HEDONIC FUNCTIONING AND SUBTHRESHOLD PSYCHOTIC SYMPTOMS

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ABSTRACT

Schizophrenia is a debilitating disorder with an array of affective, cognitive, and behavioral consequences. In addition to these impairments, research suggests that there is a distinct pattern of hedonic functioning in schizophrenia that may contribute to some of the most intractable symptoms of the disorder, the negative symptoms. Specifically, individuals with schizophrenia appear to experience deficient levels of pleasure during *anticipation* of a pleasurable stimulus, while experiencing typical levels of pleasure while directly engaged with a pleasurable stimulus. Despite these findings, it is unclear whether hedonic functioning deficits occur in individuals with subthreshold levels of psychotic symptoms and/or in individuals at clinical high risk for the disorder. The purpose of this study was to examine hedonic functioning in relation to the continuum of psychotic symptoms in a college undergraduate student sample, and in those at clinical risk for schizophrenia. Participants were 679 students who completed self-report measures of current psychotic-like experiences, and trait-like components of hedonic functioning (i.e., anticipatory and consummatory pleasure). Consistent with study hypotheses, deficits in anticipatory pleasure, but not in consummatory pleasure, were significantly associated with increased clinical risk for schizophrenia. However, this relation was found exclusively among women in the sample, whereas men did not show a significant relation between anticipatory pleasure deficits and clinical high-risk. Furthermore, anticipatory pleasure deficits were not significantly associated with increases in the number of positive psychotic symptoms endorsed. Moreover, consummatory pleasure was not associated with increases in the number of subthreshold positive psychotic symptoms, nor was there a relation with the number of distressing positive psychotic symptoms or

clinical risk status. The present study provides the first examination of the relation between hedonic functioning and subthreshold psychotic symptoms, as well as the relation with clinical high-risk for psychosis. These findings suggest that anticipatory pleasure deficits may be more closely related to increased clinical risk for psychosis among women rather than increases in psychotic symptoms in the general population. Anticipatory pleasure deficits may be a useful target for intervention and prevention techniques among those at clinical risk for psychosis, especially in female at risk populations. Additional longitudinal studies will be essential for testing whether anticipatory pleasure deficits predict the occurrence of future psychotic disorders among those at high risk for the disorder in order to improve early identification and early intervention efforts in this population.

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CHAPTER 1

INTRODUCTION

Hedonic Functioning and Subthreshold Psychotic Symptoms

Characterized by devastating functional outcomes, schizophrenia is a disorder with widespread symptoms impacting affect, cognition, and behavior (e.g., Horan, Blanchard, Clark, & Green, 2008). In addition to the positive symptoms of schizophrenia, such as delusions and hallucinations, accumulating evidence suggests that elevations in negative symptoms among schizophrenia patients are related to a more severe course of the disorder and poorer functional outcomes (McGlashan & Fenton, 1992). Among the negative symptoms, anhedonia, or the lack of interest or experience of pleasure in response to previously enjoyable activities (American Psychiatric Association, 2000), appears to contribute substantially to poorer social and occupational functioning in the course of schizophrenia (e.g., limited social network, poor work adjustment; McGlashan et al., 1992). Whereas the general diminution of pleasure can be observed in various clinical disorders, emerging evidence suggests the nature of hedonic deficits in schizophrenia presents in a fashion unique to schizophrenia (Kring, 1999). Namely, schizophrenia patients experience deficient levels of pleasure during the *anticipation* of a pleasurable stimulus or event, yet experience conventional levels of pleasure "in the moment" or during *consummation* of a pleasurable stimulus or event (Kring, 1999). Together, anticipatory and consummatory pleasure can be considered to reflect complementary mechanisms of hedonic functioning, which helps individuals develop and pursue goals that serve important primary (e.g., sustenance, reproduction) and secondary (e.g., social, occupational) hedonic functions (Bradley, Codispoti, Cuthbert, & Lang,

2001; Gard, Gard, Kring, & John, 2006). These components of hedonic functioning are particularly relevant to schizophrenia, as the presence of anhedonia in schizophrenia patients is related to a more severe course of the disorder and integrally linked with difficulties in social and role functioning (Herbener, Harrow, & Hill, 2005; Niendam, Jalbrzikowski, & Bearden, 2009). Indeed, understanding the nature of hedonic functioning throughout the initial prodromal stages of schizophrenia may improve current understanding of risk factors associated with the development of the disorder, and provide insight for developing early intervention and treatment strategies.

Clinical Investigations of Hedonic Experience in Schizophrenia

Various studies have suggested that patients diagnosed with schizophrenia are engaged in fewer enjoyable activities relative to non-patient controls, and that individuals diagnosed with schizophrenia typically report experiencing lower levels of pleasure based on self-report and clinical interview measures (Horan, Green, Kring, & Neuchterlein, 2006; Horan, Kring, & Blanchard, 2006). Likewise, Horan and colleagues (2008) recently conducted an extensive review of trait measures of affect in schizophrenia, and concluded that individuals diagnosed with schizophrenia experience stable, low positive affect. For the purpose of their review, Horan et al. (2008) identified positive affect as an individual's willingness to engage the environment, which reflects an overall temperament of approaching life events actively, enthusiastically, and with confidence. In contrast, low positive affect was defined as the tendency to isolate, be reserved and/or aloof, display lower energy, and lack confidence (Horan et al., 2008). For individuals with schizophrenia, these trait-like dispositions to isolate, be reserved, and so on, have been shown to be present at first-onset and chronic stages of the disorder, and are

associated with functional outcomes of schizophrenia (e.g., occupational, intellectual, quality of life; Horan et al., 2008). As described by Horan et al. (2008), the tendency to isolate, be aloof, and display low energy associated with low positive affect are conceptually similar to tendencies associated with diminished anticipatory pleasure such as withdrawal, asociality and amotivation. Thus, deficits in hedonic functioning (e.g., anticipatory pleasure deficits) may reflect pervasive trait-like dispositions that are not only present at onset and chronic stages of psychosis, but also present before the initial onset of schizophrenia. Moreover, examining relatively stable and enduring hedonic deficits (in relation to temporary affective states) may provide more insight into fundamental mechanisms of psychosis.

Also consistent with these results, studies incorporating experience sampling methods have found that patients diagnosed with schizophrenia reported less experiential pleasure throughout the course of 1 week compared to non-patient controls and unaffected family members (Myin-Germeys, Delespaul, & deVries, 2006; Myin-Germeys, van Os, Schwartz, Stone, & Delespaul, 2001). These findings corroborate self-report and clinical interview data indicating that individuals diagnosed with schizophrenia tend to experience less pleasure compared to non-patient controls (Horan, Green et al., 2006, Horan, Kring et al., 2006; Horan et al., 2008).

Experimental Studies of Hedonic Functioning in Schizophrenia

Experimental studies have provided further insight into the nature of hedonic functioning in schizophrenia. A large number of studies have found that schizophrenia patients experience comparable levels of pleasure to controls when directly engaged with a range of pleasurable stimuli (e.g., films, slides, odors, written words; Cohen & Minor,

2010). A recent meta-analysis conducted by Cohen and Minor (2010) concluded that utilizing data from 26 studies, schizophrenia patients endorsed similar levels of hedonic experience relative to controls in response to emotionally evocative stimuli. These findings are particularly critical given that they contradict clinical reports described above suggesting that individuals diagnosed with schizophrenia experience low levels of pleasure compared to controls (Horan, Green et al., 2006, Horan, Kring et al., 2006). It also deserves mention that diminished pleasure has been observed in experimental studies among individuals with schizophrenia (e.g., Crespo-Facorro et al., 2001; Curtis, Lebow, Lake, Katsanis, & Iacono, 1999), which could be attributed to small sample sizes (e.g., Crespo-Facorro et al., 2001) or individual differences in voluntary/subjective responding (Curtis et al., 1999). Nonetheless, these studies have been the exception to the general pattern of findings, and the bulk of findings in this area suggest that individuals with schizophrenia experience comparable levels of pleasure when directly engaged with pleasurable stimuli (Cohen et al., 2010).

Differentiating Anticipatory and Consummatory Pleasure

Kring (1999) was among the first theorists to suggest the utility of considering anticipatory and consummatory pleasure in schizophrenia, which was based on the initial distinction noted by Klein (1984) in reference to depression. Emerging neurobehavioral evidence has provided additional support for distinct pathophysiological mechanisms of "wanting" and "liking" (Berridge & Robinson, 1998; 2003) that are similar to the constructs of anticipatory and consummatory pleasure, respectively (Berridge et al., 1998; Gard et al., 2006). For instance, taste reactivity experiments in rats in which dopamine transmission is depleted (e.g., using a dopamine-selective neurotoxin) appears

to alter approach-related, or wanting, behavior, while not altering the ability of rats to make hedonic evaluations, or "liking" of stimuli (i.e., tongue protrusions; see Berridge et al., 1998 for review). In contrast, key neurotransmitters involved in serotonergic and opioid systems appear to impact liking responses but not wanting responses (Berridge et al., 1998; 2003; Burgdorf and Panksepp, 2006; Treadway et al., 2011). Taken together, current evidence suggests specific neural pathways may contribute to different components of hedonic functioning (Berridge et al., 1998; Treadway et al., 2011).

