Less words, more words: psychometric schizotypy and verbal fluency

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Abstract

Positive and negative symptoms of schizophrenia have been differentially associated with irregularities in verbal production, suggesting the involvement of different underlying mechanisms in psychotic symptomatology. In view of that, the present investigation examined whether the amount of verbal production would be also differentially associated with negative and positive symptoms of psychometric schizotypy in a sample of college students (N=190). The participants were tested on a typical verbal fluency test and completed the O-LIFE schizotypy scales. The analyses revealed that decreased verbal fluency was associated with increased levels of negative schizotypy in participants who scored one standard deviation above the mean on the ‘Introvertive Anhedonia’ scale. In contrast, increased verbal fluency was associated with increased levels of positive schizotypy in participants who scored one standard deviation above the mean on the ‘Unusual Experiences’ scale. The obtained results are discussed in terms of the proposal that psychotic-like unusual experiences, like hallucinations, may be the product of a higher automatic spreading activation among stored lexical units, a mechanism which seems to account for the previously reported link between positive schizotypy and creativity.

Key words: automatic spreading activation; creativity; executive functioning; hallucinations; phonological (letter) fluency; positive/negative schizotypy; individual differences in speech production

Abnormalities in verbal communication, such as irregularities in speech production, are frequent in people with schizophrenia. Dramatic fluctuations between increase (pressure of speech) and decrease (poverty of speech) in the amount of verbal production have been related to linguistic impairments in schizophrenia, and have been consistently associated with different aspects of the psychotic symptomatology (Harvey, 2000). Despite the presence of a wide range of communication abnormalities in schizophrenia, factor analytic studies have identified verbal productivity as a main dimension of communication disorder (Harvey, Lenzenweger, Keefe, Pogge, Serper, & Mohs, 1992).

Poor performance on verbal fluency, as assessed by the ability to generate word lists under certain stimulus constraints, has been associated with negative symptoms of schizophrenia, such as flat affect, anhedonia, and impoverished speech (Allen, Liddle & Frith, 1993; Howanitz, Cicalese, & Harvey, 2000). Verbal fluency is thought to reflect executive functioning, such as cognitive switching, rule monitoring, and inhibition of inappropriate responses (Lezak, 1995). Impaired executive functioning has not only been associated with deficient frontal lobe functioning in schizophrenia (Crow, 1992), but also with frontal lobe dysfunction in other patient

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groups (Beatty, Goodkin, & Beatty, 1989; Joyce & Robbins, 1991). Tests of verbal fluency are generally considered to be sensitive to frontal lobe dysfunction (Lezak, 1995) as well.

Evidence suggests that verbal fluency is differentially affected in psychosis. Although poor performance has been associated with negative symptomatology (Allen et al., 1993; Howanitz et al., 2000), increased verbal fluency has been associated with positive psychotic symptoms, such as hallucinations (Lindamer & Whitman, 1997; Kerns, Berenbaum, Barch, Banich, & Stolar, 1999). This latter finding is consistent with theoretical proposals that hallucinations are produced as a result of an increased automatic spreading activation between stored lexical items (David, 1994; Hoffman & McGlashan, 1997). People who experience hallucinations may generate an increased amount of words during verbal fluency tests due to such an enhanced lexical activation.

Are irregularities in verbal fluency primary or secondary features of psychosis? Cognitive irregularities in schizophrenia can be either viewed as cognitive endophenotypes (primary features), i.e. cognitive markers intermediating between a putative genetic disposition and clinical symptoms, or as epiphenomena of the psychotic symptoms, side effects due to medication, and/or effects of hospitalization (secondary features). The presence of verbal fluency abnormalities in healthy participants who score highly on psychometric measures of schizotypy would support the possibility that these irregularities are primary features. On the contrary, a negative result would suggest that these irregularities are secondary features. Unfortunately, because of conflicting evidence in the recent literature, it is unclear whether or not verbal fluency irregularities, akin to those associated with negative and positive symptoms of schizophrenia, can be observed in positive and negative schizotypy as well.

