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Title

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Permalink

<https://escholarship.org/uc/item/83b0f5tf>

Journal

Journal of Personality Disorders, 29(1)

ISSN

0885-579X

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Publication Date

2015-02-01

DOI

10.1521/pedi_2014_28_150

Peer reviewed



Published in final edited form as:

J Pers Disord. 2015 February ; 29(1): 79–99. doi:10.1521/pedi_2014_28_150.

Aberrant Salience, Self-Concept Clarity, and Interview-Rated Psychotic-Like Experiences

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Abstract

Many social-cognitive models of psychotic-like symptoms posit a role for self-concept and aberrant salience. Previous work has shown that the interaction between aberrant salience and self-concept clarity is associated with self-reported psychotic-like experiences. In the current research with two structured interviews, the interaction between aberrant salience and self-concept clarity was found to be associated with interview-rated psychotic-like experiences. The interaction was associated with psychotic-like experiences composite scores, delusional ideation, grandiosity, and perceptual anomalies. In all cases, self-concept clarity was negatively associated with psychotic-like experiences at high levels of aberrant salience, but unassociated with psychotic-like experiences at low levels of aberrant salience. The interaction was specific to positive psychotic-like experiences and not present for negative or disorganized ratings. The interaction was not mediated by self-esteem levels. These results provide further evidence that aberrant salience and self-concept clarity play an important role in the generation of psychotic-like experiences.

Keywords

Aberrant Salience; Self-Concept Clarity; Self-Esteem; Psychotic-Like Experiences; Schizotypy

Psychosis is characterized by delusions and hallucinations and includes subclinical psychotic-like experiences (PLEs) and full-blown psychotic symptoms (e.g., Linscott & van Os, 2010; Yung et al., 2009). Delusions are defined as false beliefs not endorsed by an individual's culture or subculture, and hallucinations are visual, auditory, or other sensory experiences in the absence of external stimuli (American Psychiatric Association, 2013). PLEs are a common feature of schizotypal personality disorder, which includes the criteria

of odd beliefs or magical thinking, unusual perceptual experiences including bodily illusions, and ideas of reference (American Psychiatric Association, 2013). Research has focused on PLEs for at least three reasons. First, PLEs represent brain dysfunctions which are risk factors for the development of psychotic disorders, and may provide insight into its development (Addington & Heinssen, 2012; Lenzenweger, 1994, 2010). Second, research on PLEs helps to understand full-blown psychosis while removing confounds of patient research such as medication (Cochrane, Petch, & Pickering, 2010; Neale & Oltmanns, 1980). Third, PLEs are important in their own right because they represent clinically meaningful experiences that are related to personality disorders such as schizotypal PD (Raine, 2006).

Most theoretical models of PLEs can be characterized as social-cognitive models, in that they posit a role for the individual interacting with people in the environment to produce PLEs (e.g., Bell, Halligan, & Ellis, 2006; Freeman, 2007; Gray, 2014; Maher, 2003). Two common factors central to nearly all of these models are aberrant salience and self-relevant information processing (Bell et al., 2006; Cicero, Becker, Martin, Docherty, & Kerns, 2013; Freeman, 2007). Aberrant salience is the unusual or incorrect assignment of salience, significance, or importance to otherwise innocuous stimuli, and has been hypothesized to play a central role in the development of psychosis and PLEs (Kapur, 2003). This theory posits that individuals develop psychosis or PLEs as they attempt to rationally explain the aberrant feelings of salience, and often come to delusional conclusions. At the same time, few studies have tested social-cognitive hypotheses based on the theory of aberrant Salience and many of its assumptions are untested and go beyond what is currently known about psychosis.

The theory of aberrant salience is based on a long line of research on the role of the neurotransmitter, dopamine, in both psychosis and normal incentive salience processes. Previous research has consistently shown that psychosis is associated with dysregulated subcortical dopamine (see Stone, Morrison, & Pilowsky, 2007, for a review). For example, drugs that increase subcortical dopamine, such as methamphetamine, can cause symptoms of psychosis or exacerbate symptoms in people with a history of psychosis (e.g., Harris & Batki, 2000), imaging studies have found excessive dopamine in subcortical brain regions of people when they are acutely psychotic or at risk for psychosis (Abi-Dargham et al., 2000; Howes et al., 2009), and antipsychotic medications' mechanism of action is blocking dopamine D2 receptors, functionally decreasing the amount of dopamine (e.g., Kapur, 2004). Moreover, recent research has suggested that one function of striatal dopamine is to regulate incentive salience (i.e., the "wanting," as opposed to the "liking" aspects of reward learning; Berridge, 2007). Taken together, these studies suggest that the increased dopamine found in people with psychosis may result in the aberrant assignment of incentive salience to stimuli and lead to the development and maintenance of psychosis and PLEs.

In addition to aberrant salience, social-cognitive models of psychosis suggest that the way people process information about the self is important in the early stages of psychosis. Recent research suggests that disturbances in the perception of self may be a premorbid indicator of psychosis risk that is related to dysmaturational neurodevelopmental processes such as aberrant synaptic pruning and abnormal cortical neural cell migration. Disturbances

in these processes have been hypothesized to be related to abnormalities in brain regions involved in processing self-relevant information such as the medial prefrontal cortex, superior temporal sulcus, and inferior lateral lobule (Brent, Seidman, Thermenos, Holt, & Keshavan, 2014).

In previous work, we have found that the interaction between aberrant salience and clarity of self-concept is associated with PLEs (Cicero et al., 2013). Self-concept clarity (SCC) refers to “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). Theorists have suggested that disturbances in the perception of self are among the first symptoms to appear in the prodromal phase of schizophrenia (Nelson, Thompson, & Yung, 2012b; Raballo, Saebye, & Parnas, 2009), and may combine with aberrant salience to be “key experiential dimensions” of the prodrome (Moller & Husby, 2000). According to these models, low self-concept clarity may interfere with an individual’s attempt to rationally explain an aberrant salience experience, resulting in a higher likelihood of a psychotic-like explanation for the experience. Similarly, confusion about the self, in the form of low self-concept clarity, may trigger a “search for meaning” that when combined with aberrant salience results in more PLEs.

