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A Word Game: Trends of Associative Processing in Individuals with Schizotypal Characteristics

Kathryn Tierney Roberts
College of William and Mary

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Trends of Associative Processing in Individuals with Schizotypal Characteristics

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by

Kathryn Tierney Roberts

Accepted for ______________________________________
(Honors)

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Jennifer A. Stevens, Ph.D., Director

____
Glenn D. Shean, Ph.D.

____
Adam S. Potkay, Ph.D.

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ABSTRACT

Individuals with schizotypal personality disorder (SPD), or characteristics thereof, demonstrate elevated creativity, particularly visible in associative processing tasks. It is thought that an abnormal activation of semantic networks underlies the tendency for these individuals to form remote associations through loose and over-inclusive processing. Elevated scores of magical ideation (MI), which surveys beliefs in mysterious causation, have been specifically associated with similar thinking to individuals with SPD. Through a series of three experiments, the current study seeks to examine several associative trends with regards to judgment and response time. In Study 1, low and high MI participants completed an image-word pair association task, judging word pairs produced by other low and high MI participants. Neither convergence nor divergence of associative processes was observed, suggesting an individualized loosening of associative processing. High MI raters, however, did form associations faster and judged words as more likely descriptors of the images than low MI raters. In a follow-up forced-choice judgment task performed by randomly selected participants (Study 2), words that had been given by low MI participants were rated as more likely descriptors of the image than words given by high MI participants. Furthermore, word generation times (Study 3) by low and high MI participants suggest that the creative and loose processing of individuals with high MI scores may translate to verbal fluency tasks as well, as high MI participants generated words slightly faster than low MI participants. Cohesively, the experiments demonstrate the creative and loose associative processing of individuals with SPD by noting their unusual word generation, consistency in judging words as likely descriptors of the image, as well as quick association and word production times.

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A Word Game:

Trends of Associative Processing in Individuals with Schizotypal Characteristics

For centuries, scientific research has provided evidence linking creativity to psychotic disorders (Andreasen, 1996). Particularly with the schizoid spectrum of mental illnesses, creative thinking has been specifically considered a function of loose and over-inclusive associative processes (Bleuler, 1911/1966; Merten, 1993; Eysenck, 1994). In investigations of associative creativity, researchers have focused little attention on the creative interactions among individuals with psychosis. Do their creativities diverge, so that they cannot understand the associative processes of one another? Or, do their creativities converge in a realm not as well understood by those without illness? The current study specifically examines the interplay of creative ingenuity among individuals with characteristics of schizotypal personality disorder (SPD), as well as further investigates trends in their associative processing.

The schizotypal personality

Schizotypal personality disorder (SPD) is a DSM-IV Axis II personality disorder, with which individuals are diagnosed if they exhibit five of DSM's nine defining features (American Psychiatric Association, 2000). Raine (1994) organizes these nine features by three latent factors: cognitive-perceptual, interpersonal, and disorganized. The cognitive-perceptual component considers the DSM features of ideas of reference, magical thinking, unusual perceptual experiences, and paranoid ideation. Paranoid ideation is also considered in the interpersonal factor, along with excessive social anxiety, lack of friends, and inappropriate affect. Finally, the disorganized component incorporates unconventional behavior and odd speech. Evidence for the three factor paradigm for schizotypy has been confirmed cross-culturally, cross-genders, and across the continuum of schizoid illnesses (Raine, 2006). Furthermore, Arndt and colleagues (1991) confirm that two of the factors fall within the well-accepted two dimensions of schizotypy: positive and negative. The cognitive-perceptual component has been considered analogous to the positive symptoms, considering the presence of odd beliefs and behaviors. Negative symptoms are highly correlated with Raine's interpersonal factor and reflect lack of interest in interpersonal relations. Arndt and colleagues consider Raine's disorganized factor to be merely indicative of the thought disorder.

The DSM-IV reports that SPD is found in approximately 3% of the general population (American Psychiatric Association, 2000), although prevalence varies both demographically and ethnically. Rates have been documented as low as 0.6% in Norway and as high as 4.6% in the United States (Raine, 2006). Regarding ethnicity, SPD is found to be most prevalent in African Americans (28%), while still common among Caucasians (16%) and Hispanics (11%) (Chavira et al., 2003). Gender differences have also been noted in the symptoms of SPD. Females have been found to score higher on positive schizotypy, particularly with the features of ideas of reference and social anxiety. Males, on the other hand, tend to score higher on negative schizotypy, specifically on the features of lack of friends, constricted affect, and unusual behavior (Fossati, Raine, Caretta, Leonardi, & Maffei, 2003; Fonseca-Pedrero, Lemos-Giraldez, Muniz, Garcia-Cueto, & Campillo-Alvarez, 2008).

Literature suggests relatively similar contributions of genetic predisposition and environmental factors to schizotypy. Suggesting genetic influence, the heritability of schizotypy has been estimated at 0.61 (Raine, 2006). Family studies reveal consistent evidence that individuals are more likely to develop SPD if they have family members who also have SPD (Kendler & Walsh, 1995; Torgersen et al., 2000). There is no consensus on cause of the heritability, although four different gene loci are currently believed to have a link to SPD (Raine, 2006).

Suggesting environmental precursors, evidence is building cross-culturally that SPD may result from impaired brain development due to early pre- and post-natal influences. Specific factors associated with harmed neurodevelopment include exposure to influenza, prenatal stress, anoxia during birth, lack of breastfeeding, and prenatal malnutrition (Venables, 1996; Machon, Huttunen, Mednick, Sinivuo, & Tanskanen, 2002; Manchon, Mednick, Huttunen, & Tanskanen, 2005; Bakan & Peterson, 1994; Foerester, Lewis, Owen, & Murray, 1991; McCreadie, 1997). Childhood factors have also been found as poignant markers in increasing the likelihood of developing schizotypal symptoms. For example, childhood abuse is linked to higher magical ideation and perceptual aberration scores (Berenbaum, 1999), and childhood neglect has a particularly high correlation with a schizotypal outcome (Berenbaum, Valera, & Kerns, 2003). Forms of anxious and avoidant parental attachment have also been found to increase the likelihood of developing SPD (Wilson & Costanzo, 1996), while lower socioeconomic status and poor IQ are considered indirect precursors (Erlenmeyer-Kimling, Rock, Squires-Wheeler, Roberts, & Yang, 1991). Finally, Raine and colleagues (2003) found that proper nutrition, exercise, and mental stimulation in the first few years are associated with lower scores in schizotypy in early adulthood.

The onset of SPD typically occurs by early adulthood (Raine, 2006), from whence the American Psychiatric Association describes it as an enduring and steady disorder

(American Psychiatric Association, 2000). Suggesting the persistence of symptoms, one longitudinal study found that 75% of ten-year olds diagnosed as schizoid, and 70% of sixteen-year olds diagnosed with SPD, retained their status at age 25 (Squires-Wheeler, Skodol, & Erlenmeyer-Kimling, 1991). On the contrary, both longitudinal and cross-sectional studies have revealed a decrease in schizotypy scores and the presence of psychotic symptoms over time. Multiple cross-sectional studies reveal that adolescents score significantly higher in measures of schizotypy than adults (Badcock & Dragovic, 2004; Fossati et al., 2003). When Mata and colleagues (2005) examined the change in scores among a large sample of undergraduate students within an age range of five years, their results again supported previous research that schizotypal symptoms decrease with age. In an analysis of these scoring mechanisms, young participants were found to score higher on questions reflecting physical anhedonia and magical thinking than those who were older (Paino-Pineiro, Fonseca-Pedrero, Lemos-Giralez, & Muniz, 2008). Raine attributes the incongruent data on the perseverance of SPD to signifying two subtypes of schizotypy: first, an unstable form that is likely formed from environmental factors, and second, a more stable form that is genetically and/or neurodevelopmentally based (Raine, 2006).

With regards to the persistent subtype of schizotypy, research shows that a portion of individuals with SPD progress to a more severe form of the illness: schizophrenia. Thus, the schizotypal personality is viewed on a continuum in accordance with the severity of symptoms. The present study utilizes participants on the lesser end of the continuum. Subjects in the current study exhibit characteristics of SPD, but it is unknown whether or not they would be clinically diagnosed as having the illness later on. Data are incongruent as to the rate of individuals that progress from SPD to schizophrenia (Raine, 2006). One study reports that 25% of schizotypal patients met the criteria for schizophrenia in a two year follow-up (Schultz & Soloff, 1987). Another study reports that 17% of individuals with comorbidity for SPD and borderline personality disorder progress to schizophrenia (Fenton & McGlashan, 1989). No matter the prevalence, symptoms of SPD have been found to be consistent with schizophrenia, albeit in milder forms (Trotman, McMillan, & Walker, 2006). Thus, SPD has been viewed by many as the prototype for schizophrenia spectrum disorders, allowing researchers to feasibly obtain a participant pool and draw conclusions that may likely predict even more pronounced trends in severe schizoid illnesses.

The magical ideation component of schizotypy

Meehl (1964) characterized magical ideation as the belief that "events which, according to causal concepts of this culture, cannot have a causal relation with each other, might somehow nevertheless do so." To simplify Meehl's definition, magical ideation is the belief in mysterious causation - particularly as it relates to personal experiences, rather than the theoretical possibility of occurrence (Eckblad & Chapman, 1983). Magical ideation (MI), or magical thinking, is currently one of the nine accepted DSM defining-features of SPD (American Psychiatric Association, 2000).

