Social and Non-Social Pleasure in Schizophrenia: Associations with Negative Symptoms and Depression

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Table of Contents

List of Figures

List of Tables

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ABSTRACT OF THE THESIS

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Individuals with schizophrenia can experience both negative and depressive symptoms, which may differentially relate to hedonic experience. Additionally, it is unclear whether these symptoms relate to social pleasure in the same way as overall pleasure. This study used Ecological Momentary Assessment in schizophrenia to investigate the unique relationships of negative and depressive symptoms to anticipatory and consummatory pleasure overall, and when split into social and non-social instances. Depressive symptoms negatively related to both anticipatory and consummatory pleasure, while negative symptoms negatively related to anticipatory but not consummatory pleasure. Although negative symptoms negatively related to both anticipatory and consummatory non-social pleasure, they did not relate to either anticipatory or consummatory social pleasure. Instead, anxiety negatively related to anticipatory social pleasure. This study indicates the need to account for severity of both negative and depressive symptoms when examining pleasure in schizophrenia and suggests that social and non-social pleasure have distinct symptom correlates.

Social and Non-Social Pleasure in Schizophrenia: Associations with Depression and Negative
Symptoms

Pleasure deficits in Schizophrenia

Pleasure deficits in schizophrenia are associated with negative symptoms as well as

symptoms of depression. While core symptoms of schizophrenia putatively include a diminished

experience of pleasure (see Horan, Kring, & Blanchard, 2006 for a review), individuals with

schizophrenia show intact experiences of pleasure in response to emotion-eliciting stimuli (see

Kring & Moran, 2008 for a review). Thus, it has been hypothesized that individuals with

schizophrenia have deficits in anticipatory pleasure (pleasure from anticipation of positive

events) but not consummatory (in-the-moment) pleasure (Kring, 1999). The findings regarding

this hypothesis are mixed and these deficits in anticipatory but not consummatory pleasure tend

to be associated with the severity of negative symptoms (e.g., Chan et al., 2010). However, little

work has addressed the potential role of depressive symptoms, which are often elevated in

people with schizophrenia spectrum disorders and have been associated with deficits in both

anticipatory and consummatory pleasure (Wu et al., 2017). Additionally, much of the work on

pleasure in schizophrenia has involved stimuli that are non-social in nature. As such, it is less

clear whether findings to date regarding pleasure in schizophrenia extend to pleasure from

socialization. The goal of the current work is to examine the unique relationships of negative and

depressive symptoms to both anticipatory and consummatory pleasure in schizophrenia and to

assess whether these symptoms relate to social pleasure in the same way as they do to other

forms of pleasure.

Hedonic deficits in schizophrenia have been considered integral parts of this disorder

since the works of Bleuler (1950) and Kraeplin (1919), who documented reports suggesting

diminished emotional experience in this population. Pleasure deficits, often referred to as "anhedonia," in schizophrenia are a component of negative symptoms. For example, a two-factor model of negative symptoms comprised of: 1) diminished verbal and nonverbal expression, and 2) diminished motivation and pleasure has been suggested to well represent this domain (Horan, Kring, Gur, Reise, & Blanchard, 2011) and has been supported through confirmatory factor analyses (e.g., Richter et al., 2019).

Importantly, research suggests that the experience of pleasure is comprised of two dissociable components: anticipatory and consummatory. Anticipatory pleasure, or "wanting", refers to thinking about pleasure or enjoyment in the future, while consummatory pleasure, or "liking", refers to the in-the-moment experience of pleasure (Kring, 1999). Neural distinctions of "liking" and "wanting" have also been proposed, suggesting that "wanting" is driven by manipulation of dopamine systems and that other systems (e.g., opiod) drive "liking" (e.g., Berridge & Robinson, 1998).

While there is consistent evidence of trait-level diminished emotional experience in schizophrenia (see Horan, Kring, & Blanchard, 2006 for a review), lab-based studies using film clips (e.g., Kring et al., 1993), pictures (e.g., Herbener et al., 2008), and food (Berlin, Givry-Steiner, Lecrubier, & Puech, 1998; Horan, Green, Kring, & Nuechterlein, 2006) to induce state consummatory pleasure, find that individuals with schizophrenia tend to report feelings that are both comparable in intensity to healthy controls as well as consistent with the valence of the stimuli (Cohen & Minor, 2010; Kring & Moran, 2008). While this is a well replicated finding via participant self-report, neuroimaging studies have found more of a mixed picture in regards to consummatory pleasure in schizophrenia (see Barch & Dowd, 2010 for a review), with some studies (e.g., Kirsch et al., 2007) showing intact consummatory pleasure in this population and

others (e.g., Schneider et al., 1998) showing a deficit. However, neural studies have found fairly consistent evidence for deficits in reward anticipation in BOLD response (see Radua et al., 2015 for a metanalysis). Importantly, experimental studies' artificial induction of emotional states may limit their ability to reflect real-world emotional experience. Ecological Momentary Assessment (EMA) is a method that accounts for this by prompting users to report on their daily experiences in real-time. While the pioneering EMA study on pleasure in schizophrenia found anticipatory but not consummatory pleasure deficits (Gard, Kring, Gard, Horan, & Green, 2007), follow-up studies using EMA have found that individuals with schizophrenia exhibit increased anticipatory pleasure compared to healthy controls (Edwards et al., 2018; Gard et al., 2014) or that individuals with schizophrenia generally overestimate the intensity of their emotions (Brenner & Ben-Zeev, 2014). Overall, while work seems to point to deficits in anticipatory but not consummatory pleasure in schizophrenia, findings are mixed; suggesting that further research examining pleasure in everyday contexts within a schizophrenia population would be useful.

Notably, several self-report and experience sampling studies have linked these anticipatory (but not consummatory) pleasure deficits to clinician-rated motivation and pleasure negative symptoms (Chan et al., 2010; Favrod, Ernst, Giuliani, & Bonsack, 2009; Gard et al., 2007; Horan, Green, et al., 2006; Moran, Culbreth, Kandala, & Barch, 2019; Moran & Kring, 2018). For example, studies have found that individuals with schizophrenia high in these negative symptoms show decreased anticipatory pleasure via self-report than those low in negative symptoms (e.g., Chan et al., 2010), and that anticipatory but not consummatory pleasure is associated with clinician-rated anhedonia in schizophrenia (e.g., Gard et al., 2007) and with subclinical negative symptoms in healthy controls (e.g., Engel, Fritzsche, & Lincoln, 2013). A number of fMRI studies have also shown a negative relationship between ventral striatal activity

during reward anticipation and negative symptom severity (Dowd & Barch, 2012; Juckel et al., 2006; Kirschner et al., 2016; Waltz et al., 2010). Together, these findings paint a picture of clinician-rated motivation and pleasure negative symptoms' association with anticipatory but not consummatory pleasure. Therefore, it is possible that variations in clinician-rated negative symptom severity contribute to inconsistent findings across studies. This suggests a need to further examine relationships between negative symptoms and pleasure deficits within a schizophrenia population to assess whether negative symptoms uniquely relate to anticipatory but not consummatory pleasure in schizophrenia.

