The Role of Aberrant Salience and Self-Concept Clarity in Psychotic-Like Experiences

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Most theories of psychotic-like experiences posit the involvement of cognitive mechanisms. The current research examined the relations between psychotic-like experiences and two cognitive mechanisms, high aberrant salience and low self-concept clarity. In particular, we examined whether aberrant salience, or the incorrect assignment of importance to neutral stimuli, and low self-concept clarity interacted to predict psychotic-like experiences. The current research included three large samples ($n = 667, 724, 744$) of participants and oversampled for increased schizotypal personality traits. In all three studies, an interaction between aberrant salience and self-concept clarity was found such that participants with high aberrant salience and low self-concept clarity had the highest levels of psychotic-like experiences. In addition, aberrant salience and self-concept clarity interacted to predict a supplemental measure of delusions in Study 2. In Study 3, in contrast to low self-concept clarity, neuroticism did not interact with aberrant salience to predict psychotic-like experiences, suggesting that the relation between low self-concept clarity and psychosis may not be a result of neuroticism. Additionally, aberrant salience and self-concept clarity did not interact to predict two other SPD criteria, social anhedonia or trait paranoia, which suggests the interaction is specific to psychotic-like experiences. Overall, our results are consistent with several cognitive models of psychosis suggesting that aberrant salience and self-concept clarity might be important mechanisms in the occurrence of psychotic-like symptoms.

Keywords: aberrant salience, self-concept clarity, psychotic-like experiences, schizotypal personality disorder, schizotypy

Psychotic symptoms include delusions and hallucinations and are a common experience in people with schizophrenia-spectrum disorders and in people at risk for psychosis (e.g., Andreasen, Arndt, Alliger, Miller, & Flaum, 1995). Recent research suggests that psychotic-like experiences (PLEs) may also be relatively common in the general population, with estimates as high as one of every five people reporting at least one psychotic experience at some point in their lifetime (van Os, Hanssen, Bijl, & Vollebergh, 2001). PLEs are similar to symptoms of psychosis, but in diminished form, and may precipitate a psychotic episode (Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001). For example, two criteria for schizotypal personality disorder (SPD) include odd beliefs or magical thinking and unusual perceptual experiences (American Psychiatric Association, 2000), which are similar to the psychotic symptoms of delusions and hallucinations respectively. Many theorists who have attempted to explain the origin of psy-

chosis and PLEs have posited a role for cognitive mechanisms in the development and maintenance of these experiences (e.g., Bell, Halligan, & Ellis, 2006; Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001; Freeman, 2007; Garety et al., 2001). The current research examined the relations between PLEs (i.e., odd beliefs or magical thinking and unusual perceptual experiences) and two cognitive mechanisms, aberrant salience and low self-concept clarity.

Aberrant salience is the incorrect assignment of importance to neutral stimuli and has been proposed to be centrally involved in psychosis and PLEs (Kapur, 2003). Anecdotal reports of people with psychosis suggest that they initially often go through periods in which stimuli that ordinarily would not seem significant become much more salient and important (Bowers, 1968; Moller & Husby, 2000). Based in part on these phenomenological observations, Kapur (2003) suggested that occurrences of aberrant salience may be central to the development of psychosis and that aberrant salience may be related to dopamine dysregulation. This is consistent with a long line of research supporting an association between psychosis and increased subcortical dopamine (e.g., Seeman, 1987). For example, brain imaging studies have found dysregulated dopamine activity when people with schizophrenia are actively psychotic (e.g., Laruelle & Abi-Dargham, 1999) and in the prodromal phase of the illness (Howes et al., 2009). Therefore, both phenomenological and neurobiological research suggests a role for aberrant salience in psychosis and PLEs.

A role for aberrant salience in psychosis and PLEs is also consistent with most previous models of PLEs. Two cognitive

mechanisms that are common to nearly all models of PLEs are (a) aberrant salience or anomalous experiences and (b) self-relevant information processing (e.g., Bell et al., 2006; Bentall et al., 2001; Freeman, 2007). According to these models, anomalous experiences contribute to psychosis because people adopt delusional beliefs in part to account for these anomalous experiences (Maher, 1974). In addition, a number of these models have also hypothesized that aberrant salience is the mechanism that contributes to the occurrence of anomalous experiences (Freeman, 2007; Kapur, 2003).

Until recently, there was not a direct method for measuring aberrant salience. In a series of studies, the Aberrant Salience Inventory was recently developed (ASI; Cicero, Kerns, & McCarthy, 2010) and found to be a valid and reliable measure of aberrant salience in people at risk for the development of psychosis. The ASI is distinct from, albeit highly correlated with, other measures PLEs such as the Perceptual Aberration (Chapman, Chapman, & Raulin, 1978) and Magical Ideation Scales (Eckblad & Chapman, 1983). The current research aims to further test the nomological network of the construct of aberrant salience by using the ASI to examine theories of PLEs that posit a central role for aberrant salience.

Another cognitive mechanism of PLEs examined in the current research is low self-concept clarity. Self-concept clarity (SCC) refers to "the extent to which one's beliefs about one's attributes are clear, confidently held, internally consistent, stable, and cognitively accessible" (Stinson, Wood, & Doxey, 2008, p. 1541). People with low self-concept clarity have been found to report more fluctuating levels of self-esteem (Kernis, Paradise, Whitaker, Wheatman, & Goldman, 2000), which is associated with a host of negative psychological outcomes (Campbell et al., 1996).

