEP    | BOARD    |
| 7.  | SHIP     | OUTER    | CRAWL    |
| 8.  | BALL     | STORM    | MAN      |
| 9.  | FAMILY   | APPLE    | HOUSE    |
| 10. | ATTORNEY | SELF     | SPENDING |
| 11. | WORM     | SCOTCH   | RED      |
| 12. | WATER    | PICK     | SKATE    |
| 13. | RIVER    | NOTE     | BLOOD    |
| 14. | ROUGH    | RESISTOR | BEER     |
| 15. | FOOD     | CATCHER  | HOT      |
| 16. | HEARTED  | FEET     | BITTER   |
| 17. | DARK     | SHOT     | SUN      |
| 18. | SANDWICH | GOLF     | CANADIAN |
| 19. | GRAVY    | SHOW     | TUG      |
| 20. | ARM      | COAL     | PEACH    |

Appendix E

Deductive Reasoning Problems

Kelsey and Candy are Jackie's sister's mother-in-law's son's daughters.  
What relation is Jackie to Kelsey and Candy?

What is the value of R?

$$Q + M = C$$

$$C + K = R$$

$$R + Q = S$$

$$M + K + S = 20$$

$$Q = 4$$

Adam is older than Bob and Carl. Carl is older than Dick. Eli is younger than Bob but older than Dick. Eli is younger than Carl. Adam is younger than Mark. Who is the second oldest man in this group?

I recently returned from a trip. Today is Thursday. I returned three days before the day after the day before tomorrow. On what day did I return?

Two women, Arlene and Cheryl, and two men, Burton and Donald, are musicians. One is a pianist, a second is a violinist, a third is a flutist, and a fourth is a drummer. On a day they were seated around a square table:

1. The person who sat across from Burton was the pianist.
2. The person who sat across from Donald was not the flutist.
3. The person who sat on Arlene's left was the violinist.
4. The person who sat on Cheryl's left was not the drummer.
5. The flutist and the drummer were married.

Who is the drummer?

Mary won't eat fish or spinach, Sally won't eat fish or green beans, Steve won't eat shrimp or potatoes. Alice won't eat beef or tomatoes, and Jim won't eat fish or tomatoes. If you are willing to give such a bunch of fussy eaters a dinner party, which items from the following list can you serve: green beans, creamed codfish, roast beef, roast chicken, celery, and lettuce.

## Appendix F

Self-Appraised Creativity Questions

*In this section, you are required to assess your own creative ability in a certain area of your life. Creative behaviour is innovative, original, but also useful towards a goal/purpose (that is, not different for the sake of being different). Think of a piece of modern art...a creative piece of art conveys a message, and perhaps uses the materials in a way few others have done before. The same piece of art would not be creative if it was haphazardly slapped together with no reason or thought.*

**How creative are you in your professional life (any paid position or post-secondary education)?** No significant creativity is a position involving pre-established procedures, moderate creativity involves situations requiring initiative and new problem solving approaches, and exceptional creativity involves a radical departure from the commonplace.

No significant creativity  
Minor degree of creativity  
Some creativity

Moderate creativity  
High creativity  
Exceptional creativity

**To what extent are you creative in your professional life?** No significant involvement would indicate little or no time is spent on creative activities, moderate involvement would be consistently engaging in creative activity, and exceptional involvement would be an intensive and pervasive preoccupation with creative activities.

No significant involvement  
Minor degree of involvement  
Some involvement

Moderate involvement  
High involvement  
Exceptional involvement

**How creative are you in your extra-curricular life (hobbies, volunteering, etc.)?** No significant creativity is routine activities with few innovative aspects, moderate creativity might involve major modifications of common practices or products, and exceptional creativity involves a radical deviation from the commonplace.