Depression and Pleasure

Although the majority of the work on anhedonia in schizophrenia has been in the context of negative symptoms, anhedonia is also a common symptom of depression (e.g Berlin et al., 1998). Research on individuals with major depressive disorder (MDD) has found reduced levels of both anticipatory and consummatory pleasure (Wu et al., 2017). For example, individuals with MDD show decreased levels of consummatory pleasure via self-report (Berlin et al., 1998; Nakonezny, Carmody, Morris, Kurian, & Trivedi, 2010), when presented with pleasure-eliciting stimuli (e.g., Sloan, Strauss, & Wisner, 2001; Wexler, Levenson, Warrenburg, & Price, 1994; see Bylsma, Morris, & Rottenberg, 2008 for a metanalysis), and in daily reports of experiences (Barge-Schaapveld, Nicolson, Berkhof, & Devries, 1999; Bylsma, Taylor-Clift, & Rottenberg, 2011; Wu et al., 2017). There is also evidence that people with MDD experience decreased anticipatory pleasure both in the lab (MacLeod & Salaminiou, 2001; Sherdell, Waugh, & Gotlib, 2012) and in daily report of future pleasurable experiences (Wu et al., 2017).

Importantly, individuals with schizophrenia also commonly experience depressive symptoms which studies have found to be dissociable from negative symptoms (Häfner, Löffler,

4

Maurer, Hambrecht, & An Der Heiden, 1999; Kitamura & Suga, 1991; Kulhara & Avasthi, 2003; Rey et al., 1994). As both negative symptoms and depressive symptoms are associated with schizophrenia and with pleasure deficits, it is important to examine the unique relationships of each of these symptom-types to the experience of pleasure in schizophrenia. Little work to date on pleasure in schizophrenia has controlled for the effect of depression to assess the unique contribution of negative symptoms (or vice versa). However, Campellone and colleagues (2016) indicated that depressive symptoms could serve as a pathway for pleasure impairment in individuals with schizoypy (Campellone, Elis, Mote, Sanchez, & Kring, 2016) which suggests that it is critical to examine the role of depression as it relates to pleasure in schizophrenia as well. If depressive symptoms relate to deficits in both anticipatory and consummatory pleasure in this population as they do in MDD, then variation in the level of depression across study samples may also contribute to mixed findings in the literature. More specifically, individuals (or samples) with schizophrenia high in depressive symptoms may show deficits in both anticipatory and consummatory components of pleasure, while those lower in depressive symptoms may not show this same pattern.

Pleasure and Socialization

Most of the studies on pleasure in schizophrenia use stimuli that are non-social in nature or assess pleasure generally without distinguishing between pleasure from social versus non-social experiences, which limits our understanding of social pleasure in this population. However, some studies have examined pleasure specifically related to socialization in schizophrenia. Self-report and interview-based measures have consistently shown that individuals with schizophrenia report decreased social pleasure (Berenbaum & Oltmanns, 1992; J. J. Blanchard, Bellack, & Mueser, 1994a; J. L. Blanchard, Horan, & Brown, 2001; Chapman,

Chapman, & Raulin, 1976) which is associated with deficits in social functioning (Blanchard et al., 1998). One lab-based study (Engel, Fritzsche, & Lincoln, 2016) found that individuals with schizophrenia experienced less positive emotion related to both anticipated and experienced social inclusion than did healthy controls, and others found that individuals with schizophrenia-spectrum disorders placed less trust, anticipated less pleasure from, and expended less effort to increase the likelihood of future social interactions with positive outcomes than did the control comparison (Campellone & Kring, 2018; Campellone, Truong, Gard, & Schlosser, 2018). On the other hand, studies that measure social pleasure from social role-play type interactions in the lab have found evidence of intact consummatory pleasure from positive social interactions (Aghevli, Blanchard, & Horan, 2003; J. J. Blanchard, Park, Catalano, & Bennett, 2015). Similarly, EMA studies have found that individuals with schizophrenia report a normative need for social affiliation (Gard et al., 2014), greater positive and less negative affect when with others compared to when alone (Mote et al., 2019; Mote & Fulford, 2020; Oorschot et al., 2013; see Cho et al., 2016 for a metanalysis), and that happiness in this population predicts their social interaction (Granholm, Ben-Zeev, Fulford, & Swendsen, 2013).

As described above, the available studies show mixed findings regarding social pleasure in schizophrenia. Though the data are limited, most of the research on anticipatory pleasure from socialization in schizophrenia shows that this is reduced, and it has broadly been suggested that individuals with schizophrenia may not anticipate social activities to be as enjoyable (Engel et al., 2016; Gard et al., 2014). However, EMA studies suggest that consummatory social pleasure may be intact (see Mote and Fulford, 2020 for a review). Further, one study (Buck & Lysaker, 2013) found that anticipatory but not consummatory pleasure was associated with poorer interpersonal relationships. Thus, it is possible that experience of pleasure from socialization

may look similar to that of non-social pleasure in schizophrenia, with schizophrenia being more associated with deficits in anticipatory pleasure from socialization with intact consummatory pleasure. This could be reflected by individuals with schizophrenia reporting in-the-moment enjoyment for socialization that may not translate to anticipation for future social activities.

Similarly, it has been suggested that as negative symptoms increase, social enjoyment decreases (J. J. Blanchard, Park, Catalano, & Bennett, 2015; Oorschot et al., 2013), and that negative symptoms are related to fear before an upcoming social situation (Strauss, Rakfeldt, Harding, & Lieberman, 1989) and less willingness to engage in social interactions (J. J. Blanchard et al., 2015). Research also indicates that individuals with MDD tend to report less in-the-moment enjoyment from social interactions than healthy controls (e.g., Nezlek, J. B., Hampton, C. P., & Shean, G. D, 2000). In this vein, it is possible that motivation and pleasure negative symptoms and symptoms of depression in schizophrenia may contribute to anticipatory and consummatory social pleasure, as they do to overall pleasure, with negative symptoms predicting anticipatory but not consummatory social pleasure, and depression symptoms predicting both anticipatory and consummatory social pleasure.