As mentioned, researchers have long suggested that basic problems with self-relevant information processing may be related to the development of psychosis (e.g., Hemsley, 1998; Parnas, Handest, Saebye, & Jansson, 2003). Recently, some evidence suggests that low self-concept clarity in particular might be related to PLEs. One phenomenological study concluded that "disturbance of perception of self" is a core experiential dimension of the development of psychosis (Moller & Husby, 2000), with this disturbance described as a loss of a clear conceptualization of the self. For instance, people in the prodromal phase of psychosis reported often feeling like they were confused about their identities (Moller & Husby, 2000), suggesting low self-concept clarity. Hence, it is possible that low self-concept clarity might be a specific type of self-processing disturbance related to PLEs.

As previously discussed, a role for both aberrant salience and low self-concept clarity in PLEs is consistent with nearly all models of psychosis. However, another important feature of cognitive models of psychosis is that they suggest that by themselves neither aberrant salience nor self-processing disturbances may be sufficient to produce PLEs. Instead, these models posit that the combination of aberrant salience and self-processing disturbances results in PLEs (Bell et al., 2006).

Therefore, based on previous PLEs theories and research, aberrant salience and low self-concept clarity might be two cognitive mechanisms that interact to predict PLEs. Nevertheless, a number of important questions have not been examined in previous research. For instance, no previous research has actually examined whether aberrant salience and low self-concept clarity interact to predict PLEs. Similarly, previous research has not examined whether aberrant salience and low self-concept clarity interact to uniquely predict PLEs and do not interact to predict other aspects of SPD. Furthermore, although previous research suggests that low self-concept clarity might be associated with PLEs, no previous research has directly measured and examined whether self-concept clarity is associated with PLEs. Given that self-processing disturbances are also associated with increased neuroticism (Campbell et al., 1996), it is important to examine whether self-concept clarity is uniquely associated with PLEs or whether neuroticism would be similarly associated with PLEs.

In three studies, the current research examined whether aberrant salience and self-concept clarity interacted to predict symptoms of SPD, specifically magical ideation and perceptual aberration (Chapman et al., 1994). In addition, Study 1 tested whether this interaction was specific to PLEs and not to another facet of SPD, social anhedonia, which is closely related to the "lack of close friends" criterion of SPD. In Study 2, we attempted to replicate the interaction between aberrant salience and self-concept clarity in predicting PLEs and to test the specificity of the interaction by including a supplementary measure of delusion-like beliefs, the Peters Delusion Inventory (PDI; Peters, Joseph, Day, & Garety, 2004). In Study 3 we tested whether only self-concept clarity interacted with aberrant salience to predict PLEs or whether neuroticism would also interact with aberrant salience to predict PLEs. Finally, in Study 3, we tested whether the interaction was specific to PLEs or whether aberrant salience and self-concept clarity would interact to predict trait paranoia, which is another symptom of SPD.

Study 1

The main goal of Study 1 was to test the prediction that aberrant salience and self-concept clarity interact to predict PLEs. Additionally, we tested whether this interaction is specific to predicting PLEs and whether aberrant salience and self-concept clarity would not interact to predict social anhedonia.

Method

Participants.   All undergraduate students enrolled in an introduction to psychology course were invited to complete a battery of questionnaires for partial completion of a course requirement. 1,901 students completed this testing battery. Embedded in the testing battery were abbreviated versions of the Perceptual Aberration Scale (PerAb; Chapman, et al., 1978), Magical Ideation Scale (MagicId; Eckblad & Chapman, 1983), and Social Anhedonia Scale (SocAnh; Chapman, Chapman, & Raulin, 1976). As is commonly done in schizotypy research, to ensure adequate numbers of participants with high schizotypal personality, participants scoring two standard deviations above the mean or higher on these scales or a combined three standard deviations above the mean on PerAb and MagicId were recruited to the laboratory for an individual testing session. Participants who scored less than 0.5 standard deviations above the mean on all three scales were also recruited to ensure a full range of schizotypy scores. Finally, all students taking the introduction to psychology course were invited to participate in an individual testing session. In total, 667 undergraduates took part in an individual testing session and provided

data used in the current research. During the individual testing session, they completed full versions of these three scales, and all analyses were based on the full versions of the scales. Participants ranged from 18–26 years old, with an average age of 18.47 (*SD* = 0.93). Participants were 63% female, 86% White, 6% African American, and 8% other.

Measures.

Aberrant Salience. Aberrant Salience was measured with the Aberrant Salience Inventory (ASI; Cicero et al., 2010). The ASI is a 29-item yes–no questionnaire that has five subscales measuring different aspects of the experience of aberrant salience, including feelings of increased significance (e.g., *Do certain trivial things suddenly seem especially important or significant to you?*), sharpening of senses (e.g., *Do your senses ever seem especially strong or clear?*), impending understanding (e.g., *Do you sometimes feel like you are on the verge of something really big or important but you aren't sure what it is?*), heightened emotionality (e.g., *Do you go through periods in which you feel overstimulated by things or experiences that are normally manageable?*), and heightened cognition (e.g., *Do you ever feel like the mysteries of the universe are revealing themselves to you?*). Previous research has found that the ASI is highly correlated with other measures of schizotypal personality traits, is elevated in participants at risk for the development of psychotic disorders, and is elevated in inpatients with a history of psychosis compared with inpatients without a history of psychosis (Cicero et al., 2010). Moreover, the ASI has discriminant validity from other measures of schizotypal personality traits, as the ASI has been found to be correlated with measures reflecting increased subcortical dopamine, whereas other psychosis-proneness measures were not (Cicero et al., 2010). At the same time, there is very little if any overlap in item content between the types of experiences asked about on the ASI and the types of experiences on the PerMag or on other PLEs scales (Cicero et al., 2010).

