Cognitive factors in predisposition to auditory and visual hallucinations

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Objectives. This study adapted the Launay Slade Hallucination Scale (LSHS) to measure predisposition to auditory and visual hallucinations and examine the relationship between meta-cognition and predisposition in a non-psychiatric population. It also tested the hypothesis that individuals highly predisposed to hallucination would show positive and negative meta-cognitive beliefs and report the use of different thought control strategies.

Design. A within participants correlational design was employed.

Methods. A revised LSHS was administered to 105 normal participants who were also asked to complete questionnaires assessing paranoia, meta-cognitive beliefs, thought control strategies, anxiety, depression and beliefs about unusual perceptual experiences.

Results. Two empirically distinct but correlated hallucinatory traits (auditory and visual) were measured by the modified LSHS. Consistent with predictions, it was found that positive beliefs about unusual perceptual experiences were the best predictor of predisposition to auditory and visual hallucinations and that those participants who scored higher on predisposition to hallucination used different thought control strategies and had different negative meta-cognitive beliefs in comparison with participants of low predisposition.

Conclusions. Meta-cognitive beliefs about thoughts and hallucinatory phenomena appear to be implicated in predisposition to hallucination. The theoretical and clinical implications of the findings are discussed.

Recently, there has been a growing interest in the measurement of psychotic traits among general population samples (Claridge *et al*., 1996). Much of this work has been done by attempting to assess schizotypy, or psychosis-proneness, which appears to

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be of heterogeneous structure, consisting of four components that have been replicated; these are, aberrant perceptions and beliefs, cognitive disorganization, introvertive anhedonia and asocial behaviour (Bentall, Claridge, & Slade, 1989; Claridge *et al*., 1996). Interestingly, the first three components of these schizotypal traits correspond very closely to the three syndromes found by Liddle (1987) in his study of schizophrenic symptoms in diagnosed patients (these were positive symptoms, negative symptoms and conceptual disorganization). Scales have been designed to measure predisposition to specific positive symptoms of schizophrenia, such as hallucinations (Launay & Slade, 1981) or paranoia (Fenigstein & Vanable, 1992). As a result of such advances in the measurement of psychotic experiences in the general population, there is now an opportunity to examine psychological factors contributing to psychosis-proneness in such samples.

Hallucinations in non-clinical subjects

There is some evidence that auditory hallucinations are a normal psychological phenomenon and there is a long tradition of viewing hallucinations as being on a continuum with normal functioning (Strauss, 1969). Studies assessing the prevalence of auditory hallucinations in college students have consistently found that a large minority (37–39%) report experiencing such phenomena (Barrett & Etheridge, 1992; Posey & Losch, 1983), and that these experiences were unrelated to incipient psychopathology. Studies of different populations have certainly found that the experience of hearing one's thoughts spoken aloud (a Schneiderian first rank symptom of schizophrenia) is a relatively common one that is endorsed by over 30% of respondents (Launay & Slade, 1981; Posey & Losch, 1983). Surveys of hallucinatory experiences suggest that 10–25% of the general population have had such experiences at least once (Slade & Bentall, 1988) and that the annual incidence rate is 4–5% (Tien, 1991). When considered together, these findings do suggest that the hypothesis that auditory hallucinations are normal phenomena is a plausible one.

In addition, some researchers have examined the predisposition of non-psychiatric populations to hallucinations. Launay and Slade (1981) developed a 12-item questionnaire (LSHS) to assess hallucinatory predisposition that included both pathological and sub-clinical items and used this to test hypotheses regarding behavioural correlates of hallucinatory predisposition. Other researchers have used highly predisposed non-psychiatric participants to make inferences about the mechanisms underlying clinical symptoms. For example, Rankin and O'Carroll (1995) found that normal participants highly predisposed to hallucination (as measured by the LSHS) scored higher on a signal detection task measure of perceptual bias than those with lower predisposition, but that there was no difference on a measure of sensitivity, and concluded that this was more consistent with an account that suggests auditory hallucinations result from a bias in normal information processing rather than a deficit in functioning.