On the other hand, it has been suggested that social pleasure may be distinct from non-social pleasure in schizophrenia (J. J. Blanchard et al., 1994b, 1998; Cohen et al., 2010), and thus the symptom correlates could vary based on clinical profile. For example, Behrens and colleagues (2009) posit that there are two main brain networks associated with anticipation of social pleasure in healthy individuals. The first involves general neurocircuitry involved in anticipation and reward processing and the second, that is social-specific, involves processes involved when making estimations of another person's intentions (Behrens, Hunt, & Rushworth, 2009). This suggestion that social pleasure involves dissociable psychological and neural

processes raises the possibility that the nature of social pleasure deficits in schizophrenia may differ from non-social pleasure deficits and that their correlates may differ. Further, it is possible that additional symptoms associated with psychosis, such as persecutory delusions or anxiety, may interfere with the anticipation or experience of social pleasure in schizophrenia.

Aims and Hypotheses

While there is generally robust evidence that individuals with schizophrenia show anticipatory pleasure deficits coupled with intact consummatory pleasure, there are some mixed findings across studies, and few studies have dissociated the unique relationships of negative symptoms and depression to hedonic experience. The literature reviewed above indicates that it is important to investigate whether clinician ratings of negative symptoms, which often affect treatment decisions, map on to individuals' own experiences in their day-to-day lives. This relationship has been shown globally in past EMA literature (e.g., Moran et al., 2019) but not when these pleasurable experiences are split into their social and non-social components. Additionally, these daily experiences of pleasure can be confounded by depressed mood, which indicates a need to control for self-reported depressive symptoms as they may color individuals' daily pleasure ratings.

As such, this research aims to investigate daily anticipatory and consummatory pleasure within a schizophrenia population to test the hypotheses that: 1) motivation and pleasure (MAP) negative symptoms will negatively relate to anticipatory but not consummatory pleasure even when controlling for depression, 2) depression symptoms will negatively relate to anticipatory and consummatory pleasure in schizophrenia even when controlling for MAP negative symptoms 3) current socialization in daily life will relate to current (i.e., consummatory) pleasure but anticipated socialization will not relate to anticipatory pleasure, and 4) symptom

relationships to social pleasure will look similar to those for general pleasure: depression will negatively relate to both anticipatory and consummatory pleasure for socialization, while social motivation and pleasure negative symptoms will relate to anticipatory but not consummatory pleasure from social experiences.

Methods

Participants

Stable outpatients with schizophrenia or schizoaffective disorder (SCZ; total: n=66, schizophrenia: n=54, schizoaffective: n=12) were recruited as part of two studies investigating negative symptoms of SCZ using EMA. Diagnoses were confirmed using the Structured Clinical Interview for DSM-IV-TR (American Psychiatric Association, 2000) administered by a master's or PhD level clinician. Exclusion criteria included (1) DSM-IV diagnosis of substance abuse or dependence in the past 6 months; (2) DSM-IV diagnosis of a current mood disorder; (3) changes in medication within two weeks prior to consent; (4) IQ less than 70 as measured by the Wechsler Test of Adult Reading (WTAR; Wechsler, 2001); and (5) history of severe head trauma and/or loss of consciousness. Of note, we did not have a healthy control group as this was not necessary to our goals to dimensionally explore symptom correlates within a schizophrenia population. Additionally, our mood disorder exclusion allowed us to unconfound comorbid diagnosed depression, which allowed us to better investigate variation in symptom dimensions.

All participants provided written informed consent to the protocol approved by the Washington University Institutional Review Board. Participant demographics are presented in Table 1. Consistent with prior EMA research (e.g., Myin-Germeys, Delespaul, & Devries, 2001) participants with less than 33% response rate to the EMA survey (n=3) were excluded from the

analyses, resulting in a final sample size of 63.

Procedure

The study was made up of three phases: an initial study visit, a week of EMA, and a final study visit. The initial laboratory visit included a diagnostic interview and a training session on how to use the provided Android-enabled smartphones for the EMA portion of the study. Training involved instructing participants on how to use the device, and review of the EMA survey prompts to ensure comprehension and ability to answer questions. After completion of the EMA protocol, participants returned to the laboratory to complete clinician-rated clinical interviews and self-report measures regarding their symptoms during the week of the EMA protocol. Participants were compensated $1.75 per EMA survey completed and $40 per laboratory visit.

Clinical Assessments

Participant diagnoses were confirmed through a DSM-IV-TR Structured Clinical Interview for Axis I disorders administered by a master's or PhD level clinician at the start of the study. After the week of responding to EMA prompts, additional clinician-rated assessments were administered to assess for participant symptoms in the past (EMA) week. Negative symptoms were assessed with the clinician-rated Clinical Assessment Interview for Negative Symptoms (CAINS; Kring, Gur, Blanchard, Horan, & Reise, 2013). The CAINS includes a Motivation and Pleasure (MAP) subscale and an Expression (EXP) subscale. We used the MAP subscale, which includes sections related to motivation and frequency of pleasure for social relationships, work and school, and recreation for our overall ratings of motivation and pleasure negative symptoms. We also created a measure of social negative symptoms (Social MAP negative symptoms; α= 0.71) by using participants' scores from the social relationships section

of the MAP subscale (motivation for relationships with family/friends/romantic partners, frequency of anticipated and experienced pleasurable social activities) and a measure of non-social negative symptoms (Non-Social MAP negative symptoms; α= 0.48) by using participants' scores from the work, school and recreation sections of the MAP subscale (motivation for work/school/recreation activities, frequency of anticipated and experienced pleasurable work/school/recreational activities).

The Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962) was also administered by a clinician at this time to get a broader sense of past-week state psychiatric symptoms including Unusual thought content (i.e., delusions) and Anxiety. State depression symptoms for the past week were also assessed at the second visit using the Beck's Depression Inventory—Second Edition (BDI; Beck, Steer, & Brown, 1996) self-report measure. Higher scores on the CAINS, BPRS, and BDI indicate increased impairment.

EMA

EMA Protocol: For the EMA portion of the study, participants were provided Android-enabled smartphones and prompted to complete the EMA survey 4 times per day for the duration of one week. These prompts occurred pseudorandomly, approximately every 3 hours and fell between the hours of 10:00 AM and 7:00PM. Surveys started more than 15-minutes after the prompt were not counted and, as noted above, participants who responded to less than 33% of the questionnaire prompts (n= 3) were excluded from the current analyses. The mean response rate for the EMA surveys was 80.5%, with a standard deviation of 19.07%.

