Schizotypy and latent inhibition: non-linear linkage between psychometric and cognitive markers

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Abstract

Auditory latent inhibition (LI) and schizotypy were measured in (n = 54), showing that LI was an inverted-U function of schizotypy score. Only average levels of schizotypy were associated with undiminished LI while both low- and high-SPQ subjects showed reduced LI. No relationship was found between LI and either psychoticism or any of the five NEO PI-R domains. These results complement the similar complex relationship of neuroleptic drug dose effects on LI in normals and schizophrenics. A priming task and the unusual uses and pattern meanings measures of creativity were related to personality measures of schizotypy, N, E, and O (but not the EPQ-R psychoticism, LI, or priming performance). Priming effects tracked the inverted-U function of schizotypal personality questionnaire (SPQ) scale scores shown in the LI task. It is suggested that LI is dependent on a non-linear interaction with masking task load and attentional allocation, modulated by schizotypy. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Latent inhibition; Schizotypal personality disorder; Psychoticism; Creativity; Priming

1. Introduction

The purpose of this study was to examine the relationships between schizotypy and three putative explanatory markers of vulnerability to psychosis; latent inhibition (LI), creativity, and priming. In addition, the five-factor model dimensions and Eysenck’s psychoticism scale were examined.

Schizophrenia has long been characterised as involving an attentional dysfunction, a contention supported by numerous studies differentiating psychosis-prone or schizophrenic performance from that of controls on attentional paradigms as diverse as skin conductance (Bernstein et al., 1982), negative priming (Beech, Powell, McWilliam & Claridge, 1989), prepulse inhibition (Kumari, Toone & Gray, 1997), P50–c/t evoked potential measure (Griffith et al., 1998), and
dichotic listening (Dykes & McGhie, 1976). The present study focuses on LI, an inhibitory function reflected in the reduced ability of a stimulus pre-exposed without consequence to subsequently enter into associations that would otherwise have been readily accessible (Lubow & Moore, 1959; Lubow, Ingberg-Sachs, Zalstein-Orda & Gerwirtz, 1992).

People with acute schizophrenia typically exhibit reduced LI in comparison to non-psychotic controls (Baruch, Hemsley & Gray, 1988a; Gray, Hemsley & Gray, 1992). Importantly, the LI deficit is commonly found in acute, but not in chronic schizophrenia (Baruch et al., 1988a; Gray et al., 1992), possibly because of different dopamine neurotransmitter activity-consequences of either illness duration or antipsychotic medications (Gray et al., 1997; Williams et al., 1998).

1.1. Models of latent inhibition

Human LI models include conditioned attention theory (CAT) (Lubow, 1989) and, more recently, a related distractibility model (De la Casa, Ruiz & Lubow, 1993a; De la Casa & Lubow, 1994). CAT proposes that LI acts by reducing the ability of pre-exposed stimuli to elicit an attentional response. This modulation of selective-attention is argued to be context specific, with the pre-exposed context acting as an occasion-setter for the stimulus/no-consequence association, preventing previously irrelevant stimuli from entering short-term memory. Under normal circumstances, LI therefore acts to effectively reduce working memory load (Lubow & Gewirtz, 1995) and dysfunction leads to increased processing of irrelevant stimuli. This is supported by normal participants being unaware of target stimuli (Ginton, Urca & Lubow, 1975), while psychosis prone individuals recall more task-irrelevant stimuli (De la Casa et al., 1993a; De la Casa & Lubow, 1994).

1.2. Why is the LI effect so variable?

While acute schizophrenia, and high psychosis proneness scores often relate to decreased LI, recent experiments have shown opposite results. Williams et al. (1998) compared auditory-LI performance in drug-naive and acutely medicated patients and found that LI was intact in the drug-naive group but was abolished in medicated patients. As medicated normal controls showed disrupted LI, these authors concluded that antipsychotic medication itself might be responsible for the LI deficiencies typically shown in acute schizophrenia. We should note here that these authors have themselves previously reported an enhancement of LI in normals following haloperidol administration (Williams et al., 1997), so the data are not simple.