Recently, anticipatory and consummatory pleasure have been specifically targeted in a line of research by Gard, Kring, Gard, Horan, and Green (2007). As theorized by Gard and colleagues (2007), hedonic deficits (i.e., anticipatory pleasure deficits) in schizophrenia patients are believed to reflect underlying disturbances in dopaminergic pathways that have been repeatedly associated with schizophrenia (Abi-Dargham, 2004; Gard et al., 2007; Toda & Abi-Dargham, 2007). Thus, Gard et al. sought to validate the Temporal Experience of Pleasure Scale (TEPS), a measure designed to measure stable and enduring trait-like dispositions to experience anticipatory and consummatory pleasure. First, Gard and colleagues (2007) examined daily reports of anticipatory and consummatory pleasure using the TEPS, and the ability of participants to predict future pleasure, over the course of one week using experience sampling methodology. Second, Gard and colleagues (2007) examined the correlates of anticipatory and consummatory pleasure in schizophrenia patients, with measures of anhedonia, approach motivation, and functional outcomes. Results from these investigations (Gard et al., 2007), and a subsequent investigation by Wynn et al. (2010), suggest that schizophrenia patients reported comparable consummatory pleasure relative to control participants in their daily

lives, but experienced less anticipatory pleasure compared to healthy control participants. Although there have been two noted failures to replicate these findings (Cassidy, Lepage, Harvey, & Malla, 2012; Strauss et al., 2011), a number of examinations using the TEPS have supported the notion that individuals with schizophrenia experience diminished anticipatory, but not consummatory, pleasure. Moreover, it should be noted that a subset of patients in the Cassidy et al. (2012) sample displayed deficits in anticipatory pleasure, which characterized a group of patients that continued their use of cannabis following the initial onset of psychosis. Taken together, the extant findings support the possibility that hedonic experience in schizophrenia is intact while directly engaging emotionally evocative stimuli. Nevertheless, findings involving the TEPS differ from overall reports of emotional experience and clinical interviews examining hedonic functioning in schizophrenia, likely because these studies differentiate the components of anticipatory and consummatory pleasure.

Hedonic Deficits in the Schizophrenia Prodrome

Although emerging evidence suggests that individuals diagnosed with schizophrenia display anticipatory pleasure deficits, it is unclear when these affective impairments first appear. Evidence suggests there is a distinct period (1-5 years) prior to the onset of schizophrenia referred to as the prodrome where symptoms begin to emerge, but do not reach full disorder criteria (Meyer et al., 2005; Yung & McGorry, 1996). As described by Cornblatt and colleagues (2003), exclusive to the initial prodromal phase are symptoms such as decline in cognitive performance, reduced motivation and drive, depressed mood, anxiety, and social withdrawal. Indeed, depression has been implicated as the earliest prodromal symptom preceding the onset of psychosis (Häfner et al., 1999;

Häfner, 2006). In turn, within approximately a year preceding schizophrenia onset, the development of positive symptoms begin and intensify within several months immediately preceding the onset of schizophrenia (Cornblatt et al., 2003; Meyer et al., 2005). Considering the typical progression of the schizophrenia prodrome, it is plausible that deficits in anticipatory pleasure may be observed during the initial phase of the prodrome, which could explain symptoms such as reduced motivation and drive, and social withdrawal. In line with this prediction are prospective longitudinal data suggesting that negative symptoms of schizophrenia predict the eventual conversion to a psychotic disorder in a general population study of a large German cohort (N = 3,021) of adolescents and young adults (Dominguez, Saka, Lieb, Wittchen, & van Os, 2010). Furthermore, various prospective studies of large samples of undergraduate students have reported that social anhedonia (i.e., the ability to derive pleasure from people, talking, exchanging expressions) predicts the development of psychotic symptoms and eventual onset of schizophrenia. For instance, in a general population study among undergraduate students, Kwapil (1998) reported that a greater proportion of students with elevations in social anhedonia at an initial timepoint later developed psychosis at a 10-year follow-up evaluation relative to controls without initial elevated social anhedonia. In a similar general population study, Gooding and colleagues (2005) found that initial increases in social anhedonia among undergraduate students predicted the development of psychosis at a 5-year follow-up (i.e., odds ratio = 4.518; Gooding, Tallent, & Matts, 2005). These examinations provide some additional evidence that negative symptoms precede psychosis. However, no study has determined whether anticipatory pleasure deficits emerge prior to the onset of psychosis or whether these deficits are only displayed once

clinical psychosis has developed. Thus, understanding the course of when hedonic deficits emerge in relation to psychotic symptoms may help shed light as to whether affective impairments are part of the developmental course of the disorder, or result as a secondary consequence of the disorder (e.g., mistrust of others, medication side effects).

Psychosis in the General Population

Accumulating evidence suggests that symptoms associated with schizophrenia likely exist on a dimension, within the categories of positive, negative, and disorganized symptoms (McGlashan et al., 1992). This view has been supported by data suggesting that minor psychotic experiences occur frequently in the general population and are related to a number of risk factors for schizophrenia (Kendler et al., 1996; Loewy et al., 2007; Poulton et al., 2000; van Os, Linscott, Myin-Germeys, Delespaul, & Kraddenbaum, 2008). For instance, risk factors such as lower IQ, lower education levels, cannabis or alcohol dependence, stressful life events, and victimization confer risk for individuals with a psychotic disorder and lead to increases in minor psychotic symptoms in the general population (Johns et al., 2001; Johns et al., 2004; Verdoux & van Os, 2002). Furthermore, van Os et al. (2009) conducted a meta-analysis of 35 cohorts and found that exposure to cannabis, alcohol or other psychoactive substances, traumatic experiences, and urbanicity were all risk factors for subclinical and clinical psychosis. Additionally, a comprehensive review by Kelleher et al. (2011), suggests that in addition to those factors identified by van Os and colleagues (2009), various additional social (e.g., migration, ethnic minority status) and obstetric/developmental deficits (e.g., maternal infection, neuromotor deficits) are risk factors for non-clinical and clinical psychotic symptoms. Furthermore, minor psychotic-like symptoms also have been found to be more prevalent

in relatives of individuals with schizophrenia (Kendler et al. 1996). In addition, many phenomenological similarities have been noted among individuals displaying minor psychotic-like experiences and those displaying full-blown psychotic symptoms (i.e., convictional delusions/hallucinations with associated functional impairment; Johns & van Os, 2001; van Os et al., 1999), which has led to the belief that psychosis occurs on a continuum (e.g., Esterberg & Compton, 2009; van Os, Hanssen, Bijl, & Ravelli, 2000, Verdoux & van Os, 2002).

This research has provided the basis for suggesting that the same mechanisms responsible for the pathogenesis of subthreshold psychotic symptoms are also responsible for psychotic symptoms in schizophrenia. The conceptual approach of a psychosis continuum highlights the importance of examining psychosis in both clinical and non-clinical populations to better understand the underlying mechanisms for psychosis. Thus, examining variation of potential risk factors in the general population (i.e., non-clinical samples) can provide crucial insight into the development of schizophrenia. Although anticipatory and consummatory pleasure have not been studied in the general population in relation to subthreshold psychotic symptoms, some limited evidence is available for the presence of anhedonia in the general population. Consistent with early considerations of this construct being normally distributed in nonclinical populations (e.g., Meehl, 1975; Meyerson, 1923), anhedonia appears generally in nonclinical populations (e.g., Chapman, Chapman, & Raulin, 1976) as well as schizophrenia populations (Collins, Blanchard, & Biondo, 2005; Dubal & Jouvent, 2004; Gooding et al., 2005). Furthermore, various studies have observed that first-degree relatives of individuals with schizophrenia also endorsed heightened levels of anhedonia (e.g., Kendler et al., 1996; Franke et al., 1994)

although these results have not been found consistently across studies (e.g., Kuha et al., 2011). Recent research in a general population study also has suggested a relation between increased social anhedonia and greater frequency of psychotic-like experiences (Blanchard et al., 2011; Collins et al., 2005). However, despite the considerable research in this area, there is a critical lack of clarity regarding the nature of hedonic deficits in relation to dimensional approaches to psychosis (Horan, Kring et al., 2006). As suggested by Horan, Kring et al. (2006), many commonly used measures of anhedonia do not reflect current evidence of distinct aspects of anticipatory and consummatory pleasure. Thus, given that specific components of hedonic functioning have not been studied in relation to the continuum of psychotic experiences, this is an important area of inquiry.