EMA Survey: The EMA survey assessed daily motivation and pleasure and related factors across various time-points and domains. Participants were asked a series of questions regarding their current behavior and anticipated behavior. Anticipated behavior prompts asked

about expectations for the next two hours to focus on time window with a high likelihood of occurrence before the next prompt (~3 hours later). Participants were asked to select their activities (current and anticipated) from a drop-down list of options (e.g., TV/Reading/Computer, Running an Errand, Cleaning/Hygiene/Chores). They were also asked to select their most enjoyed (or anticipated most enjoyed) activity and to rate their anticipatory (predicted) or consummatory (current) enjoyment of that activity on a 5-point Likert scale, with higher scores indicating greater enjoyment. Additionally, socialization (in-person contact) was measured by participant responses indicating who they were with in-the-moment in person as well as who they anticipated being within the next two hours. A social experience was operationalized as being (or anticipating being) with known others and a non-social experience was coded if the person was (or anticipating being) alone or with strangers. We added being with strangers to the non-social category, as we thought that active interaction was unlikely and wanted to prevent the non-social category from being constrained to at-home activities. From this survey, we computed the following variables:

Anticipatory Pleasure*:* Individuals' reported anticipated enjoyment (1-5) of the activity they predict most enjoying in the next two hours across both social and non-social instances.

Consummatory Pleasure*:* Individuals' reported current enjoyment (1-5) of the activity they report most enjoying across both social and non-social instances.

Anticipatory Social Pleasure: Individuals' reported anticipated enjoyment (1-5) of the activity they predict most enjoying in the next two hours in instances when they anticipate socializing.

Consummatory Social Pleasure*:* Individuals' reported current enjoyment (1-5) of the activity they report most enjoying in instances when they are currently socializing.

Anticipatory Non-Social Pleasure: Individuals' reported anticipated enjoyment (1-5) of the activity they predict most enjoying in the next two hours in instances when they do not anticipate socializing.

Consummatory Non-Social Pleasure: Individuals' reported current enjoyment (1-5) of the activity they report most enjoying in instances when they are currently not socializing.

Statistical Analysis

We used Hierarchical Linear Modeling (HLM) with random effects and data nested by participant to examine relationships between within-subjects observations from the EMA survey responses and between-subjects measures.

We first assessed the relationship of negative and depressive symptoms to pleasure. Each model included both negative and depressive symptom scores as fixed, between-subjects variables in Level 2 to predict either participants' repeated reports of anticipatory or consummatory pleasure in Level 1. Both Level 2 symptom measures were added simultaneously to assess the unique contribution of each of these symptoms. For these analyses we did not make a distinction between social and non-social pleasure.

To assess whether socialization (coded 1= with known others, coded 0= alone or with strangers) related to pleasure, we used models with either current or anticipated socialization as random effects in Level 1 to predict anticipatory or consummatory pleasure. Next, to assess negative and depressive symptoms' relationship to social and non-social pleasure individually, we split the data by instances of socialization versus non-socialization and analyzed these different instances separately.

This led us to four distinct models examining the relationship of negative and depressive symptoms to: 1) anticipatory pleasure for social instances, 2) consummatory pleasure for social

13

instances, 3) anticipatory pleasure for non-social instances, and 4) consummatory pleasure for

social instances. As in the original analyses, each model included both negative and depressive

symptom scores as fixed, between-subjects variables in Level 2 to predict participants' repeated

reports of anticipatory pleasure, or consummatory pleasure in Level 1.

Lastly, we conducted follow-up analyses comparing correlated correlation coefficients

(e.g., relative strength of the association of negative symptoms with anticipatory versus

consummatory pleasure) using the Meng, Rosenthal and Rubin method (Meng, Rosenthal, &

Rubin, 1992) by creating average scores of each measure per individual in order to compute the

correlations. False Discovery (FDR) corrections were used for exploratory analyses (Benjamini

& Hochberg, 2000).

Results

Table S1 in the Supplemental Materials available online outlines the zero-order

correlations between all measured variables.

Negative and Depressive Symptom Relationships to General Pleasure

To test our first two hypotheses, we first examined the unique relationships of negative

symptoms and depressive symptoms ($r = 0.12$ between the two) to anticipatory and

consummatory pleasure in daily life. As shown in Table 2 and Figure 1a, consistent with our

hypothesis, we found that MAP negative symptoms negatively predicted anticipatory, but not

consummatory pleasure when controlling for depressive symptoms. In contrast, we found that

depressive symptoms negatively predicted both anticipatory and consummatory pleasure when

controlling for MAP negative symptoms (Table 2 and Figure 1b). In follow-up analyses

comparing correlated correlation coefficients, MAP negative symptoms were significantly more

associated with anticipatory than consummatory pleasure (Z = -1.66, p = 0.048), while depressive symptoms were significantly more associated with consummatory than anticipatory pleasure (Z = 1.86, p = 0.031).

Socialization and Pleasure

As described above, socialization was determined by when individuals reported being with known others (M percentage of reports = 41.4%, SD = 28.8%) or anticipated being with known others (M percentage of reports = 60.49%, SD = 32.85%). Consistent with hypothesis 3, we found that anticipated socialization did not predict anticipatory pleasure (Figure 2b; β = - 0.04, p = 0.542), but current socialization in daily life predicted current pleasure (Figure 2a; β = 0.18, p = 0.018).

Negative and Depressive Symptom Relationships to Daily Social Pleasure

We next examined the unique associations of Social MAP negative symptoms and depressive symptoms to daily reports of anticipatory and consummatory social pleasure (Table 2), to test hypothesis 4 that social pleasure would have the same symptom correlates as non-social pleasure. Consistent with this hypothesis, depressive symptoms negatively predicted both anticipatory and consummatory social pleasure when controlling for Social MAP negative symptoms. However, inconsistent with our hypothesis, Social MAP negative symptom scores did not predict either anticipatory or consummatory pleasure for socialization when controlling for depressive symptoms. As a follow-up, we assessed whether Non-Social MAP negative symptoms predicted anticipatory or consummatory social pleasure and found that they did not.