In accordance with Meehl's classical definition of magical ideation, an MI scale was formulated to survey if one's beliefs in causation are deemed to be unconventional by societal standards. The MI scale presents thirty true/false questions that allow individuals to interpret their own prior experiences. In particular, the questions survey for the beliefs in thought transmission, astrology, spiritual causation, transfer of psychic energies, and psychokinetic effects. In an analysis of the MI scale, individuals who scored higher were found to report more psychotic symptoms in the forms of thought transmission, visual and auditory hallucinations, and aberrant beliefs (Eckblad & Chapman, 1983). Subsequent research has revealed strong correlations between MI scores and schizotypy, resulting in the MI scale as a commonly used index of schizotypy (Venebles, Wilkins, Mitchell, Raine, & Bailes, 1990).

The creative nature of the schizotypal personality

To create is to forge a novel analogy between formerly unassociated elements (Sternberg, 1999). For centuries, biographical reports of some of the most creative individuals – musicians, artists, scientists, and writers -- have portrayed innumerable psychotic episodes and suicides (Brod, 1997). Psychological studies provide tangible evidence of this connection between creativity and psychoticism, consistently revealing that individuals with high creativity tend to score higher on measures of psychoticism than less creative individuals (Andreasen, 1996). Additionally, a family study by Heston found that children born to, but separated shortly after birth from, schizophrenic mothers demonstrated artistic talent that far exceeded a control group (Heston, 1966). Likewise, another study gathered highly creative adults who had been adopted as children and examined the rates of mental illness in their biological and adoptive families. The mental illness in their biological, not adoptive, parents again correlated psychosis to creativity (McNeil, 1971).

The creative nature of individuals with SPD was actually recognized nearly a century ago by Eugen Bleuler. In the preliminary defining of schizophrenia, Bleuler (1911/1966) noted four main features of schizoid disorders, one of which was loose and over-inclusive associative processing. The facilitation of distant and loose relations among elements is considered to form the basis of creativity, as individuals who form loose associations generate a larger pool of ideas than those who do not think in this fashion (Eysenck, 1994). One must consider at all times that the unusual and intrinsic responses by individuals with schizotypy should by no means be considered a mental shortcoming. Rather, it should open one's eyes to their creative potentials (Merten, 1995).

With regards to formation of loose associations, Weinstein and Graves (2001) noted an association between three variables, each in distinct domains: creativity in the cognitive domain, schizotypy in the personality domain, and cerebral hemisphere laterality in the neurophysiological domain. Weinstein and Graves, through experimentation and meta-analyses of previous research, integrated the three quite different domains into a cohesive framework. This framework attributes the formation of loose associations to decreased dominance of the left hemisphere and increased processing in the right hemisphere. In other words, information shifts from being processed in strict, strategic ways in the left hemisphere to more creative and flexible ways in the right hemisphere. The increased availability of loose associations, defining creativity, then correlates highly with schizotypy scores, which involve a looser form of thinking about reality.

More specifically, vulnerability to schizotypy is associated with reduced cognitive inhibition. Cognitive inhibition is the process of restraining irrelevant stimuli from selective attention. Thus, the inability to prevent superfluous stimuli from entering the working memory results in increased associative links (Green & Williams, 1999). This way of thinking is likely the reason for magical thinking, as magical ideations are beliefs in causation that do not reflect conventional and societal standards (Eckblad & Chapman, 1983). Still, research suggests that the underlying basis for this process is cognitive processing deficits (Dickey, McCarley, & Shenton, 2002) and/or right hemispheric dominance associated with SPD (Carlsson, Wendt, & Risberg 2000; Buchsbaum et al., 1997). Among other forms of measurement, investigations with MRIs, CTs (Dickey et al., 2002), and measurements of cerebral blood flow (Carlsson et al., 2000) are the basis of these postulations. Much research remains to be performed to uncover the biological roots of this thought disorder, as well as to link the formation of cognitive inhibition with neurological changes.

Despite uncertainty of the causation, the loose creativity seen in individuals with SPD has been studied experimentally in the contexts of both verbal fluency and word association tasks. With regards to verbal fluency, numerous research studies have found that individuals with high scores of schizotypy generate more rare and unusual responses (Duchene, Graves, & Brugger, 1998; Rawlings & Locarnini, 2007). Furthermore, in a preliminary study by Kent (2008), the neural correlates of emotional processing were studied through event-related potential as participants with schizotypal characteristics viewed a series of images. To encourage active processing of the stimulus, participants were asked to verbally provide two words to describe the image they had just seen. Consistent with previous research, qualitative differences were noted between the types of words given by schizotypal and control participants. It appeared that individuals who scored high in measures of schizotypy provided more sensorial or affective descriptors, while low-scoring participants provided more visually-based terms. Such qualitative differences provided the basis for the current study.

Word association tasks as a measure of creativity in schizotypy

Word association tasks form the basis of numerous psychological theories on schizotypy, and are considered a reliable means by which to predict creativity (Merten, 1995; Eysenck, 1994). Merten, in particular, using more rigorous methodology than previous experimentation, examined associations among several lines (free association, individual response condition, and usual responses) to integrate the methods within a theoretical parameter. In each condition, participants who scored higher on measures of psychoticism gave more unusual, less common responses in all measures. This led him to conclude that various methodologies of word association tasks all serve equally to demonstrate the creativity of individuals with magical thinking (Merten, 1993). This is important to emphasize as the current experiment involves yet another methodology of forming associations: image-word pair associations.

Furthermore, based on the consistently unusual and divergent responses produced by psychotic individuals, Merten's data also confirmed Bleuler's trend of loose associative processing. Eysenck (1994) is another lead experimenter who has performed collaborative experiments involving psychoticism, creativity, and word associations. He found that high scores on psychoticism predict increased creativity using two methodologies: unusual responses on the Word Association Test and preferences for complex drawings on the Barron-Welsh Scale. Like Merten, Bleuler, and others, Eysenck concluded that the creativity was again due to divergent thinking and over-inclusive associative processing.

One study specifically examined the association between magical ideation and creative associative processes. In this study, which is of particular interest to this experiment, Mohr and colleagues performed two experiments that cooperatively sought to investigate the ability of individuals scoring high and low in magical thinking to appreciate loose associations. In the first experiment, when they presented their subjects with unrelated words, they found that high MI participants considered the words more closely related than did low MI participants. In the second experiment, they found that high MI participants found indirectly related words to be more meaningful than did low MI participants. Because the researchers found a significant relationship between subjects' tendency to believe in magical forms of causation and loose semantic associations between words, they concluded that loose semantic processing is crucial to forming meaningful magical beliefs (Mohr, Graves, Gionotti, Pizzagalli, & Brugger, 2001).

The present study

The objective of the current study was to explore the creative interactions of persons with schizotypal characteristics, as well as further investigate trends related to their associations. The foundation of this experiment was built upon the qualitative differences Kent noted between low and high MI participants in the looseness of word pairs produced when looking at corresponding images. The experiment sought to determine if the loose associative processes of Kent's high MI participants were more or less well understood by other individuals scoring high on magical ideation tests. Thus, low and high MI raters in the current study judged word pairs on a scale of atypicality, with the poles labeled as typical (likely descriptors of the image) and atypical (unlikely descriptors of the image). The experimenter hypothesized that high MI raters would judge word pairs given by low MI participants as more typical than low MI raters, demonstrating the loose associative processing of individuals with high MI scores. In contrast, the experimenter hypothesized that high MI raters would judge words given by other high MI participants as either extremely typical (showing convergence of loose associations) or extremely atypical (showing divergence of loose associations). Furthermore, the experimenter hypothesized that reaction times would confirm their judgments – with quicker judgment times for typical judgments and longer judgment times for atypical judgments.

Two follow-up studies were also conducted based on the results of the first study. Due to the bias towards normalization discovered in Study 1, the second study sought to force participants to classify the word pairs as "likely" or "unlikely" descriptors. The experimenter predicted that words given by high MI participants would be judged as more unlikely descriptors of the image than words given by low MI participants. A third study measured word generation time between high and low MI participants, so the experimenter could compare word generation time with the associative response times found in the first study. It was hypothesized that high MI participants would exhibit greater verbal fluency and generate words more quickly than low MI participants.

STUDY 1: JUDGMENT OF TYPICAL AND ATYPICAL WORD PAIRS

Method

Participants

Forty students (31 females and 9 males) between the ages of 17 and 21 were recruited from the William and Mary Research Participation Pool. When joining the Research Participation Pool, undergraduate students completed an introductory psychology mass testing survey, which included a magical ideation (MI) scale component. One experimenter identified students in the Research Participation Pool who had scored 1.75 standard deviations above and below the mean on the MI scale. An anonymous email list was presented to another experimenter, who contacted eligible students with an invitation to participate in the study. Students were awarded research participation credit for their Introductory Psychology class in exchange for their participation in the study. All researchers conducting the study were blind to the MI scores of the participants.

Behavioral task

The purpose of the task was to judge the word pairs given by high and low MI participants in the study by Kent (2008). Kent's participants were categorized by MI scores in the mass testing survey of 1.5 SD below and above the mean, respectively. To diminish confusion associated with Kent's low and high MI subjects and the low and high MI participants in the current study, we will hereforth refer to Kent's participants as typical (representing low MI) or atypical (representing high MI) participants, and the words they donate as typical or atypical word pairs. Participants in the current study will be referred to as low and high MI raters.

Participants in Kent's study viewed 160 images: 40 positive, 40 negative, 40 emotional, and 40 neutral. Images presented in Kent's study were chosen to elicit emotional processing. Images were drawn from the International Affective Picture System (IAPS). For her study, Kent chose 40 images for each category: high valence (6.34 - 9.00) and medium arousal (2.60 - 6.33), low valence (1.00 - 2.66) and medium arousal, and neutral valence (2.67 - 6.33) and low arousal (1.00 - 2.66). These constituted the positive, negative and neutral image types, respectively. Additionally, forty highly emotional still-shots were captured from William Kurelek's film entitled "The Maze," which characterizes his personal struggle with mental illness. These 160 images constituted the image pool for the current study.