In addition to drug effects, task variables have been shown to significantly modulate LI. For instance, Braunstein-Bercovitz and Lubow (1998) compared LI magnitude among students varying in psychosis proneness and tested under two levels of masking task load. While high schizotypals in the low-load condition showed abolished inhibition, under a high-load masking task, patterns of inhibition were reversed, with low schizotypals demonstrating abolished LI, and high schizotypals showing intact LI. The authors propose that the increase in masking task load resulted in reduced processing of the irrelevant stimuli. It is suggested that low psychosis-prone participants failed to develop a stimulus-no consequence association due to the increased masking load, while the high psychosis prone participants paradoxically now developed this stimulus-no consequence association.
These results might be expected if LI follows a non-linear function of vulnerability and the difficulty or rate of masking task stimuli. Lubow and Gewirtz (1995) have proposed such a theoretical LI function of masking load in which using LI is absent with very low loads, a moderate masking task load results in normal inhibition, and a hard masking task attenuates LI. They further suggest that the location of individual subjects on this inverted-U function is dependent on vulnerability levels. Support for elements of this model comes from animal drug studies, which also demonstrate complex effects relating to the amounts of anti-psychotic drug administered, as well as at the stage in the experiment when the drugs are administered (De la Casa, Ruiz & Lubow, 1993b). In the present study we test the proposition that LI may be an inverted-U function of subject-specific attentional resources and task-specific attentional demands. To aid this test, the proposed theoretical curve relating LI to schizotypy is examined in detail by incorporating five levels of schizotypy, rather than dichotomised schizotypy, and a harder masking task is used to investigate the patterns of inhibition shown under this more demanding cognitive state.

1.3. Priming

One avenue for further understanding the basis of LI is to explore the predictions which theories of LI make beyond the strict LI paradigm. One prediction from conditioned attention theory, for instance, is that non-target materials in general should be better recognised by subjects who are distractable and/or schizophrenia-prone. In addition, the short-term memory access element of CAT (Lubow, 1989), might predict that in a priming task (in which subject’s explicit memory for task irrelevant information is subsequently tested), recognition memory should be inferior. The priming paradigm also gives access to implicit memory. In tests of implicit memory, subjects are given tasks that are ostensibly unrelated to the exposed stimuli. Again, if the LI mechanism operates at the same level of interaction with STM as does implicit memory, then one might predict reduced priming in schizotypal or LI deficient subjects.

In the present experiment, both LI and priming performance are measured together with a group of prospective vulnerability measures. These psychometric tools are now discussed.

2. Latent inhibition and personality

Support for LI as a marker of psychosis proneness comes from reports that high scorers on scale such as the Raine (1991) schizotypal personality questionnaire (SPQ) and the psychoticism (P) scale of the EPQ show some of the attentional and biological dysfunctions shown by schizophrenics (Eysenck, 1995; Raine, Lencz & Benishay, 1995; Raine, Benishay, Lencz & Scarpa, 1997). To further examine the relationship between psychosis-proneness and the LI marker, this study uses these two personality measures as well as the standard five-factor model as potential measures of schizophrenia vulnerability. These personality measures are now discussed in more detail.

2.1. Schizotypy

Meehl (1962) described the activity of a schizogene as a necessary thought not sufficient cause of schizophrenia. He argued in addition that this gene was most frequently expressed in a compensated
‘normal’ form as a schizotypal personality defined by perceptual-cognitive, semantic, motivational, and affective dysfunctions (Meehl, 1989). Since his influential 1962 APA address, several self-report measures of schizotypy have been formulated (Claridge & Broks, 1984; Golden & Meehl, 1979; Chapman, Chapman & Raulin, 1976), including the SPQ (Raine, 1991), a scale based on the 9 DSM-III-R schizotypal personality disorder (SPD) criteria against which the scale has high construct validity (Raine, 1991). SPD is thought to share in part the genetic basis of schizophrenia, a view supported by its prevalence among the relatives of people with schizophrenia (Berenbaum & Fujita, 1994) and heightened risk for schizophrenia in SPD patients (Walker & Gale, 1995).