Negative and Depressive Symptom Relationships to Non-Social Pleasure

We conducted follow-up analyses to examine how negative and depressive symptoms related to non-social pleasure (Table 2). We found that Non-Social MAP negative symptoms

negatively predicted both anticipatory and consummatory non-social pleasure when controlling for depressive symptoms. Further, even Social MAP negative symptoms predicted both anticipatory and consummatory non-social pleasure when controlling for depressive symptoms. Depressive symptoms negatively predicted consummatory pleasure from non-socialization events when controlling for Non Social MAP negative symptoms, but only trended on predicting anticipatory pleasure for non-socialization when controlling for Non Social MAP negative symptoms (significant when these negative symptoms were not in the model; $\beta = -0.04$, p = 0.008). Interestingly, follow-up correlated correlation coefficient comparisons found that Non-Social MAP negative symptoms were significantly more associated with non-social versus social anticipatory pleasure ($Z = -2.68$, $p = 0.037$) but not more highly associated with non-social than social consummatory pleasure ($Z = 0.34$, $p = 0.633$). Similarly, Social MAP negative symptoms were significantly more associated with non-social than social anticipatory pleasure ($Z = -2.68$, $p = 0.004$) but were not significantly more associated with non-social than social consummatory pleasure ($Z = 0.46$, $p = 0.678$). Depressive symptoms, on the other hand, did not differ in their associations with social versus non-social anticipatory or consummatory pleasure (anticipatory: $Z = 1.23$, $p = 0.109$, consummatory: $Z = 1.36$, $p = 0.087$).

Additional Symptom Relationships to Pleasure (Exploratory Analyses)

To assess whether there might be other clinical symptoms associated with anticipated or consummatory social pleasure, we conducted exploratory analyses regarding associations with BPRS Unusual thought content (i.e., delusions) and BPRS Anxiety (Table S2 in the Supplemental Material available online). Delusions predicted anticipatory but not consummatory social pleasure when controlling for CAINS MAP Social, but it did not predict either

anticipatory or consummatory non-social pleasure when controlling for Non-Social MAP negative symptoms. Anxiety negatively predicted anticipatory social, consummatory social, and consummatory non-social pleasure when controlling for the respective MAP negative symptoms but did not predict anticipatory non-social pleasure when controlling for Non-Social map negative symptoms. However, the only finding that survived FDR corrections was the association of anxiety with anticipatory pleasure for socialization. Follow-up analyses comparing correlated correlation coefficients found that both delusions ($Z = 3.38$, $p < 0.001$) and anxiety ($Z = 1.99$, $p = 0.023$) were more associated with anticipatory social than anticipatory non-social pleasure.

Discussion

The goal of the current study was to examine the unique relationships of clinician-rated MAP negative symptoms and depressive symptoms to pleasure in schizophrenia, and to assess whether these symptoms would associate in the same way to pleasure for social versus non-social experiences. We found that MAP negative symptoms and depressive symptoms differed in their relationships to anticipatory and consummatory pleasure, and that MAP negative symptoms related differently to social versus non-social pleasure. These findings indicate a need for pleasure research in schizophrenia to account for symptom heterogeneity in this population and to assess social and non-social pleasure as separate constructs. We discuss our findings and their implications below.

When examining pleasure broadly within a schizophrenia population, we found that MAP negative symptoms negatively predicted anticipatory but not consummatory pleasure, while depressive symptoms negatively predicted both anticipatory and consummatory pleasure. These findings indicate that MAP negative symptoms and depression differentially relate to the

17

experience of pleasure in schizophrenia. Specifically, these findings support previous literature that suggests that MAP negative symptoms are related to deficits in anticipatory pleasure (Chan et al., 2010; Favrod et al., 2009; Gard et al., 2007; Horan, Green, et al., 2006), while depressive symptoms are related to deficits in both anticipatory and consummatory pleasure (see Wu et al., 2017 for a review). Since individuals with schizophrenia may experience both MAP negative symptoms and symptoms of depression, the mixed findings in the literature on pleasure in schizophrenia could be a product of participant's differing symptom profiles within their schizophrenia diagnosis across studies. For example, individuals with schizophrenia who have higher levels of depression than MAP negative symptoms may show deficits in both anticipatory and consummatory pleasure, while those who demonstrate MAP negative symptoms without as many depressive symptoms may show deficits in anticipatory but not consummatory pleasure. As such, research that does not assess both MAP negative symptoms and depressive symptoms when making statements about the nature of pleasure deficits in schizophrenia may fail to account for the differing experiences of pleasure within this population based on their symptom profiles.

In terms of social pleasure, we found that when individuals with schizophrenia reported socializing in-the-moment, their reported consummatory pleasure increased. This is consistent with findings from other EMA studies (Mote & Fulford, 2020; Mote, Gard, Gonzalez, & Fulford, 2019; Oorschot et al., 2013) that showed that individuals with schizophrenia reported increased positive affect from social experiences. In contrast, we found that individuals with schizophrenia did not report increased anticipatory pleasure when they anticipated socialization. This finding supports literature suggesting that individuals with schizophrenia may not anticipate social activities to be as enjoyable (Engel et al., 2016; Gard et al., 2014). Together, these findings

suggest that there is a disruption in the translation of current pleasure from social experiences to anticipated pleasure for these experiences.

From the limited literature on anticipatory and consummatory social pleasure in schizophrenia, it was unclear what symptoms may contribute to this pattern. If social pleasure behaved similarly to overall pleasure, MAP negative symptoms' association with anticipatory but not consummatory pleasure could relate to this lack of increased anticipatory pleasure for socialization. Instead, we found that MAP negative symptoms (social and non-social) did not predict either anticipatory or consummatory social pleasure, which suggests that social pleasure does not align with overall pleasure in terms of associated symptoms. On the other hand, both social and non-social MAP negative symptoms negatively predicted both anticipatory and consummatory pleasure for non-socialization. MAP negative symptoms were also significantly more associated with anticipatory non-social than anticipatory social pleasure. In combination, these findings suggest that social and non-social pleasure in schizophrenia are distinct from one another and that MAP negative symptoms more strongly predict non-social than social pleasure. They also indicate that in future work, it will be critical to investigate social and non-social pleasure separately.

In contrast to MAP negative symptoms, depressive symptoms stayed fairly consistent across analyses in their negative prediction of both social and non-social anticipatory and consummatory pleasure. The one exception to this was that depressive symptoms only trended on predicting anticipatory non-social pleasure when controlling for MAP negative symptoms, though it was significantly associated without MAP symptoms in the model. Our findings that depressive symptoms fairly consistently predicted all pleasure variables even when controlling for MAP negative symptoms is especially relevant given that anybody with a current major

19

depressive episode was excluded from the study. Some might consider our exclusion of individuals meeting diagnostic criteria for depression as a limitation. However, this allowed us to examine more subtle individual differences in symptoms of depression that may be more likely to be confounded with negative symptoms in schizophrenia. Further, the fact that we still saw independent relationships of depression to daily anticipatory and consummatory pleasure suggests important relationships even amongst those not meeting diagnostic criteria for depression and speaks to the importance of accounting for depression symptom severity in future work on pleasure in schizophrenia.