Study Aims

The purpose of the current study is to examine hedonic functioning in relation to the continuum of psychotic symptoms in a college undergraduate student sample and in those at clinical risk for schizophrenia. By aiming to provide clarity to the relation of hedonic functioning and risk for schizophrenia, it is the hope of this research to be able to potentially inform the development of improved assessments and targeted early intervention strategies incorporating these components of hedonic functioning (i.e., anticipatory and consummatory pleasure).

Aim #1.

The first aim of the present study was based on the notion that negative symptoms predict the development of positive symptoms and eventual onset of schizophrenia. Whereas the relation of negative symptoms and positive symptoms has been documented elsewhere (e.g., Dominguez et al., 2010), relatively little research has investigated the

relation of anticipatory and consummatory pleasure with positive symptoms. Two investigations using the TEPS found a relation between anticipatory pleasure and the presence of positive symptoms (Chan et al., 2010; Strauss et al., 2011), where greater anticipatory pleasure deficits were associated with greater positive symptom severity. Importantly, positive symptom severity was not correlated with consummatory pleasure in the same study (Strauss et al., 2011), although positive symptom severity was associated with consummatory pleasure in the other (Chan et al., 2010). It is important to note that both of these samples consisted of schizophrenia patients, and these relations were only examined among individuals diagnosed with schizophrenia and not among control participants. Thus, the current study aims to examine the relation between hedonic deficits and the continuum of positive symptoms by utilizing a college student sample with no pre-selection criteria. Moreover, to provide a more detailed analysis of the relation with hedonic deficits, the frequency of positive symptoms, and the frequency of distressing positive symptoms will be examined.

Aim #2.

Another aim of this proposed study was to better understand whether hedonic deficits predict clinical high-risk status. This could provide initial evidence for a relation between anticipatory pleasure deficits prior to the onset of full-blown psychosis in those at clinical high risk. Thus, preliminary analyses sought to examine whether greater deficits in aspects of hedonic functioning (i.e., anticipatory pleasure) confer greater risk for being at clinical high risk for psychosis.

Study Hypotheses

H1: Greater deficits in anticipatory pleasure, but not consummatory pleasure, will be significantly related to positive symptoms in the current sample. Specifically, it was hypothesized that greater deficits in the TEPS-ANT subscale (i.e., reflected by lower TEPS-ANT scores) would be significantly associated with increases in the prevalence of positive symptoms endorsed on the Prodromal Questionnaire (i.e., PQ-POS scale). Moreover, greater deficits observed in the TEPS-ANT subscale would be significantly associated with increases in the prevalence of positive distressing symptoms (i.e., PQ-POS Distress). No relation was expected for the TEPS-CON subscale and both positive symptoms endorsed and positive distressing symptoms.

H2: Greater deficits in anticipatory pleasure, but not consummatory pleasure, will significantly increase the odds of being at clinical high risk for schizophrenia. Specifically, it was hypothesized that greater deficits indexed by the TEPS-ANT subscale (i.e., reflected by lower TEPS-ANT scores) would significantly predict high clinical risk status. In contrast, the TEPS-CON subscale was not predicted to significantly predict clinical risk status.

CHAPTER 2

METHOD

Participants

Participants were 679 undergraduate college students from Temple University. For inclusion in the study, participants needed to be at least 17 years of age. No other exclusionary criteria or pre-selection criteria were incorporated in the recruitment phase of this study. However, to access the online recruitment system, participants needed to be enrolled in at least one psychology course offering course research credits to be eligible for the study. Five participants were removed from the present study due to being greater than 3 standard deviations above the mean for age (i.e., greater than 38 years old; age range 38-53 years), as well as being substantially past the age of onset for schizophrenia (age range 17-35 years; APA, 2000). Furthermore, data on the TEPS (the main independent variable) were unavailable for one participant in the study. Thus, final *n*'s in the current sample are: TEPS; $n = 673$, all other measures; *n*'s = 674.

Measures

A series of self-report questionnaires were administered in a research room located within Weiss Hall at Temple University. Descriptions of the measures utilized in this study are provided below.

Subthreshold Psychotic Symptoms. The Prodromal Questionnaire (PQ; Loewy, Bearden, Johnson, Raine, & Cannon, 2005) is a 92-item self-report measure that was used to assess the presence of subthreshold psychotic symptoms within the past month. Symptoms included in this measure are categorized as comprising 1 of 4 major symptom domains: positive, negative, disorganized, and general/affective. Symptom domain scores

are calculated by summing the respective items for each of the 4 scales: positive symptoms, 45 items; negative symptoms, 19 items; disorganized symptoms, 13 items; general/affective, 14 items. The assessment of each symptom included in this measure consists of 2 parts. First, the frequency of the symptom is determined by providing 5 response options organized along a frequency scale (i.e., "0 times," "1-2 times," "Once/week," "Few times/week," "Daily"). Second, for any symptom occurring at a frequency greater than "0 times," participants are instructed to indicate if that experience was distressing to them (i.e., "No" or "Yes").

The PQ previously has been suggested as a potential screening tool for identifying individuals at increased risk for developing psychosis (Loewy et al., 2007). During the initial validation of the measure, Loewy and colleagues (Loewy et al., 2005) administered the PQ to a treatment-seeking sample of adolescents and young adults. The Structured Interview of Prodromal States (SIPS; Miller et al., 1999) was also administered, which is an interview displaying high inter-rater reliability and positive predictive value for conversion to schizophrenia in treatment seeking individuals (Miller et al., 2003). Results from this initial investigation suggested that a cutoff score of 8 distressing positive symptoms provided the greatest sensitivity (i.e., 90%) to identify true positive cases of prodromal or psychotic SIPS diagnosis, and specificity (i.e., 49%) to identify true negative cases (Loewy et al., 2005). Thus, for use in non-treatment-seeking populations, a cutoff score of 8 would be most appropriate for general population screening (Loewy et al., 2005).

Further work by Loewy et al. (2007) examined the frequencies of prodromal symptoms in an undergraduate university sample. Findings from this study are consistent

with prior research (Hanssen, Peeters, Krabbendam, Radstake, Verdoux, & van Os, 2003) suggesting the proportion of individuals endorsing some type of unusual or psychotic experience is relatively higher than those meeting a diagnosis for psychotic disorder. Specifically, in the follow-up study by Loewy and colleagues (2007), results indicated that 43% of individuals in their study endorsed experiencing 8 or more positive symptoms within the past month. However, when considering whether 8 or more positive symptoms were experienced as *distressing,* the proportion of the sample decreased to roughly 2% of the sample (Loewy et al., 2007). This figure is consistent with the relative base rate of individuals meeting clinical diagnosis for a psychotic disorder in the general population. Thus, the authors suggest that the PQ can provide an effective screening tool that incorporates valuable constructs of frequency and distress, and shows strong concurrent validity with the SIPS (Loewy, Bearden et al., 2005; Loewy, Johnson et al., 2007). Moreover, the PQ shows particularly high internal consistency for the positive and negative scales (Cronbach's alpha = .92 and .88, respectively), which are the scales that were used in the present study (Loewy et al., 2005). Consistent with the results originally reported by Loewy et al. (2005), the PQ in the present study also possessed high internal consistency for the positive and negative scales (Cronbach's alpha = .92 and .92, respectively).

In the current study, based on the scoring criteria of the SIPS, 2 subscale scores were calculated for the positive symptom domain of the PQ that were the main dependent variables of interest. First, a *PQ-POS Score* was calculated as the number of positive symptoms endorsed to have occurred at least once in the past month. Second, a *PQ-POS Distress Score* was calculated as the number of positive symptoms endorsed to have

caused distress during the past month. Third, the PQ-POS Distress Score was utilized to determine high-risk status, with high-risk status indicating the endorsement of 8 or more positive symptoms that the participant deemed as distressing (Loewy et al., 2005). To obtain a purer group of individuals with low risk status for comparison purposes, low-risk status was determined as any participant endorsing fewer distressing positive symptoms than the overall mean of the sample. Lastly, for descriptive purposes, a score for negative symptoms was calculated as the number of negative symptoms to have occurred at least once in the past month.

Anticipatory and Consummatory Pleasure. The Temporal Experience of Pleasure Scale (TEPS; Gard et al., 2007) is an 18-item self-report measure that consists of separate subscales of anticipatory (TEPS-ANT) and consummatory (TEPS-CON) pleasure. This measure aims to assess trait-like dispositions for pleasure by asking participants to consider how true each statement is for them in general. Individual items on the TEPS are scored on a Likert-type scale with response options ranging from 1 (very true for me) to 6 (very false for me). An overall TEPS score (TEPS-Total) can be calculated by summing the values of each item of the measure, and individual subscale scores can be calculated by summing the 10 unique items comprising the anticipatory subscale and the 8 unique items comprising the consummatory pleasure subscale. Of the 18 items included in the measure, one item is designed to be reverse scored prior to the final summing of items.