In one series of studies, we found that participants with high levels of aberrant salience, but low levels of SCC have the highest levels of PLEs (Cicero et al., 2013). In all three studies, probes of the interaction between aberrant salience and SCC revealed that SCC was negatively associated with PLEs at high levels of aberrant salience, but not low levels of aberrant salience. Moreover, the interaction was specific to PLEs and not to more general symptomology such as paranoia or negative symptoms. Although paranoia could be seen as a type of PLE, several previous studies have found that subclinical paranoia is distinct from subclinical PLEs (Chmielewski & Watson, 2008; Cicero & Kerns, 2010; Stefanis et al., 2004), and there may be some important differences between subclinical paranoia and persecutory delusions. Unlike PLEs, paranoia may be readily explained by extreme ends of personality traits such as high neuroticism and low agreeableness (Lynam & Widiger, 2001; Tackett, Silberschmidt, Krueger, & Sponheim, 2008). Thus, delusions and hallucinations may share a common mechanism with persecutory delusions, but paranoia may not share a mechanism with PLEs. In addition, the interaction was also specific to SCC and not to distress more generally, because neuroticism did not interact with aberrant salience to be associated with PLEs (Cicero et al., 2013). These findings are consistent with theoretical and phenomenological work that has found aberrant salience and self-concept disturbances to be core experiential domains related to the development of psychosis (e.g., Bell et al., 2006; Freeman, 2007; Moller & Husby, 2000). The first goal of the current research was to replicate this interaction with an interview measure of PLEs.

One potential limitation of previous work on the interaction between aberrant salience and SCC in associating with PLEs is that all of these studies relied on the same self-report measure of PLEs (Cicero et al., 2013). Although these measures have strong support for their reliability and validity, replication within a multi-method framework is needed to provide confidence in the validity of the previous findings. Although primarily still a form of self-report, methodologists have suggested that structured clinical interviews have several

advantages over self-report measures (Sher & Trull, 1996; Trull, Widiger, & Burr, 2001). For example, an interview allows for the experimenter to probe for further information about the nature of experiences endorsed on self-report scales including interviewee interpretations of questions, distress, and duration. The use of interviews may be especially important for the assessment of PLEs, as studies have found that interview measures of PLEs are more accurate than self-report alone (e.g., L. J. Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994; Kendler, Thacker, & Walsh, 1996).

Thus, in the current research, we used the Structured Interview for Prodromal Syndromes (SIPS; Miller et al., 2003), which has been used as the gold standard in psychosis risk research (Kline et al., 2012). The SIPS is used in the North American Prodrome Longitudinal Study and has been shown to predict the development of psychosis with up to a 35% accuracy rate (Addington et al., 2012; Cannon et al., 2008). In the current research, we also included a more in depth interview measure of anomalous perceptual experiences, the Structured Interview for Assessing Perceptual Anomalies (SIAPA; Bunney et al., 1999).

Another potential limitation of previous research is that it is not clear that the interaction is specific to SCC. In addition to disturbances in self-concept, psychosis researchers have conceptualized the self-relevant information processing aspects of social-cognitive models to include self-esteem. At the same time, low self-esteem appears to be a risk factor for many different types of psychopathology, not just for psychotic disorders (Zeigler-Hill & Jordan, 2013). Phenomenological studies of the psychosis prodrome suggest that it is a lack of clarity in self-concept, as opposed to lower self-esteem, that is specifically present at the early stages of psychosis (e.g., Moller & Husby, 2000; Nelson et al., 2009). Social-cognitive models suggest that disturbances in self-concept, conceptualized here as low self-concept clarity, may impede the ability to rationally explain aberrant salience experiences or initiate a search for meaning that results in a PLE. Low self-esteem, although still distressing, would not be expected to trigger the same search for meaning, which opens the possibility of a PLE. However, research has shown that SCC and self-esteem are highly correlated (Campbell, 1990), and both have been implicated in the development and maintenance of psychosis (Palmier-Claus, Dunn, Drake, & Lewis, 2011). One possible explanation for the finding of an interaction between aberrant salience and SCC is that it is reduced self-esteem, and not SCC, that is driving the interaction. If this is the case, then we would expect to find that the interaction between aberrant salience and SCC could be statistically accounted for by self-esteem levels.

The current research uses a cross-sectional design to describe the relations among aberrant salience, self-concept clarity, and PLEs. The first goal was to replicate the interaction between aberrant salience and SCC in associating with PLEs found in previous research with an interview measure of PLEs. We expected to find that the interaction between aberrant salience and SCC would be associated with PLE composite scores, delusional ideation, perceptual aberration, grandiosity, and Structured Interview for Anomalous Perceptual Experiences scores, but not paranoid ideation, disorganized communication, negative, or disorganized scores. The second goal of the current research was to examine whether this interaction can be statistically accounted for by self-esteem. We expected to find that the interaction between aberrant salience and SCC could not be statistically

accounted for my self-esteem. Finally, the last goal of the current research was to examine the specificity of the interaction by testing whether a) the interaction between aberrant salience and another self-report measure of psychosis risk was associated with PLEs, and b) the interaction between aberrant salience and self-esteem was associated with PLEs.

Method

Participants

Participants were 162 undergraduate who participated for partial completion of a course requirement. Students had the option of completing an alternate assignment to fulfill their course requirement. Overall, participants had a mean age of 18.62 ($SD = 1.23$), were 54% female, 82% White, 11% African American, 2% Asian American, and 5% other.