Self-Concept Clarity (SCC). Self-concept clarity was measured with the self-concept clarity scale in Study 1 (SCCS; Campbell, 1990). The SCCS is a 12-item scale on which participants rate statements on a scale from 1 (*Strongly Agree*) to 5 (*Strongly Disagree*) (e.g., My beliefs about myself often conflict with one another). The SCCS has been found to be correlated with other measures of self-concept clarity including agreement of pairs of adjectives describing the self (Campbell et al., 1996).

Psychotic-like experiences. Perceptual aberration was measured with the Perceptual Aberration Scale (PerAb; Chapman, Chapman, & Raulin, 1978). The PerAb is a 35-item true–false scale that measures schizophrenic-like distortions in perceptions (e.g., "my hearing is sometimes so sensitive that ordinary sounds become uncomfortable"). Magical ideation was measured with the Magical Ideation Scale (MagicId; Eckblad & Chapman, 1983), a 30-item true–false scale designed to measure "beliefs in forms of causation that by conventional standards are invalid" (Eckblad & Chapman, 1983, p.215). For example, "I have worried that people on other planets may be influencing what happens on Earth." The PerAb and MagicId have considerable support for the reliability and validity of their scores (for a review, see Edell, 1995). As commonly done in schizotypy research (Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994), scores on PerAb and MagicId were added together to form a single Perceptual Aberration/Magical Ideation (PerMag) score.

Social Anhedonia. Social Anhedonia was measured with the Revised Social Anhedonia Scale (SocAnh; Chapman, et al., 1976). The SocAnh contains 40 true–false items that measure a lack of relationships and a lack of enjoyment derived from social interactions (e.g., "I am usually content just to sit alone, thinking and daydreaming") and has been found to predict future development of schizophrenia-spectrum disorders (e.g., Gooding, Tallent, & Matts, 2005). Previous research has found that SocAnh loads on the same factor as measures of the no close friends criterion of SPD (Cicero & Kerns, 2010b).

Infrequency. Participants also completed the Chapman Infrequency Scale, which measures invalid or careless responding. The scale includes items that should rarely be answered in the affirmative (e.g., I have never talked to someone wearing eyeglasses). Following convention in schizotypy research, participants answering "true" to three or more items were excluded from the analyses (Chmielewski, Fernandes, Yee, & Miller, 1995).

Procedure. Participants completed the study on a single occasion in an isolated room, which took approximately 60 minutes. Participants completed the Magical Ideation, Perceptual Aberration, Social Anhedonia, and Chapman Infrequency Scales mixed together. Then participants completed a battery of questionnaires including the Aberrant Salience Inventory, Self-Concept Clarity Scale, and filler items.

Results

Zero-order correlations. Because the studies in the current research include large samples, some correlations may reach conventional significance values but not be clinically meaningful. Because of the large number of correlations being examined, we used the Bonferroni method of correcting the *p* value for multiple comparisons (Dunn, 1961). Thus, only correlations significant at the $p < .001$ level are presented and interpreted. As can be seen in Table 1, aberrant salience was associated with increased PerMag experiences. Self-concept clarity was negatively associated with aberrant salience and PerMag scores.

Psychotic-like experiences. In all of the regression analyses reported across studies, we first conducted regression diagnostics as suggested by Pedhazur (1997) to detect outliers. To treat outliers consistently across studies, data points with Cook's Ds greater than .05 and leverage values greater than .04 were excluded from the analyses. Below we mention all instances where outliers were excluded.

We then tested the prediction of cognitive models of PLEs that an interaction between high aberrant salience and low self-concept clarity predicts PLEs. To test this interaction, ASI scores and SCCS scores were centered around their means and entered as step one of a hierarchical linear regression predicting PerMag. The product of ASI and SCCS scores was entered in step two of the analysis. Following Aiken and West (1991), to interpret the interaction, scores were calculated for +1 and −1 standard deviations from the mean for both aberrant salience and self-concept clarity. Aberrant salience and self-concept clarity interacted to predict PerMag, $t(605) = 5.72$, $p < .001$; see Figure 1 and Table 2. Participants with high aberrant salience tended to have extreme levels of PerMag only if they had low levels of self-concept clarity as well, which is consistent with cognitive models of psychosis. To probe the interaction, we tested the simple slope of the relation

Table 1
Bivarate Correlations for Variables Used in All Studies

	Study 1				Study 2					Study 3					
	1	2	3	4	1	2	3	4	5	1	2	3	4	6	7
1) ASI	.90				.86					.90					
2) SCCS	−.43*	.91			−.34*	.86				−.33*	.91				
3) PerMag	.65*	−.41*	.89		.59*	−.32*	.88			.59*	−.37*	.85			
4) SocAnh	.19*	−.28*	.31*	.82	.12*	−.29*	.23*	.85		.17*	−.26*	.41*	.81		
5) PDI	—	—	—	—	.55*	−.31*	.61*	.19*	.74	—	—	—	—		
6) Neuroticism	—	—	—	—	—	—	—	—	—	.09	−.30*	.19*	.15*	.88	
7) SPQ-Suspic	—	—	—	—	—	—	—	—	—	.46*	−.40*	.45*	.39*	.24*	.72
Mean	14.18	38.27	11.35	8.66	15.63	37.82	12.82	7.34	6.10	13.94	37.32	13.77	7.24	30.24	2.62
Standard Deviation	6.80	5.04	9.04	5.17	6.12	9.42	9.61	5.70	3.18	7.11	8.10	10.15	5.28	7.08	2.21

Note. Numbers on the diagonal represent Cronbach's alpha. ASI = Aberrant Salience Inventory, SCCS = Self-Concept Clarity Scale; PerMag = Combined Perceptual Aberration and Magical Ideation Scales; SocAnh = Social Anhedonia Scale; PDI = Peters Delusions Inventory; Neuroticism = the Neuroticism subscale of the International Personality Item Pool; SPQ-Suspic = the Suspiciousness Subscale of the Schizotypal Personality Questionnaire.
* $p < .001$.

between self-concept clarity and PerMag at high and low levels of aberrant salience (Hayes & Matthes, 2009). Self-concept clarity was associated with PerMag at 1 standard deviation above the mean on aberrant salience, $t(605) = 9.15$, $p < .001$, but not at 1 standard deviation below the mean, $t(605) = 0.42$, $p = .67$. This suggests that SCC is only associated with PLEs when people also have high levels of aberrant salience.