After Kent's participants viewed each image, they verbally provided two descriptive words for the image. Figure 1 provides examples of these images and corresponding word pairs. With 20 participants, Kent's study produced a collection of 3200 word pairs. In order to gather a random sample of the word pairs for the current study, 40 of the 160 images were chosen. Through tally and discussion, the experimenter and research assistants collectively chose 10 images that were considered to be the best representations of each emotion. The purpose of choosing equally from each image type was to analyze for a significance of condition of affect. In choosing images, experimenters paid no attention to the word pairs coupled with the images. Once the 40 images had been chosen, the associated word pairs given by each of Kent's 20 participants were identified and collected.

The resulting 800 word pairs and 40 images were programmed into SuperLab 4.0. Each word pair was linked to the image to which it had corresponded in Kent's study. The word pairs were then coded by the type of image with which they were associated (positive = 1, negative = 2, emotional = 3, neutral = 4), as well as by the MI categorization of the participant who generated the word in Kent's study (low = 1, high = 2). The images were divided into two blocks, so that each participant would view a total of 400 word pairs and associated images. In other words, participants viewed the 40 images 10 times each, with a different participant's corresponding word pair each time. The blocking was prepared in such a way that each participant would view equal numbers of word pairs generated by each of Kent's participants. Within each block, word pairs and their associated images, were programmed to be presented in random order. Participants in the current study were randomly assigned Block 1 or 2.

In each trial, an image was presented for 3000 milliseconds (msec.) and was automatically followed by the presentation of an associated word pair. The participant's task was to judge the word pair's atypicality in describing the image. The response was made on a keypad with three keys labeled 1, 2, and 3. The participant was instructed to click "1" if they thought they thought the word pair was a typical description of the image, "2" if they considered the word pair mildly representative of the image, and "3" if they thought the word pair was an atypical description of the image. When the subject made his/her choice on the keypad, the computer advanced to the next image. The participants repeated this process for each of the 400 word pairs. The sequence took about 35 minutes for each participant to complete.

Data Collection

Prior to the participant's arrival, a data file was created for each participant in SuperLab 4.0, and the program was opened to the instructions page. Upon arrival, participants read and signed an informed consent form. They were then asked to silence any electronic devices that could cause interruptions during experimentation. The participant was asked to read through the instructions on the screen, after which the experimenter made any clarifications. In accordance with the instructions, the participant then hit the space bar, prompting three sample trials. The sample trials used images that were part of the study, but the word pairs were fashioned specifically to elicit each of the three responses: typical, mildly representative, and atypical. Although intended to obtain specific answers, the participant's processing of the sample images was not influenced by the experimenter. After completion of the three sample trials and any of the participant's questions about the process had been answered, the experiment began. For each of the 400 trials, the judgments (1, 2, or 3) were recorded. Furthermore, the time that each word pair was present on the screen was recorded and defined as the participant's response time.

Questionnaires

At the conclusion of the study, two untitled questionnaires were administered: the Magical Ideation (MI) scale and the Schizotypal Personality Questionnaire-Brief (SPQ-B). The MI Scale, as previously described, is a thirty question survey that serves as a general measure of proneness to schizotypy (Eckblad & Chapman, 1983). After necessary reversals are made, questions answered affirmatively receive a score of 1, so that scores can range from a minimum of zero to a maximum of 30, with high scores predicting proneness to psychotic symptoms.

Furthermore, the Schizotypal Personality Questionnaire (SPQ) was created by Raine to take into account the DSM's nine features of schizotypy (Raine, 1991). As previously mentioned, Raine and colleagues identified three latent factors underlying differences in schizotypal personality: cognitive-perceptual deficits, interpersonal deficits, and disorganization (Raine et al., 1994). In order to reliably and briefly assess individuals for schizotypy, Raine and Benishay devised the Schizotypal Personality Questionnaire-Brief (SPQ-B), comprised of 22, rather than 74, questions. The SPQ-B, used in the current study, highly considers the three factors underlying schizotypy. Specifically, eight questions measure for cognitive-perceptual deficits, eight for interpersonal deficits, and six for disorganization (Raine & Benishay, 1995). In the current study, questions answered affirmatively in the survey were given a score of 1, meaning scores could range from a minimum of zero to a maximum of 22, with higher scores predicting a greater likelihood of schizotypy. Furthermore, the scoring was broken down into the subscales for latent factors, allowing for further analysis of schizotypy.

Data Analysis

Each data file was manually cleaned by eliminating all data associated with the presentation of image. Rather, only the figures associated with word pair presentation were needed, as this included reaction time, judgment by key press (1, 2, or 3), image type (1, 2, 3, or 4), and the categorization of word pair (1 or 2). Data was then analyzed for inappropriate key responses. Several participants reported the screen going blank during trials, which impaired either image presentation or reaction time. In such cases, the experimenter instructed the participant to hit an improper key (one not labeled) so that these trials could be easily identified and discarded prior to data analysis. A total of 20 word pairs were discarded for this reason: 10 from low MI raters and 10 from high MI raters.

Following cleaning of participant data, mean reaction times were generated for low MI participants and high MI participants. Any datum found to be 4 standard deviations (SD) above or below its respective mean was then eliminated from each data set: 98 outliers were eliminated from low MI participant data, and 2 outliers were eliminated from high MI participant data. The experimenter believed that, in addition to skewing reaction time means, judgments were likely unreliable because the long response times predict extraneous thoughts or distractions. As a result, there remained 7892 artifacts for analysis of low MI raters and 7988 for analysis of high MI raters.

Results

The two participant groups, each with twenty individuals, were initially categorized as either having scored 1.75 standard deviations above or below the mean on the mass testing Magical Ideation (MI) scale. When administered the Chapman MI scale at the end of the experiment, a significant difference was again seen in the general measure of schizotypy using the Chapman MI scale, $t(38) = -7.427$, $p < 0.001$. Individuals who were initially categorized as high scorers in mass testing ($M = 9.7$, $SD = 4.3$) scored significantly higher than initial low scorers ($M = 2.1$, $SD = 1.5$) on this scale. However, on the Schizotypal Personality Questionnaire-Brief (SPQ-B), initial high scorers ($M = 7.4$, $SD = 5.3$) did not score significantly different from initial low scorers ($M = 7.4$, $SD = 3.6$), $t(38) = 0.00$, $p = 1.000$. Among the three characteristic categories of the SPQ-B, the greatest difference was seen in the cognitive-perceptual factor, with high MI participants ($M = 4.3$, $SD = 1.6$) scoring significantly higher than low MI participants ($M = 2.8$, $SD = 1.9$), $t(38) = -2.806$, $p = 0.008$. Differences for the interpersonal and disorganization factors were not found to be of significance between the two groups. High MI participants ($M = 1.7$, $SD = 2.0$) scored lower than low MI participants ($M = 3.0$, $SD = 2.8$) for the interpersonal factor, $t(38) = 1.54$, $p = 0.132$. Furthermore, high MI participants ($M = 1.3$, $SD = 1.7$) scored slightly lower than low MI participants ($M = 1.5$, $SD = 1.7$) for the disorganization factor, $t(38) = 0.38$, $p = 0.706$. See Table 1 for a summary of these results. A low and insignificant correlation was found between the Chapman MI scale and SPQ-B, $r(39) = 0.19$, $p = 0.245$. A moderate correlation, however, was found between the Chapman MI scale and the cognitive-perceptual factor, $r(39) = 0.51$, $p < 0.001$.

Associative judgments

In the judging of word pairs' description of images (as typical [1], mildly representative [2], or atypical [3]), two trends were particularly poignant. First, all raters judged words given by atypical participants as more atypical than those given by typical participants, $t(39) = 15.869$, $p < 0.001$. Secondly, high MI raters were more likely to judge words as typical than low MI raters, $t(38) = 1.144$, $p = 0.260$. These results are given in Tables 2 and 3, as well as visually represented in Figure 2.

With regards to the first trend, raters were found to judge words given by atypical participants as significantly more atypical than those given by typical participants. In looking at the two rater groups separately, the low MI raters judged atypical words as significantly more atypical ($t[19] = -10.155$, $p < 0.001$); the same trend occurred for high MI raters ($t[19] = -12.387$, $p < 0.001$). Therefore, the experimenter has extremely high confidence that word pairs generated by atypical participants in Kent's study are more atypical in nature than those given by atypical participants.

With regards to the second trend, high MI raters judged word pairs as more typical than low MI raters, regardless of whether the word pairs were generated by typical and atypical participants; however, neither difference reached significance ($t[38] = 0.972$, $p = 0.337$ and $t[38] = 0.801$, $p = 0.428$, respectively). It is important to note that the overall difference had greater significance ($p = 0.260$) due to its increased power. The experimenter does not have high confidence in concluding that high MI participants consistently judge words as more typical than low MI participants; however, it is important to note the trend.

Response times

The time between the presentation of the word pair on the screen and the participant's pressing of a key constituted the response time. Two trends were again noteworthy with regards to response time. First, typical word pairs elicited significantly quicker response times than atypical word pairs, $t(39) = -10.410$, $p < 0.001$. Secondly, high MI raters made their judgments more quickly than low MI raters, $t(38) = 1.989$, $p = 0.054$. The data can be found in Table 4 with a visual supplement in Figure 3.

With regards to the first trend, raters judged typical words significantly faster than atypical words. In considering the subject groups separately, low MI raters had significantly quicker reaction times when judging typical words ($t[19] = - 8.652$, $p < 0.001$); this same trend occurred with high MI raters ($t[19] = -6.292$, $p < 0.001$). Because the trend reached significance collectively and within the two rater groups, the experimenter suggests with a high degree of certainty that there is a significant difference in the time to form an association due to the categorization of word presented (typical or atypical).

