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## Associations between trait anhedonia and emotional memory deficits in females with schizophrenia versus major depression

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### ABSTRACT

Individuals with schizophrenia (SZ) and individuals with major depressive disorder (MDD) demonstrate impaired emotional memory and decreased enjoyment of pleasant experiences (e.g., anhedonia). However, it is unclear whether these impairments reflect similar or different processes in the two diagnostic groups. This study compared emotional memory performance in three groups of females – controls, MDD, and SZ. Given that physical and social trait anhedonia has been shown to differentiate course of illness and emotional functioning within each disorder, the present study also examined whether trait anhedonia related to emotional memory differently in the groups. Participants viewed emotional and neutral images and twenty-four hours later completed an incidental recognition test. SZ participants demonstrated a trend for the worst memory performance. Across all groups, high intensity and negative images were remembered most accurately, while groups were not differentially influenced by the valence of the stimuli. Physical anhedonia was predictive of reduced memory for negative stimuli across all diagnostic groups. Group specific findings indicated that higher levels of social anhedonia were predictive of poorer memory, but only in the SZ group. Effects remained significant when controlling for depressive symptoms. Results are considered in light of the differing role of anhedonia in SZ and MDD.

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### 1. Introduction

In the general population, emotional material with positive or hedonic content is particularly salient as people remember positive stimuli better than neutral stimuli (LaBar and Cabeza, 2006; Mickley and Kensinger, 2008) and overestimate positive emotions when recalling past experiences (Walker et al., 2003). Similarly, material that is negatively valenced and highly arousing is more memorable than neutral material (Cahill and McGaugh, 1998). However, the facilitative effect of emotional valence on memory seen in the general population (e.g., Bradley et al., 1992) appears to be abnormal in schizophrenia (SZ). Individuals with SZ do not consistently show the enhanced recognition memory for positive stimuli seen in healthy controls (Koh et al., 1981; Calev and Edelist, 1993; Hall et al., 2007; Lakis et al., 2011), although some studies report this pattern (Harvey et al., 2009; Sergerie et al., 2010). While SZ participants show a robust negativity bias similar to controls (Calev and Edelist, 1993; Mathews and Barch, 2004), negative stimuli have also been shown to have a detrimental effect

on memory in SZ (Hall et al., 2007). Also atypical is the pattern of superior memory for negative compared to positive stimuli observed in some studies in SZ (Calev and Edelist, 1993; Herbener et al., 2007). In sum, individuals with SZ evidence atypical emotional memory, albeit with considerable variability among the pattern of identified abnormalities.

#### 1.1. Specificity of emotional memory deficits

Emotional memory impairments are also found in other mental disorders, most notably, major depressive disorder (MDD) (Mathews and MacLeod, 2005; Dere et al., 2010). For instance, depressed individuals show reduced memory enhancement for positive emotional stimuli and enhanced memory for negative material (Sloan et al., 2001; Ridout et al., 2003; Hamilton and Gotlib, 2008), when compared to controls. There do appear to be differences between SZ and MDD in emotional memory. For instance, enhanced memory for negative stimuli is more robustly found in MDD than in SZ. However, a number of factors in past studies – such a differences in methods, task parameters, and clinical presentation – make it difficult to reach conclusions about relative impairments in the two groups.

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## 1.2. Emotional memory and clinical symptoms

Deficits in memory for positive experiences may be particularly important in both disorders, given that activities associated with past hedonic states are believed to motivate pursuit of similar activities in the present (Berridge and Robinson, 2003). Researchers in schizophrenia (Horan et al., 2006) and depression (Liu et al., 2012) have noted that hedonic deficits may be related to poor memory for pleasurable events. Trait anhedonia, which reflects stable diminished attitudes towards pleasurable social and physical/sensory experiences (Chapman et al., 1976), has long been recognized as a core feature of schizophrenia (Bleuler, 1911; Herbener and Harrow, 2002) and depression (Klein, 1987; Clark and Watson, 1991). It has also been hypothesized that trait anhedonia may broadly relate to deficient recruitment of neural regions responsible for signaling salient information, and supportive of this hypothesis, a number of past studies demonstrate that elevated anhedonia in SZ, MDD, and control samples is associated with less differentiated ventral striatal BOLD response to neutral versus emotional stimuli (Epstein et al., 2006; Dowd and Barch, 2010; Harvey et al., 2010). This diminished salience signaling could contribute to difficulties in prioritizing emotional experiences for memory consolidation. Moreover, trait anhedonia is also strongly implicated in prefrontal regions responsible for reward guided decision making, regulation of positive emotion, and linking affect with goal directed behavior (Keedwell et al., 2005; Harvey et al., 2007; Wacker et al., 2009; Becerril and Barch, 2011; Ursu et al., 2011; Hooker et al., 2014). Collectively, deficient functioning in frontal-striatal networks may relate to trait anhedonia and emotional memory deficits.