Importantly, individuals who score highly (above the median) on schizotypy measures demonstrate reduced LI similar to that found in acute schizophrenia (Lubow et al., 1992; Alan et al., 1995; Williams et al., 1998). These findings suggest that LI dysfunction may be an important marker for schizophrenia vulnerability.

2.2. Psychoticism (P)

Where Meehl suggested that schizotypy is a Mendelizing trait, Eysenck and Eysenck (1977) proposed the vulnerability to psychosis rests on a normal personality dimension, P which defines a continuum ranging from altruistic over-socialised behaviour at the low end, to schizophrenia at the high extreme. To date, little evidence has been found for the validity of P as a measure of schizophrenic vulnerability, certainly in comparison with the by now well-established relationship of neuroticism to emotional disorders. High P scorers have been shown to differ on the amplitude of P300 event-related potentials compared to low P scorers, a finding also reported in people with schizophrenia (Stelmack, Houlihan & McGarry-Roberts, 1993). In addition, family studies show first-degree relatives of schizophrenics have higher P scores (Berenbaum & Fujita, 1994). P has been related to LI (Baruch, Hemsley & Gray, 1988b; Lubow et al., 1992; De la Casa et al., 1993a) with high P scorers showing an LI deficit similar to acute schizophrenics.

However, while high P-scorers appear to be psychotic-like, they do not experience higher rates of psychosis (Chapman, Chapman & Kwapil, 1994). Longitudinal studies indicate that the impulsive non-conformity shown by high P scorers does not predict subsequent schizophrenia (Chapman, Chapman, Kwapil & Eckblad, 1994). Conversely, people with schizophrenia do have somewhat elevated P scores, but no more so than university arts students (Eysenck, Eysenck & Barrett, 1985).

Eysenck’s model predicts that intermediate levels of P and situational stressors will cause milder psychoses, and criminality. Importantly, Eysenck suggested that cognitive over-inclusiveness underpinned both creativity and the psychotic thinking of high P subjects. Thus Eysenck’s theory predicts that the socially desirable trait of creativity should be associated with P and also identifies the cognitive basis of creativity with that underlying psychosis. Given that creative, allusive or loose thinking weighs so strongly in Eysenck’s (1995) theory, we also administered two tests of creativity: the Torrance (1974) ‘Unusual Uses’ test, and the Wallach and Kogan (1965) Pattern Meanings Test of Creativity.

2.3. The five-factor model of personality

Many authors now suggest that a five-factor structure is more suitable for an open and comprehensive assessment of personality (Goldberg, 1997). Although the five-factor domains have not
typically been argued to be predictive of psychosis, comparison studies between the EPQ-R and the NEO indicate that P can be accounted for in terms of low scores on A and C (McCrae & Costa, 1985; Digman, 1990; Avia et al., 1995; Heaven, 1996). Whether or not the NEO can completely capture P is still hotly debated (Eysenck, 1992; Costa & McCrae, 1992). To the extent that these traits do constitute psychoticism, Eysenck’s theory predicts that we should expect psychotic-like performance in low A–low C individuals. Similarly, although limited research is available, the SPQ appears to have modest relationships to the five-factor dimensions of low-E, low-A, and high-N (Widiger, 1998). The possibility that the 5-FM domains may be associated with LI have not previously been investigated. However, if the 5-FN is truly a comprehensive system, then correlates of schizotypal personality should be predictable from some combination of the five major domains or their facets.

3. Method

3.1. Participants

Fifty-four participants were tested. Thirty-five first-year psychology students (13 males, aged 18–49 years, mean = 21.8), who participated in the study for course credit. Nineteen other participants (10 males, aged 17–28 years, mean = 20.0) were recruited from among the experimenter’s colleagues and acquaintances.

3.2. Materials

3.2.1. Personality scales

Measures used were the P scale of the EPQ-R (Eysenck et al., 1985), the SPQ (Raine, 1991) and the NEO PI-R (Costa & McCrae, 1992). In order to reduce response bias on the SPQ (in which all items are scored positively) the SPQ was modified to use the NEO PI-R’s five-point Likert scale format and SPQ items were intercalated with the items of the NEO.