The original validation of the TEPS was undertaken by examining 4 undergraduate student samples (Gard et al., 2006). The separate subscales of anticipatory and consummatory pleasure showed good internal consistency, Cronbach's alphas of 0.74

and 0.71, respectively, and for the total scale, Cronbach's alpha of 0.79 (Gard et al., 2006). Likewise, further investigations have reported good internal consistency of the total scale, Cronbach's alphas > .80 (Favrod et al., 2009; Strauss et al., 2011), the anticipatory pleasure subscale, Cronbach's alphas > 0.70 (Favrod et al., 2009; Loas et al., 2009; Strauss et al., 2011), and the consummatory pleasure subscale, Cronbach's alphas > 0.70 (Favrod et al., 2009; Strauss et al., 2011). Consistent with these results, the anticipatory and consummatory pleasure scales also showed good internal consistency in the present study (Cronbach's alphas = .74 and .75, respectively).

The TEPS also has displayed high test-retest reliability for the TEPS-Total (r = 0.81), TEPS-ANT (r = 0.80), and TEPS-CON (r = 0.75) over a relatively short period of time (e.g., 5-7 weeks, mean = 6.32 weeks; Gard et al., 2006). Gard et al. (2006) originally collected a sample of 1035 undergraduate students (roughly 35% men), and later retested a subset of approximately 15% of the sample (n = 153; roughly 40% men). An additional examination of the test-retest reliability was undertaken by Strauss et al. (2011), who examined a subset of schizophrenia patients. Although the Strauss et al. (2011) study originally incorporated a sample of 86 patients with schizophrenia, only a limited number of these individuals were later retested (n = 19), and the range of re-administration was highly variable (e.g., range of 39-121 weeks, mean = 88 weeks). In contrast to the results found by Gard et al. (2006), Strauss et al. (2011) reported intraclass correlation coefficients (ICCs) that were moderate for the TEPS-ANT (ICC = 0.74) and high for the TEPS-CON (ICC = 0.91). These results suggest that the temporal stability of the TEPS-CON subscale may be more sensitive to individual differences than the TEPS-ANT subscale (Strauss et al., 2011). However, these findings are based on a relatively small

sample of patients with schizophrenia with a rather large retest sampling window (i.e., range of 39 to 121 weeks, or approximately 0.81 to 2.5 years; Strauss et al., 2011) relative to the sampling window reported by Gard et al. (2006; range of 5-7 weeks). Thus, the current evidence suggests a moderate to high level of test-retest reliability for the TEPS total score and subscales.

Various investigations also have aimed at establishing the construct validity of the TEPS. The initial validation study by Gard et al. (2006) found that both the TEPS-ANT and TEPS-CON subscales were negatively correlated with the revised Physical Anhedonia Scale (PAS; Chapman et al., 1976), which was later replicated by Gard and colleagues (2007). Another study replicated this finding using the anhedonia scale of the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1982), which was maintained, even after controlling for depression severity (Favrod et al., 2009). Furthermore, the TEPS scales were found to negatively correlate with the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and positively correlate with the Fawcett-Clark Pleasure Scale (Fawcett, Clark, Scheftner, & Gibbons, 1983). Furthermore, the TEPS scales showed a positive association with the positive affect general scale (i.e., not the current affect scale) of the Positive and Negative Affective Scales (PANAS; Watson, Clark, & Tellegen, 1988), although the TEPS-ANT only approached significance whereas the TEPS-CON scale was significantly associated (Gard et al., 2006). With regard to discriminant validity, the TEPS-ANT subscale has been found to be correlated with measures of appetitive motivation, such as the Reward Responsiveness subscale of the Behavioral Inhibition System and Behavioral Activation System Scales (BIS/BAS; Carver & White, 1994), significantly more so compared to the

TEPS-CON (Gard et al., 2006). This finding was also replicated by Gard et al. (2007), who found the TEPS-ANT subscale significantly related to the Drive and Reward Responsiveness subscales of the BIS/BAS, whereas the TEPS-CON was not significantly correlated with these measures. Overall, these findings suggest that the TEPS subscales are inversely associated with measures of anhedonia and depression, and positively associated with scales of positive affect/pleasure. Furthermore, preliminary findings support the notion that the TEPS-ANT is more closely related to appetitive motivation relative to the TEPS-CON (Gard et al., 2007).

The TEPS-ANT subscale, and not the TEPS-CON, also has been found to be related to constructs such as social anhedonia and social role functioning (Gard et al., 2006). In line with this finding, Strauss et al. (2011) found the TEPS-ANT to inversely relate to social anhedonia, whereas the TEPS-CON was unrelated. These results have led to the speculation that the TEPS-ANT and TEPS-CON subscales may differ in the number of items involving social affective experiences (e.g., Strauss et al., 2011). However, upon careful consideration of TEPS items, the majority of items involve physical or sensory affective experiences (e.g., "When something exciting is coming up in my life, I really look forward to it" and "The sound of crackling wood in the fireplace is very relaxing"). In fact, the only item that directly involves the explicit encounter and interaction with another individual is included in the TEPS-CON subscale (e.g., "I love it when people play with my hair"). An alternative explanation is that deficits in social functioning are more closely related to decreased motivation to interact with and bond with others (i.e., anticipatory pleasure) rather than the inability to enjoy social

interactions (i.e., consummatory pleasure), which can explain the stronger relation of TEPS-ANT with measures of social anhedonia (Gard et al., 2006; Strauss et al., 2011).

In line with the scope of the current study, it also was important to understand the relation between TEPS subscales and psychotic symptoms. To date, studies have reported on the relations of these measures. First, in a sample of 55 patients with schizophrenia, Chan et al. (2010) reported that both the TEPS-ANT and TEPS-CON were negatively correlated with the positive and negative symptom profile of the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987). However, Chan et al. (2010) found no significant differences in the relative strength of relation between the TEPS subscales and symptom profiles. Second, in a sample of 86 patients with schizophrenia, Strauss et al. (2011) reported the TEPS-ANT subscale, and not the TEPS-CON, was robustly negatively associated ($p < 0.001$) with the severity of positive symptoms assessed using the Brief Psychotic Rating Scale (BPRS; Overall & Gorham, 1988). These findings extend the current knowledge to suggest that specific hedonic deficits, not just negative symptoms, show a relation with positive symptoms of schizophrenia. As such, the TEPS was utilized in the present study to yield separate scores for anticipatory pleasure and consummatory pleasure.

Depression. For the purpose of this study, an adapted version of the Center for Epidemiological Studies – Depression Scale (CES-D; Radloff, 1977) was used. The original version of this questionnaire included 20 items with 4 response options to assess the presence and severity of depressive symptoms during the past week. The modified version (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993) includes 10 items with 4 response options. Items are scored on a 4-point Likert scale with response options

including: 0 (rarely or none of the time), 1 (some or a little of the time), 2 (occasionally or a moderate amount of time), and 3 (all of the time). Of the items included in this measure, 2 items are designed to be reverse scored prior to analysis of this measure. Once scored, this measure can be summed to yield an overall depression score. This measure has been shown to possess high internal consistency, with a Cronbach's alpha of .81 (Kohout et al., 1993). Likewise, the internal consistency of the CES-D in the current study was also high, with a Cronbach's alpha of .81.

Detailed Demographic Questionnaire. A modified version of the Cross Racial Identity Scale (CRIS; Vandiver, Cross, Worrell, & Fhagen-Smith, 2002) was created by Drs. Ellman and Anglin (City University of New York) to examine demographic variables of interest. Specifically, this form was utilized to examine specific characteristics of age, gender, and racial/ethnic background as potential covariates in analyses.

Procedures

Participants were recruited from an online system (SONA) in which information is provided regarding how to schedule an appointment for participating in this study. Upon arrival to the study, the research study was described and informed consent was obtained. After obtaining consent, participants then completed the questionnaires identified above at a computer workstation. Finally, participants were compensated with research course credit to be utilized in psychology courses they were currently enrolled in. This study was approved by the Temple University Institutional Review Board.

Power Analysis

The current study incorporated TEPS data from 673 participants, which is a sample size greater than the original proposed total of 600 participants. Based on a prior investigation using the TEPS, the anticipatory and consummatory subscales were correlated with positive psychotic symptoms in a patient sample (ρ'*s*= -0.39 and -0.18, respectively; Strauss et al., 2011). To ensure significant power to examine relations for both of these constructs, the smaller correlation of ρ = -0.18 was utilized to calculate a more conservative estimate of the required sample size. For significant power at the level of .80 or greater, a sample of 189 would be required. Thus, a sample of 673 participants should yield sufficient power to examine differences among aspects of hedonic functioning (i.e., anticipatory and consummatory pleasure) and positive symptoms.