Psychological theories of hallucinations

Several cognitive theories have accounted for the occurrence of hallucinations. Some authors have attempted to explain auditory hallucinations by supposing that they are

internal cognitive events which are misattributed to an external source (Bentall, 1990; David, 1994; Frith, 1992; Hoffman, 1986; Morrison, Haddock, & Tarrier, 1995). Some support for this comes from findings that auditory hallucinations are accompanied by subvocalization or covert movements of the speech musculature (Gould, 1950; Inouye & Shimizu, 1970), which also accompanies normal thinking or inner speech (McGuigan, 1978). If auditory hallucinations are a type of inner speech which is misattributed to an external source, this would explain the finding that verbal tasks which block subvocalization also inhibit the occurrence of auditory hallucinations (Gallagher, Dinan, & Baker, 1994; Margo, Hemsley, & Slade, 1981). However, while there is some agreement about the links between internal mental events and auditory hallucinations, there is still debate regarding the mechanisms that are involved in the development and maintenance of such misattributions.

A number of theorists have speculated that this misattribution is caused by a deficit in some aspect of cognitive functioning, such as a difficulty in the integration of stored material with current sensory input (Hemsley, 1993), a disruption in language production processes (David, 1994; Hoffman, 1986) or a deficit in internal monitoring (Frith, 1992). Other theorists have suggested that auditory hallucinations result from biases of normal functioning. Bentall (1990) has argued that a hallucinator's tendency to misattribute internal events to an external source may reflect a bias in the monitoring of internal events that is influenced by top-down processes including beliefs and expectations and that reinforcement processes are involved in the maintenance of such misattributions. Morrison *et al*. (1995) outlined an account which proposed that meta-cognitive beliefs inconsistent with intrusive thoughts lead to their external attribution as auditory hallucinations, and that such a misattribution is maintained by reducing cognitive dissonance; this is based upon a number of similarities in form and content between intrusive thoughts and auditory hallucinations. It is also suggested that the appraisal of the resulting hallucinatory experience elicits behavioural, emotional and physiological responses that may be involved in the maintenance process. Morrison *et al*. also speculate that a similar misattribution of intrusive imagery may be responsible for visual hallucinations.

Wells and Matthews' (1994) self-referent executive function (S-REF) model can also be used as a framework for understanding hallucinations. This model suggests that vulnerability to psychological dysfunctions is associated with a cognitive-attentional syndrome characterized by heightened self-focused attention, attentional bias, ruminative processing and activation of dysfunctional beliefs. In this model, cognitive-attentional experiences, such as biased information processing and cognitive intrusions, are mediated by executive processes which are directed by the patients' beliefs. Some beliefs are meta-cognitive in nature and are linked to the interpretation, selection and execution of particular thought processes. Chadwick and Birchwood (1994) have demonstrated that beliefs about voices are meaningfully related to their emotional and behavioural consequences, and Wells and Butler (1997) have suggested that meta-cognitive beliefs about hallucinations will also influence emotional and behavioural responses to them. In particular, positive beliefs may be associated with efforts to engage and maintain particular hallucinatory experiences; indeed, Chadwick and Birchwood (1994) found that voices believed to be benevolent were engaged. In addition, a study examining the attitudes of 50 psychiatric in-

patients to their hallucinations found that over 50% reported some positive effects of hallucinating, with the most commonly cited benefits being that the hallucinations were relaxing or soothing and that they provided companionship (Miller, O'Connor, & Di Pasquale, 1993), supporting an association between positive beliefs and hallucinations.

In contrast, negative beliefs about hallucinations may be associated with unhelpful coping strategies. Chadwick and Birchwood (1994) found that voices believed to be malevolent were resisted by patients and it has been suggested that deliberate suppression of auditory hallucinations may be counterproductive (Morrison *et al.*, 1995). Positive and negative beliefs about thoughts may also be implicated in the development and maintenance of hallucinations. Baker and Morrison (1998) found that patients experiencing auditory hallucinations scored higher on meta-cognitive beliefs concerning both positive beliefs about worry and negative beliefs about uncontrollability and danger associated with thoughts; however, the mechanisms linking beliefs about thoughts with beliefs about hallucinations are unknown at present.

This study adapted the LSHS to measure the frequency of experiences that are predisposing to auditory and visual hallucinations. We tested the specific hypothesis that predisposition to hallucinatory experiences in normal participants is associated with positive beliefs about such experiences, independent of mood (anxiety and depression) and other schizotypal factors. We also tested the hypothesis that those individuals highly predisposed to hallucination will exhibit different meta-cognitive beliefs about thoughts and use different thought control strategies in comparison with individuals of low predisposition.