3.2.2. Latent inhibition

Latent inhibition was measured in a between-subject auditory pre-exposure and test task on Ginton et al. (1975). The non-exposed audio tape contained a recording of 29 nonsense syllables, repeated five times each in a random order. The syllable ‘de’ was repeated 28 times rather than five, and participants were required to count occurrences of this stimulus. The syllables were spoken in a female voice at a mean intensity of 70 dB (range 65–76), with an ISI of 0.5–2 s. The pre-exposed group heard the same syllable list with the addition of 25 randomly superimposed bursts of white noise each with a 60 dB intensity and mean duration of 1.25 s (range 0.5–2.0 s). Each list lasted 5 min. In phase 1, participants heard either the non pre-exposed tape or the pre-exposure tape. In the test phase, all participants listened to the pre-exposed version of the tape. During this time, the experimenter raised sequentially numbered 15×13 cm cards in response to each offset of the white noise. Participants wrote their predictions on a provided numbered response sheet. Each participant obtained a learning score representing the number of times the pre-exposed stimulus (white noise) was presented before they correctly identified that the white noise predicted number incrementation.
3.2.3. Priming

Priming was measured by a word-stem completion and recognition task. Thirty words, were selected based on Rajaram and Roediger (1993) and recorded on tape spoken in a female voice with average intensity 68 dB and ISI of 1–2 s. Each word-stem was chosen so that only one word from the target list would complete it, however each stem has multiple solutions outside of the target list. A repetition factor was generated by repeating each word either once, twice or three times during the duration of the tape. To mask the priming task, subjects were required to count occurrences of a 494 Hz tone presented 15 times at random and interspersed with 15 tones of 440 Hz (30 times in total). Tones were randomly presented with durations ranging from 0.5–2 s and with an intensity of 65 dB.

In the testing phase, participants heard the initial syllable of each of 40 words; 30 primed and 10 non-primed words, presented aurally by the experimenter. Participants’ task was to write down a word completing the stem. Priming scores were computed as the ratio of primed words to non-primed words correctly completed. After this, a recognition task was completed in which the 30 primed and 10 non-primed words were listed on paper with scores consisting of hits (correct detections) and false alarms.

3.2.4. Creativity

Creativity was measured by the pattern meaning (Wallach & Kogan, 1965) and unusual uses (Torrance, 1974) tasks. The pattern meanings task requires participants to write down as many possibilities, objects, or scenes which each of eight abstract patterns could represent. In the unusual uses task, participants wrote down as many interesting and unusual uses they could think of for a tin can. The tests were scored in accordance with their manuals. Subjects had a fixed 10-min response period for each test. Scoring followed the manual with one exception being that participants’ responses to unusual uses were given a score of 3 if they exceeded the responses given in the manual (which was normed on children). Inter-rater reliability calculated on a random sample of 25% of answers scored by an independent judge, indicated that the reliability was adequate (fluency \( r = 0.98 \), originality \( r = 0.97 \)).

3.3. Procedure

After providing written informed consent, participants completed the P-scale of the EPQ-R followed by administration of the verbal and figural creativity tasks. They were then allocated at random to a pre-exposed or a non pre-exposed LI condition, and in groups of up to 10, were played the appropriate recording via a tape recorder and amplified speaker situated at the front of the room. Participants were instructed to listen carefully to the tape and to count and then record the number of times the syllable ‘de’ was repeated. No person erred in this count by more than 1 point. In the test phase, subjects were instructed to listen and to write down the rule which they thought explained the raising of numbered cards (which followed each white noise burst).

For the priming task all subjects were told to count how many times the higher tone was presented on the recording. To ensure subjects had been paying attention, they were to be excluded if their count was out by more than 2, but all subjects were within this criterion. In subsequent testing, participants listened to 40 word-stems, and were instructed to write down the first word that came into their mind that completed the word-stem. After completion, participants were
given the list of 40 words and were asked to circle the words that they thought they had heard previously on the tape. Subjects then finished the session by completing the SPQ and NEO PI-R and were debriefed about the experiment.