Second, preliminary analyses were conducted to determine whether hedonic capacity was related to increased likelihood of clinical risk status for psychosis in this cohort. Based on preliminary base rate findings, it was expected that approximately 12 per 200 participants (i.e., 6%) would meet clinical risk status, and it was expected that approximately 36 out of 600 would meet clinical risk status. However, data from the current sample identified 88 individuals (13.1%) as meeting clinical high risk for psychosis in the study. In contrast, 466 individuals (69.1%) were classified as low risk for psychosis in the study. Using the overall mean number of distressing positive symptoms endorsed in the sample (M = 3.26), the low-risk group was considered to include individuals endorsing 3 or fewer distressing positive symptoms. Consistent with prior use of the PQ measure, the high-risk group was considered to include individuals endorsing 8 or more distressing positive items (Loewy et al., 2005, 2007). All other participants (i.e., those endorsing 4 to 7 distressing positive symptoms) were excluded from subsequent

analyses examining clinical risk status. Given the low base rates of schizophrenia in the population and the necessity for very large samples to study these populations, examining individuals at clinical risk was viewed as preliminary, but was compared to analyses using the PQ scales on a continuum in order to determine whether hedonic capacity abnormalities are specific to those at risk for schizophrenia.

Data Analysis Plan

Statistical analyses were carried out using SPSS version 18.0 (SPSS Inc., Chicago, IL). For all analyses, an alpha value of $p < .05$ was selected as the threshold for determining statistical significance. As an initial step, descriptive statistics were calculated to examine demographic variables of age, race/ethnicity, and gender, and depression severity and PQ scores (positive and negative symptoms) for the sample. For each of the continuous variables (i.e., age, depression, and PQ scales), the mean, standard deviation and range of scores were calculated. For categorical variables (i.e., gender, race/ethnicity), the number of individuals falling within each category along with the corresponding percentage of the overall sample was computed. Additionally, this same set of descriptive statistics was also calculated as a function of clinical risk status, and computed separately for the Low-Risk and High-Risk groups. To examine differences in the Low-Risk and High-Risk groups, one-way ANOVAs were conducted for age, depression, the PQ positive symptom scales, the negative symptom scale, and the TEPS scales. Furthermore, a chi-square test was conducted to examine whether these groups differed on gender.

Next, tests of normality (i.e., skewness and kurtosis) were conducted for age, the TEPS scales, and the PQ scales. For any of these variables that were non-normally

distributed, they were subsequently log-transformed and these transformed variables were utilized in further analyses. Given that the TEPS and PQ scales could have a value of zero, a constant value of 1 was first added to all values before applying the log transformation for a given variable. The variables of age and gender also were subsequently examined as possible covariates. Age was examined by conducting bivariate correlation analyses with the main independent (i.e., TEPS) and dependent variables (i.e., the PQ scales). Bivariate correlations were also conducted between the TEPS scales, PQ scales, negative symptom scale, and depression for the overall sample. Gender was examined as a covariate by conducting ANOVAs with gender as the independent variable and the TEPS scales and PQ scales as dependent variables. Additionally, for descriptive purposes, an ANCOVA was conducted with clinical risk status as the independent variable, each of the TEPS scales as dependent variables, and gender entered as a covariate. The results of this ANCOVA provided means and estimated marginal means for the TEPS scales.

Additional analyses also were conducted for descriptive purposes. First, a quartile split was created for the number of negative symptoms endorsed by participants in order to determine whether those at clinical risk for psychosis, also had elevations in negative symptoms (Table 3 lists the mean number of negative symptoms endorsed and standard deviations for each quartile). Individuals were classified as having high negative symptoms if in the fourth quartile and low negative symptoms if in the first quartile. Second, also for descriptive purposes to determine if experiences were more likely to be rated as distressing if they also occurred more frequently (Loewy et al., 2007), the distressing positive symptoms occurring at the greatest frequency was determined for

each participant. For each of the PQ response options (i.e., none, 1 or 2 times in past month, weekly, and so on), percentages of the overall sample were calculated to determine the proportion of participants endorsing at least one distressing positive symptom for each level of frequency.

Next, multiple regression models were conducted with TEPS-ANT and TEPS-CON subscale scores entered simultaneously as independent variables, and PQ-POS and PQ-POS Distress as separate dependent variables. The TEPS scales were tested together (in addition to the bivariate correlations of the TEPS with PQ scales mentioned above) based on hypotheses of the present study that anticipatory and consummatory reflect conceptually distinct components of hedonic experience. By entering the TEPS scales simultaneously, these analyses provided more insight into the unique variance associated with each component of hedonic functioning. Furthermore, as detailed in the results section below, gender (and not age) was identified as a covariate for models including PQ-POS Distress. Thus, an adjusted model was tested for the PQ-POS Distress score with gender entered as a covariate in the model. Thus, 3 multiple regression analyses were conducted (i.e., unadjusted testing PQ-POS, unadjusted testing PQ-POS Distress, and adjusted for gender testing PQ-POS Distress). Furthermore, a post hoc analysis also was conducted to explore the relation of the TEPS with PQ-POS Distress while stratifying for gender, which involved an additional multiple regression with gender as the grouping variable. Specifically, while stratifying for gender, the TEPS scales were entered simultaneously as independent variables with PQ-POS Distress as the dependent variable.

In turn, logistic regression analyses were conducted in order to determine whether low anticipatory or consummatory pleasure increases the odds of being at clinically high risk for psychosis. Two logistic regression analyses were conducted. First, anticipatory and consummatory were entered simultaneously as independent variables, with clinical high-risk status constituting the dependent variable. The model specified above was considered unadjusted as there were no covariates entered into the model. Next, an adjusted model was tested with gender entered as a covariate. Like the unadjusted model, anticipatory and consummatory pleasure were entered simultaneously as independent variables, and clinical high-risk status was the dependent variable. In addition, a post hoc analysis also was conducted to explore the relation of the TEPS with PQ-POS Distress while stratifying for gender. Thus, 2 additional logistic regressions were conducted stratifying by gender, while the TEPS scales were entered simultaneously as independent variables with PQ-POS Distress as the dependent variable.

CHAPTER 3

RESULTS

Demographic characteristics of the sample are presented in Table 1. The majority of participants were female, and although the sample was racially diverse, the most highly represented racial group was Caucasian (non-Hispanic). Demographic characteristics of the sample were representative of the undergraduate population at Temple University. Furthermore, these same descriptive statistics are also listed separately for the Low-Risk and High-Risk groups in Table 2, with negligible differences in demographic characteristics between the Low- and High-Risk groups. Specifically, Low- and High-Risk groups did not differ in age ($p = .993$) nor did they differ in the breakdown of gender ($p = .139$). However, with regard to the PQ scales, significantly greater values were observed among the High-Risk group with regard to PQ-POS ($p < .0001$), PQ-POS Distress ($p < .0001$), and the negative symptom scale ($p < .0001$). Likewise, the High-Risk group also displayed greater depression scores relative to the Low-Risk group ($p < .0001$). In turn, Table 4 presents the greatest frequency of at least one distressing positive symptom endorsed across the overall sample. A somewhat different pattern emerged from a prior investigation in an undergraduate sample by Loewy et al. (2007), which found that the PQ positive scales were more likely to be distressing if they occurred more frequently (e.g., daily relative to 1 or 2 times in past month). In contrast, the present results show the largest proportion of individuals experiencing at least one distressing symptom (with the greatest frequency) as occurring 1 or 2 times in the past month relative to greater frequency levels (e.g., weekly, daily).

Tests of normality revealed that variables of age (skewness = 2.317, kurtosis = 8.452), PQ-POS (skewness = 1.304, kurtosis = 1.416), and PQ-POS Distress (skewness = 2.209, kurtosis = 5.690) were all non-normally distributed. Figure 1 provides a histogram of the age distribution for the study, which shows age is positively skewed in the sample. Histograms are also presented in Figure 2 to illustrate the distribution of PQ-POS and PQ-POS Distress in the overall sample, of which both PQ scales are positively skewed. The negative symptom scale did not show non-normal distribution in the current sample (skewness = .608, kurtosis = -.647). Neither the TEPS-ANT (skewness = -.653, kurtosis = .835) nor the TEPS-CON scales displayed non-normal distribution (skewness = -.708, kurtosis = .535), and were consequently not transformed. Likewise, depression did not display non-normal distribution (skewness = .986, kurtosis = .839) and was not transformed.

Next, as illustrated in Table 5, age was not significantly correlated with the independent or dependent variables included in the study. Thus, age was not utilized as a covariate in further analyses. Additional bivariate correlations of the continuous variables in the study are displayed in Table 5. Consistent with prior investigations using the TEPS (Gard et al., 2006), anticipatory and consummatory pleasure were significantly related in the current study ($p < .0001$). However, neither of the TEPS scales was significantly related to the PQ scales (see Table 5). In turn, the PQ scales were significantly associated with each other ($p < .0001$), and both PQ scales were positively associated with the negative symptom scale (p's $< .0001$). The negative symptom scale was also associated with depression ($p < .0001$), and was negatively correlated with the TEPS-ANT subscale ($p = .001$) but not the TEPS-CON subscale ($p = .401$). Gender was determined to be a

covariate as significant differences between males and females were found for the TEPS-ANT subscale ($F(1,671) = 28.499$, Cohen's $d = .45$, $p < .0001$), and the TEPS-CON subscale ($F(1,671) = 6.337$, Cohen's $d = .21$, $p = .012$). Although, gender was not significantly related to PQ-POS ($F(1,671) = 0.121$, Cohen's $d = .03$, $p = .728$), it was significantly related to PQ-POS Distress ($F(1,671) = 5.081$, Cohen's $d = .19$, $p = .025$). Thus, gender was included as a covariate for subsequent analyses of models that included PQ-POS Distress (i.e., the number of distressing positive symptoms endorsed). Lastly, mean values and estimated marginal means (adjusted with gender as a covariate) are provided for the TEPS-ANT in Figure 3, with mean values and estimated marginal means for TEPS-CON displayed in Figure 4.