Participants were recruited following the psychometric high risk strategy (Lenzenweger, 1994), which ensured an adequate range of PLEs. First, 2100 undergraduates completed an online prescreen that included abbreviated versions of the Magical Ideation Scale (MagicId; Eckblad & Chapman, 1983), Perceptual Aberration Scale (PerAb; L. J. Chapman, Chapman, & Raulin, 1978), and Revised Social Anhedonia Scale (SocAnh; Eckblad, Chapman, Chapman, & Mishlove, 1982). Participants scoring higher than 1.96 standard deviations above the mean on the PerAb, MagicId, or SocAnh, or a combined three standard deviations above the mean on the PerAb and MagicId were invited to participate in the first in-person session. Second, 976 participants completed the three full scales during an in-person session. Participants scoring in 1.96 above the mean on the MagicId, PerAb, SocAnh, a combined 3 SD above the mean on the MagicId and PerAb, or less than .5 SD above the mean on all three scales were invited to participate in the final phase of the study which included the structured interviews and is reported in the current manuscript.

Finally, the 162 participants meeting these criteria participated in the final phase of the study which included the structured interviews. In schizotypy research, participants scoring high on the MagicId and/or PerAb (as described above) are referred to as a “positive schizotypy” group while participants scoring high on the SocAnh are referred to as a “negative schizotypy” group and participants scoring less than .5 SD above the mean on all scales are a “comparison” group. In the current research, 53 participants met criteria for the positive group only, 64 participants met criteria for the negative group only, 6 participants met criteria for both groups, and 45 participants met criteria for the comparison group. In some schizotypy research, the positive and negative groups are analyzed separately. However, this approach is questionable for regression-based research because the range of the dependent variable is severely restricted by selecting only extreme scores based on highly correlated variables (i.e., only the top 2.5% of scores in the current research). If the regression analyses are reported separately for each group, this could lead to erroneous results (Preacher, Rucker, MacCallum, & Nicewander, 2005). Thus, we used the psychometric high-risk approach only to ensure a wide enough range of PLEs for the resource-intensive structured interviews, but included all participants in all of the analyses.

Materials

Symptom Assessment and Ratings—The Structured Interview for Prodromal Syndromes (SIPS; Miller et al., 2003) was used to obtain ratings for PLEs, negative, and disorganized symptoms of the prodromal syndrome. The SIPS, and accompanying Scale of Prodromal Syndromes (SOPS), was designed to be similar to rating scales for schizophrenia symptoms such as the Positive and Negative Syndromes Scale (PANNS; Kay, Fiszbein, & Opler, 1987), but to assess a broader spectrum of PLEs including prodromal positive, negative, and disorganized symptoms. Among PLEs, the SOPS allows the interviewer to complete ratings for delusional ideation, paranoia, grandiosity, perceptual anomalies, and disorganized communication. Among negative symptoms, the SOPS has ratings for social anhedonia, avolition, impaired/diminished expression of emotion, impaired experience of emotions and self, impaired ideational richness, and impaired occupational functioning. Among disorganized ratings, the SOPS measures odd behavior, bizarre thinking, impairment in focus and attention, and impairment in personal hygiene.

The first and second authors were trained in the administration and scoring of the interview at the Psychosis Prodrome Research Clinic (PRIME Clinic) at Yale University run by the authors of the SIPS/SOPS. Previous research has found that this workshop is successful in training researchers to conduct the interview with excellent inter-rater reliability and this model is currently used to train new interviewers for the North American Longitudinal Prodromal Study, which uses the SIPS as its primary diagnostic interview (Miller et al., 2003). The first and second authors met criteria for certification in the administration of the SIPS by meeting a standard for inter-rater reliability with clinicians and researchers at the PRIME Clinic.

Anomalous Perceptual Experiences—The Structured Interview for Assessing Perceptual Anomalies (SIAPA; Bunney et al., 1999) was used to assess anomalous perceptual experiences. Participants are asked open-ended questions about their perceptual experiences in the last week, and ratings were made on a Likert scale. The SIAPA contains three subscales for perceptual hypersensitivity (increased sensitivity to stimuli), inundation (feeling flooded or overwhelmed by sensory experiences), and selective attention to external sensory stimuli (the ability to selectively focus on one stimulus in the presence of several). These ratings are made on a scale of 1 *Never*, 2 *Rarely*, 3 *Half the time*, 4 *Often*, and 5 *Always*. Previous research has found that the SIAPA has high inter-rater reliability, and patients with schizophrenia had higher scores than control participants on all three rating scales (Bunney et al., 1999).

Aberrant Salience—Aberrant salience was measured with the Aberrant Salience Inventory (ASI; Cicero, Kerns, & McCarthy, 2010). The ASI is a 29-item yes-no questionnaire that includes five subscales including increased significance, sharpening of senses, impending understanding, heightened emotionality, and heightened cognition. The theory of aberrant salience (Kapur, 2003) and the Aberrant Salience Inventory were heavily influenced by early phenomenological descriptions of emerging psychosis. For example, the initial item pool for the ASI was developed from consulting these accounts of the onset of psychosis, which are also cited heavily in Kapur's 2003 paper (Bowers, 1968; Bowers &

Freedman, 1966; J. Chapman, 1966). Previous research has found elevated ASI scores in people with a history of psychosis compared to similarly impaired psychiatric controls and in people at risk for the development of psychosis (Cicero et al., 2010).

Self-Concept Clarity—Self-concept clarity was measured with the Self-Concept Clarity Scale (SCCS; Campbell et al., 1996). 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 seem to change very frequently). The SCCS has been found to be correlated with other measures of SCC including agreement of pairs of adjectives describing the self (Campbell et al., 1996).

Schizotypy—Magical Ideation was measured with the Magical Ideation Scale (MagicId; Eckblad & Chapman, 1983). The MagicId is a 30-item true-false scale that measures a tendency to endorse beliefs that by conventional standards are considered invalid (e.g., the government refuses to tell us the truth about flying saucers). A second measure of positive schizotypy was the Perceptual Aberration Scale (PerAb; L. J. Chapman et al., 1978). The PerAb is a 35-item true-false scale that measures schizophrenic-like distortion in one's perception of their own body (e.g., I can remember times in which it seemed that one of my limbs took on an unusual shape). The MagicId and PerAb scales have considerable support for their reliability and validity (see Edell, 1995, for a review). Several previous studies have shown that the MagicId and PerAb load on a single factor in confirmatory factor analyses, and they are often analyzed as a combined score (e.g., Cicero & Kerns, 2010; Kwapil, Barrantes-Vidal, & Silvia, 2008). Thus, in the current research, the MagicId and PerAb were combined as a single index.