Specificity of moderation. To test whether the interaction between aberrant salience and self-concept clarity was specific to PLEs, we tested whether there was a significant interaction between the ASI and SCCS in predicting social anhedonia. There was not a significant interaction between aberrant salience and self-concept clarity in predicting social anhedonia, $t(605) = 0.98$, $p = .33$, which suggests that the interaction between aberrant salience and self-concept clarity is specific to PLEs and not schizotypal personality in general. Examining the main effects revealed that SCCS is negatively related to social anhedonia, but the ASI is not.

Discussion

The results of Study 1 are consistent with several cognitive models of psychosis as well as phenomenological descriptions of PLEs (Bell et al., 2006; Freeman, 2007; Moller & Husby, 2000). Specifically, Study 1 found that participants with a combination of

Figure 1. Perceptual aberration/magical ideation as a function of Aberrant Salience and Self-Concept Clarity in Study 1.

high aberrant salience and low self-concept clarity had the highest levels of PLEs. The probe of the interaction revealed that low self-concept clarity tended to be unrelated to PLEs in people with low aberrant salience but was strongly associated with increased PLEs in people with high aberrant salience. This finding is consistent with cognitive models of PLEs that have predicted that self-relevant information processing interacts with aberrant salience or anomalous experiences to produce PLEs (Bell et al., 2006; Freeman, 2007). Moreover, Study 1 found that the interaction between aberrant salience and self-concept clarity is specific to PLEs and not to social anhedonia, a common negative symptom that is closely related to the SPD criterion of a lack of close friends. This is also consistent with previous theoretical models of PLEs which suggest that aberrant salience may only be related to positive symptoms but not to negative symptoms (Kapur, 2003).

Study 2

The first goal of Study 2 was to replicate the results of Study 1 in an independent sample. This is important because Study 1 was the first study to test whether there was an interaction between aberrant salience and self-concept clarity in predicting PLEs. In addition, the second goal of Study 2 was to further test the specificity of the interaction by including a measure of delusion-like experiences, the Peters Delusions Inventory (PDI). We predicted that Study 2 would replicate the results of Study 1 and that aberrant salience and self-concept clarity would interact in the same pattern to predict PDI scores.

Method

Participants. Participants were 724 native English-speaking undergraduate students screened from a larger pool ($n = 2,244$) who took part in the study as partial fulfillment of a course requirement. Thirty-two participants were excluded for having Chapman Infrequency Scores of three or greater. Participants ranged from 18–26 years old, with an average age of 18.44 (SD =
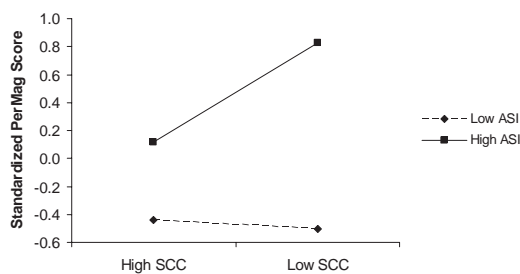
Table 2

Regression Analyses for the Interaction Between Aberrant Salience and Self-Concept Clarity in Predicting PerMag, Social Anhedonia, and PDI Scores in Study 1 and Study 2

	Study 1		Study 2		
	PerMag	SocAnh	PerMag	PDI-total score	SocAnh
Step 1 (ΔR^2)	.46***	.08***	.36***	.33***	.09***
ASI (β)	.58***	.07	.55***	.52***	.03
SCCS (β)	−.17***	−.25***	−.13***	−.12***	−.28***
Step 2 (ΔR^2)	.03***	.01	.02***	.01*	.00
ASI × SCCS (β)	−.17***	−.03	−.13***	−.07*	−.05

Note. ASI = Aberrant Salience Inventory; SCCS = Self-Concept Clarity Scale; PerMag = combined Perceptual Aberration Scale; Magical Ideation Scale; SocAnh = the Revised Social Anhedonia Scale; PDI = Peters Delusion Inventory.
*** $p < .001$.

0.84). Participants were 64% female, 84% White, 11% African American, and 5% other.

Measures.

Aberrant Salience. Like in Study 1, aberrant salience was measured with the Aberrant Salience Inventory (ASI; Cicero et al., 2010).

Self-Concept Clarity (SCC). Like in Study 1, self-concept clarity was measured with the self-concept clarity scale (SCCS; Campbell, 1990).

Psychotic-like experiences. Like in Study 1, perceptual aberration was measured with the Perceptual Aberration Scale (Chapman et al., 1978) and magical ideation was measured with the Magical Ideation Scale (Eckblad & Chapman, 1983).

In addition to PerMag, PLEs were measured with the 21-item Peters Delusion Inventory (PDI; Peters et al., 2004), which includes yes–no questions regarding delusion-like experiences (e.g., *Have your thoughts ever been so vivid that you were worried other people would hear them?*). As can be seen in Table 1, PDI scores were highly correlated with PerMag scores.