Because MAP negative symptoms did not relate to social pleasure, we explored whether delusions or anxiety might relate to social pleasure deficits. We found that both delusions and anxiety negatively predicted anticipatory social pleasure, though only the finding with anxiety survived FDR corrections. Additionally, both delusions and anxiety were more associated with social than non-social anticipatory pleasure. This is the reverse of MAP negative symptoms which were more associated with non-social than social anticipatory pleasure. While there is very limited literature on delusions and anxiety as they relate to anticipatory pleasure for socialization, our findings align with research that has found that social anxiety is higher in individuals with schizophrenia than in healthy controls, and that it is associated with decreased positive affect as well as poor social functioning (J. J. Blanchard, Bellack, & Mueser, 1994b). Together, our findings and the literature suggest that anxiety could also be implicated in anticipated pleasure for socialization, are consistent with the suggestion that social and non-social pleasure are distinct, with social pleasure being more associated with negative affect (J. J. Blanchard et al., 1994a, 1998; Cohen et al., 2010).

These results should be interpreted in the context of several limitations. First, our study

did not have a healthy control group for comparison. However, as our aim was to investigate symptom relationships within a schizophrenia population, a healthy control group was not needed for this goal. Still, since we did not compare this population to a healthy control group, we cannot state that the disconnect between anticipatory and consummatory pleasure for socialization necessarily indicates a deficit in anticipatory social pleasure in schizophrenia. Additionally, as our assessments of social and non-social pleasure were limited to when participants reported being with known others versus alone or with strangers, our power for these analyses was decreased compared to those for overall pleasure.

It is also worth noting that our measure of socialization had limitations. First, it was limited to in-person contact and as such we do not have a measure of how virtual forms of socialization (e.g., social media use, texting, phone calls) would contribute to emotional experience. Additionally, socialization was measured through participant responses of whether they were with known others or alone/ with strangers, rather than a specific measure of their active interactions with these individuals. It is certainly possible that individuals were in the presence of known others without interaction, or that they were interacting with strangers.

We included strangers in the non-social category to try to decrease some of these social limitations. We thought it was more likely that individuals would be in the presence of strangers in a non-social (e.g., shopping or walking down the street) than a social context, while allowing us to control for the mere effects of being in the presence of others. Additionally, we did not want pleasure ratings to be constrained to the types of activities in which individuals partook. By including strangers into the non-social category, we decrease the likelihood that non-social versus. social ratings were simply a product of being at home versus leaving the house.

Another limitation to this study is that delusions and anxiety were each assessed via only

one item on the BPRS clinical interview, which may constitute limited coverage of these

symptom-types. Our assessment of anxiety was general, and a measure of social anxiety could be

a more specific assessment of symptoms that contribute to social pleasure. Future research

should also collect EMA data for a longer period of time to assess for time variation (e.g.,

weekends vs. weekdays), and potential shifts in experienced anticipatory and consummatory

pleasure as symptoms of depression fluctuate. Additionally, investigating whether the findings

from this study would replicate in those with first-episode psychosis, at clinical high risk for

psychosis, with schizotypy, or for individuals with deficit and non-deficit psychosis would allow

us to better understand how broadly these symptom types hold this pattern.

Most work on hedonic experience in schizophrenia has assessed pleasure as a broad

construct that groups together its social and non-social components. However, the results of this

study suggest that increased work should be conducted on social and non-social pleasure as

distinct entities when assessing pleasure in this population. Studies on pleasure in schizophrenia

should also take care to control for symptom heterogeneity in this population. It is especially

important for work to account for depression symptom severity before making broad statements

about the overall nature of pleasure deficits in schizophrenia. Finally, the factors that contribute

to the disconnect between consummatory and anticipatory pleasure for socialization should be

further explored, and social anxiety and delusions-related positive symptoms seem to be

promising places to start. As the likelihood of engaging in an activity is associated with

anticipated pleasure for that activity (e.g., Mellers & McGraw, 2001), an increased

understanding of factors that may reduce anticipatory pleasure for socialization could reflect

some of what may inhibit socialization in this population. As social support predicts functional

outcomes in schizophrenia (e.g., Norman, Windell, Manchanda, Harricharan, & Northcott,

2012), targeting factors that may inhibit socialization, could lead to increased forming of social

connections in this population and ultimately contribute to beneficial functional outcomes.

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Table 1		Mean (SD)
Demographics		
	Age	38.92 (10.54)
	Sex (% Female)	39.7%
	Education	12.75 (2.86)
	Parental Education	14.31 (6.25)
Race (%)		
	White	36.5%
	African American	60.32%
Clinical Ratings		
	CAINS MAP	17.79 (5.44)
	CAINS MAP Social	6.39 (3.93)
	CAINS MAP Non-Social	9.68 (4.21)
	BPRS Unusual thought content	1.94 (1.47)
	BPRS Anxiety	2.22 (1.63)
Self-Report		
	BDI	11.86 (10.09)

Note: CAINS MAP Non-Social (frequency of and motivation for work/school/recreation activities) contains one additional item than does CAINS MAP Social which may account for the higher value.

Table 2: Motivation and Pleasure Negative Symptom and Depression Relationships to Anticipatory and Consummatory Pleasure

	b	t	p
Anticipatory Pleasure			
BDI Depression (controlling for CAINS MAP)	-0.02	-3.15	0.003**
CAINS MAP (controlling for BDI depression)	-0.04	-2.55	0.013*
Consummatory Pleasure			
BDI Depression (controlling for CAINS MAP)	-0.03	-3.14	0.003**
CAINS MAP (controlling for BDI depression)	-0.02	-1.64	0.107
Anticipatory Social Pleasure			
BDI Depression (controlling for Social CAINS MAP)	-0.03	-3.16	0.003**
Social CAINS MAP (controlling for BDI depression)	-0.07	-0.75	0.457
Non-Social CAINS MAP (controlling for BDI depression)	-0.24	-1.76	0.084
Consummatory Social Pleasure			
BDI Depression (controlling for Social CAINS MAP)	-0.02	-2.43	0.019*
Social CAINS MAP (controlling for BDI depression)	0.03	0.30	0.766
Non-Social CAINS MAP (controlling for BDI depression)	-0.30	-1.78	0.079
Anticipatory Non-Social Pleasure			
BDI Depression (controlling for Non-Social CAINS MAP)	-0.02	-1.89	0.0643
Social CAINS MAP (controlling for BDI depression)	-0.32	-3.34	0.002**
Non-Social CAINS MAP (controlling for BDI depression)	-0.46	-3.32	0.002**
Consummatory Non-Social Pleasure			
BDI Depression (controlling for Non-Social CAINS MAP)	-0.03	-3.43	0.001**
Social CAINS MAP (controlling for BDI depression)	-0.23	-2.35	0.023*
Non-Social CAINS MAP (controlling for BDI depression	-0.32	-2.23	0.030*

Figure Captions

Figure 1: A) BDI Scores (controlling for MAP negative symptoms) negatively predicted both

Anticipatory and Consummatory Pleasure in daily life; B) CAINS MAP Scores (controlling for BDI)

negatively predicted Anticipatory but NOT Consummatory) Pleasure in daily life.