4. Results

4.1. Personality measures

Descriptive statistics for the personality dimensions are shown in Table 1. Replicating the normative data, extraversion decreased with age \((r = -0.30, P < 0.05)\), males scored higher on psychoticism \((t(52) = 3.46, P < 0.001)\), and females scored higher on neuroticism \((t(52) = -2.76, P < 0.01)\). No other variables differed significantly with age or gender.

Significant correlations between the personality measures are shown in Table 2. Of note were the following: psychoticism correlated with both agreeableness \((r = -0.40, P < 0.005)\) and conscientiousness \((r = -0.43, P < 0.005)\), replicating previous reports showing that P is an amalgam of A and C (cf McCrae & Costa, 1992; Digman, 1990; Avia et al., 1995), or that A and C are subfactors of P, depending on one’s theoretical stance (Eysenck, 1995). The very low correlation between A and C supports the former position. Schizotypy correlated with both neuroticism \((r = 0.47, P < 0.005)\) and extraversion \((r = -0.36, P < 0.01)\), again replicating previous reports (cf

<table>
<thead>
<tr>
<th>Variable</th>
<th>Male mean</th>
<th>Male SD</th>
<th>Female mean</th>
<th>Female SD</th>
<th>Total mean</th>
<th>Total SD</th>
</tr>
</thead>
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<tr>
<td>Psychoticism</td>
<td>9.87</td>
<td>3.81</td>
<td>6.68</td>
<td>2.98</td>
<td>8.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Schizotypy</td>
<td>134.8</td>
<td>42.4</td>
<td>117.9</td>
<td>29.0</td>
<td>125.1</td>
<td>36.0</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>53.3</td>
<td>10.9</td>
<td>60.5</td>
<td>8.0</td>
<td>57.4</td>
<td>10.0</td>
</tr>
<tr>
<td>Extraversion</td>
<td>55.8</td>
<td>10.9</td>
<td>54.8</td>
<td>9.7</td>
<td>55.2</td>
<td>10.2</td>
</tr>
<tr>
<td>Openness</td>
<td>44.4</td>
<td>11.0</td>
<td>48.7</td>
<td>10.2</td>
<td>46.8</td>
<td>10.7</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>40.0</td>
<td>9.4</td>
<td>44.8</td>
<td>9.7</td>
<td>42.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Conscientious</td>
<td>30.0</td>
<td>12.1</td>
<td>35.2</td>
<td>12.7</td>
<td>33.0</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Table 2

Correlations between the personality and creativity dimensions (*P < 0.05, **P < 0.01, ***P < 0.005)

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>SPQ</th>
<th>N</th>
<th>E</th>
<th>O</th>
<th>A</th>
<th>C</th>
<th>Verbal</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPQ</td>
<td>0.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>-0.20</td>
<td>0.47***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>0.23</td>
<td>-0.36**</td>
<td>-0.29*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>-0.11</td>
<td>0.05</td>
<td>0.27*</td>
<td>-0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>-0.39***</td>
<td>-0.20</td>
<td>0.13</td>
<td>-0.08</td>
<td>0.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>-0.42***</td>
<td>-0.24</td>
<td>-0.06</td>
<td>-0.32*</td>
<td>0.08</td>
<td>-0.06</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>0.05</td>
<td>0.19</td>
<td>0.20</td>
<td>-0.01</td>
<td>0.05</td>
<td>-0.06</td>
<td>0.01</td>
<td>0.30*</td>
</tr>
<tr>
<td>Figural</td>
<td>0.06</td>
<td>0.28</td>
<td>0.34*</td>
<td>-0.14</td>
<td>-0.01</td>
<td>-0.02</td>
<td>0.30*</td>
<td>0.52***</td>
</tr>
</tbody>
</table>
In this sample, extraversion correlated with neuroticism ($r = -0.29$, $P < 0.05$) and conscientiousness ($r = -0.32$, $P < 0.05$), and openness correlated significantly with neuroticism ($r = 0.27$, $P < 0.05$).

4.2. **Latent inhibition**

The LI task was validated by a significant main effect of exposure ($F(1,52) = 5.63$, $P = 0.021$). The relationship between LI and personality was analysed using conventional ANOVA techniques with each personality variable re-coded into a five-level factor with equal numbers of participants in each group, except for the highest level group, which contained one less subject.