Multiple regression analyses indicated that the relation between anticipatory pleasure and PQ-POS scores did not reach statistical significance ($p = .271$; see Table 6), when entered simultaneously with consummatory pleasure. Likewise, the relation between anticipatory pleasure and PQ-POS Distress did not reach significance ($p = .427$) when entered simultaneously with consummatory pleasure (see Table 6). Consistent with study hypotheses, consummatory pleasure was neither associated with PQ-POS ($p = .141$), nor with PQ-POS Distress ($p = .185$), when entered simultaneously with anticipatory pleasure. Furthermore, for the PQ-POS Distress Scale, neither anticipatory pleasure nor consummatory pleasure was significantly related when gender was added as a covariate in the model (p's = .202 and .168, respectively; see Table 6). When stratifying for gender (see Table 7), a similar pattern emerged for anticipatory pleasure in which no significant associations were found for males in relation to PQ-POS ($p = .980$) or PQ-POS Distress ($p = .679$). For females, although a greater relation was shown than relative

to males, anticipatory pleasure was neither associated with PQ-POS (p = .174), nor was it associated with PQ-POS Distress (p = .197). Also while stratifying for gender, no significant relations were found among males for consummatory pleasure and PQ-POS (p = .692) or PQ-POS Distress (p = .368). Lastly, for females, there was no significant relation between consummatory pleasure and the PQ-POS scale (p = .140), and no association with PQ-POS Distress (p = .307; see Table 7).

Additional analyses regarding the relation of TEPS scales with clinical risk status are illustrated in Table 8. Decreases in anticipatory pleasure led to a 1.04 times non-significant increase in the odds of clinical high-risk status, whereas increases in consummatory pleasure led to a 1.037 times non-significant increase in the odds of clinical high-risk status (p's = .075 and .069, respectively). Furthermore, with the TEPS scales entered simultaneously in the model adjusting for gender, decreases in anticipatory pleasure led to a significant 1.04 times increase in the odds of clinical high-risk status (p = .045; see Table 8), whereas increases in consummatory pleasure led to a 1.038 non-significant increase in the odds of clinical high-risk status (p = .066).

After stratifying for gender, differences in the general pattern of association between the TEPS scales and clinical risk status emerged (see Table 9). Specifically, decreases in anticipatory pleasure among women led to a significant 1.06 times increased odds of being at clinical high risk (p = .014), and this finding was not observed for men (p = .850). With regard to consummatory pleasure, a non-significant relation was found for men, indicating that increased consummatory pleasure among men was non-significantly associated with a 1.07 times increased odds of being at clinical high risk (p = .070). However, this finding was not observed among men when the TEPS scales were

entered simultaneously as independent variables (p = .154). Moreover, women did not show a significant relation between consummatory pleasure and clinical risk status, when TEPS-CON was entered simultaneously with TEPS-ANT (p = .217).

CHAPTER 4

DISCUSSION

The present study is the first investigation to our knowledge examining different components of hedonic functioning in relation to the continuum of psychotic symptoms, as well as clinical risk for psychosis. Hypotheses for the study were based on prior findings that individuals with schizophrenia display diminished anticipatory pleasure but comparable consummatory pleasure while directly engaged with a stimulus compared to healthy controls (e.g., Cohen et al., 2010; Gard et al., 2006). In line with study predictions, anticipatory pleasure was significantly associated with clinical risk status. Namely, lower anticipatory pleasure was associated with significantly increased odds of clinical high-risk status when controlling for other variables in the model. This finding supports the notion that anticipatory pleasure deficits may emerge prior to the onset of psychosis, but at an attenuated level. Furthermore, when examining this relation as a function of gender, this finding was only observed among women in the current sample, but not among men. This is an interesting finding, particularly when considered in the context of prior research. For instance, schizophrenia has been observed to be more common among men than women (e.g., Abel, Drake, & Goldstein, 2010; Häfner, Maurer, Loffler, & Riecher-Rossler, 1993; Iacono & Beiser, 1992), and men classified as high-risk (as determined by the SIPS) have been shown to be more likely to convert to schizophrenia relative to women (Willhite et al., 2008). Moreover, various investigations have suggested that negative symptoms are more common among men with schizophrenia relative to women at first onset (Leung & Chue, 2000; Morgan et al., 2008, Willhite et al., 2008) and chronic stages of the disorder (Fennig, Putnam, Bromet, &

Galambos, 1995; Köhler et al., 2009; Thorup et al., 2007). However, with specific regard to affective symptoms of psychosis, various studies have provided evidence of greater affective symptoms (e.g., depression) among women relative to men in the prodromal stage (Cotton et al., 2009) and at first-onset (Chang et al., 2009; Køster, Lajer, Lindhardt, & Rosenbaum, 2008; McGlashan & Bardenstein, 1990). In this sense, our findings are consistent with prior findings that women are more likely than men to display affective symptoms in the course of psychosis, as decreases in anticipatory pleasure were associated with depression in the current study (e.g., Cotton et al., 2009; Køster et al., 2009). Lastly, it deserves mention that a main gender difference in schizophrenia involves an earlier age of onset among men relative to women (e.g., Castle, Abel, Takei, & Murray, 1995). Estimates suggest that the mean age of onset for men is in the early 20s whereas the mean age of onset for women is the mid-to-late 20s (Goldstein, Tsuang, & Faraone, 1989; Shtasel, Gur, Gallacher, Heimberg, & Gur, 1992). Given the mean of the current sample was approximately 20 years of age, it is possible that men in the current sample may have surpassed the most common period for onset of psychosis whereas women in the sample may be just entering the age of highest risk for psychosis. At this age, it may be the case that men with schizophrenia (and conceivably with more anticipatory pleasure deficits) have never attended or discontinued their undergraduate education. Further support for this notion is also reflected in the relative percentage of men in the low- and high-risk groups. Specifically, the percentage of men in the low-risk group was over 30%, compared to 23.9% of the high-risk group (see Table 2). Taken together, it is plausible that the lack of a relation between anticipatory pleasure deficits and clinical risk among men is impacted by the timepoint examined in this sample.

Nonetheless, our current understanding of hedonic functioning in the prodrome of schizophrenia is limited. The current findings appear to be the first results to observe gender differences in the relation between anticipatory pleasure deficits and risk for psychosis. Future research can help examine the role of gender in predicting risk for psychosis, and the possible disparate relation of symptoms and high-risk status among men and women.

Given that the current data are cross-sectional, future studies are also needed to determine the longitudinal progression of anticipatory pleasure deficits, and whether gender differences in anticipatory pleasure and psychosis are observed throughout the course of the disorder (e.g., the prodrome). For instance, anticipatory pleasure deficits may worsen as the disorder emerges and progresses, and/or as positive symptoms intensify. Overall, future research will be instrumental for determining the nature of hedonic functioning in the schizophrenia prodrome and whether anticipatory pleasure may be an important factor to consider for identifying those at clinical risk. One potential caveat to the present findings is the high level of negative symptoms observed among individuals at clinical high risk for psychosis. As displayed in Table 2, the mean number of negative symptoms in the high-risk group is roughly 13 negative symptoms. Furthermore, over 80% of the individuals at clinical high risk endorsed negative symptoms in the highest quartile (see Table 3); therefore, it is possible that the apparent relation between anticipatory pleasure deficits and positive symptoms is being influenced by the presence of negative symptoms. It is also likely that the considerable overlap between the constructs of negative symptoms and anticipatory pleasure make it difficult to parse the specific influence of each construct. Consistent with this notion, as presented

in Table 5, greater deficits in anticipatory pleasure, but not consummatory pleasure, were significantly associated with negative symptoms in this study. Overall, the possible influence of negative symptoms is an important consideration when interpreting the current results.

With regard to anticipatory pleasure and positive symptoms, there was no significant association between these measures. These results suggest that anticipatory pleasure deficits do not exist on a continuum along the dimension of psychosis in the general population. Nevertheless, anticipatory pleasure deficits were significantly related to increased clinical risk for psychosis. Thus, these findings suggest that anticipatory pleasure deficits only emerge in those at risk for psychosis and among those with psychotic disorders, but are unrelated to commonly occurring positive symptoms in the general population. These findings provide initial evidence that anticipatory pleasure deficits may be a clinically meaningful characteristic of those at risk for psychosis and not merely associated with the whole dimension of positive symptoms. Moreover, anticipatory pleasure deficits may be an additional component that can differentiate those at risk for psychotic disorders versus those experiencing normal subthreshold psychotic phenomena. Future longitudinal studies will be essential to providing a better understanding of how these hedonic deficits operate within the prodrome of psychosis in those who eventually convert to a psychotic disorder.