Figure 2: A) Current Socialization significantly predicts consummatory pleasure; B) Anticipated

Socialization does not significantly predict anticipatory pleasure.

Figure 1a: Figure 1b:

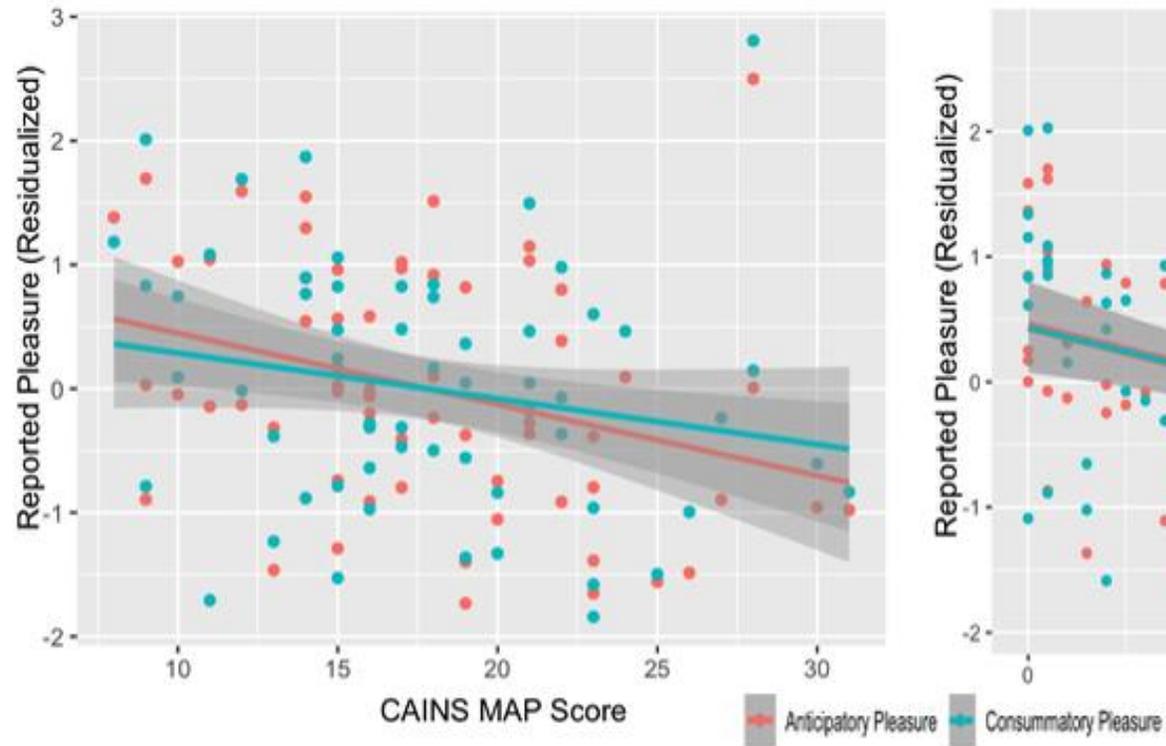Motivation and Pleasure Negative Symptoms and Pleasure
(Controlling for Depression Symptoms)

Depression Symptoms and Pleasure
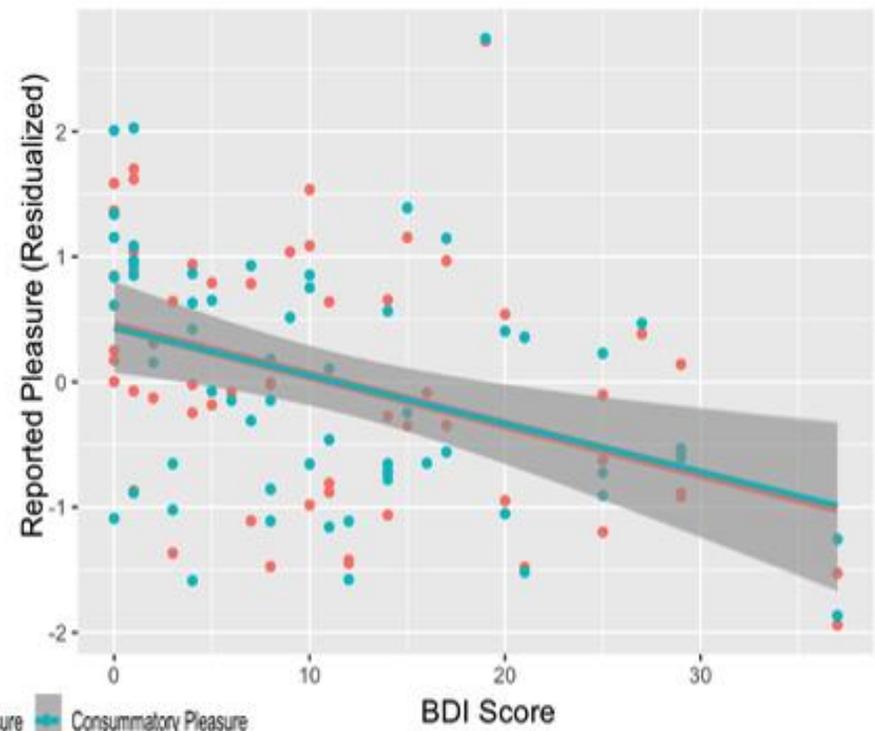(Controlling for Motivation and Pleasure Negative Symptoms)