Social Anhedonia. Like in Study 1, social anhedonia was measured with the revised Social Anhedonia Scale (SocAnh; Chapman, et al., 1976).

Infrequency. Participants also completed the Chapman Infrequency Scale as in Study 1.

Procedure. Participants completed the study on a single occasion in an isolated room. The entire study took approximately 60 minutes. First, participants completed the Aberrant Salience Inventory, Self-Concept Clarity Scale, and then the Magical Ideation, Perceptual Aberration, Social Anhedonia, and Chapman Infrequency Scales mixed together and called the "Survey of Attitudes and Experiences." Then, participants completed the Peters Delusion Inventory.

Results

Zero-order correlations. As can be seen in Table 1, aberrant salience was associated with perceptual aberration/magical ideation, and PDI scores. It was negatively correlated with both measures of self-concept clarity. The SCCS was negatively correlated with magical ideation, perceptual aberration, PDI scores, and social anhedonia.

Aberrant Salience, Self-Concept Clarity, and Psychotic-like experiences. We first tested the interaction between ASI and SCCS scores in predicting PerMag scores. Like in Study 1, mean

centered ASI and SCC scores were entered in step 1 of a hierarchical linear regression predicting PerMag, and the product of these two terms was entered in step 2. Overall, there was a significant interaction between aberrant salience and self-concept clarity predicting PerMag, $t(692) = -4.36$, $p < .001$; see Table 2. A probe of this interaction revealed that self-concept clarity was associated with PerMag when participants were one standard deviation above the mean on the ASI, $t(692) = 6.01$, $p < .001$ but not when participants were one standard deviation below the mean on the ASI, $t(692) = -0.08$, $p = .93$. This suggests that self-concept clarity is only related to PerMag at high levels of aberrant salience.

In addition, we tested the same model to see whether aberrant salience and self-concept clarity interacted to predict PDI scores. There was a significant interaction between aberrant salience and self-concept clarity in predicting PDI scores, $t(691) = 2.01$, $p = .04$; see Table 2. One outlier was excluded from these analyses. This participant had a cook's distance value of .11 and a leverage score of .04, which suggests that the participant was an outlier in terms of residual distance from the slope and that this observation had an unduly large influence on the data (Pedhazur, 1997). Like PerMag, self-concept clarity was associated with PDI when participants had high ASI scores, $t(691) = 4.26$, $p < .001$, but not low ASI scores, $t(691) = 1.37$, $p = .17$. This suggests that self-concept clarity is only related to PDI scores at high levels of aberrant salience.[1]

Specificity of moderation to psychotic-like experiences. To test whether the interaction between aberrant salience and self-concept clarity was specific to PLEs, we tested whether there was a significant interaction between the ASI and SCCS in predicting social anhedonia. There was not a significant interaction between aberrant salience and self-concept clarity in predicting social anhedonia, $t(692) = -1.21$, $p = .22$, which suggests that the interaction between aberrant salience and self-concept clarity is specific to PLEs and not schizotypal personality in general. No outliers were identified. Examining the main effects revealed that SCCS is negatively related to social anhedonia, $t(692) = -8.14$, $p < .001$, but ASI is not, $t(692) = -0.06$, $p = .95$.

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[1] There was a significant interaction between aberrant salience and self-concept clarity predicting PDI delusional distress, $t(692) = -3.66$, $p < .001$, and PDI preoccupation, $t(692) = -2.69$, $p < .001$, subscale scores. However, the interaction was not significant in predicting conviction, $t(692) = -1.02$, $p = .31$.

Specificity of moderation to Aberrant Salience.   In Study 2, the ASI was positively correlated with PerMag ($r = .59$). Although previous research has found that the ASI and PerMag measure distinct constructs (Cicero et al., 2010), this high correlation raises questions about the discriminant validity of the two scales. If ASI and PerMag measure the same construct, we would expect to find that PerMag would interact with SCC to predict the other measure of PLEs, PDI scores, in the same manner that does the ASI. However, there was not a significant interaction between PerMag and SCC in predicting PDI scores, $t(692) = 0.69$, $p < .49$.

Discussion

Study 2 replicated the results of Study 1. First, there was a significant interaction between aberrant salience and self-concept clarity such that participants with high aberrant salience and low self-concept clarity had the highest levels of PLEs. Second, Like Study 1, Study 2 did not find an interaction between aberrant salience and self-concept clarity in predicting another facet of SPD, social anhedonia. Finally, Study 2 replicated the interaction with a separate measure of odd beliefs/magical thinking, the PDI. These results provide strong support that aberrant salience interacts with self-concept clarity to predict PLEs and that this interaction is specific to PLEs and not more generally to SPD.

Study 3

Although Study 2 replicated and extended the results of Study 1, one potential explanation for the finding that self-concept clarity interacts with aberrant salience to predict PLEs is that the role of self-concept clarity can be explained by its overlap with neuroticism. For example, previous research has found that low self-concept clarity is associated with neuroticism (Campbell et al., 1996). Similarly, there is a vast literature linking psychosis with a tendency to experience negative affect, particularly as a response to stressors (e.g., van Os, Kenis, & Rutten, 2010). Theorists have suggested that stress sensitivity, defined as an increased negative mood reaction to stress and assessed with measures of neuroticism, may be a suitable endophenotype for psychosis (see Myin-Germeys & van Os, 2007, for a review). Aberrant Salience may interact with negative affect, or neuroticism, such that people with high aberrant salience have PLEs if they also have high neuroticism. This would suggest that it is not disturbances in self-processing that contribute to psychotic-like disturbances but neuroticism. If the current result is specific to self-disturbances, then we would expect to replicate the interaction between aberrant salience and self-concept clarity found in Study 1 and Study 2 but not find an interaction between aberrant salience and neuroticism in predicting PLEs.