In some recent studies, positive schizotypy has been associated with increased verbal fluency (O’Reilly, Dunbar, & Bentall, 2001; Weinstein & Graves, 2002). Considering that fluency is typically regarded as a main facet of creativity, the authors of these studies have interpreted this association as evidence of a biological link between creativity and ‘positive’ psychotic-like features (e.g. aberrant perceptual experiences). This reported association between positive schizotypy and increased verbal fluency (O’Reilly et al., 2001; Weinstein & Graves, 2002) seems to accord with the hypothesis that hallucinations are the product of an increased automatic spreading activation between related lexical units (David, 1994; Hoffman & McGlashan, 1997). However, other studies have failed to demonstrate a similar association between positive schizotypy and verbal fluency (Barrantes-Vidal, Fananas, Rosa, Caparros, Riba, & Obiols, 2002; Dinn, Harris, Aycicegi, Greene, & Andover, 2002). In addition, unlike the schizophrenia literature (Allen et al., 1993; Howanitz et al., 2000), none of the above schizotypy studies (Barrantes-Vidal et al., 2002; Dinn et al., 2002; O’Reilly et al., 2001; Weinstein & Graves, 2002) have revealed any specific association between poor performance on verbal fluency and negative schizotypy.

One possible explanation for the above inconsistent results might be related to the sample size. With the exception of the Barrantes-Vidal et al study, which employed a sample of adolescents with mean age = 13.4 years (a methodological pitfall, considering that the schizotypy scales employed were designed for adults), in studies with adults (Dinn et al., 2002; O’Reilly et al., 2001; Weinstein & Graves, 2002) the largest sample size was 103 participants. Therefore, the aim of the investigation was to re-examine the relationship between verbal fluency and
positive/negative schizotypy in a larger adult sample. Moreover, any systematic relationship between verbal fluency and schizotypy might not be necessarily linear. For instance, a differential association between positive/negative schizotypy and verbal fluency may be detectable only for the extreme scorers. Consequently, the second aim was to look for evidence on possible non-linear markers. To evaluate the above possibilities, 190 participants were tested on a typical verbal fluency test (Lezak, 1995) and completed a multi-dimensional schizotypy inventory (O-LIFE; Mason, Claridge, & Jackson, 1995).

**Method**

**Participants**

One hundred and ninety students, recruited from the University College London (UCL) campus, took part in this study. Their mean age was 23.5 years, ninety-nine were female, and were unpaid volunteers. English as a second language was an exclusion criterion. Four participants were dropped from the analysis due to a large number of unanswered questions in the O-LIFE.

**Schizotypy measures**

The Oxford–Liverpool Inventory for Feelings and Experiences (O-LIFE) consists of 159 items selected on the basis of factor-analytic studies of older schizotypy scales (Bentall, Claridge, & Slade, 1989; Mason et al., 1995). The inventory includes four schizotypy measures: The ‘Unusual Experiences’ (positive schizotypy) scale consists of items assessing magical thinking, unusual perceptual aberrations, and hallucinatory experiences. The ‘Cognitive Disorganization’ (disorganized schizotypy) scale reflects the disorganized aspect of psychosis, and consists of items assessing difficulties with concentration, decision-making and social anxiety. The ‘Introvertive Anhedonia’ (negative schizotypy) scale reflects the negative symptoms of psychosis, and consists of items assessing the lack of enjoyment from social contact, physical activities, coupled with aversion to emotional and physical intimacy. ‘Impulsive Non-conformity’ is largely based on the Psychoticism scale (Eysenck & Eysenck, 1975), and consists of items assessing aggressive, anti-social and impulsive behaviour.

Attesting to the experimental validity of these scales, high-schizotypy scorers, as identified by the O-LIFE sub-scales, demonstrate neuro-cognitive deficits akin to those seen in schizophrenic patients (Steel, Hemsley, & Jones, 1996; Rawlings & Goldberg, 2001; Tsakanikos & Reed, 2003).

**Verbal fluency**

A phonological (letter) fluency task, frequently used in neuropsychological research (Lezak, 1995), was employed to assess verbal fluency. The task consisted of three 1 min trials. In each trial, the participants were asked to generate as many words as possible that started with a certain letter (C, F, and L), avoiding names, non-English words, and derivatives of the same word. The total number of correct responses generated was the dependent measure.