In considering the second trend, high MI raters made judgments faster than low MI raters – a trend that was consistent in the judging of both typical and atypical word pairs. The difference was only significant, however, when judging atypical word pairs, $t(38) = 2.053$, $p = 0.047$. In contrast, when judging typical word pairs, the difference in response time did not quite reach significance, $t(38) = 1.893$, $p = .066$. The overall trend, however, was significant, due to the increased power.

High MI raters consistently responded more quickly than low MI raters across all conditions of affect (positive, negative, emotional and neutral). As visually distinguishable in Figure 4, the effect was found to be significant when raters judged positive and neutral images, $t(38) = 2.088$, $p = 0.044$ and $t(38) = 2.215$, $p = 0.033$, respectively. Significance was also approached with negative and emotional images, $t(38) = 1.981$, $p = 0.055$ and $t(38) = 1.580$, $p = 0.122$, respectively.

Analysis of Variance

The experimenter conducted a repeated-measures ANOVA with a within-group factor of condition of affect and a between-group factor of raters' MI scores. There was a within-group main effect of condition of affect ($F[3, 114] = 7.949$, $p < 0.001$), and, as expected, a between-group main effect of magical ideation scores ($F[1, 38] = 4.899$, $p = 0.033$). Regarding the within-factor effect, post hoc t-tests revealed several significant differences in overall reaction times between the following conditions of affect: positive and negative ($t[39] = -5.644$, $p < 0.001$), positive and emotional ($t[39] = -8.611$, $p < 0.001$), and negative and emotional ($t[39] = -4.084$, $p < 0.001$). Overall differences were not found to be significant between positive and neutral ($t[39] = -1.700$, $p = 0.097$), negative and neutral ($t[39] = 0.412$, $p = 0.682$), and emotional and neutral ($t[39] = 1.861$, $p = 0.070$). Table 5 presents the statistics for this data, which is visually displayed in Figure 4.

A second repeated-measures ANOVA was conducted with a within-group factor of judgment (key press) and a between-group factor of raters' MI scores. A within-group main effect was found of key ($F[2, 74] = 105.180$, $p < 0.001$), while no between-subjects effect of magical ideation grouping was found, ($F[1, 37] = 2.658$, $p = 0.112$). Post hoc t-tests revealed that significant differences in response times when comparing the judgments made. In comparing responses time between judging a word pair as typical (key 1) or mildly representative (key 2), $t(39) = -13.619$, $p < .001$. Significant differences were also found between typical (key 1) and atypical (key 3), and mildly representative (key 2) and atypical (key 3), shown in t-tests $t(38) = -10.914$, $p < 0.001$, and $t(38) = -2.140$, $p = 0.039$, respectively. Refer to Table 6 for data and to Figure 5 for a visual representation.

Discussion

Participant group differences

Obtaining two statistically significant groups of high and low MI were vital to the integrity of the study. Because the reliability of identifying and grouping individuals through mass testing was questioned, the experimenters administered two questionnaires: Chapman's MI survey and the SPQ-B. Significant differences were found between the two groups on Chapman's MI survey. Furthermore, despite no difference in the overall scores on the SPQ-B between the two groups, the cognitive-perceptual factor reached significance. This parallels the scores on the MI survey well, since Raine considers magical ideation to be a component of the cognitive-perceptual factor. Contrary to predictions, however, low MI participants scored slightly higher on the interpersonal and disorganized factors – yet not close to significance. With a larger sample size, higher scores on interpersonal and disorganized factors would likely shift to high MI participants, resulting also in a higher correlation between the MI and SPQ-B surveys. While the correlation between the MI and SPQ-B surveys for the present study was fairly low, the correlation for the MI survey and the cognitive-perceptual factor alone was moderate, indicating that both measures were moderately appropriate to use together. Still, differences in MI scores and the cognitive-perceptual factor differentiated the participants into two statistically distinct groups.

Associative judgments

The only statistically significant trend observed in forming judgments (key press) was that all raters judged words given by typical participants as more typical; likewise, they judged words given by atypical participants as more atypical. This observation is consistent with evidence that individuals scoring higher for schizotypy tend to give more uncommon words (Merten, 1993; Rawlings & Locarnini, 2008), and confirms the qualitative differences noted by Kent and the current experimenters between words given by typical and atypical participants. Finding a statistically significant difference in the words was critical to the integrity of the experiment because it allowed these two categorizations of word pairs (typical or atypical) to form the foundation for our examination. In other words, the experimenters were able to determine whether the creative, loose associative processes of high MI individuals converged or diverged, based on responses to these significantly distinct word pair groupings.

In contrast to the experimenter's hypothesis, the associative judgments do not suggest either a convergence or divergence in the creative associative processing of individuals with SPD. As is depicted in Figure 2, high MI raters consistently judge words as more typical than low MI raters. Had the data predicted convergence or divergence, high MI raters would have broken from the trend of how low MI raters judged words. In particular, if the results predicted convergence, the experimenter would have expected to see high MI raters judge words given by atypical participants as much more typical than low MI raters. This would suggest that the creative and loose associations of those with SPD are similar, so that they could better understand each other's thinking. Although high MI raters did judge the atypical words as slightly more typical than low MI raters, the difference followed the trend seen in the judging of typical words. Had convergence occurred, the judging of atypical words as "typical" would have been more pronounced. On the other hand, if the results predicted divergence, the experimenter would have expected that high MI raters would have judged atypical words as atypical when compared to the low MI raters. This would suggest that the creative and loose associative processes of those with SPD stem in different directions, indicating difficulty in their abilities to understand each other's creativity.

While the trend does not predict convergence or divergence, it does reflect the tendency of high MI raters to judge words as more typical, and suggests a confirmation of the loose associative processing theorized to be present in individuals with SPD (Bleuler, 1911/1966; American Psychiatric Association, 2000). The loose processing allows associations to be over-inclusive, so that these individuals deem more associations typical. Furthermore, the lack of convergence and divergence suggest that the types of loose associations are unique, and hence are understood similarly by those with and without illness. While high MI raters judge words as more typical than low MI raters, it is important to note that the difference only approaches, but does not reach, significance. By increasing the number of participants in the study, the increased power may find the difference to be significant.

Reaction times

With regards to reaction time, words given by typical participants elicited significantly quicker response times by raters than words given by atypical participants. Interestingly, in the associative judgments, word pairs given by typical participants were also judged as more typical as those given by atypical participants. This poses the question of a relationship between the factors of judgment (key press) and time to make the judgment. Do participants make quicker associations to the image when they considered words as more typical?

Literature suggests that the time it takes to form an association is the product of word recognition and the relationship between elements. Solomon & Howes (1951) found that the more often that a word is presented, the word increases in availability in our memory, hence shortening the latency of word recognition. Thus, one must consider the nature of the words presented. Numerous studies have noted that less common words are given by schizotypal individuals (Duchene et al., 1998; Rawlings & Locarnini, 2008). Furthermore, words analyzed in the present study were more often repeated when provided by typical participants, due to the sensorial nature of the words (see Figure 1). Thus, the commonality of words given by typical participants may, as a consequence of how quickly they come to the rater's mind, elicit a quickened response time. Additionally, DeLuicia and Stagner (1954) note that in forming an association, one must also consider the relationship between the two words. Participants require more time to form their judgment when words less clearly depicted the image to them, as they searched for an association. The commonality of the word may also play a role in the relationship, as words that are more familiar to the participant may be more easily manipulated to create form an association (Solomon & Howes, 1951).

A second key trend was that high MI raters were significantly quicker to make judgments than low MI raters. This trend again complements the associative judgment trend found with high MI raters – that they were more likely to judge words as typical. Cooperatively, these trends have even more strength in suggesting the presence of loose associative processing in individuals with high MI scores. Through their over-inclusive and creative associative processes, they generate a larger pool of ideas. This mediates their easier formation of associations, and results in less time to generate responses.

In fact, high MI raters responded more quickly across all conditions of affect, with the difference reaching significance when forming word associations to positive and negative images. Furthermore, there was a main effect of condition of affect. DeLucia and Stagner (1954) equated slower association times with the stimulation of emotions. They found little indication of latency in word recognition, but a long delay in associative processing due to the activation of emotions and subsequent thoughts pertaining to that emotion. Our data did not support their conclusion, as reaction times were fastest to positive, rather than neutral, words.

Follow-up studies

Two questions arose from the conduction of the first study. The first question arose from the bias towards normalize of judgments through key press. Unexpectedly, judgments of both typical and atypical words fell on the typical end of the spectrum. While the difference between the two groups was found to reach significance, the experimenter hoped to further differentiate the typicality ratings of the two groups through methodology that did not permit bias towards normalization. The experimenter thus designed a forced-choice follow-up experiment (Study 2), in which participants had to choose equal numbers of word pairs as "likely" and "unlikely" descriptors of each image.

Additionally, the quick judgment times by high MI participants, across categorizations of word pairs and conditions of affect, led to another question. If the creative and loose associative processes assist individuals with characteristics of SPD to form associations faster, would they also generate words faster? As noted previously, creativity has been studied in the contexts of both word association and verbal fluency. Thus, the integration of a third study would allow experimenters to note if the loose processing seen in judging associations also is attributable to quickened verbal fluency. Study 3 examines this idea through the measurement of word generation time.

STUDY 2: FORCED-CHOICE JUDGMENT

Method

Participants

Twenty students (15 females and 5 males) between the ages of 18 and 21 were selected at random from the William and Mary Research Participation pool.

Behavioral Task

The experimenter, with the aid of an online random number assigner, gave numbers between 1 and 40 to the images used in the previous study. The images were programmed into SuperLab 4.0. A text screen that presented the randomized number was then created and linked to the corresponding image. The study was programmed with several instructional slides, after which the trials began. For each trial, the image number

(1-40) was presented on the screen and remained until the participant hit the space bar. Upon such response from the participant, the corresponding image appeared on the screen. Images were presented in a random order.