Negative schizotypy was measured with the Revised Social Anhedonia Scale (SocAnh; Eckblad et al., 1982), a 40-item true-false scale that measures a lack of pleasure from social relationships and interactions (e.g., I never really had close friends in high school). Previous research has found that social anhedonia is predictive of future schizophrenia-spectrum disorders (Kwapil, Miller, Zinser, Chapman, & Chapman, 1997).

Self-Esteem—Self-esteem was measured with the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965). The RSES has been shown to have high internal consistency and test-retest reliability (Rosenberg, 1965) and is one of the most commonly used measure of trait self-esteem (Leary, Tambor, Terdal, & Downs, 1995).

Procedure

In Session 1, participants completed the MagicId, PerAb, and SocAnh randomly mixed together and titled the Survey of Attitudes and Experiences, the ASI, the SCCS, and the RSES. In Session 2, participants were administered the SIPS and the SIAPA.

Results

Aberrant Salience, Self-Concept Clarity, and Interview-Rated Psychotic-Like Experiences

The first goal of the current research was to examine whether the interaction between aberrant salience and SCC was associated with interview-rated PLEs. We expected to find a

significant interaction for the PLE composite score (i.e., the mean of the five positive symptom ratings), delusional ideation, grandiosity, perceptual anomalies, but not for disorganized communication, or paranoia. Prior to conducting the regression analysis, we examined a scatter plot of the interaction term (ASI X SCCS) and PLE ratings. One participant was identified as an outlier and removed from all analyses. This participant had a studentized deleted residual of 2.27 (SDR values greater than 2 suggest a data point is an outlier) and a leverage value of .08. Table 1 shows the zero order correlations for all variables included in the analyses.

To test the interaction between ASI and SCC, mean-centered ASI scores and mean-centered SCCS scores were entered in step one of a hierarchical linear regression with a composite PLE rating score as the outcome variable. The product of ASI and SCCS scores was entered in step 2. We probed all significant interactions by examining the relation among SCC and PLEs at one SD above and below the mean on aberrant salience. As can be seen in Table 2, there was a significant interaction between aberrant salience and SCC such that participants with high aberrant salience and low SCC had the highest levels of interview rated PLEs ($t(159) = -2.64, p = .009; f^2 = .17$). Figure 1 shows this interaction by plotting standardized PLE composite scores at 1 standard deviation above and below the mean on aberrant salience and SCC. Similarly, the interaction between aberrant salience and self-concept clarity was associated with delusional ideation ($t(159) = 2.00, p < .05; f^2 = .14$) and grandiosity ($t(159) = 2.43, p = .02; f^2 = .17$), but not perceptual anomalies ($t(159) = 1.50, p = .14; f^2 = -.09$), paranoia ($t(159) = 1.37, p = .15; f^2 = .10$), or disorganized communication ($t(159) = 1.34, p = .18; f^2 = .13$). According to convention, these significant effects are medium in size (Cohen, 1988).

Consistent with previous research, SCC was negatively associated with PLE composite scores, delusional ideation, and grandiosity at 1 standard deviation above the mean of aberrant salience (ps range from $< .001$ to $.04$), but not at 1 standard deviation below the mean on aberrant salience (ps range from $.48$ to $.99$). Since there were no significant interactions for perceptual anomalies, paranoia, and disorganized communication, we examined the main effects of aberrant salience and SCC. As can be seen in Table 2, there were main effects for both aberrant salience and SCC in associating with paranoia and main effects for aberrant salience with perceptual anomalies and disorganized communication. However, SCCS was unrelated to perceptual anomalies and disorganized communication.

Aberrant Salience, Self-Concept Clarity, and Interview-Rated Anomalous Perceptual Experiences

Although the interaction was not significantly associated with perceptual anomalies on the SIPS, we included an additional interview measure of anomalous perceptual experiences, the SIAPA. As can be seen in Table 3, the interaction between aberrant salience and SCC was significantly associated with SIAPA total, hypersensitivity, inundation, and attention scores (ps been $.002$ and $.007$). Like the SIPS ratings, the probe of the interaction showed that SCC was associated with all four SIAPA scores at 1 SD above the mean on aberrant salience ($p < .004$), but not at 1 SD below the mean (ps between $.59$ and $.80$)

Aberrant Salience, Self-Concept Clarity, and Negative Symptoms

In contrast to PLEs, the interaction between aberrant salience and SCC was not significantly associated with the SIPS composite negative score ($t(159) = 0.34, p = .73$) or any of the individual negative rating scores (ps range from .16-.97). Since these interaction effects were not significant, main effects were examined. There was not a significant main effect for the association between aberrant salience and any negative symptom rating or the negative composite score (ps range from .07-.92). Conversely, SCC was negatively associated with negative composite ($ps < .036$), social anhedonia, avolition, impaired expression of emotion, impaired experience of emotions and self, and impaired occupational function, but not ideational richness ($t(159) = -1.52, p = .13$) ratings.

Aberrant Salience, Self-Concept Clarity, and Disorganized Symptoms

The interaction between aberrant salience and SCC was not significantly associated with the composite disorganized score, odd behavior, impairment in focus and attention, and impairment in personal hygiene (ps between .33 and .98). However, there was a significant interaction for bizarre thinking ($t(159) = -2.80, p = .006$). Further analyses revealed that SCC was negatively associated with bizarre thinking at high levels of aberrant salience ($t(159) = -2.99, p = .003$), but not associated with bizarre thinking at low levels of aberrant salience ($t(159) = 0.67, p = .51$).