Consistent with prior findings, consummatory pleasure was not significantly associated with positive symptoms in this study (Strauss et al., 2011). As reported by Strauss and colleagues (2011), no significant relation was observed between consummatory pleasure and positive symptoms in a sample of patients with

schizophrenia. The present results extend findings of Strauss et al. (2011) to suggest that a relation is also not observed among subthreshold psychotic symptoms in the general population, which provides further evidence for the lack of an association between consummatory pleasure and psychosis.

There are several important implications of the present study. First, determining the nature and role of hedonic functioning in the prodromal stages of schizophrenia requires additional empirical attention. Given that many symptoms emerge prior to the onset of schizophrenia, it is crucial to identify specific risk factors and understand the mechanisms associated with conversion to schizophrenia (Knowles & Sharma, 2004; Yung et al., 2007). In the current study, we identified greater anticipatory pleasure deficits in those at clinical risk for schizophrenia; however, only a portion of these individuals likely will develop a full-blown psychotic disorder, based on previous prodromal studies (Cannon et al., 2008). Consequently, it is possible that the magnitude of our results would be larger if we examined those who converted to a psychotic disorder compared to the non-converters, as anticipatory pleasure deficits may be a unique predictor of conversion in clinical high risk groups. Nonetheless, anticipatory pleasure appears to be a target for future research to examine as a factor conferring risk for psychosis.

Second, the present study may provide clinical insights that would help improve risk identification. Developing the most accurate set of predictive factors is essential to minimizing potential harm associated with identifying individuals at risk for psychosis (Yung et al., 2007). For instance, among instances of false-positives there is the potential for unnecessarily exposing individuals to antipsychotic medications as well as the stigma

associated with mental illness (Corcoran, Malaspina, & Hercher, 2004). This notion is further highlighted by prior evidence suggesting that a limited proportion of individuals at clinical high risk (e.g., 35%), as determined by SIPS criteria alone, will develop psychosis (Cannon et al., 2008). However, as noted by Cannon et al. (2008), risk algorithms can increase significantly the positive predictive value (e.g., 68%-80%) when additional risk factors (e.g., greater levels of unusual thought content, substance abuse) are considered. Thus, determining additional risk factors hopefully can lead to improved risk identification for schizophrenia.

Furthermore, as identified by Correll and colleagues (2010), the identification of biomarkers for conversion to psychosis is a critically important future direction. In the current study, trait-like components of hedonic functioning were examined using a self-report measure of hedonic functioning. Future research could aim to examine hedonic functioning using multiple channels of emotion (e.g., self-report, psychophysiology, brain imaging, and facial expressions). The potential implications of this type of additional research would be twofold. First, additional research could further validate the relation of anticipatory pleasure and risk for psychosis. Second, the identification of biomarkers may provide increased specificity for identifying individuals at risk for psychosis.

Third, this research may have additional clinical implications with regard to early intervention techniques. Early intervention can be critical given that duration of untreated psychosis (DUP) is associated with a worse progression of symptoms, greater functional impairments, and a decreased likelihood of remission (e.g., Bottlender & Möller, 2003; Harris et al., 2005; Malla et al., 2002; Marshall et al., 2005). Furthermore, reducing the DUP with early intervention has been found to be associated with decreased levels of

negative symptoms (Larsen et al., 2011; Melle et al., 2008), which is a crucial consideration given the worse prognosis and poorer course of the disorder associated with negative symptoms (McGlashan et al., 1992). It is further possible that improved early intervention techniques could provide additional benefits not only for negative symptoms broadly defined, but for functional outcomes as well (e.g., social/occupational interest and/or motivation). In support of this notion, emerging evidence has supported the efficacy of various clinical interventions designed to improve anticipatory pleasure deficits in individuals diagnosed with schizophrenia (e.g., Favrod et al., 2010, Johnson et al., 2011). First, anticipatory pleasure skills training has been developed to help individuals imagine a given activity and then practice feeling sensations involved with the activity (Favrod et al., 2010). This program also asks individuals to remember past occurrences of these activities to help practice the generation of anticipatory pleasure. Initial evidence from this program suggests that participants showed increases in anticipatory pleasure, as measured by the TEPS, and increase engagement in enjoyable activities (Favrod et al., 2010). Another potentially promising intervention showing some preliminary support involves loving-kindness meditation designed to improve caring for self and others (Johnson et al, 2011). Evidence from this initial investigation suggests that participants displayed significant improvements in frequency of positive emotions and a decrease in negative symptoms. Like these programs, similar interventions could be developed that might help diminish the severity of anticipatory pleasure deficits after conversion to psychosis occurs. In sum, including aspects of hedonic functioning in early intervention may lead to improved clinical efforts for those at risk of conversion to psychosis.

Several limitations of this study should be noted. First, these data are cross-sectional; therefore, the ability to identify factors predicting psychotic symptoms is critically limited. Future studies should aim to utilize longitudinal designs to prospectively examine whether deficits in hedonic functioning (i.e., anticipatory and consummatory pleasure) confer risk for developing schizophrenia and related psychotic disorders. Second, diagnostic assessment was not part of the current research study. Therefore, it is difficult to know whether any of the participants in the study have been diagnosed with a psychotic disorder, or whether these individuals were experiencing clinically significant psychotic symptoms at the time of research participation. It is certainly plausible that individuals endorsing high levels of negative and positive symptoms could be clinically diagnosed with schizophrenia or another psychotic disorder. Consistent with this speculation, individuals in this study identified as being at clinical high risk displayed a substantially greater frequency of negative symptoms compared to those at low-risk for psychosis. Third, the present study is limited in the sense that cognitive measures (e.g., memory, imagination) were not obtained during this investigation. This could be particularly relevant to interpretation of TEPS data, which presumably requires participants to remember hedonic experiences (e.g., When I hear about a new movie starring my favorite actor, I can't wait to see it") and/or imagine these situations (e.g., "I love the sound of rain on the windows when I'm lying in my warm bed"). Future studies utilizing the TEPS should consider examining individual differences in aspects of cognitive functioning that may be relevant to accurately responding to items of the TEPS.

In sum, the present study extends the current literature by providing an initial investigation of the relation between hedonic functioning and the continuum of subthreshold psychotic symptoms, as well as clinical high-risk status. Findings suggest that deficits in anticipatory pleasure were significantly associated with increased odds of being at clinical risk for conversion to schizophrenia. However, upon further examination, this finding appears to be restricted to women in the current sample, which is consistent with prior research suggesting greater affective symptoms of psychosis among women. It is possible that anticipatory pleasure deficits may confer different levels of risk as a function of gender, and consideration of gender may be crucial for identifying individuals at increased risk for psychosis. Furthermore, anticipatory pleasure deficits were not significantly associated with positive symptoms in the overall sample. This study presents the first evidence to suggest that anticipatory pleasure deficits might occur prior to the onset of psychosis. These findings also suggest that anticipatory pleasure deficits are only related to those at clinical risk for psychosis and those with psychotic disorders, but these deficits are not related to those experiencing subthreshold psychotic symptoms that are commonly observed in the general population. Furthermore, the present findings present initial evidence that anticipatory pleasure may be an important target of future research designed to examine the positive predictive value of hedonic functioning. Such future research will be essential for improved early identification and early intervention for those at risk of developing schizophrenia.

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Table 1

Demographic Characteristics of Overall Sample

	Overall Sample (n = 674)
Demographics	
Male, n (%)	195 (28.9)
Age (years), mean (SD) [range]	20.50 (2.34) [17-35]
Race, n (%)	
Non-Hispanic White	395 (58.6)
African-American	93 (13.8)
Asian	96 (14.2)
Hispanic/Latino	27 (4.0)
Other	63 (9.4)
CES-D Scores, mean (SD) [range]	7.51 (4.98) [0-26]
PQ Scores, mean (SD) [range]	
Positive Items	8.81 (7.41) [0-37]
Positive Distressing Items	3.26 (4.53) [0-27]
PQ Scores, mean (SD) [range]	
Negative Items	6.49 (5.03) [0-19]

Table 2

Demographic Characteristics of Low- and High-Risk Groups

	Low-Risk (n = 466)	High-Risk (n = 88)
Demographics		
Male, n (%)	141 (30.3)	21 (23.9)
Age (years), mean (SD) [range]	20.54 (2.37) [17-35]	20.53 (2.43) [17-31]
Race, n (%)		
Non-Hispanic White	272 (58.4)	52 (59.1)
African-American	62 (13.3)	12 (13.6)
Asian	70 (15.0)	15 (17.0)
Hispanic/Latino	22 (4.7)	0 (0.0)
Other	40 (8.6)	9 (10.3)
CES-D Scores, mean (SD) [range]	6.03 (3.98) [0-26]	13.24 (5.71) [3-26]
PQ Scores, mean (SD) [range]		
Positive Items	5.58 (4.63) [0-37]	21.41 (6.66) [9-37]
Positive Distressing Items	0.94 (1.11) [0-3]	12.99 (4.59) [8-27]
PQ Scores, mean (SD) [range]		
Negative Items	4.68 (3.87) [0-18]	13.59 (3.78) [3-19]

Table 3

Descriptive Statistics of Negative Symptoms Endorsed for Low- and High-Risk Groups

	Low-Risk (n = 466)	High-Risk (n = 88)
Quartile, n (mean) [SD]		
First (n = 182)	172 (1.01) [.795]	0 (N/A) [N/A]
Second (n = 163)	129 (3.91) [.839]	3 (4.00) [1.000]
Third (n = 168)	119 (7.71) [1.330]	14 (8.29) [1.729]
Fourth (n = 161)	46 (12.72) [1.628]	71 (15.04) [2.169]

Note: Risk status was determined based on number of distressing positive symptoms endorsed. Quartile groups were determined based on quartile split data reflecting the number of negative symptoms endorsed.