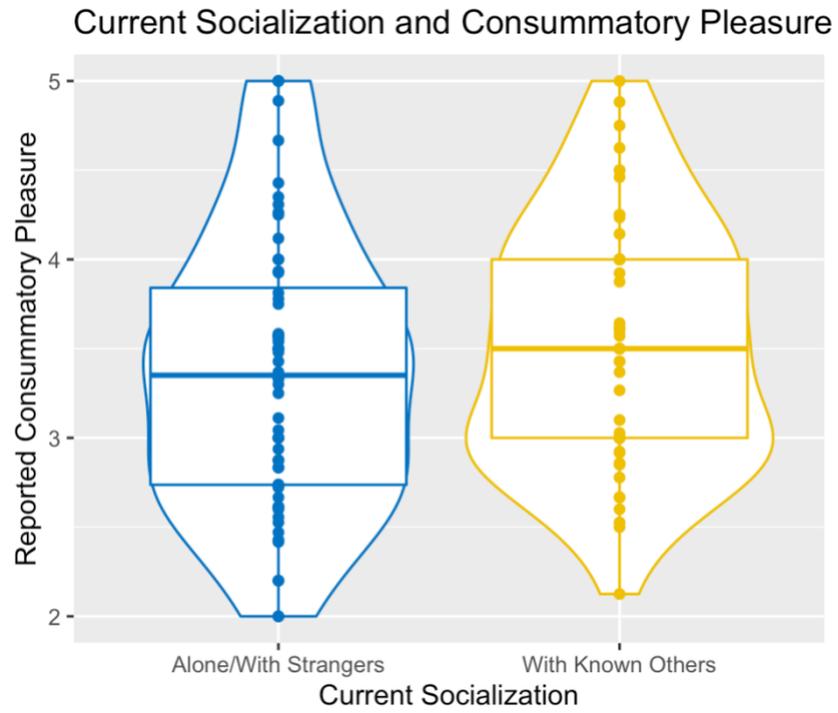Anticipatory Pleasure   Consummatory Pleasure

Figure 2a:

Current Socialization and Consummatory Pleasure

Figure 2b:

Anticipated Socialization and Anticipatory Pleasure

33
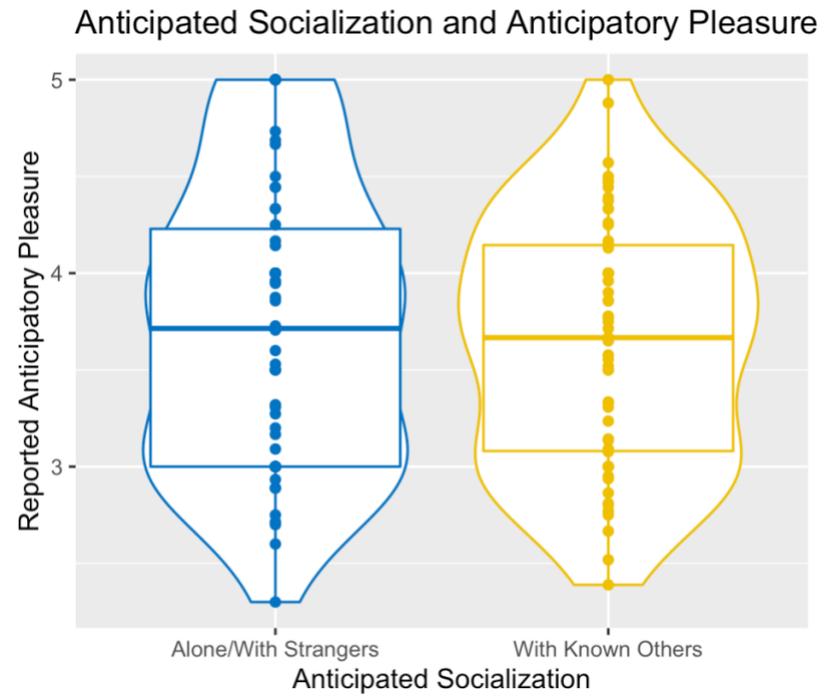
Table S1: Zero-Order Correlation of all variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BDI = 1	1													
CAINS MAP = 2	0.12	1												
CAINS Social = 3	0.08	0.84	1											
CAINS Non-Social = 4	0.11	0.78	0.32	1										
Anxiety = 5	0.38	-0.01	-0.12	0.13	1									
Delusions = 6	0.47	-0.09	-0.10	-0.03	0.38	1								
Anticipated Socialization = 7	-0.02	-0.15	-0.31	0.09	0.14	0.16	1							
Current Socialization = 8	-0.002	0.081	-0.11	0.27	0.07	0.02	0.70	1						
Anticipatory Pleasure = 9	-0.41	-0.46	-0.30	-0.46	-0.24	-0.02	0.04	0.03	1					
Consummatory Pleasure = 10	-0.46	-0.41	-0.26	-0.41	-0.28	-0.12	0.03	0.11	0.90	1				
Anticipatory Non-Social Pleasure = 11	-0.27	-0.50	-0.38	-0.43	-0.16	0.09	0.10	0.01	0.88	0.77	1			
Anticipatory Social Pleasure = 12	-0.41	-0.41	-0.28	-0.39	-0.25	-0.12	0.004	0.04	0.95	0.90	0.77	1		
Consummatory Non-Social Pleasure = 13	-0.43	-0.46	-0.34	-0.42	-0.24	-0.06	-0.02	0.09	0.85	0.94	0.77	0.84	1	
Consummatory Social Pleasure = 14	-0.32	-0.31	-0.10	-0.43	-0.22	-0.17	0.003	0.01	0.80	0.84	0.66	0.80	0.69	1

Table S2: Exploratory Analyses: Delusions and Anxiety contributions to Anticipatory and Consummatory Pleasure

	b	t	p (pre-FDR corrections)	p (post-FDR corrections)
Anticipatory Social Pleasure				
Delusions (controlling for Social CAINS MAP)	-0.13	-2.19	0.033*	0.084
Anxiety (controlling for Social CAINS MAP)	-0.15	-2.86	0.006**	0.047*
Consummatory Social Pleasure				
Delusions (controlling for Social CAINS MAP)	-0.12	-1.80	0.078	0.178
Anxiety (controlling for Social CAINS MAP)	-0.12	-2.09	0.042*	0.083
Anticipatory Non-Social Pleasure				
Delusions (controlling for Non-Social CAINS MAP)	0.05	0.79	0.431	0.431
Anxiety (controlling for Non-Social CAINS MAP)	-0.06	-1.09	0.280	0.319
Consummatory Non-Social Pleasure				
Delusions (controlling for Non-Social CAINS MAP)	-0.11	-1.74	0.088	0.118
Anxiety (controlling for Non-Social CAINS MAP)	-0.14	-2.59	0.012*	0.084