Most importantly, schizotypy was related to LI magnitude ($F(4,44) = 5.31$, $P = 0.0014$). In particular, the interaction between LI and schizotypy level was significant ($F(4,44) = 2.78$, $P = 0.384$) (see Fig. 1). Learning in the pre-exposed group was related to schizotypy in an inverse-U function, with low schizotypes learning quickly, moderate schizotypes learning slowly, and high schizotypes again learning quickly. Learning in the non-exposed group decreased as schizotypy levels increased. A contrast analysis confirmed that exposed and non-exposed group’s LI levels did not differ for the lowest ($F = 0.786$, $P = 0.380$) or highest ($F = 1.1$, $P = 0.300$) SQP groups respectively, but that there was a significant LI effect in the average group ($F = 7.27$, $P = 0.01$). Contrasts between the lowest, average, and highest SQP groups in the exposed condition revealed that while the lowest and highest groups did not differ in LI ($F = 1.485$, $P = 0.23$), the average group’s LI was greater than that of the lowest and highest SQP groups ($F = 7.126$, $P = 0.011$).

None of the other personality variables (P, N, E, O, A, and C) showed any significant relationship to LI. This remained the case when the analyses were recalculated treating the personality

![Fig. 1. Relationship of schizotypy level to latent inhibition.](image-url)
trait-scores as dichotomised variables or as continuous variables in a MANOVA. The finding
that EPQ-R P is not related to LI is consistent with previous reports, for instance Kumari
et al. (1997). Finally, adding gender to the ANOVA showed no significant main effect of gender
on LI ($F(1,34) = 2.08, \ P = 0.16$, nor were the gender-based interaction effects significant: exposure condition × gender ($F(4,34) = 0.746, \ P = 0.39$); exposure condition × gender × SPQ group ($F(4,34) = 0.277, \ P = 0.89$).

4.3. Priming

4.3.1. Validity of the priming task

Word-stem completion for primed words was significantly above the baseline control list
(33.7% primed vs 8.3% baseline, $t = 27.30, \ P < 0.005$). There was also an effect of repetition, such
that more repetitions increased priming $F(1,3) = 25.12, \ P < 0.005$.

4.3.2. Priming and personality

Our prediction that priming would be significantly related to psychoticism was tested using an
ANCOVA analysis but was not confirmed ($F(1,52) = 1.62, \ NS$). However, schizotypy group was
significantly related to priming ($F(4,49) = 3.01, \ P = 0.026$), with priming scores showing a similar
inverted-U curve response to SPQ level as found for LI (see Fig. 2). No other personality vari-
ables were significantly related to priming and there were no interaction effects with the repetition
factor when this was entered.

![Fig. 2. Relationship of SPQ level to priming.](image)
4.3.3. Recognition

A point estimate of recognition was computed as simply (hits–false-alarms). The priming paradigm was validated by a significant effect of repetition on recognition: words repeated at each level were recognised better than control list words, 1 ($t = 3.57, P < 0.005$), 2 ($t = 3.58, P < 0.005$), 3 ($t = 9.33, P < 0.005$).

4.3.4. Recognition and personality

The schizotypy data followed the inverted-U pattern shown in priming and LI analyses (see Fig. 3), but this effect was not significant ($F(4,48) = 1.64, P = NS$). No personality variable significantly related to recognition memory and no personality-repetition interactions were significant.

4.4. Creativity

Unusual uses and pattern meanings measures of creativity were related to personality measures of schizotypy, neuroticism, extraversion and openness to experience, but were unrelated to psychoticism, latent inhibition and priming (see Table 2).