For the nonsignificant interactions, we tested main effects for aberrant salience and SCC. Aberrant salience was positively associated with the disorganized composite score, odd behavior, and impairment in focus and attention (all $ps < .02$), but not impairment in personal hygiene ($p = .10$). SCC was negatively associated with the disorganized composite score and impairment in focus and attention ($ps < .04$), but not odd behavior or impairment in personal hygiene ($ps > .47$).^{1,2}

Specificity of Interaction

One potential explanation for these findings is that the interaction is not specific to aberrant salience. Rather, the interaction between SCC and risk for psychosis more generally may be associated with PLEs. To test this possibility, we examined whether the interaction between SCC and self-reported Perceptual Aberration/Magical Ideation (PerMag) scores was associated with interview-rated PLEs. There was not a significant interaction between

¹Including only positive and control participants for the PLE analyses and negative and control for the negative symptom analyses resulted in very similar findings. There was a significant interaction between aberrant salience and self-concept clarity in associating with PLE composite scores ($t(159) = 2.60, p = .01; f^2 = .26$), delusional ideation ($t(159) = 2.56, p = .01; f^2 = .26$), paranoia ($t(159) = 2.47, p = .02; f^2 = .25$), grandiosity ($t(159) = 2.29, p = .02; f^2 = .23$), but not perceptual anomalies ($t(159) = 0.09, p = .38; f^2 = .09$) or disorganized communication ($t(159) = 1.44, p = .15; f^2 = .15$). The only difference in PLE symptoms was that the interaction was not significant for paranoia when all participants were included in the analysis, but was significant when only control and positive schizotypy participants were included. Finally, there was not a significant interaction for any negative symptom when only negative and control participants were included (ps ranged from .25-.91).

²As can be seen in Table 1, the data for PLEs, negative, and disorganized variables were skewed. If the data were transformed by adding 1 and taking the natural log of each value, the data approached normality. Regression analyses with these transformed variables revealed a nearly identical pattern of results. There was significant interaction for PLE composite ($t(159) = 2.34, p < .02; f^2 = .18$), delusional ideation ($t(159) = 2.02, p < .05; f^2 = .16$) and grandiosity ($t(159) = 2.84, p < .01; f^2 = .22$), but not perceptual anomalies ($t(159) = 1.58, p = .12; f^2 = .13$), paranoia ($t(159) = 1.10, p = .27; f^2 = .09$), or disorganized communication ($t(159) = 1.68, p = .10; f^2 = .13$). Like the non-transformed data, there was not a significant interaction for any negative symptom (ps ranged from .25-.91) or disorganization symptoms (ps ranged from .27-.49) except bizarre thinking ($t(159) = 2.02, p < .05; f^2 = .16$).

PerMag and SCCS for the composite PLE ratings, delusional ideation, paranoia, grandiosity, or perceptual anomalies (*ps* from .06 to .85). These results suggest that the interaction between aberrant salience and SCC is specific to aberrant salience and not to a related but distinct perceptual aberration/magical ideation construct.

In addition to the specificity of the interaction to aberrant salience, an alternative explanation could be that the interaction between aberrant salience and unpleasant self-processing more generally is associated with PLEs. Thus, we examined whether the interaction between self-esteem and aberrant salience was associated with PLEs. There was not a significant interaction for composite PLE ratings, delusional ideation, paranoia, grandiosity, perceptual anomalies, or any SIAPA scores (*ps* from .05-.65).

Mediated Moderation Analysis

Finally, we tested whether self-esteem could statistically account for the interaction effects found in the previous sections (i.e., a mediated moderation). To test this effect, we used Hayes' Process macro for SPSS (Hayes, 2012, 2013). This macro computes an asymmetric confidence interval (ACI; Shrout & Bolger, 2002) for the indirect effect of the self-esteem mediating the interaction between SCC and aberrant salience in associating with PLEs. If the ACI includes zero, the indirect effect is not statistically significant. As can be seen in Figure 2, self-esteem could not account for these relationships ($\beta = .0000$, *CI*: -.0002 to .0004). In other words, the interaction between aberrant salience and SCC was still significant after removing variance shared with self-esteem, and self-esteem did not statistically explain a significant portion of the effect of SCC on PLEs at high, medium, or low levels of aberrant salience. We tested this indirect effect for all significant interactions in the previous sections. Self-esteem did not statistically explain any of these interactions, as evidenced by the ACIs all including zero.

Discussion

The first goal of the current research was to replicate the results of previous work with a more comprehensive, interview measure of PLEs. Results were consistent with previous work in that the interaction between aberrant salience and SCC was associated with PLE composite, as well as delusional ideation, grandiosity, and SIAPA perceptual anomalies scores. The probe of the interaction found the same pattern as previous work, suggesting that SCC is negatively associated with PLEs at high levels of aberrant salience, but is unassociated with PLEs at low levels of aberrant salience. The current research is also consistent with previous research in terms of the specificity of the interaction. The interaction between aberrant salience and SCC was not associated with paranoia, negative, or disorganized symptoms (except for bizarre thinking). Instead, like in previous work, there was a main effect for SCC being negatively associated with negative symptoms, but no main effect for aberrant salience. Overall, these results of the current research are very similar to previous work testing the same hypotheses (Cicero et al., 2013).

The primary limitation of the current research is that it is a correlational study that aims to test a causal model. Although the results of the current study are consistent with predictions of a causal model, they cannot establish whether the combination of high aberrant salience

and low SCC actually *causes* PLEs. In a recent paper, Sass suggested that “future research should treat self-experience as an independent variable, manipulating and measuring this dimension (in both schizophrenic and non-schizophrenic populations) to study its associations with anomalies of cognition, affect, expression, and neural functioning already identified in schizophrenia (Sass, 2014, p. 5).” One way to examine whether aberrant salience and SCC cause PLEs could be to experimentally manipulate aberrant salience and or SCC. For example, future research could experimentally induce low SCC and test whether participants with high aberrant salience are more likely to report PLEs than people with low aberrant salience. Similarly, future research could experimentally manipulate aberrant salience and test whether people with low SCC experience more PLEs than people with high SCC. These studies could potentially establish whether high aberrant salience and low SCC actually produce PLEs. Finally, future research could use longitudinal designs to test whether aberrant salience experiences occur before PLEs, which could provide more evidence for a causal mechanism.