A booklet was also composed for each participant. Each page was devoted to one of the forty images, presenting the 20 word pairs given by participants in Kent's study that corresponded to that specific image. Kent's participants were assigned a random number (1-20), and word pairs given by these participants were presented in this order on each page. Beside the word pairs were two columns, labeled "Likely" and "Unlikely." Under each of the headings were ten blanks. An example of a page in this booklet is shown in Figure 6, with words given by atypical participants highlighted.

Data Collection

Prior to participant arrival, the SuperLab script was opened to the instructions page. Upon arrival, each participant read and filled out a consent form and was given a booklet. Participants were asked to silence electronic devices, and were then instructed to read the directions on the screen, after which the experimenter made any clarifications in regard to the procedure. As directed, participants hit the space bar to begin the first trial. They were presented with the image number, prompting participants to find the corresponding page in their booklet. They then hit the spacebar to advance to the specific image. Their task was to choose which 10 of the 20 word pairs they felt described the image best ("likely"), and which ten did not describe the image as well ("unlikely"). Participants were instructed to write the number of each word pair (1-20) on the lines under the heading indicating their choice. This process was repeated for each of the forty images. The study took about 65 minutes to complete, after which participants filled out the MI and SPQ-B surveys. Scoring of the surveys as completed as described in Study 1.

Data Analysis

To analyze the atypicality of word pairs given by typical and atypical participants, the experimenter was interested in determining the frequencies that word pairs given by each group were judged as likely and unlikely. As noted previously, each numbered word pair seen in Figure 6 corresponds to a participant in Kent's study, and this numbering is consistent on every page. Thus, to score each booklet, the number of times that each participant number (1-20) appeared in the "Likely" and "Unlikely" columns was summed. Scores from each of the booklets were then compiled to generate total frequencies.

In summing judgment frequencies, cases in which the same word pair was categorized either twice in a column, or as both likely and unlikely, were discarded. For cases in which a word pair was placed in the same category twice, only one judgment was counted, resulting in the elimination of the missing datum. In cases in which a word pair was placed in both categories, two pieces of data were eliminated: both the datum that was judged twice and the missing datum. Of the initial 16,000 total judgments, 11 judgments for typical word pairs and 7 judgments for atypical word pairs were eliminated prior to analysis.

Results

The surveys were administered to the random selection of participants who partook in the study. As expected, their MI scores ($M = 8.9$, $SD = 4.6$) fell between those of high and low MI participants in Studies 1 and 3. Their scores on the SPQ-B ($M = 7.6$, SD = 3.5) were similar to those in Study 1 for both high and low MI participants. Within the SPQ-B survey, participants scored similarly on the cognitive-perceptual factor (M = 3.0, SD = 1.7), interpersonal (M = 2.6, SD = 2.2), and disorganized (M = 2.0, SD=1.7) factors. This data is presented in Table 7.

In the forced choice judgments, there was a significant relationship between the MI score of the participant who generated the words and judgment, X^2 (1, n=15,982) = 425.6, $p < 0.001$. The data is presented in Table 8 with a visual representation in Figure 7. Words given by typical participants in Kent's study were judged more often as likely descriptors of the image, and words given atypical participants were judged more often as unlikely descriptors of the image.

Discussion

The SPQ-B and MI surveys were administered in accordance with the IRB protocol, although their main necessity was to confirm the original groupings of mass testing in Studies 1 and 3. Because Study 2 was comprised of a random selection of individuals, their administration was not pertinent to the integrity of the study; however, the SPQ-B and MI surveys did establish that the participants had with overall average scores, allowing researchers to understand the creative and mental states from which they formed their judgments.

In Study 1, words given by typical participants were judged as significantly more typical than words given by atypical participants. However, all words were judged heavily on the typical end of the spectrum. Through a forced-choice study in which bias towards normalization was eliminated, the experimenter hoped to see a greater differentiation between words given by typical and atypical participants. In fact, the study again found a significant difference between words given by typical and atypical participants. This confirmed that, although the methodology of Study 1 permitted a bias towards normalization, the judgments made in Study 1 still produced trends that could be replicated by other forms methods of research.

The experiment also served another purpose: it allowed experimenters to individually examine participant who had generated words. In Study 1, the sheer quantity of data and variables prevented a simple means of performing this type of analysis. Through examination of the frequency of "likely" and "unlikely" responses, 60% of Kent's typical participants were found to generate more words that were judged as "likely" descriptors of the image. Moreover, 70% of Kent's atypical participants were found to generate more words that were judged as "unlikely" descriptors of the image. Of those participants whose ratings were not consistent with expectation by their MI categorization, all but three participants had frequencies of "likely" and "unlikely" ratings that were within 100 of each other (800 possible marks). The participant-specific data, in addition to the overall significance found in the chi-square, coincides with Study 1 to note distinct dissimilarities in the words given by typical and atypical participants.

STUDY 3: WORD PAIR GENERATION

Method

Participants

Forty students (22 females and 18 males) between the ages of 18 and 25 were recruited from the William and Mary Research Participation Pool. These students, as in Study 1, had completed an introductory mass testing survey that included a magical ideation (MI) component. One experimenter identified students in the Pool who scored

1.5 standard deviations above and below the mean on the MI scale. This experimenter than gave an anonymous email list to another experimenter, who contacted eligible students with an invitation to participate in the study. Students were awarded research participation credit for their Introductory Psychology class in exchange for their participation in the study. All researchers conducting the study were blind to the MI scores of the participants.

Behavioral Task

Based on the premise that high MI participants judged word pairs more quickly than low MI participants, the purpose of this experiment was to determine if high MI participants also generated word pairs more quickly. For this experiment, the identical 160 images presented in Kent's study programmed into SuperLab 4.0. Each image was coded by type (positive = 1; negative = 2, emotional = 3, neutral = 4). To expand on the Kent's word pair pool, images were presented and numbered in the identical order commenced by Kent. Thus, as was consistent with Kent's study, images were programmed to be presented in eight 20-image blocks in the following order: neutral, negative, positive, emotional, neutral, emotional, positive, and negative images. Each image was presented for 6000 msec., after which the image disappeared and a central fixation "+" sign appeared. As instructed, this cued participants to verbally provide two words to describe the image. Participants were instructed to press the space bar as soon as they had provided the two words, which would advance to the next image. The sequence took about 30 minutes to complete.

Data Collection

Prior to the participant's arrival, a data file was created for the subject in SuperLab 4.0, and the program was opened to the instructions page. Upon arrival, participants read and signed an informed consent form. They were instructed to silence any electronic devices that could cause interruptions during experimentation. The experimenter then asked the participant to read through the instructions on the screen, after which the experimenter made any clarifications. In accordance with the instructions, the participant then hit the space bar, prompting two sample trials. The sample trials used images that were not part of the study, and no words were recorded. The purpose of the sample trials was to ensure that the participant understood the procedure prior to word generation time recording. For each of the 160 trials, the experimenter recorded the two words given verbally given by the participant while the "+" cue symbol was present on the screen. Furthermore, the word generation time, defined by the length of time the cue symbol was on the screen, was recorded after the presentation of each image. After stimulus presentation, participants were given the MI scale and the SPQ-B surveys, and scoring was completed as described in Study 1.

Data Analysis

The study was conducted to measure the difference in word generation time between low and high MI participants. While the collection of word pairs was not of direct benefit to this study, the word pairs will benefit subsequent experimentation on associative processes, as it increased the word pool started by Kent by 200%.

Solely the word generation times were prepared for analysis. Each participant's data was cleaned by eliminating practice trials and all times associated with image presentation. The data from all forty participants was then compiled into one document for analysis. The initial data consisted of 160 word generation times (one per image) for each of the 40 participants, totaling 6400 response times. The mean word generation times for high and low MI participants were calculated, and any datum that fell 4 or more standard deviations above or below each mean was eliminated. Forty-seven data were eliminated: 26 from low MI participants and 21 from high MI participants. Thus, analysis was conducted on 6353 word generation times: 3174 low MI participant data and 3179 high MI participant data.

Results

The two groups of participants, each with 20 individuals, were categorized by either having scored 1.5 standard deviations above or below the mean on the mass testing's Magical Ideation (MI) scale. Participants completed the Chapman MI and SPQ-B surveys following stimulus presentation, and significant differences were seen on both measures of schizotypy. Participants who were initially categorized as high scorers in mass testing ($M = 13.2$, $SD = 5.0$) scored significantly higher than initial low scorers ($M = 3.6$, $SD = 3.5$) on the Chapman MI scale, $t(38) = -7.079$, $p < 0.001$. Likewise, on the SPQ-B, initial high scorers in mass testing ($M = 10.1$, $SD = 4.0$) scored significantly higher than initial low scorers ($M = 6.9$, $SD = 3.0$), $t(38) = -2.848$, $p = 0.007$. Pertaining to the three characteristic categories of the SPQ-B, the main difference between the two groups was seen in the cognitive-perceptual factor, for which high MI participants ($M = 5.3$, $SD = 2.2$) scored significantly higher than low MI participants ($M = 2.7$, $SD = 1.5$), $t(38) = -4.45$, $p < 0.001$. Differences between the two groups for the interpersonal and disorganization factors were not found to be of significance. High MI participants ($M =$

2.5, SD = 1.9) scored slightly lower than low MI participants (M = 2.5, SD = 2.1) for the interpersonal factor, t(38) = 0.079, p = 0.938. Regarding the disorganization factor, high MI participants (M = 2.4, SD = 1.9) scored higher low MI participants (M = 1.8, SD = 1.3), t(38)= -1.168, p = 0.250. These data are found in Table 9. A moderate correlation was found between the Chapman MI scale and the SPQ-B, r(39) = 0.690, p < 0.01.