In addition to testing the specificity of aberrant salience interacting with self-concept clarity to predict PLEs, a goal of Study 3 was to test whether the interaction between aberrant salience and self-concept clarity was specific to PLEs. In Study 1 and Study 2, social anhedonia was used to examine specificity. To examine specificity in Study 3, we measured paranoia as an enduring trait. In people with psychotic disorders, persecutory delusions are the most common type of delusion (Appelbaum, Robbins, & Roth, 1999) and one of the models heavily relied upon in the current research is a model of persecutory delusions (Freeman, 2007).

However, there are some important differences between paranoia as an enduring trait versus persecutory delusions. For instance, research suggests that paranoia as an enduring trait and an individual difference variable in the general population may be explained as a combination of high neuroticism and low agreeableness (e.g., Lynam & Widiger, 2001; Trull, Widiger, & Burr, 2001). In contrast, persecutory delusions, like PLEs, may not be easily accounted for by extreme ends of normal personality traits (Tackett, Silberschmidt, Krueger, & Sponheim, 2008). Thus, persecutory delusions may share a common mechanism with other types of delusions (e.g., aberrant salience), but subclinical paranoia may not share this mechanism with perceptual aberration and magical ideation. At the same time, in at least 20 studies, previous SPD research clearly shows that paranoia is distinct from a positive or cognitive-perceptual factor that includes PerMag (e.g., Chmielewski & Watson, 2008; Cicero & Kerns, 2010b; and see Stefanis et al., 2004, for a review of additional studies). Thus, Study 3 examined whether there was a significant interaction between aberrant salience and self-concept clarity in predicting paranoia as a more stringent test of the specificity of the interaction.

Method

Participants.   Participants were 744 introductory to psychology students screened from a larger pool of participants ($n = 2,197$) who participated in the study for partial completion of a course requirement. Sixty-four participants were excluded for having Chapman Infrequency scores of three or greater. Participants ranged from 18–24 years old, with an average age of 18.47 ($SD = 0.77$). Participants were 61% female, 88% White, 4% African American, and 10% other.

Measures.

Aberrant Salience.   Aberrant Salience was measured with the Aberrant Salience Inventory (Cicero et al., 2010), like in Study 1 and Study 2.

Self-Concept Clarity.   Self-concept clarity was measured with the Self-Concept Clarity Scale (Campbell, 1990), like in Study 1 and Study 2.

Psychotic-like experiences.   As in Study 1 and Study 2, PLEs were measured with the Magical Ideation Scale (Eckblad & Chapman, 1983) and the Perceptual Aberration Scale (Chapman et al., 1978).

Social Anhedonia.   Like in Study 1 and Study 2, participants completed the Revised Social Anhedonia Scale (Chapman et al., 1976).

Neuroticism.   Neuroticism was measured with the 10-item subscale of the International Personality Item Pool (IPIP; Goldberg, 1999). Participants rate items on a scale from 1 (*very accurate*) to 5 (*very inaccurate*). An example item is, "I get stressed out easily." Previous research has found that the 10-item neuroticism subscale of the IPIP is highly correlated with other measures of neuroticism and has high internal consistency.

Paranoia.   Paranoia was measured with the eight-item yes–no Suspiciousness subscale of the Schizotypal Personality Questionnaire (SQP-S; Raine, 1991; e.g., *Do you sometimes get concerned that friends or coworkers are not really loyal or trustworthy?*). In previous research, the SPQ-S has consistently been found to load

with other measures of paranoia on a factor distinct from PerMag scales (e.g., Cicero & Kerns, 2010b).

Infrequency. Participants completed the Chapman Infrequency Scale like in Study 1 and Study 2.

Procedure. As part of a larger study that included filler items, participants completed the Magical Ideation, Perceptual Aberration, Social Anhedonia, and Chapman Infrequency Scales mixed together and called the "Survey of Attitudes and Experiences." Then participants completed the Aberrant Salience Inventory, the Self-Concept Clarity Scale, the Neuroticism subscale of the International Personality Item Pool, and the Suspiciousness subscale of the Schizotypal Personality Questionnaire.

Results

First, we tested whether there was a significant three-way interaction between ASI, SCC, and Neuroticism scores in predicting PerMag scores (see Table 3). Mean centered ASI, SCC, and Neuroticism scores were entered in step 1 of a hierarchical linear regression. The three two-way interactions were entered in step 2, and the three-way interaction was entered in step 3. There was not a significant three-way interaction, $t(675) = .72$, $p = .47$. However, as in Study 1 and Study 2, there was a significant interaction between ASI and SCC scores in predicting PerMag, $t(675) = 3.73$, $p < .001$, such that participants with high aberrant salience and low self-concept clarity had the highest levels of PerMag. There was not a significant interaction between aberrant salience and neuroticism in predicting PerMag, $t(680) = 0.94$, $p = .34$. Because there was not a significant two-way interaction between aberrant salience and neuroticism, we tested whether there were significant main effects for aberrant salience and neuroticism. Both aberrant salience, $t(680) = 18.45$, $p < .001$, and neuroticism, $t(680) = 3.98$, $p = .03$ uniquely contributed to the prediction of PerMag. Similarly, there was not a significant interaction between neuroticism and self-concept clarity in predicting PerMag, $t(680) = 1.86$, $p = .06$, but both SCC, $t(680) = 9.14$, $p < .001$ and neuroticism, $t(680) = 2.35$, $p = .02$, uniquely contributed to the prediction of PerMag. This suggests that the interaction between