The current study extended previous work in several other important ways. First, the current study showed that the effect is specific to SCC and not more generally to self-relevant information processing. Low self-esteem could not explain the relation between SCC and PLEs at low, moderate, or high levels of aberrant salience. Additionally, interaction between aberrant salience and self-esteem was not significantly associated with any PLEs. However, it should be noted that many of these interactions approached significance, (i.e., had p values between .05 and .10) and their effect sizes were moderate. It is possible that if the current research had a larger sample size, these effects would have been statistically significant. The specificity of this interaction is important because previous work has suggested that self-esteem may be an important variable in the development and course of psychotic disorders (e.g., Palmier-Claus et al., 2011; Smith et al., 2006), and self-esteem and SCC have been shown to be highly correlated (Campbell, 1990). Phenomenological work on the psychosis prodrome suggests that it is the deterioration or disturbance in the clarity of a self-concept, as opposed to reductions in self-esteem, that drives the development of psychosis (e.g., Moller & Husby, 2000; Nelson et al., 2009), and recent studies have found that these subjective basic experiences may themselves be important predictors of “conversion” to psychosis in prodromal studies (Nelson, Thompson, & Yung, 2012a). Thus, the current research is consistent with phenomenological and prodromal studies that have posited a central role for the clarity of self-concept in the development and maintenance of psychosis.

In addition to showing that the interaction effect cannot be accounted for by individual differences in self-esteem, the current work provided more evidence that the interaction is specific to aberrant salience and not to unusual beliefs and experiences more generally. In previous work (Cicero et al., 2013), the dependent variable has been scores on the Perceptual Aberration and Magical Ideation Scales (PerMag). One possible alternative explanation for these results is that the interaction between aberrant salience and SCC being associated with PerMag scores is a result of the Aberrant Salience Inventory and PerMag measuring very similar constructs. If this is the case, then we would have expected to find an interaction between PerMag and SCC that is associated with PLEs as measured with the SIPS. We found a nonsignificant interaction between PerMag and the SCCS in for PLE ratings

based on the SIPS. This suggests that the interaction is specific to aberrant salience and not unusual beliefs and experiences more generally. Moreover, this provides further evidence of the discriminant validity of the ASI from PerMag.

Although the majority of the results were consistent with previous work, both in terms of replication and logical extensions, there were several notable findings that were not consistent. First, the interaction between aberrant salience and SCC was not significantly associated with perceptual anomalies on the SIPS. One potential explanation for the lack of a significant finding for perceptual anomalies is that the role of aberrant salience and SCC may better explain delusion-like experiences than hallucination-like experiences. However, most of these models posit that in addition to delusion-like experiences a combination of aberrant salience/anomalous experiences and self-processing are involved in the development of perceptual anomalies when the individual attributes the perceptual anomaly to an external source (e.g., Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001; Kapur, 2003). In the current research, we found the expected interaction for SIAPA scores, which is a very similar construct to perceptual anomalies. Second, the interaction was not significantly associated with the disorganized communication rating. Although the disorganized communication rating is listed with the PLEs, it has been found to form a coherent factor with the disorganized ratings in previous research (Delawalla et al., 2006). Thus, the reason the interaction between aberrant salience and SCC was not associated with disorganized communication may be that disorganized communication is more like a disorganized symptom than a PLE. Finally, we found a significant interaction for bizarre thinking, which is listed with the disorganized scales. However, bizarre thinking was highly correlated with delusional ideation in the current research and may represent more of a PLE than a disorganized .

One potential limitation of the current study is that it involved an undergraduate sample. However, a methodological problem in examining social-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, as aberrant salience is thought to be related to dysregulated dopamine (Kapur, 2003). Kapur has argued that, since antipsychotic medications block dopamine, their main function in reducing PLEs is to eliminate occurrences of aberrant salience. The current research over-sampled participants with a high level of PLEs that are associated with future psychotic disorder (Chapman et al., 1994). This allowed us to examine the social-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 and not psychotic disorder, the current studies can provide useful information on the nature of psychosis. Previous research has found that measures of positive schizotypy are strongly correlated with ratings of psychotic symptoms in people with schizophrenia (Cochrane et al., 2010) and with interview-rated psychotic-experiences in people at risk for psychosis (Kwapil, Chapman, & Chapman, 1999). In addition to not including people with full-blown psychosis, one limitation could be that the participants in the current research were undergraduates, who may be higher functioning

than the general population. Future research could examine the interaction between aberrant salience and SCC in people with psychotic disorders.

The current research is also consistent with the psychometric schizotypy model of psychosis risk (Lenzenweger, 2006, 2010; Meehl, 1962). This model suggests that schizotypy, as often measured with the Magical Ideation, Perceptual Aberrant, and Revised Social Anhedonia Scales, represents a genetic risk for the development of schizophrenia. Individuals with schizotypy may decompensate into schizophrenia if they have additional risk factors such as social learning history and other genetic factors, termed polygenic potentiators. In the current research, we recruited people who are thought to have a genetic risk for schizophrenia using the psychometric high risk strategy and examined whether other social-learning factors are associated with PLEs. Drawing on Kapur (2003), our model suggests that the tendency to have aberrant salience experiences may be a manifestation of the genetic risk for schizophrenia, and that disturbances in the perception of self (here operationalized as self-concept clarity) may be a potentiator related to schizotypal personality organization.