During stimulus presentation, high MI participants were slightly faster in overall word generation time than low MI participants, although this difference was not significant, t(38) = 0.136, p = 0.892. Across all conditions of affect (positive, negative, emotional, and neutral), no significant differences were found in the word generation times between high and low MI participants. The largest difference in word generation time was seen when participants looked at emotional images: high MI participants were 346 msec. quicker, on average, to generate words, but the response was not significant, t(38) = 0.475, p = 0.638. Similarly, high MI participants generated negative and positive descriptive words faster than low MI participants; however, the results were not significant in either case (t[38] = 0.261, p = 0.796 and t[38] = 0.029, p = 0.977, respectively). In contrast, low MI participants generated words a mean of 163 msec. faster than high MI participants after viewing neutral images, the difference was also not significant, t(38) = -0.288, p = 0.775. Thus, although no significant differences were found in word generation time, it is interesting to note that atypical participants generated words faster after viewing positive, negative, and emotional images, and typical participants generated words faster when looking at neutral images. The data are found in Table 10 and visually supplemented in Figure 8.

A repeated-measures ANOVA was then conducted with a within-group factor of condition of affect and a between-group factor of participant MI score. A within-group main effect was found of condition of affect, $F(3, 114) = 7.308$, $p < 0.001$. Post hoc paired t-tests revealed significant differences between word generation times for the following conditions of affect: positive and negative ($t[39] = -3.370$, $p = 0.002$), positive and emotional ($t[39] = -3.611$, $p = 0.001$), negative and neutral ($t[39] = 2.992$, $p = 0.005$) and emotional and neutral ($t[39] = 2.768$, $p = 0.009$). Word generation differences were not found to be significant between positive and neutral ($t[39] = 0.662$, $p = 0.512$) and negative and emotional ($t[39] = -0.289$, $p = 0.774$) conditions of affect. Furthermore, the ANOVA did not conclude a between-group main effect of MI score ($F[1, 38] = 0.022$, $p = 0.883$).

Discussion

Participant group differences

As discussed in Study 1, the integrity of the experiment relied heavily on the differentiation of participants' MI scores. Although the groups were again formed through possibly unreliable mass testing measures, significant differences were found in the MI and SPQ-B scores of the groups. The two surveys had a correlation of $r = 0.69$, suggesting the appropriate joint use of the two questionnaires. As with Study 1, the cognitive–perceptual factor of SPQ-B was the only factor to reach significance, although the disorganized factor also approached significance. While low MI participants scored slightly higher in the interpersonal factor, the difference was not of significance. With a larger sample size, this trend would likely reverse.

Word generation time

Creativity of individuals with SPD has been studied through both word association and verbal fluency tasks. When high MI raters were found to make image-word pair associations more quickly than low MI raters in Study 1, the experimenters were interested in seeing if the creative nature of their associative processing was the root cause of this. In other words, could the same trend be replicated in a verbal fluency task, where participants generated descriptor words for an image?

The results show that high MI participants were slightly faster in their generation of words than low MI participants, although the difference was not significant. Far less research has been conducted on the response times related to associative processing than the products of such associations. In one study, though, participants with high and low creativity were asked to list as many items as possible that fell into certain categories within three minutes (Rushton, 1990). Participants were then judged as to the uniqueness of their word choices, as well as the total number of ideas generated. While researchers found that more creative individuals generated more unique words, they noted that the highest correlation was found between increased creativity and the number of words generated. Given that our study replicates the results found by Rushton with regards to creativity, the creative nature of high MI participants may be responsible for their ability to generate words more quickly. Specifically, the loose associative processes may produce a larger collection of ideas through increased semantic networking in the mind of high MI participants. In response to an image, words can be retrieved more easily, and hence quickly, since the individual is drawing from an enlarged pool.

The trend that high MI participants generated words faster held true across all across all conditions of affect, except neutral images, for which low MI participants were found to be quicker. Additionally, while a main effect of condition of affect was found, it is interesting to note that the significant differences seen were not the same as those in Study 1. This suggests that condition of affect does not play a central role in associative processing, neither in the judgment of associations nor verbal fluency.

A final distinction involves the qualitative differences in word pairs. Very similar to those analyzed in this experiment, differences were again observed in the words generated by low and high MI participants. Low MI participants provided more concrete, visual descriptors that related directly to the stimulus, while high MI participants produced a more diverse lexicon on descriptors – appearing again to make more convoluted associations.

General Discussion

Because higher MI scores have been associated with the style of thinking found in individuals with SPD, the formation of two statistically significant groups (low and high MI) was very important to the integrity of this study. The experimenter was concerned that mass testing would not be a reliable means of gathering and organizing participants. However, the Chapman MI and SPQ-B surveys confirmed the presence of significant differences between the groups. In Studies 1 and 3, both of which used these distinct groupings, significant differences were found between low and high MI participants on the MI scale. While the correlations between the MI and SPQ-B surveys were not consistent, there were significant differences between high and low MI groups on the cognitive-perceptual factor. Within the cognitive-perceptual factor, Raine (1994) tests for unconventional ideas of reference, magical thinking, unusual perceptual experiences, as well as paranoid ideation. Thus, the cognitive-perceptual scores complement the differences in MI scores well. Furthermore, reliability of the SPQ-B, in comparison with the full-length SPQ, has proven to be reasonable (r = 0.72 to 0.95) with good criterion validity (r = 0.62) as well (Raine & Benishay, 1995). Thus, the integrity of the study was also not affected by the use of the shortened SPQ-B.

The initial investigation of this study was to examine the convergence or divergence of associative processing in individuals with SPD. Because high MI participants rated (through key press) all words as more typical than low MI participants in Study 1, neither convergence nor divergence was found. Instead, the trend suggests that the way in which associations become loose is unique to the individual. As such, a compilation of our experimental results function to demonstrate the *unique* creative qualities of individuals with SPD in forming associations. Both Studies 1 and 2, through different judgment methodologies, suggest differences in words generated by typical and atypical participants in response to visual stimuli. Furthermore, high MI raters in Study 1 were found to judge more words as typical across all conditions. Coupled with the significantly faster association times by these individuals, the creativity of high MI participants appears to result from over-inclusive associative processes. Because this allows high MI individuals to fashion a greater assortment of ideas, it takes less time to retrieve one, resulting in a quicker reaction time. Furthermore, although not of statistical significance, the trend that high MI participants generate words more quickly also enhances the plausibility of the theory of loose creative processing.

Although these trends suggest the *unique* formation of loose associations in individuals with high MI, it is difficult to postulate a neuropsychological mechanism for this trend. While many associations have been noted between both biological roots and semantic network dysfunctions, there has been little convergence as to a functional reason for the formation of loose associations. The closest that the biological approach has come to analyzing loose associative processing is through neurological deficits related to language. Dickey and colleagues (2002), in a review of numerous MRI and CT investigations suggest that unusual language may result from thalamic and temporal lobe abnormalities associated with SPD. Pulvinar nuclei, distinct components of the thalamus, are often found to be reduced in individuals in SPD. Because these nuclei relay information to the primary visual and auditory sensory regions, as well as to the prefrontal cortex, they are postulated to cause language disturbances. It appears that these language disturbances may be particularly critical to the processing of visual information -- a finding of particular interest to the current study. Moreover, the temporal lobe structures, because of their roles in language processing, and have been correlated with formal thought disorders and verbal memory problems. Further biological studies postulate that the dysfunctions are limited to the right hemisphere, in which creative processing occurs (Goodarzi, Wykes, & Hemsley, 2000).

With only speculative biological foundations for the cause, it is difficult to integrate the semantic processing level, which appears, through reduced cognitive inhibition, to be the direct link to loose processing. The use of functional magnetic resonance imaging (fMRI) to study SPD, in an attempt to integrate the biological roots with the semantic processing, would greatly benefit research in this field. Understanding the root changes in SPD would allow researchers to delve into a deeper exploration of cognitive and behavior trends.

The present study was unusual in its methodology in comparison with other association tasks because it was comprised of both visual and linguistic components. Despite the uncommon methodology, the study confirmed trends noted in previous word-only based experiments. Thus, the study serves to offer further evidence in confirmation of Bleuler's theory of loose associative processes. Furthermore, the addition of a visual component allowed the integration of condition of affect as a variable. Although a main effect of condition of affect was found in both Studies 1 and 3, the significant differences in each did not coincide (see Figures 4 and 8). As a result, the study does not conclude that any overall trends are present in associative processes with regards to eliciting emotions.

To further analyze the trends in association, a follow-up experiment should compare forced-choice assessments made by both low and high MI participants. The results of the forced-choice experiment with a random selection of participants revealed significant differences in the types of words given by typical and atypical participants. Because the forced-choice methodology does not allow for a bias towards normalization as in Study 1, a forced-choice investigation on both high and low MI raters may better predict any convergence or divergence in associative processing, or it may confirm our results from Study 1. Additionally, further analysis of the word pool would provide a rich supplement to the finding that atypical participants generate more atypical words than typical participants. Quantifying the representation of visual, sensorial, and affective words, as examples, in each participant group may reveal reasoning for the pronounced differences in associative judgments towards the two groups. Finally, increasing the participant number for Study 1 may increase its power, so that differences in judgments (key press) between the high and low MI raters may reach significance.

Through various methodologies, the current study examined trends of associative processing in individuals with schizotypal characteristics. In suggesting neither convergence nor divergence of associative processes, the study opens the doors to the idea of *unique* creative and loose associative processing. Additionally, it demonstrates that there is a complexity to the creativity in individuals with SPD that, in comparison, makes the creativity in normal individuals appear dilute. While the trends of association, such as those found in this study, reveal distinct creative characteristics of individuals with SPD, further research on the neurological roots will assist in providing a more complete understanding of the hidden potentials of the schizotypal personality.