Method

Participants

The number of participants completing the study was 105; all participants were undergraduate students or health professionals who volunteered to participate in the study. No financial incentive was offered. The mean age of the group was 30.4 (SD = 9.3; range 20–57 years). The male:female ratio of the sample was 21:84.

Materials

Revised Hallucination Scale. A 16-item questionnaire based upon the Launay Slade Hallucination Scale (Launay & Slade, 1981). It was revised to incorporate additional items measuring predisposition to visual hallucination and to allow items to be endorsed using a 4-point scale to measure frequency (1 = never, 2 = sometimes, 3 = often, 4 = almost always) rather than a forced true/false response.

Visual Analogue Scales. Several 0–100 visual analogue scales were used to assess tendency towards depression (three measures assessing depressed mood, loss of interest and lack of pleasure) and positive and negative beliefs about unusual perceptual experiences (one measure for each). Participants indicated their responses by placing a mark on a 10-cm line anchored at 'not at all' and 'could not be more so'. Positive beliefs were assessed with the item, 'Unusual experiences, such as those mentioned in the previous questionnaire, are beneficial and help me cope', and negative beliefs were assessed with the item, 'Unusual experiences, such as those mentioned in the previous questionnaire, are potentially dangerous and interfere with my life' (in both cases the previous questionnaire was the Revised Hallucination Scale).

Paranoia Scale (Fenigstein & Vanable, 1992). Paranoid thought was measured using this self-report scale. It consists of 20 items and scores range from 20 to 100.

State–Trait Anxiety Inventory (STAI; Speilberger, Gorusch, Lushene, Vagg, & Jacobs, 1983). Trait anxiety was measured using the trait anxiety sub-scale (version Y2) of this inventory. STAI trait scores range from 20 (almost never anxious) to 80 (almost always anxious). The sub-scale has an alpha of .90 in college students.

Thought Control Questionnaire (TCQ; Wells & Davies, 1994). This is an instrument designed to measure strategies that are used to control unpleasant or unwanted thoughts. It consists of 30 items and comprises five sub-scales: distraction, social control, punishment, worry and reappraisal. Each item is endorsed on a 4-point rating scale. Sub-scales exhibit acceptable internal consistency (alphas ranged between .64 and .79) and good test–retest reliability (coefficients ranged between .67 and .83).

Meta-cognitions Questionnaire (MCQ: Cartwright-Hatton & Wells, 1997). This scale measures meta-cognitive beliefs using 65 items. The questionnaire generates scores for the following five sub-scales: (1) Positive beliefs about worry (typical items include 'Worrying helps me to get things sorted out in my mind' and 'Worrying helps me cope'); (2) Negative beliefs about the controllability of thoughts and corresponding danger (typical items include 'Worrying is dangerous for me' and 'I cannot ignore my worrying thoughts'); (3) Cognitive confidence (typical items include 'I have a poor memory' and 'I have difficulty knowing if I have actually done something, or just imagined it'); (4) Negative beliefs about thoughts in general, including responsibility, punishment and superstition (typical items include 'Not being able to control my thoughts is a sign of weakness' and 'If I did not control a worrying thought, and then it happened, it would be my fault'); (5) Cognitive self-consciousness (typical items include 'I think a lot about my thoughts' and 'I pay close attention to the way my mind works'). Items are scored from 1 to 4, whereby 1 = 'do not agree', 2 = 'agree slightly', 3 = 'agree moderately', and 4 = 'agree very much'. Sub-scales exhibited good internal consistency (alphas ranged between .72 and .89) and test–retest reliability (coefficients ranged between .76 and .94).

Procedure

Participants completed the questionnaires in the order listed above and returned them to the research assistant. The questionnaires took approximately 15 minutes to complete.

Data analysis

Several of the variables were not normally distributed, but were found to be normalizable using logarithmic transformations (auditory hallucinations, visual hallucinations, paranoia, negative beliefs about controllability and danger, positive beliefs about worry, beliefs about responsibility and superstition, beliefs about cognitive confidence, distraction and worry) or square root transformations (depression). Parametric statistical analyses were performed using these transformed variables.