As mentioned, one strength of the current research is the use of a structured interview rather than relying on self-report for measurement of PLEs. Interviews have several advantages over self-report questionnaires that may lead to more valid assessments. For example, an interviewer can probe for more information, clarify questions for the participant, observe non-verbal behavior, and potentially reduce anxiety in participants (Sher & Trull, 1996; Trull et al., 2001). The clarification of participant answers may be especially important for the current research because it is often difficult to discern whether PLEs are normal or abnormal and where these beliefs fit on the psychosis continuum. Moreover, the interview provided in depth information about negative and disorganized symptoms, many of which might be more valid when observed than when obtained with self-report (Becker, Cicero, Cowan, & Kerns, 2012). At the same time, interviews are still primarily a form of self-report and many of the limitations of self-report questionnaires still apply. For example, information garnered from an interview is still limited by response biases such as social desirability, limitations in how much participants understand their own behaviors, and inaccuracies in memory of past symptoms (Paulhus & Vazire, 2007). Moreover, the use of interviews may introduce interviewer bias and interactional effects that could influence ratings and bias results (Groth-Marnat, 2009).

The current research has implications for a growing body of work suggesting an important role of disturbances in self-processing in the development of psychosis (Moller & Husby, 2000). As mentioned, recent work using interview measures of prodromal symptoms and self-experiences have found that basic disturbances in the perception of self are important predictors of conversion to psychosis over and above other clinical symptoms (Nelson et al., 2012a). Since this study found that self-experience predicted conversion to psychosis over and above other clinical symptoms, self-disturbances hold promise in improving both the sensitivity and specificity of predicting conversion to psychosis. The current research adds further evidence for the potential importance of self-processing in predicting and preventing psychosis. Nelson et al. used the Examination of Anomalies of Self-Experience (Parnas et al., 2005), which is an interview measure of disturbances in self-experience. In addition to

interview-rated PLEs, future research could examine whether aberrant salience interacts with interview-rated self-disturbances to predict PLEs.

Acknowledgments

Work on this article was supported by a National Research Service Award from the National Institute of Mental Health.

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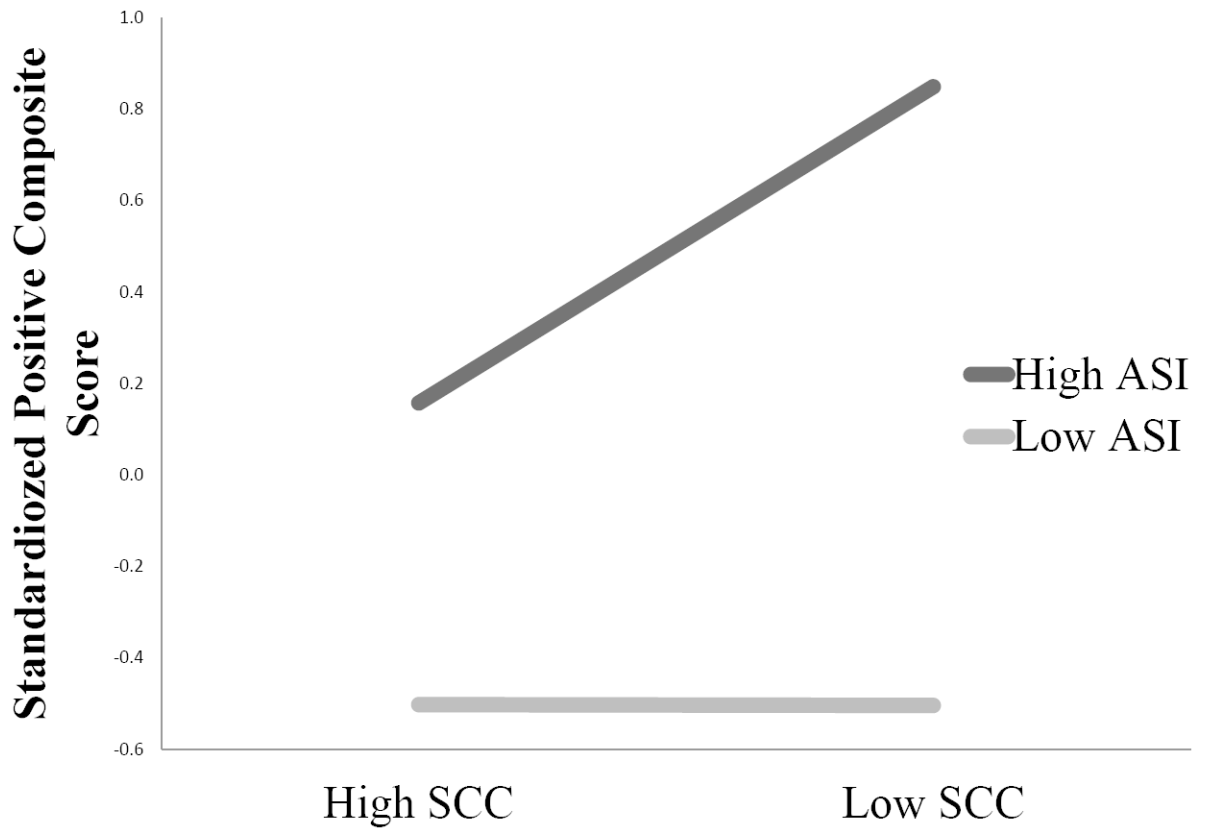
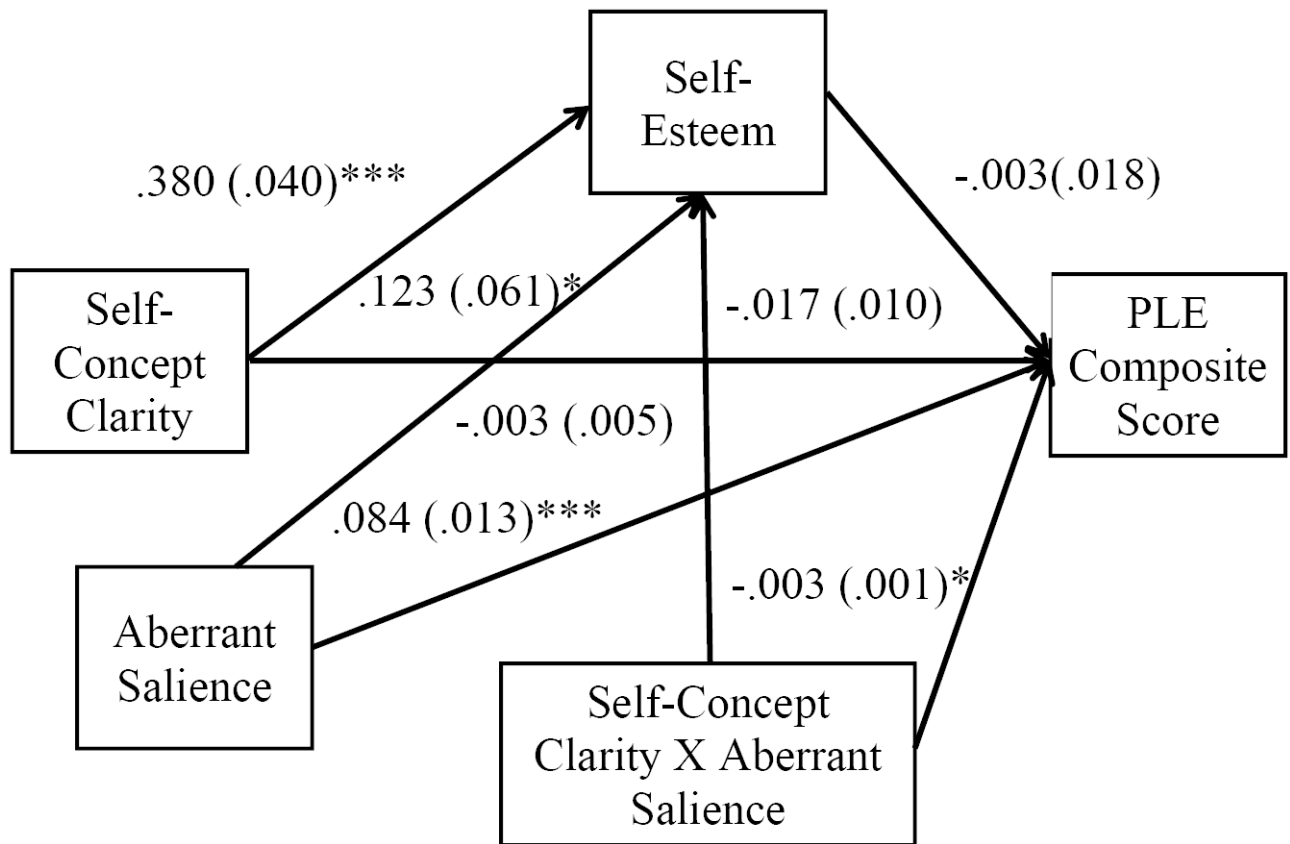