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Table 1

Study 1: Mean SPQ—B and MI scores for low and high MI raters

	Low MI Raters		High MI Raters	
	Mean	SD	Mean	SD
Cognitive-Perceptual	2.75	1.916	4.30	1.559
Interpersonal	2.95	2.837	1.75	2.023
Disorganized	1.50	1.701	1.30	1.625
SPQ—B total	7.35	5.304	7.35	3.631
MI total	2.05	1.538	9.70	4.342

Table 2

Judgment of images' atypicality

	Low MI Raters		High MI Raters	
	Mean	SD	Mean	SD
Typical word pairs	1.303	0.136	1.264	0.117
Atypical word pairs	1.455	0.186	1.412	0.148
Average judgment	1.379	0.160	1.328	0.121

Table 3

Frequency of judgments (key press)

	Low MI Raters		High MI Raters	
	Typical Words	Atypical Words	Typical Words	Atypical Words
Typical (1)	2952	2481	3138	2684
Mildly Rep. (2)	826	1134	657	978
Atypical (3)	176	323	197	334

Table 4
Response times with regards classification of word pair (seconds)

	Low MI Raters		High MI Raters	
	Mean	SD	Mean	SD
Typical word pairs	4.933	0.534	4.671	0.314
Atypical word pairs	5.142	0.570	4.833	0.356
Average response time	5.038	0.804	4.752	0.330

Table 5
Response times with regards to image type (seconds)

	Low MI Raters		High MI Raters	
	Mean	SD	Mean	SD
Positive images	4.863	0.521	4.576	0.325
Negative images	5.047	0.584	4.746	0.349
Emotional images	5.143	0.591	4.903	0.333
Neutral images	5.096	0.564	4.634	0.740

Table 6
Response times with regards to judgment (seconds)

	Low MI Raters		High MI Raters	
	Mean	SD	Mean	SD
Typical (1)	4.720	0.458	4.544	0.280
Mildly Rep. (2)	5.796	0.770	5.474	0.515
Atypical (3)	5.982	0.969	5.572	0.784

Table 7

Study 2: Mean SPQ—B and MI scores

	Mean	SD
Cognitive-Perceptual	3.000	1.685
Interpersonal	2.600	2.234
Disorganized	2.000	1.717
SPQ—B	7.600	3.485
MI total	8.850	4.591

Table 8

Frequency of forced choice judgments

	Typical Word Pairs	Atypical Word Pairs
Likely	4649	3347
Unlikely	3340	4646

Table 9

Study 3: Mean SPQ—B and MI scores for typical and atypical groups

	Low MI Subjects		High MI Subjects	
	Mean	SD	Mean	SD
Cognitive-Perceptual	2.65	1.531	5.30	2.179
Interpersonal	2.50	2.090	2.45	1.932
Disorganized	1.75	1.293	2.35	1.899
SPQ—B total	6.90	2.989	10.10	4.038
MI total	3.55	3.517	13.20	4.980

Table 10
Word generation times with regards to image type (seconds)

	Low MI Subjects		High MI Subjects	
	Mean	SD	Mean	SD
Positive images	4.082	2.298	4.062	2.020
Negative images	4.535	2.547	4.348	1.943
Emotional images	4.643	2.542	4.296	2.046
Neutral images	3.912	1.766	4.074	1.806
Overall	4.284	2.232	4.194	1.903

Figures

Figure 1: Word pairs given by high and low MI participants

Positive Image 10

Low MI word pairs	High MI word pairs
light, shining	hope, clear
clouds, shining	mystery, awe
sunlight, clouds	light, glory
clouds, sun	heaven, beauty
light, clouds	beautiful, divine

Negative Image 8

Low MI word pairs	High MI word pairs
torture, cruelty	judging, harsh
chair, torture	solid, electric
punishment, confinement	extreme, pointless
execution, chair	systematic, death
belts, electric	inhumane, death

Emotional Image 4

Low MI word pairs	High MI word pairs
bullying, cruel	fear, isolation
kids, bullies	painful, blood
bullying, anxiety	child, parenting
bully, money	unfair, unreal
bully, scolding	psychic, kid

Neutral Image 10

Low MI word pairs	High MI word pairs
coffee, mug	contrast, mug
mug, blue	addiction, everyday
bright, blue	blue, wood
coffee, empty	coffee, stains
light, blue	plain, useful

Positive Image 8

Low MI word pairs	High MI word pairs
childhood, beach	interaction, friendship
kids, sand	multicultural, tolerance
sandy, playground	intriguing, young
hug, fun	innocence, joy
happy, kids	annoying, repetitive

Negative Image 3

Low MI word pairs	High MI word pairs
heroin, injection	repulsion, sadness
needle, injection	dependent, unhappy
drug, addict	addiction, pain
drugs, inject	need, dependence
drugs, bathroom	drugs, bad

Emotional Image 6

Low MI word pairs	High MI word pairs
flies, animals	buzzing, strange
bugs, flying	decay, disease
fly, face	weird, funny
insects, face	bug, man
grotesque, humanoid	user, weep

Neutral Image 6

Low MI word pairs	High MI word pairs
fire, hydrant	urine, fire
hydrant, water	suburban, useful
yellow, hydrant	bright, out of place
dogs, water	yellow, unattended
water, fire	dogs, fall