5. Discussion

As reported (Tien et al., 1992; Widiger, 1998) SPQ schizotypy loaded onto the five-factor model dimensions of N and low-E. The additional low-A and high-O correlates of schizotypy

![Fig. 3. Non-significant relationship of SPQ level on recognition memory.](image-url)
reported by Widiger were not replicated in this sample. While schizotypy may be characterised by phenotypic similarities to both N and E, reducing schizotypy to high-N and low-E is problematic. Schizotypes may show only a superficial similarity to N and low-E. Such ‘phenocopy’ behaviour has been described by numerous authors, for instance Cattell (1952) who referred to ‘pseudo-neurotic’ schizophrenia. Clearly more research is needed to distinguish these theoretical interpretations. However, it is important to note that while N and low-E correlated with SPQ, they did not relate to LI. Prima-facie, this is strong evidence that the LI effect is specific to the SPQ and is not due to correlated five-factor variance.

In contrast to some reports (Baruch et al., 1988b; Lubow et al., 1992; Kumari et al., 1999), P was unrelated to LI. Similar failures have, however, been reported elsewhere (Kumari et al., 1997; Lipp, Siddle & Arnold, 1994). One interpretation of these data is that the revised P scale, while psychometrically improved, no longer accesses psychosis-proneness. Revision towards a less skewed dimension approximating a combination of low-A and low-C (as occurred in the EPQ-R) may have (further) reduced the construct validity of the scale. The failure of P to correlate with creativity supports this notion. Again, previous reports relating P to creativity have used earlier versions of the P scale (Woody & Claridge, 1977; Stavridou & Furnham, 1996) or else have used adjectival personality descriptors rated according to face validity (Rushton, 1997). A number of studies, including the present study, have found creativity correlated instead with O (McCrae, 1987). Likewise the finding that schizotypy is weakly related to figural creativity has also received some previous support (Zanes, Ross, Hatfield, Hoult & Whitman, 1998).

While the intention of the P scale was to index creativity, the current scale does not appear to relate strongly to creativity or to psychosis proneness. It may also confound increased frequency of unusual responses with decreased fluency (Aguilar-Alonso, 1996). This is to say, P may measure a variable which negatively affects the fluency component of creativity and also a second component which increases the infrequency or idiosyncrasy of responding. Rather than over-inclusive associations, P (low-A/low-C) might index a hypo-frontal dysexecutive syndrome (Poreh, Ross & Whitman, 1995). The finding of hypo-frontality in schizophrenia (Evans, Chua, McKenna & Wilson, 1997) and criminality (Stoddard, Raine, Bihle & Buchsbaum, 1997) suggests to us a model of P not dissimilar in purpose to that envisaged by Eysenck, but one in which P is not (directly) related to high creativity and in which P acts via a hypo-frontality, rather than the over-inclusive associative mechanism envisioned by Eysenck (1995).

5.1. Schizotypy and LI

Clearly a central finding of the present report is the inverted-U relationship of schizotypy to LI. Previous reports have demonstrated relationships between LI and both schizophrenia and schizotypy (Lubow et al., 1992; Alan et al., 1995), although the data are certainly complex (Williams et al., 1998). In the present study only medium schizotypals showed LI. Such ‘reversed” results may reflect systematic effects of symptom severity, task, and drug status upon LI (Braunstein-Bercovitz & Lubow, 1998), as exemplified by the Williams et al. (1998) demonstration of abolition of LI in medicated normals and patients, along with intact LI in patients naïve to antipsychotic medication and in volunteers given saline. These data strongly suggest that the relationship between psychosis and LI cannot be a simple linear function of either state or trait vulnerability.
Williams et al. (1998) suggest that disrupted LI is a consequence of medication. If so, LI might best be conceived of as an iatrogenic side-effect of medication rather than as a trait marker for vulnerability. However, the finding that LI is systematically related not only to drugs effects but also to stimulus parameters suggests the latter: that LI is a non-linear correlate of vulnerability for schizophrenia. A mechanism for modulating LI according to stimulus parameters has been proposed by Braunstein-Bercovitz and Lubow (1998) who found that, when masking task load was increased, high schizotypals again showed LI, while low schizotypals demonstrated abolished LI. A very recent report by Hofer, Dell Casa and Feldon (1999) further supports this interpretation, demonstrating that task speed is a critical variable affecting LI expression.