Figure 1. Psychotic-like experiences composite scores as a function of aberrant salience and self-concept clarity.



* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 2.

Mediated moderation analysis of self-esteem mediating the moderated relation between self-concept clarity and psychotic-like experiences by aberrant salience

Table 1
Pearson Correlations among the variables in moderation and mediation analyses

	1	2	3	4	5	6	7	8	9	10
1. Aberrant Salience	.90									
2. Self-Concept Clarity	-.42*	.87								
3. Magical Ideation	.76*	-.37*	.86							
4. Perceptual Aberration	.68*	-.39*	.74*	.89						
5. SocAnh	.02	-.31*	-.03	-.08	.86					
6. SIPS PLE Composite	.55*	-.34*	.61*	.60*	.02	.99				
7. SIPS Negative	.10	-.35*	.12	.11	.48*	.37*	.90			
8. SIPS Disorganized	.37*	-.32*	.38*	.46*	.06	.70*	.46*	.74		
9. SIAPA Total	.45*	-.30*	.43*	.51*	-.04	.58*	.11	.35*	.93	
10. Self-Esteem	-.15*	.62*	-.17*	.22*	-.24*	-.16*	-.27*	-.20*	-.05	.86
Mean	18.10	34.52	11.49	8.50	12.07	1.18	0.60	0.49	23.14	30.43
Standard Deviation	6.51	9.90	7.48	8.18	8.12	1.08	0.66	0.60	7.71	5.54
Skewness	-0.39	0.23	0.31	1.13	0.50	0.93	1.23	1.82	0.94	-0.26
Kurtosis	-0.69	-0.39	-1.05	0.66	-0.70	0.48	0.95	3.21	-0.05	-0.39

* p < .05.

SIPS = Structured Interview for Prodromal Syndromes, SIAPA = Structured Interview for Assessing Perceptual Anomalies, Values on the diagonal represent Cronach's alpha and inter-rater reliability for SIPS ratings.

Table 2
 Regression Analyses for the Interaction between Aberrant Salience and Self-Concept Clarity Associated with SIPS PLE Ratings

	PLE Composite	Delusional Ideation	Paranoia	Grandiosity	Perceptual Anomalies	Disorganized Communication
Step 1 (R ²)	.32****	.29****	.25****	.15****	.17****	.14****
ASI (β)	.42****	.52****	.39****	.33****	.37****	.34****
SCC (β)	-.17*	-.10	-.21**	-.16*	-.11	-.09
Step 2 (R ²)	.03***	.02*	.01	.04**	.01	.01
ASI X SCC (β)	-.17*	-.15*	-.10	-.19**	-.11	-.12

 p < .001,

**
 p < .01,

*
 p < .05,

ASI = Aberrant Salience Inventory, SCC = Self-Concept Clarity Scale.

Table 3

Regression Analyses for the Interaction between Aberrant Salience and Self-Concept Clarity Associated with SIAPA Ratings

	SIAPA Total	Hypersensitivity	Inundation	Selective Attention
Step 1 (R ²)	.22***	.12***	.16***	.15***
ASI (β)	.40**	.39***	.33***	.34**
SCC (β)	-.19*	-.16*	-.18*	-.15 ⁺
Step 2 (R ²)	.05**	.04**	.03*	.04**
ASI X SCC (β)	-.22**	-.20**	-.16*	-.21**

p < .001,

**
p < .01,

*
p < .05,

⁺
p < .10,

ASI = Aberrant Salience Inventory, SCC = Self-Concept Clarity Scale.