Results

Reliability and factor structure of revised LSHS

A factor analysis was conducted in order to determine whether predisposition to auditory and visual hallucinations were distinct traits. Two sub-scales were identified by a factor analysis (principal components with OBLIMIN rotation) guided by the scree plot which clearly suggested a two-factor solution. One item (No. 11) was removed prior to factor analysis because of a lack of variance (all participants

endorsed 'never'). Criteria for defining the factors were as follows: items were required to load above 0.3 on a factor to contribute to it, and, because the aim was to identify distinct sub-scales, if an item loaded over 0.3 on both factors it only contributed to the factor it loaded highest on (if there was a difference of less than 0.1 in the loadings such items were excluded). After the application of these criteria, the two factors consisted of a 6-item sub-scale assessing predisposition towards visual hallucinations/disturbances (alpha = .75) and a 7-item sub-scale measuring tendency towards experiencing auditory or verbal hallucinations/daydreaming (alpha = .64). These two factors accounted for 38% of the variance (27% and 11% respectively), and were correlated ($r = .31$). The factor structure matrix is shown in Table 1. It was noted that 24% of respondents endorsed responses suggesting that they experienced hearing a voice speaking their thoughts aloud at least sometimes.

Table 1. Factor loadings of revised hallucination scale items

Item	Factor 1	Factor 2
1. A passing thought will seem so real that it frightens me.	.51	.42
2.[a] My thoughts seem as real as actual events in my life.	.28	.45
3.[a] No matter how much I try to concentrate on my work unrelated thoughts always creep into my mind.	.11	.34
4.[a] I have had the experience of hearing a person's voice and then found that there was no one there.	.63	.39
5.[a] The sounds I hear in my daydreams are generally clear and distinct.	.08	.65
6.[a] The people in my daydreams seem so true to life that I think they are real.	.18	.69
7.[a] In my daydreams I can hear the sound of a tune almost as clearly as if I were actually listening to it.	.06	.62
8.[a] I hear a voice speaking my thoughts aloud.	.33	.54
9.[a] I have been troubled by hearing voices in my head.	.26	.57
10.[a] I have seen a person's face in front of me when no one was there.	.53	−.34
12. I have heard the voice of God speaking to me.	.39	.42
13.[a] When I look at things they appear strange to me.	.75	.40
14.[a] I see shadows and shapes when there is nothing there.	.65	.34
15.[a] When I look at things they look unreal to me.	.74	.14
16.[a] When I look at myself in the mirror I look different.	.64	.16

[a] Items retained in the final version of the questionnaire.

Effects of positive beliefs about hallucinatory experiences

In order to examine the hypothesis that predisposition to hallucination is associated with positive beliefs about such experiences (independently of mood and schizotypy), two multiple regression analyses were conducted (one for auditory hallucinations and one for visual hallucinations).

Auditory hallucinatons. In order to investigate the relationship between mood, schizotypal factors, beliefs and predisposition to auditory hallucinations, a multiple regression analysis was performed using direct entry. The predisposition to auditory hallucinations/daydreams score was used as the dependent variable. The independent (or predictor) variables included in the analysis were the mood variables (trait anxiety and depression composite score) on step 1, schizotypal factors on step 2 (paranoia and predisposition to visual hallucinations/disturbances) and positive and negative beliefs about unusual perceptual experiences on step 3. The correlation matrix and the results of the final multiple regression equation can be seen in Tables 2 and 3 respectively.

Table 2. Correlation matrix for schizotypal, mood and belief variables

Variable	1	2	3	4	5	6
1. Predisposition to auditory hallucinations	—	—	—	—	—	—
2. Predisposition to visual hallucinations	.33**	—	—	—	—	—
3. Positive beliefs about unusual experiences	.40**	.47**	—	—	—	—
4. Negative beliefs about unusual experiences	.18	.27	.18	—	—	—
5. State–Trait anxiety	.18	.42**	.12	.33*	—	—
6. Depression composite score	.11	.41**	.17	.41**	.62**	—
7. Paranoia	.23	.50**	.27	.28	.61**	.47**

$*p \leqslant .05$; $**p \leqslant .01$.

Table 3. Multiple regression summary statistics for predisposition to auditory hallucinations

Variable	Beta	Partial r	F	Sig. of F
State–Trait anxiety	0.01	.01	0.01	n.s.
Depression composite	− 0.14	−.12	1.20	n.s.
Predisposition to visual hallucinations	0.25	.22	3.94	0.051
Paranoia	0.11	.10	0.73	n.s.
Negative beliefs about unusual experiences	0.08	.09	0.61	n.s.
Positive beliefs about unusual experiences	0.28	.29	7.10	0.009

The multiple R was .49 and significant ($F(6, 79) = 4.12$, $p < .002$). The adjusted R^2 was .18 indicating that a moderate amount of the variance was accounted for by these predictor variables. An examination of the tolerances of the individual variables found them to be acceptably high, indicating that colinearity was not a problem. On step 1, with the mood variables entered, the multiple R was .16 and not significant. On step 2, when the schizotypal variables were entered, the multiple R was .40 and significant, the adjusted R^2 was .12 and the increment in R^2 of .13 was significant

($F = 6.47, p < .01$). On the final step, when the beliefs were entered, the increment in R^2 was .08 and significant ($F = 4.05, p < .05$).