Two elements of trait anhedonia, physical and social anhedonia (Chapman et al., 1976), may be relevant to distinguishing clinical features and emotional memory deficits in the two disorders. For instance, physical anhedonia (PA), including deficits in physical and sensory experiences, has been found to predict lower hedonic and emotional responses (Blanchard et al., 1994; Berlin et al., 1998) in both disorders. Moreover, PA is associated with worse overall course in both disorders including prolonged illness onset in SZ (Herbener and Harrow, 2002) and with severity of depressive symptoms and social impairment in MDD (Loas et al., 1992; Shankman et al., 2010). Social anhedonia (SA), the experience of decreased interest and enjoyment from social activities and relationships (Chapman et al., 1976), is also relevant to examining emotional memory deficits. For instance, SA has been reliably associated with reduced response to emotional and social stimuli in control samples (Mathews and Barch, 2006; Hooker et al., 2014). Reductions in neurocognitive performance are also evident in control (Cohen et al., 2006) and SZ participants (Horan and Blanchard, 2003). In comparison to PA, SA appears to be more strongly implicated in clinical outcomes for individuals with SZ versus MDD. For instance, SA is a robust trait marker for schizophrenia spectrum disorders (Blanchard et al., 2001) and subsequent conversion to schizophrenia illness (Kwapil, 1998), whereas elevated SA in individuals with MDD is restricted to active depressive episodes (Blanchard et al., 2001). Altogether, PA and SA are relevant to emotional memory deficits in the two disorders, yet SA is likely to be particularly relevant to individuals with SZ.

However, data supporting the hypothesized relationship between anhedonia and emotional memory is equivocal. Associations with poor emotional memory are found for clinician-rated indices of negative symptoms among SZ (Mathews and Barch, 2004; Hall et al., 2007), but less so for self-reports of anhedonia (Horan et al., 2006; Harvey et al., 2009). Two separate studies (Mathews and Barch, 2006; Herbener et al., 2007) found associations between trait anhedonia (PA and SA) and immediate emotional responses to stimuli among controls, yet trait anhedonia

was unrelated to memory for these stimuli. Although comparable studies are less frequently found in the depression literature, as Liu et al. (2012) found associations between reduced recognition of positive words and trait anhedonia among a MDD sample.

In addition to trait anhedonia, the relative contribution of overall depressive symptoms to emotional memory in both disorders is also unclear. In MDD, heightened memory for negative stimuli has been associated with depressive mood (Ridout et al., 2003; Gotlib and Joormann 2010). Depressive symptoms have also been associated with reduced emotional memory in SZ (Mathews and Barch, 2004), but not consistently (Hall et al., 2007; Neumann et al., 2007). Additionally, depressive symptoms are also found to impact general neurocognitive and non-emotional memory in both disorders (Brebion et al., 1997, 2009). Thus, the relative role of depressive symptoms and trait anhedonia in emotional memory performance in both SZ and MDD groups is unclear.

Based on this literature, we hypothesized that (a) SZ and MDD groups would show general impairments in memory compared to controls, with the SZ group demonstrating greater memory impairment than the MDD group; (b) both the SZ and MDD groups would show poorer memory for positive stimuli than controls; and (c) the MDD group would demonstrate a heightened memory for negative stimuli in comparison to both the control and SZ groups. We also aimed to examine whether trait anhedonia and/or depressive symptoms contributed to emotional memory performance in the psychiatric samples. More specifically, physical anhedonia (PA) is suspected to impact memory performance in both SZ and MDD groups while social anhedonia (SA) is suspected to have a unique impact on performance in the SZ group.

## 2. Method

### 2.1. Participants

Twenty-five females with a diagnosis of schizophrenia, 18 females with a current diagnosis of major depressive disorder, and 33 female control participants were recruited at the University of Illinois at Chicago Medical Center, by physician referral and advertisements (see Table 1 for demographic information). Males were also recruited for the study, but analyses were limited to female subjects because men and women have been shown to exhibit different patterns of both emotional (Canli et al., 2002) and non-emotional memory (Andreano and Cahill, 2009) and sample sizes for males were extremely unbalanced across the three groups. Thirteen SZ participants and 15 controls were included in previously published data (Herbener et al., 2007).

Clinicians made diagnoses according to the Structured Clinical Interview for DSM-IV (First et al., 2002). One SZ participant met criteria for a comorbid anxiety disorder and 1 met criteria for a comorbid mood disorder. Six MDD participants met criteria for a comorbid anxiety disorder. All research participants were screened for a history of head trauma resulting in loss of consciousness, history of neurological injury or impairment, current substance abuse, and an IQ below 70 as assessed by the Wechsler Abbreviated Scale of Intelligence. Controls were excluded if they had a lifetime history of Axis I disorder or family history of SZ in first degree relatives. Chlorpromazine equivalent dosages were derived from Gardner et al. (2010) (see Table 2). All procedures were approved by the local institutional review board.

### 2.2. Assessments and measures

#### 2.2.1. Clinical symptom measures

Severity of symptoms in SZ and MDD were assessed with the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987),

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