Figure 2: Judgment of atypicality by categorization of word pair

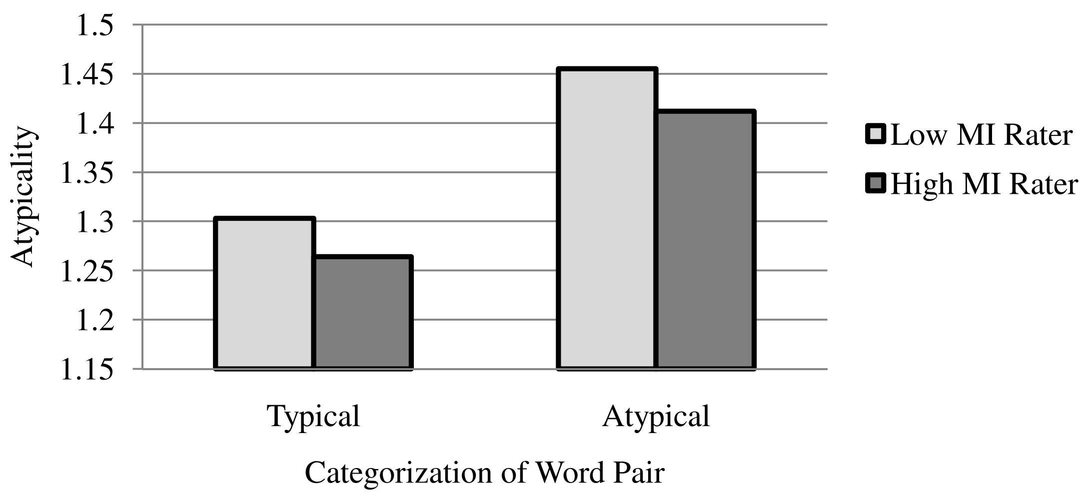

Figure 3: Response time by categorization of word pair

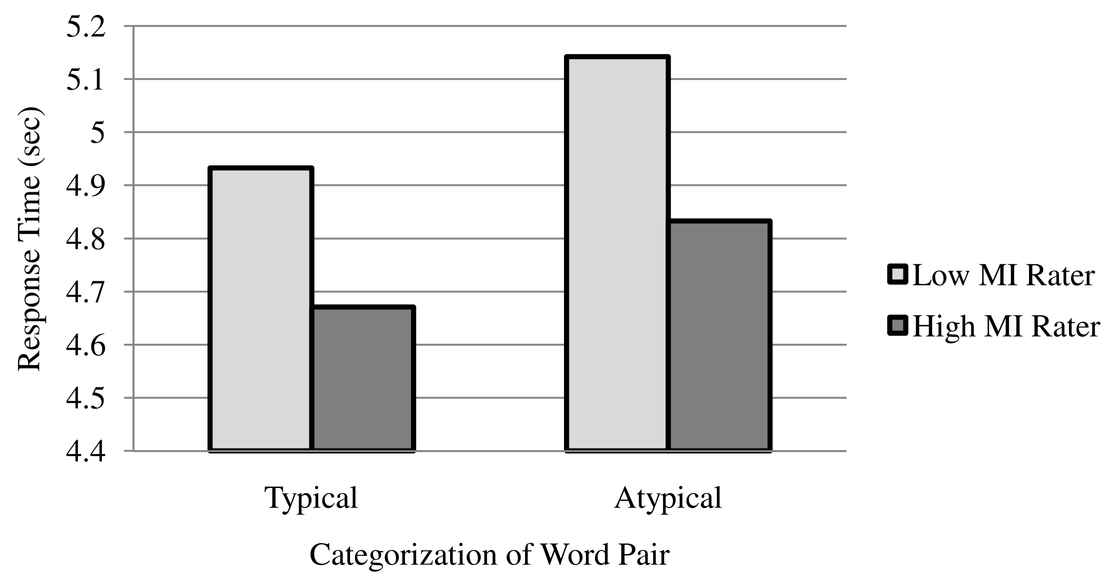

Figure 4: Response time by condition of affect

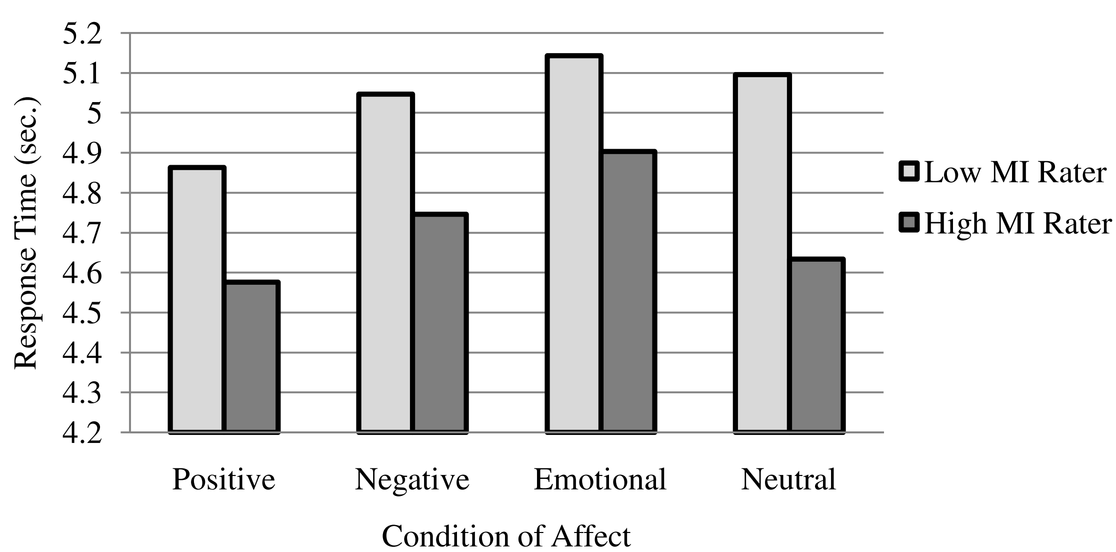

Figure 5: Response time by word pair judgment

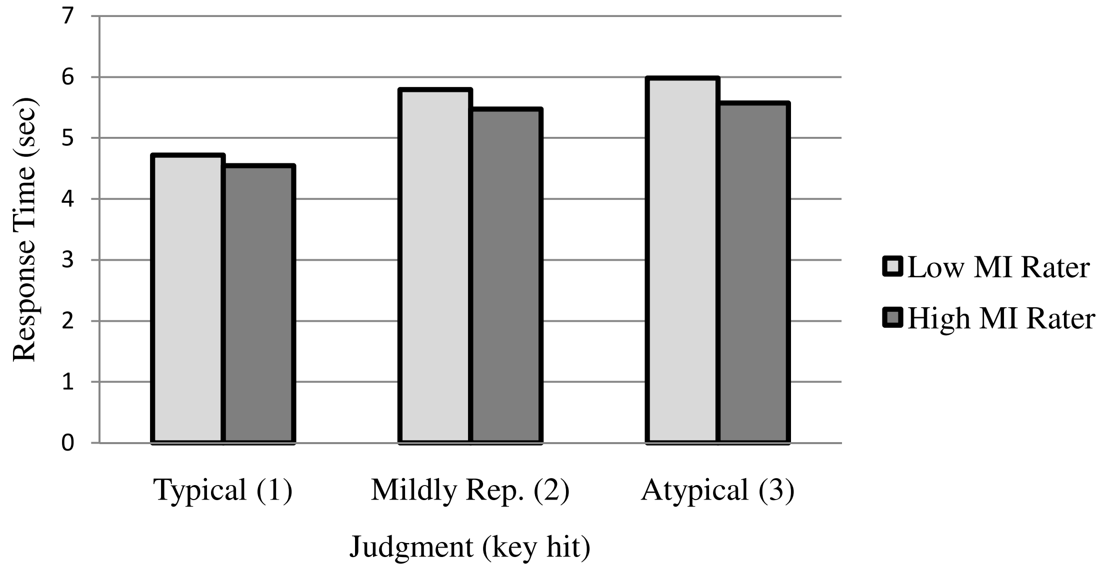

Figure 6: Sample page from forced-choice booklet

Image 13

Word Pairs

1. bad luck, open
2. umbrella, rain
3. luck, ring
4. strange, blue
5. blue, umbrella
6. blue, umbrella
7. unlucky, old
8. umbrella, home
9. try, day
10. blue, blue
11. blue, umbrella
12. umbrella, carpet
13. rain, sunlight
14. juxtaposition, umbrella
15. umbrella, shadow
16. rain, puddles
17. rainy, grimy
18. weather, superstition
19. umbrella, rain
20. blue, umbrella

Likely **Unlikely**

Figure 7: Frequency of forced-choice judgments

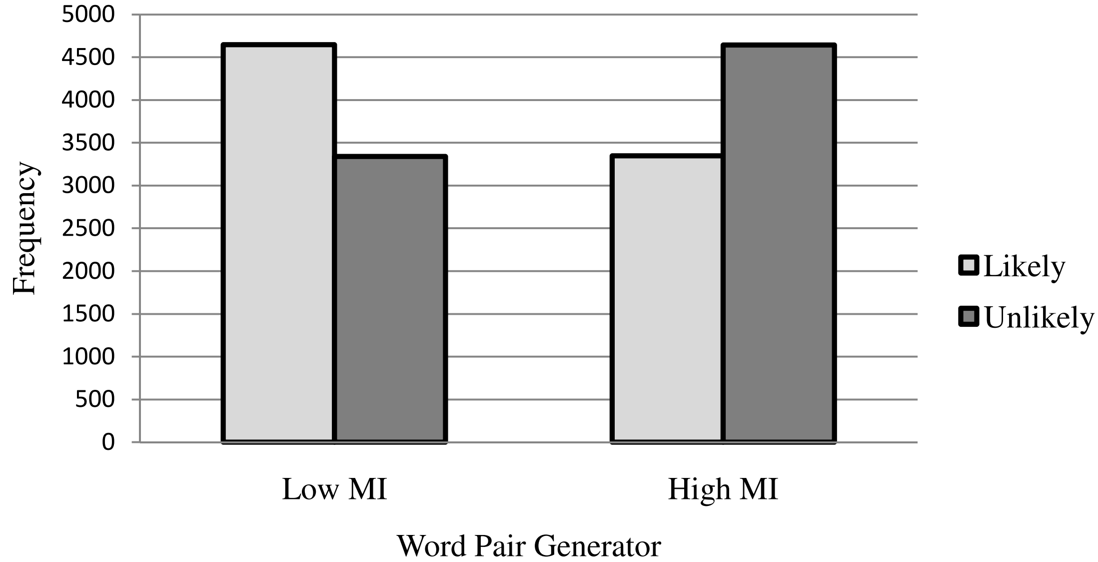

Figure 8: Response generation time by condition of affect

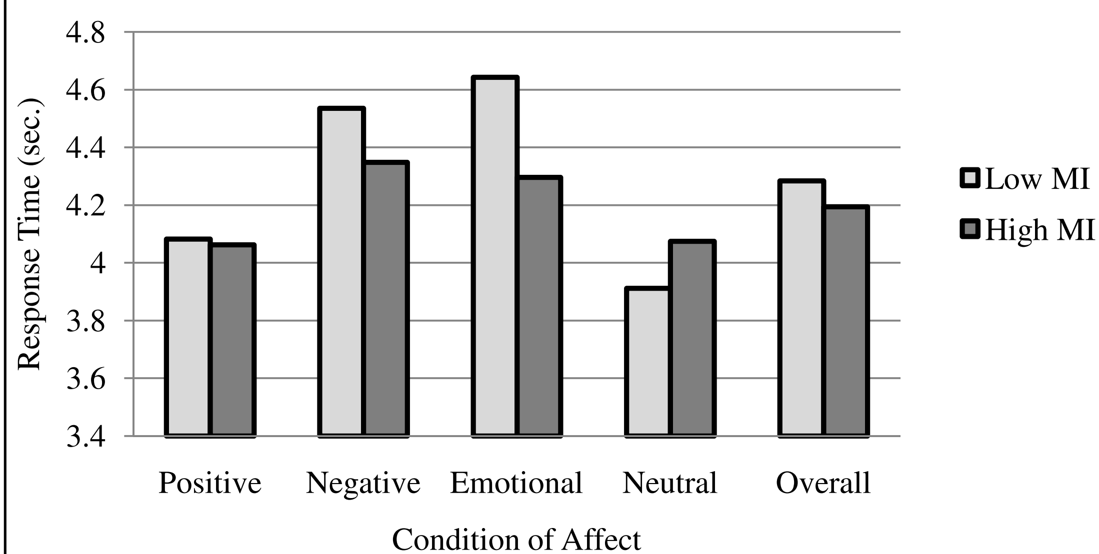

Figure Captions

Figure 1. Examples of images and associated word pairs analyzed in the current study. These are 8 of the 40 images chosen for examination in this study. The word pairs shown to the right each image are half of those donated by Kent's 20 participants.

Figure 2. Differences in low and high MI raters' judgments of word pairs given by typical and atypical participants. Atypicality was judged on a scale of 1 (typical), 2 (mildly representative), or 3(atypical). Mean responses are on a continuum of 1 to 3, from typical to atypical, respectively.

Figure 3. Differences between low and high MI raters in the time taken to make judgments with regards to who donated the word: typical or atypical participants.

Figure 4. Differences between low and high MI raters in the time taken to make judgments with regards to image type.

Figure 5. Differences between low and high MI raters in the time taken to make judgments with regards to their choice of response.

Figure 6. Sample page from booklet in forced-choice study. Words given by atypical participants in Kent's study are highlighted in yellow.

Figure 7. Differences in the frequencies of word pairs, given by typical and atypical participants in Kent's study, that were judged as "likely" or "unlikely" descriptors of corresponding images. This task was completed by a random pool of participants.

Figure 8. Differences between low and high MI participants in the time taken to generate word pairs with regards to image type. Overall differences between the two participant pools are shown on the right.