As the current study used a high-load masking task, the reversed LI result confirms these recent reports on the task-sensitivity of LI effect. However, our analysis of the effect across five levels of schizotypy extends the results of Braunstein-Bercovitz and Lubow (1998), showing the gradual inversion of LI across the SPQ dimension, together with an underlying reduction in learning in the non-exposed condition. These results support the hypothesis that, while processing load modulates LI, schizotypy is a crucial individual-difference mediating this contextual effect on subsequent access to awareness by exposed stimuli.

It would be of interest to examine this LI-masking load effect in schizophrenia proper, varying task load, symptomatology and drug doses. Further work is also required to relate the current findings to reports that nicotinic agonists modulate schizophrenia-related deficits including LI (Alan et al., 1995) and P50 c/t (Griffith et al., 1998). Paradoxical or bi-phasic effects of nicotine on other markers such as smooth pursuit eye movements (SPEM) have been reported (Olincy, Ross, Young, Roath & Freedman, 1998; Thaker, Ellsberry, Moran, Lahti & Tamminga, 1991). A unified psychopharmacological theory relating LI and measures such as SPEM and P50 would clearly represent a tremendous advance in theories of schizotypy and schizophrenic attentional dysfunction. An alternative reductive advance would be to integrate the non-linear LI finding with dopaminergic (DA) theories of latent inhibition and broader contextual effects (Williams et al., 1998; Phillips & Singer, 1997). If too much or too little DA receptor response both impair latent inhibition, then the data are compatible with a DA theory of schizotypy.

The schizotypy-related decrease in learning in the non-exposed condition is consistent with previous findings in schizophrenics (Swerdlow, Braff, Hartson, Perry & Geyer, 1996; Gray et al., 1992), and first-degree relatives of schizophrenics (Serra, unpublished, cited in Gray, 1998). The current data suggest that slower learning in the non-exposed group may also be a characteristic of schizotypy. Although previous studies have found this result, the implications of this finding for both models of schizophrenia and latent inhibition have not been widely considered.

While there appear to be two effects in the current data set: inverted-U LI in exposed condition and a linear increase in LI in the non-exposed condition, it is not clear whether these reflect a single underlying processing difficulty or are two elements of a schizotypal syndrome of processing deficit. A single factor explanation is most parsimonious and may be achieved if we explain the inverted-U effect of schizotypy on LI in the exposed condition as reflecting a simple reduction of processing resource, with more exposure trials being required to achieve adequate inhibition. In this case the failure of non-exposed schizotypes to learn the association must be assumed to reflect simple poverty of learning. An alternative two-factor explanation is supported by an interesting recent study by Lubow and Kaplin (1997). These authors also demonstrated that visual LI reflects two separate effects: one in the pre-exposed condition and one in the non-exposed...
condition. They conclude that although intact LI has previously been attributed to retarded learning in the pre-exposed group, differential LI effects may result from superior learning in the non-exposed condition. Thus the LI task may reveal two separate attentional processes. Although these conclusions were based on a visual task, the results from the current experiment are compatible with a two-factor model.

5.2. Priming, latent inhibition and personality

As noted in Section 1, theories pertaining to the short-term memory and distractibility components of LI are compatible with altered recognition and priming rates for stimuli presented in a task-irrelevant channel. The present data show a significant effect of SPQ score on implicit priming, however the implications for memory and distraction models of LI are ambiguous. To the extent that the priming task modelled the LI paradigm, word-stem priming results suggest that LI is associated with high implicit memory, high schizotypals may not gain the benefit of implicit cues in guiding their actions, at least under conditions in which LI is also disrupted.

5.3. Conclusions and further research

While little support was found for a relationship of P to LI, priming, or creativity, SPQ was significantly related to creativity, and to both LI and priming, with both these latter measures showing a significant inverted-U effect of SPQ-level on responding. That schizotypy mapped onto both of these putative measures of vulnerability increases our confidence in the SPQ as a measure of vulnerability and as an index of basic processes involved in psychotic thinking measurable in non-clinical populations. While more work is needed on the role of masking task and attentional allocation, the present study supports a non-linear LI effect modulated by schizotypy and task characteristics. This may account in part for differences between acute and chronic responding, as well as between medicated and unmedicated responding in people with schizophrenia and normals differentiated by SPQ score.

References