Table 3

Regression Analyses for the Three-Way Interaction Between the Aberrant Salience Inventory, Self-Concept Clarity Scale, and IPIP-Neuroticism Scale in Study 3

	PerMag
Step 1 (ΔR^2)	.37***
ASI (β)	.51***
SCC (β)	−.18**
Neuroticism (β)	−.08*
Step 2 (ΔR^2)	.01
ASI × SCC (β)	−.12***
ASI × Neuroticism (β)	.04
Neuroticism × SCC (β)	.04
Step 3 (ΔR^2)	.01
ASI × SCC × Neuroticism (β)	−.03

Note. PerMag = combined Perceptual Aberration and Magical Ideation Scales; Neuroticism = the Neuroticism Subscale of the International Personality Item Pool; SCC = the Self-Concept Clarity Scale.
** $p < .01$.   *** $p < .001$.

aberrant salience and self-concept clarity is specific to self-concept clarity and not related to an interaction between aberrant salience and negative affectivity.

Additionally, there was not a significant interaction between self-concept clarity and aberrant salience in predicting paranoia, $t(680) = 0.54$, $p = .59$. However, there were main effects for both self-concept clarity and aberrant salience in predicting paranoia (see Table 4).

Discussion

Study 3 replicated the results of Study 1 and Study 2 by finding that there was a significant interaction between aberrant salience and self-concept clarity in predicting PLEs. In addition, Study 3 found that there was not a significant interaction between aberrant salience and neuroticism in predicting PLEs. Although neuroticism is associated with PLEs, this association remains constant at all levels of aberrant salience. Thus, it appears that there is something specific about self-concept clarity that is distinct from negative affect that interacts with aberrant salience to predict PLEs. The current research also found that self-concept clarity and aberrant salience did not interact to predict paranoia, which provides a more stringent test for the specificity of the interaction between aberrant salience and self-concept clarity in predicting PerMag.

General Discussion

In three separate samples, the current research found that there was an interaction between aberrant salience and self-concept clarity such that participants with high aberrant salience and low self-concept clarity have the highest levels of PLEs, which is a central feature of SPD. This is consistent with cognitive models and phenomenological descriptions of psychotic experiences that have suggested a prominent role for both aberrant salience and self-concept clarity (e.g., Bell et al., 2006; Bentall et al., 2001; Freeman, 2007; Moller & Husby, 2000). These results were specific to PLEs and not related to other criteria of SPD, including social anhedonia or paranoia. Additionally, the results of Study 3 suggest that the interaction with aberrant salience is specific to self-concept clarity as the interaction between aberrant salience and neuroticism did not predict PLEs.

As previously discussed, several researchers have suggested a central role for aberrant salience in PLEs (e.g., Kapur, 2003; Roiser et al., 2008). Previous research has found that the ASI is correlated with PLEs in unselected samples, is elevated in people with high levels of schizotypal personality traits, and is higher in inpatients with a history of psychosis compared with inpatients without a history of psychosis (Cicero et al., 2010). The current research extends these previous findings to suggest that aberrant salience alone may not be sufficient to produce PLEs. Rather, the current research found that high levels of aberrant salience produced more extreme levels of PLEs when those individuals also had unclear self-concepts. This is consistent with previous cognitive models which suggest that beliefs about the self and the world frame the response of the individual to an occurrence of aberrant salience (Freeman, 2007). Thus, an unclear self-concept may make an individual more likely to develop a psychotic-like explanation for an occurrence of aberrant salience.

Table 4

Regression Analyses for the Interaction Between Aberrant Salience and Self-Concept Clarity Predicting Paranoia in Study 3

	SPQ-S
Step 1 (ΔR^2)	.29***
ASI (β)	.37***
SCC (β)	$-.28$**
Step 2 (ΔR^2)	.00
ASI $\times$ SCC (β)	.01

Note. SPQ-S = The Suspiciousness subscale of the Schizotypal Personality Questionnaire.
** $p < .01$.   *** $p < .001$.

The current research also has implications for the role of disturbances of self-relevant information processing in PLEs. Recently, self-disturbances have received attention in the schizophrenia literature, particularly with respect to the prodrome (Lysaker & Lysaker, 2010), which is similar to SPD (Seeber & Cadenhead, 2005). However, much of this research has been phenomenological or qualitative (e.g., Davidsen, 2009; Moller & Husby, 2000). One strength of the current research is that self-disturbance was measured with a quantitative measure, while most research in this area has been qualitative in nature. The probe of the interaction suggests that self-concept clarity is only related to PLEs at high levels of aberrant salience.

Recent research pertaining to the development of the DSM-V has suggested that a key criterion for personality disorders should be impairment in personality functioning as manifested by impairments in self-functioning (e.g., Skodol et al., 2011). Examples of impairments in self-functioning include a "poorly integrated sense of self or identity (and) impoverished and poorly differentiated sense of self or identity" (Skodol et al., 2011, p. 18). This conceptualization of personality pathology is consistent with the current finding of low self-concept clarity playing an important role in symptoms of SPD. The current research provides additional support for this proposed revision of diagnostic criteria for DSM-V. Because this proposal suggests that disturbances in self-processing are fundamental to all personality pathology, future research could examine whether self-concept clarity interacts with aberrant salience to predict symptoms of other PDs. For example, identity disturbance is a *DSM–IV* symptom of borderline personality disorder (BPD). Another symptom of BPD, dissociative symptoms, has been found to be indistinguishable from PLEs (Cicero & Kerns, 2010a). Thus, it is possible that a combination of high aberrant salience and low self-concept clarity would also result in an increase of some symptoms of BPD.