**Results**

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Table 1 about here

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Data from Table 1 presents the means, the standard deviations, and the inter-correlations between the O-LIFE scales, and verbal fluency. In terms of the O-LIFE scales, the overall pattern (inter-correlation and descriptive statistics) appeared similar to that reported in the original study (Mason et al., 1995), as well as to that reported in later studies (e.g., Rawlings & Goldberg, 2001; Tsakanikos & Reed, 2003). It should be noted that the only exception was the absence of a significant correlation between ‘Impulsivity Non-conformity’ and ‘Introvertive Anhedonia’ (in the original study, \( r = -0.10, p < 0.05 \)). Considering that the correlation between the two scales was quite low in both studies, this deviation was probably due sample size differences between the Mason et al study (\( N = 508 \)) and the present investigation (\( N = 186 \)). Contrary to what was expected, there was no significant correlation between schizotypy scales and verbal fluency.

Despite the absence of a statistically significant correlation between schizotypy scales and verbal fluency, it could be still argued that non-linear relationships between these measures may exist. For example, particular trends between verbal fluency and different schizotypy measures may exist only for participants with very high schizotypy scores. To investigate the above possibility, verbal fluency performance was plotted as a function of positive and negative schizotypy (Figure 1).

Inspection of the upper graph (Figure 1 - panel A) suggests that, for participants who scored one standard deviation above the mean on positive schizotypy (‘Unusual Experiences’ > 15), verbal fluency appeared to increase as a function of their schizotypy scores. For these extreme high scorers (\( N = 33 \)), there was a statistically significant positive correlation between ‘Unusual Experiences’ and ‘verbal fluency’ (\( r = 0.35, P < 0.05 \)). However, there was no significant correlation between ‘Unusual Experiences’ and ‘verbal fluency’ (\( r = 0.03, P > 0.80 \)) for participants scoring one standard deviation below the mean (‘Unusual Experiences’ < 5).

Inspection of the lower graph (Figure 1 - panel B), suggested that verbal fluency appeared to decrease as a function of negative schizotypy for participants who scored one standard deviation above the mean (> 8) on ‘Introvertive Anhedonia’. For those extreme scorers (\( N = 28 \)), there was a statistically significant negative correlation between ‘Introvertive Anhedonia’ and ‘verbal fluency’ (\( r = -0.46, P < 0.05 \)). For those participants who scored on negative schizotypy one standard deviation below the mean (‘Introvertive Anhedonia’ < 3), there was no significant correlation between ‘Introvertive Anhedonia’ and ‘verbal fluency’ (\( r = 0.01, P > 0.90 \)). The obtained results suggest that verbal fluency, at least for those who scored very high on schizotypy, was positively associated with positive schizotypy, and negatively associated with negative schizotypy.\(^2\)

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\(^2\) The same analyses run for extreme scorers on ‘Cognitive Disorganization’ and ‘Impulsivity Non-conformity’, but no evidence for similar non-linear markers were found.
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Discussion

In line with the schizophrenia literature (Allen et al., 1993; Howanitz et al., 2000; Lindamer & Whitman, 1997; Kerns et al., 1999), the present data suggested that different schizotypy dimensions were differentially associated with verbal productivity, as assessed by a typical letter fluency task. However, the relationship between verbal fluency and schizotypy was not linear; these associations were present only for those participants who scored one standard deviation above the mean. It is worth noting that this finding supports quasi-dimensional rather fully dimensional views of schizotypy (see Claridge, 1997, for a discussion). In addition, the fact that differentiated verbal fluency irregularities were observed in a student sample as a function of psychometric schizotypy suggests that such irregularities are cognitive markers (primary features) rather than epiphenomena (secondary features) of psychosis.