No significant creativity  
Minor degree of creativity  
Some creativity

Moderate creativity  
High creativity  
Exceptional creativity

**To what extent are you creative in your extra-curricular life?** No significant involvement would indicate little or no time is spent on creative activities, moderate involvement would be consistently engaging in creative activity, and exceptional involvement would be an intensive and pervasive preoccupation with creative activities.

No significant involvement  
Minor degree of involvement  
Some involvement

Moderate involvement  
High involvement  
Exceptional involvement

Considering both your professional and personal life, **what would be the highest overall level of creativity you have engaged in**, regardless of the extent to which you engaged in it? Use the examples provided above to help you decide.

No significant creativity  
Minor degree of creativity  
Some creativity

Moderate creativity  
High creativity  
Exceptional creativity

Considering both your professional and personal life, **how would you rate yourself on the amount of time that you are engaged in creative activities?** No significant involvement would be that most of your life is very routine, moderate involvement would indicate there is a notable amount of innovative activity, and exceptional involvement would be an intensive and pervasive preoccupation with creative activities.

No significant involvement  
Minor degree of involvement  
Some involvement

Moderate involvement  
High involvement  
Exceptional involvement

Appendix G

Consent Form

You are invited to participate in a research study. The purpose of this study is to examine the relationship between personality, creativity, and problem solving. You will be asked to propose solutions to a number of problems, ranging in difficulty from moderate to very challenging. You will then be asked a number of questions regarding general life experiences and attitudes. This procedure will take no longer than an hour and a half.

For participating in this study, undergraduate psychology students may be eligible for partial course credit. You may withdraw at any time during this study, and will receive credit corresponding to the length of time you did participate. Please see your professor for alternate ways to receive this credit.

By clicking on "I wish to participate" below, you indicate that you wish to participate in this study. It also indicates that you understand the following:

1. I am a volunteer who can withdraw at any time from the study for any reason.
2. There are no known risks of physical or psychological harm.
3. The data you provide will remain completely confidential.
4. Data obtained in this research will be stored at Lakehead University by Dr. John Jamieson for seven years, as per standard university procedures.
5. If you have any questions or concerns, you may contact the researcher at [dcarmstr@lakeheadu.ca](mailto:dcarmstr@lakeheadu.ca). If you feel you have not been treated according to the descriptions on this page, or your rights as a participant in research have been violated during the course of this project, you may contact Lakehead's Office of Research.
6. A copy of the results will be made available on this web-site in September of 2004.

## Appendix H

### Debriefing Form

Thank you very much for your participation!

You have just participated in one of two psychology research studies on thinking styles, personality, and creativity. Previous research in this area has demonstrated that people who report having unique experiences (e.g. feeling one's legs or arms have momentarily grown in size) or beliefs (e.g. having the ability to read other people's minds) typically have a higher number of creative accomplishments than people without those experiences or beliefs. However, the cognitive reasons (or the ways in which people think) for this are not understood. A number of tests of creative ability – the ability to generate many ideas, see similarities in discrepant objects, and the ability to solve logic problems – were all administered to see what were the strongest skills for people with unique experiences and beliefs. It is also questioned whether these skills are different than the skills other people use to solve problems.

The measurement of creative ability is a very controversial topic, because few people can agree on what creativity is, and what makes people creative. Therefore, your performance on any one of these 'creativity' tests may not reflect your overall level of creativity. These tests are designed to be very hard, and few people score highly on any of them. If you have any further questions about the purpose of this study, or concerns about how it was run, you may feel free to contact the researcher at [dcarmstr@lakeheadu.ca](mailto:dcarmstr@lakeheadu.ca) or the Lakehead University Research Department. If you would like a copy of the results, you may email the researcher. Results will also be posted on this website by August 15, 2004 .

Since this is a learning opportunity for students of introductory psychology, please ask yourself the following questions. The researcher would be happy to discuss the answers with you.

- (1) Can you name two of the variables under investigation in this study? How do you think these two variables might be related, and why?
- (2) What might be some advantages about researchers using the internet to conduct studies? What might be some disadvantages?