As mentioned, the current research found that the interaction between aberrant salience and self-concept clarity was specific to PerMag and not to paranoia. One potential explanation for the lack of an interaction between aberrant salience and self-concept clarity in predicting paranoia could be the relatively lower reliability of the SPQ-S in comparison to PerMag. However, it is unlikely that this would have caused us to make a Type II error for several reasons. First, a Cronbach's alpha of .72 is generally considered adequate, albeit not excellent. Second, the large sample size would give us more than adequate power to detect a small effect size,

even if the SPQ-S had poor reliability. Third, we have found the exact same result in a separate sample, in which paranoia was assessed with an interview measure of PLEs that has excellent reliability (Cicero & Kerns, manuscript in preparation).

One area for future research could be to examine self-disturbances in other quantitative ways. For example, previous research suggests that people with psychosis show a lack of coherence in personal narratives of their life stories (Lysaker, Clements, Plascak-Hallberg, Knipscheer, & Wright, 2002), have less clear memories of self-related past events, more difficulty in generating specific future events, and that these deficits were associated with positive but not negative symptoms (D'Argembeau, Raffard, & Van der Linden, 2008). Additionally, psychosis has been linked to other deficits in the processing of self-relevant information such as monitoring of internally versus externally generated speech (Johns, Gregg, Allen, & McGuire, 2006) and sense of self agency. Future research could examine whether these impairments in self-processing also interact with aberrant salience to predict PLEs.

In addition to being consistent with models of PLEs, the current research is consistent with models of normal belief formation. For example, the Meaning Maintenance Model (Heine, Proulx, & Vohs, 2006) posits that people reinstate meaning after a threat to meaning. A meaning threat may include a threat to a person's worldview or self-esteem. Consistent with this, aberrant salience involves irrelevant stimuli being imbued with significance and is thought to trigger a search for an explanation (Kapur, 2003). At the same time, low self-concept clarity may itself be a threat to meaning that could result in people being more likely to seek meaning for experiences. In one study, Proulx and Heine (2009) had participants write an essay arguing against the unity of their self-concepts, which may be analogous to experimentally causing low self-concept clarity. They found that participants in this condition were more likely to perceive meaning in stimuli following this manipulation. This suggests that occurrences of aberrant salience might be especially likely to be perceived as meaningful if people also have low self-concept clarity, which may lead to psychotic symptoms.

The current research suggests several areas for future research. One limitation of the current research is that it is correlational and thus could not establish whether the combination of high aberrant salience and low self-concept clarity actually causes PLEs and SPD. Future research could follow participants longitudinally and establish the temporal precedence of aberrant salience and low self-concept clarity before the development of PLEs. If having high aberrant salience and low self-concept clarity causes PLEs, then we would expect participants to report this them to reporting PLEs.

The proposed interaction between aberrant salience and self-concept clarity may make more intuitive sense when explaining delusion-like beliefs than hallucination-like experiences. However, Kapur (2003) suggested that hallucinations may arise on a similar path in which salience is aberrantly attributed to perceptual aberrations or anomalous experiences. Such experiences, which may be ephemeral in people with low aberrant salience, capture attention and continue to occur more frequently in people with high aberrant salience. Garety et al. (2001) suggest that PLEs only become psychotic *symptoms* when the individual misattributes the source of the experience to something external. Similarly, low self-concept clarity may exacerbate this source misattribution. Thus, high aberrant salience and low self-concept clarity may fuel

a feedback loop in which hallucination-like experiences capture attentional resources, in turn leading to more hallucination-like experiences. Future research could continue to examine the applicability of the interaction between aberrant salience and self-concept clarity to hallucination-like experiences in addition to delusion-like experiences.

Another issue for future research is to extend these results beyond undergraduate populations. However, one methodological problem in examining cognitive models of psychosis is that people with psychotic disorders typically take antipsychotic medications that block dopamine receptors. This might be especially important for examining the construct of aberrant salience because aberrant salience is thought to be related to dysregulated dopamine (Kapur, 2003). Kapur has argued that, because antipsychotic medications block dopamine receptors, their main function in reducing PLEs is to eliminate occurrences of aberrant salience. The current research oversampled participants with a high level of PLEs that are associated with future psychotic disorder (Chapman et al., 1994). This allowed us to examine the cognitive mechanisms associated with PLEs while removing some of the confounds associated with research on patient populations (Neale & Oltmanns, 1980).

Although the current research examined PLEs in college students and not full-blown psychosis or PLEs in people with SPD, we think the current studies can provide useful information on the nature of psychosis and SPD. Previous research has found that measures of PLEs are strongly correlated with ratings of psychosis in people with schizophrenia (Cochrane, Petch, & Pickering, 2010), and that PLEs measured with the Perceptual Aberrant/Magical Ideation Scales are very similar to psychotic experiences in individuals who go on to develop schizophrenia spectrum disorders including SPD (see Kwapil, Chapman, & Chapman, 1999, for a review). In addition to not including people with full-blown psychosis, one limitation could be that the participants in the current research were undergraduates. However, research suggests that the prevalence of SPD in undergraduate populations is similar to that of the general population (Lenzenweger, Lane, Loranger, & Kessler, 2007). Despite these findings in previous research, there may be meaningful differences between subclinical PLEs in college students and psychotic experiences in people diagnosed with a psychotic disorder. For example, college students may be higher functioning than other people with SPD or psychotic disorders by virtue of functioning well enough to be enrolled in college. Thus, future research could examine whether similar results are found in SPD, prodromal, first-break, and chronic schizophrenia samples. This would answer the question of whether these experiences (i.e., high aberrant salience and low self-concept clarity) are specific to the prepsychotic or prodromal phase of the disorder or whether these relations hold true in people with schizophrenia-spectrum or with other psychotic disorders as well.

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