During the phonological (letter) task, the participants were asked to generate as many words as possible by following certain rules, i.e. the words should start with a certain letter, and derivatives of the same words, names, and non-English words should be avoided. Consequently, adequate word production in this task relied largely on ‘executive’ functions, such as maintaining ‘on-line’ these rules and monitoring performance accordingly, while inhibiting inappropriate responses (Lezak, 1995). In the present study, negative schizotypy was found to be associated with decreased verbal fluency, following the pattern of the negative symptoms of schizophrenia (Allen et al., 1993; Howanitz et al., 2000). Given that negative symptoms of schizophrenia have been associated with impaired executive functions (Crow, 1992), it is possible that similar subtle impairments had a detrimental effect on verbal influence in participants scoring highly on negative schizotypy.

However, apart from executive functions, another cognitive process that is highly relevant to performance on a verbal fluency task is the speed of lexical retrieval. A particularly increased activation of stored lexical units would, therefore, be expected to enhance performance on a letter fluency task. Certain positive symptoms of schizophrenia, such as hallucinations, have been attributed to such an increased automatic spreading activation of related lexical items3 (David, 1994; Hoffman & McGlashan, 1997). Given that positive symptoms of schizophrenia have been associated with increased verbal fluency (Lindamer & Whitman, 1997; Kerns et al., 1999), it is possible that both positive symptoms and increased verbal fluency may be products of an enhanced automatic spreading activation. Such an account could also accommodate the finding that high levels of positive schizotypy are associated with increased verbal fluency, as has been shown in previous studies (O’Reilly et al., 2001; Weinstein & Graves, 2002) and replicated in the present investigation.

It could be argued that the positive association between verbal fluency and positive schizotypy is also predicted by the ‘sheer inhibition hypothesis’ (Spitzer, 1993). According to this hypothesis, activation tends to spread more diffusely and more rapidly due to inadequate mechanisms that control spreading activation and re-activation in the semantic networks. Unlike the automatic spreading activation

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3 For instance, a neutral sound activates automatically a similar sounding word, which in turn activates instantly and simultaneously other semantically or/and phonetically related words etc.
account, which seems limited to semantically and/or phonetically related lexical units (David, 1994; Hoffman & McGlashan, 1997), the sheer inhibition hypothesis is not limited to certain types of units (Spitzer, 1993). Nevertheless, the two accounts are not necessarily incompatible; for example, an over-activation of phonetically related lexical units, which has been proposed to be responsible for the production of acoustic hallucinations (David, 1994; Hoffman & McGlashan, 1997), could be due to inefficient control mechanisms of spreading activation and re-activation in the semantic networks (Spitzer, 1993).

In summary, the present investigation showed that personality traits that phenomenologically resemble the negative and positive symptoms of schizophrenia were differentially related to verbal fluency, suggesting different underlying mechanisms. Enhanced performance on verbal fluency was associated with high levels of positive schizotypy, i.e. increased reports of hallucination-like experiences, delusional ideation, and perceptual aberrations, a pattern of results predicted by theories of increased automatic spreading activation in the semantic networks (David, 1994; Hoffman & McGlashan, 1997; Spitzer, 1993). Given that verbal fluency is a main facet of creativity, the obtained results reinforce the notion that the link between ‘pathological’ personality traits and creativity is likely due to common cognitive features (Eysenck, 1993). This notion is consistent with the possibility of a ‘healthy schizotypy’ (McCreery & Claridge, 2002), which may account for the persistence of schizophrenia-related genes in the population despite their many dysfunctional aspects.
References


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### Table 1
Inter-correlations between schizotypy scales and performance on verbal fluency

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<td>‘Unusual Experiences’</td>
<td>9.72</td>
<td>5.92</td>
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<td>‘Cognitive Disorganization’</td>
<td>11.71</td>
<td>5.31</td>
<td>0.49**</td>
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<td>‘Introvertive Anhedonia’</td>
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<td>3.69</td>
<td>0.15*</td>
<td>0.09</td>
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<td>‘Impulsive Non-conformity’</td>
<td>10.17</td>
<td>4.07</td>
<td>0.39**</td>
<td>0.27**</td>
<td>-0.04</td>
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<td>Verbal Fluency</td>
<td>41.64</td>
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<td>-0.09</td>
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* $p < 0.05$ (two-tailed)
** $p < 0.01$ (two-tailed)
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Figure 1

panel A

positive schizotypy ('Unusual Experiences')

panel B

negative schizotypy ('Introvertive Anhedonia')