Visual hallucinations. We ran a similar regression with predisposition to visual hallucinations as the dependent variable. The independent variables included in the analysis were again, the mood variables (trait anxiety and depression composite score) on step 1, schizotypal factors on step 2 (paranoia and predisposition to auditory hallucinations/daydreams) and positive and negative beliefs about unusual perceptual experiences on step 3. The correlation matrix and the results of the final multiple regression equation can be seen in Tables 2 and 4 respectively.

Table 4. Multiple regression summary statistics for predisposition to visual hallucinations

Variable	Beta	Partial r	F	Sig. of F
State–Trait anxiety	0.18	.17	2.44	n.s.
Depression composite	0.21	.21	3.63	0.060
Predisposition to auditory hallucinations	0.19	.22	3.94	0.051
Paranoia	0.18	.19	2.89	0.093
Negative beliefs about unusual experiences	0.01	.01	0.01	n.s.
Positive beliefs about unusual experiences	0.24	.27	6.38	0.014

The multiple R was .66 and significant ($F(6, 79) = 10.0, p < .0001$). The adjusted R^2 was .39 indicating that a large amount of the variance was accounted for by these predictor variables. An examination of the tolerances of the individual variables found them to be acceptably high, indicating that colinearity was not a problem. On step 1, with the mood variables entered, the multiple R was .52 and significant ($F = 15.08, p < .001$). On step 2, when the schizotypal variables were entered, the multiple R was .62 and significant, the adjusted R^2 was .35 and the increment in R^2 of .12 was significant ($F = 7.82, p < .001$). On the final step, when beliefs were entered, the increment in R^2 was .5 and significant ($F = 3.21, p < .05$).

It can be seen from these analyses that positive beliefs about hallucinatory experiences are indeed associated with predisposition to hallucination.

Meta-cognitive beliefs about thoughts

In order to investigate the relationship between meta-cognitive beliefs about intrusive thoughts/worry and predisposition to hallucinations, a multivariate analysis of variance was conducted using the sub-scales of the MCQ as the dependent variables and using high or low predisposition to hallucinations (employing a median split on total hallucination score) as the grouping factor. There was an overall significant difference between the meta-cognitive beliefs of participants high and low

in their predisposition to hallucinations ($F(5, 87) = 2.77, p < .05$). The results of the univariate comparisons are shown in Table 5.

Table 5. Univariate analyses of variance for meta-cognitive beliefs about thoughts

Variable	Low hallucinations M (SD)	High hallucinations M (SD)	F	Sig. of F
Cognitive confidence	16.00 (4.95)	17.23 (4.84)	1.76	n.s.
Cognitive self-consciousness	14.98 (3.80)	17.50 (3.90)	9.95	0.002
Uncontrollability and danger	25.93 (7.16)	30.42 (7.75)	9.65	0.003
Positive beliefs about worry	31.31 (8.75)	34.52 (10.10)	2.64	n.s.
Responsibility and superstition	18.44 (3.93)	20.31 (5.03)	3.88	0.052

Thought control strategies

We hypothesized that individuals high and low in predisposition to hallucinations would differ in their use of thought control strategies. In order to examine the differences in use of self-regulatory thought control strategies between individuals with high or low predisposition to hallucination, a multivariate analysis of variance was performed. The overall level of predisposition (high or low as assessed by a median split on total score) was used as the between participants factor, and each of the five sub-scales from the TCQ were the independent variables. There was a significant difference between the strategies used overall by the two groups ($F(5, 96) = 2.51, p < .05$). The univariate comparisons are presented in Table 6.

Table 6. Univariate analyses of variance for thought control strategies

Variable	Low hallucinations M (SD)	High hallucinations M (SD)	F	Sig. of F
Distraction	13.82 (2.94)	14.67 (3.22)	1.79	n.s.
Punishment	8.43 (1.59)	9.47 (2.40)	6.63	0.011
Reappraisal	12.41 (3.86)	14.24 (3.38)	6.43	0.013
Worry	8.29 (2.08)	9.12 (2.45)	3.37	n.s.
Social	13.59 (3.79)	13.10 (3.95)	0.41	n.s.

Discussion

The results of the present study suggest that predisposition to auditory hallucinations/daydreams and visual hallucinations/disturbances are two distinct traits that can be distinguished with the modified LSHS. The finding that

daydreaming items loaded on the sub-scale assessing predisposition to auditory hallucinations suggests a potential common mechanism for these phenomena which is worthy of future investigation. This may be consistent with the view that auditory hallucinations may be equivalent to 'dreaming awake' (Kingdon & Turkington, 1993, p. 77) and thus implicate the failure of an inhibitory mechanism that is usually only 'turned off' during REM sleep as suggested by Asaad and Shapiro (1986). The finding that 24% of the respondents heard a voice speaking their thoughts aloud provides further support for the idea that hallucinatory experiences are normal, and that so-called first rank symptoms of schizophrenia are present in a large minority of the general population.

Consistent with predicitons based on the S-REF model (Wells & Matthews, 1994), positive beliefs about unusual perceptual experiences were the best predictor of predisposition to auditory and visual hallucinations and participants who scored higher on predisposition to hallucination used different thought control strategies and had different meta-cognitive beliefs in comparison with participants of low predisposition.

The present data not only suggest that positive beliefs about hallucinations are associated with predisposition, but also that those participants highly predisposed to hallucination scored significantly higher on cognitive self-consciousness and negative beliefs about uncontrollability and danger than those with a low predisposition (a finding that is consistent with Baker and Morrison's (1998) findings in patients experiencing auditory hallucinations). Perhaps it is the co-occurrence of positive and negative beliefs which underlies the transition from normal to pathological hallucinatory experiences; a similar co-existence of positive and negative beliefs (about worrying) has already been implicated in the development of problematic worry in generalized anxiety disorder (Wells, 1995). The combination of positive beliefs about unusual perceptual experiences and negative meta-cognitive beliefs is consistent with the suggestion that hallucinations may be partially motivated and become distressing only when appraised as uncontrollable and dangerous (as suggested by Morrison, 1998). These results are also consistent with other theories of hallucination that implicate meta-cognition (Bentall, 1990; Morrison *et al.*, 1995), and the observed combination of positive and negative beliefs may offer some support for the view that cognitive dissonance may be involved in the development and maintenance of auditory hallucinations.

Individuals prone to hallucination also appear to use different self-regulatory strategies for dealing with unwanted and distressing thoughts in comparison with less predisposed participants. Participants highly predisposed to hallucination use more punishment and reinterpretation strategies for controlling unwanted thoughts. Perhaps the execution of particular strategies increases the likelihood that thoughts are transformed into hallucinatory experiences (i.e. attributed to an external source).

The clinical implications of these findings must be considered cautiously, as the participants were from a non-clinical population. However, if similar processes are involved in the development and maintenance of hallucinations in psychotic patients, then meta-cognitive beliefs and processes (particularly negative beliefs about controllability, responsibility and superstitiousness, positive beliefs about unusual perceptual experiences and cognitive self-consciousness) should be assessed and the

modification of such beliefs may result in improvements. Similarly, the control strategies used by patients may be maladaptive under some circumstances and the causes and consequences of their usage should be explored. These findings would also suggest that it is important to assess the adaptive functions of hallucinations and provide patients with alternative ways of obtaining these functions before targeting interventions at the hallucinatory experiences.

There are a number of methodological limitations with this study that could be addressed in future research. There was no monitoring of illicit drug use by the participants, which could be a confounding factor that could, for instance, be expected to influence the frequency of visual hallucinations and paranoia. In addition, no clinical sample was examined, so it is difficult to be sure that the predisposition of normal participants to different types of hallucination is similar to that of psychotic patients. The analyses that employ a univariate median split as the grouping factor could be criticized by methodologists who argue that the artificial dichotomizing of variables is problematic as it results in loss of information; however, the effect of this is to reduce statistical power, so the significant differences reported here are likely to be robust (for further discussion see Maxwell & Delaney, 1993). Future research should examine distinctions between auditory hallucinations, daydreaming and visual hallucinations in greater detail. Finally, as this study used several measures relating to thoughts (i.e. MCQ, TCQ), future studies could develop measures of beliefs that specifically refer to hallucinations.

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