Table 4

Maximum Frequency of Distressing Positive Symptoms Endorsed

	n	(%)
No distressing symptoms endorsed	232	(34.4)
One or 2 times in past month	160	(23.7)
Weekly	88	(13.1)
Few times a week	102	(15.1)
Daily	92	(13.6)

Table 5

Pearson Correlations for Age with Independent and Dependent Variables

Measure	1	2	3	4	5	6	7
1. Age	--	-0.064	-0.025	-0.055	-0.043	-0.018	-0.002
2. TEPS-ANT		--	.550***	-0.014	-0.003	-.131**	-.128**
3. TEPS-CON			--	0.04	0.041	-0.073	-0.032
4. PQ-POS				--	.755***	.503***	.700***
5. PQ-POS Distress					--	.524***	.659**
6. CES-D						--	.669***
7. Negative Symptoms							--

Note: TEPS-ANT = Anticipatory Pleasure; TEPS-CON = Consummatory Pleasure; PQ-POS = Number of positive symptoms endorsed; PQ-POS Distress = Number of distressing positive symptoms; CES-D = Depression Severity.

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

Table 6

Association of TEPS Scales with Positive Symptoms

	Unadjusted				Adjusted[a]			
	B	*SE B*	β	*p*-value	*B*	*SE B*	β	*p*-value
Positive Symptoms								
Anticipatory Pleasure	-0.003	0.002	-0.051	0.271	--	--	--	--
Consummatory Pleasure	0.003	0.002	0.068	0.141	--	--	--	--
Distressing Positive Symptoms								
Anticipatory Pleasure	-0.002	0.003	-0.037	0.427	-0.003	0.003	-0.060	0.202
Consummatory Pleasure	0.003	0.003	0.061	0.185	0.004	0.003	0.064	0.168

[a]Multiple Regression analyses controlled for gender.

Table 7

Association of TEPS Scales with Positive Symptoms Stratifying by Gender

	B	*SE B*	β	*p*-value
Positive Symptoms				
Anticipatory Pleasure				
Male	.000	.004	-.002	.980
Female	-.004	.003	-.072	.174
Consummatory Pleasure				
Male	.002	.004	.036	.692
Female	.004	.003	.078	.140
Distressing Positive Symptoms				
Anticipatory Pleasure				
Male	-.002	.005	-.038	.679
Female	-.004	.003	-.069	.197
Consummatory Pleasure				
Male	.004	.005	.083	.368
Female	.003	.003	.054	.307

Table 8

Associations of TEPS Scales and Clinical Risk Status Unadjusted and Adjusted for Gender

	Unadjusted			Adjusted[a]		
	Odds Ratio	95% CI	*p*-value	Odds Ratio	95% CI	*p*-value
Anticipatory Pleasure	0.965	.928, 1.004	0.075	0.96	.922, .999	0.045
Consummatory Pleasure	1.037	.997, 1.079	0.069	1.038	.998, 1.080	0.066

[a]Multiple Regression analyses controlled for gender.

Table 9

Associations of TEPS Scales and Clinical Risk Status Stratifying by Gender

	Odds Ratio	95% CI	*p*-value
Anticipatory Pleasure			
Male	1.008	.928, 1.095	.850
Female	0.944	.902, .988	.014
Consummatory Pleasure			
Male	1.065	.977, 1.161	.154
Female	1.029	.983, 1.077	.217

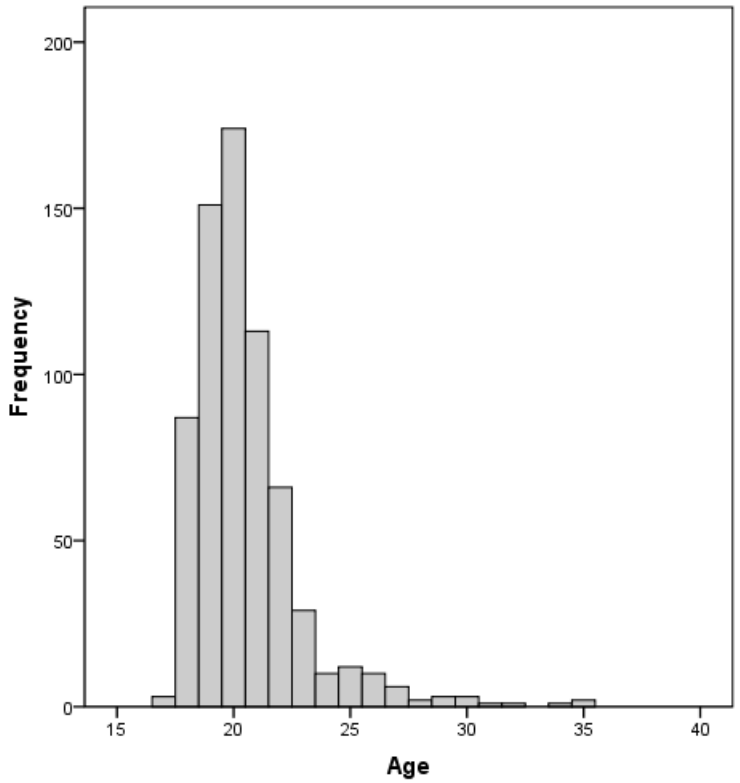

Figure 1. Age Distribution for the Overall Sample. Age (in years) presented along the x-axis, and the frequency of participants listed along the y-axis.

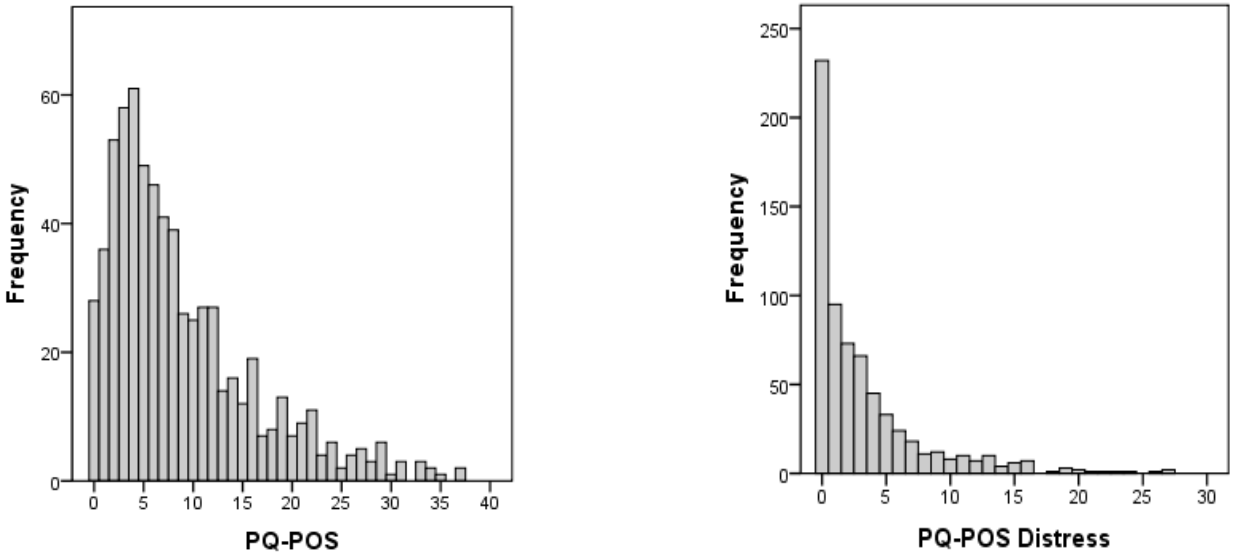

Figure 2. Distribution of Positive Symptoms for the Overall Sample. For each histogram, PQ scales are listed along the x-axis to depict the number of positive symptoms endorsed (left panel) and the number of distressing positive symptoms (right panel), with frequency presented along the y-axis.

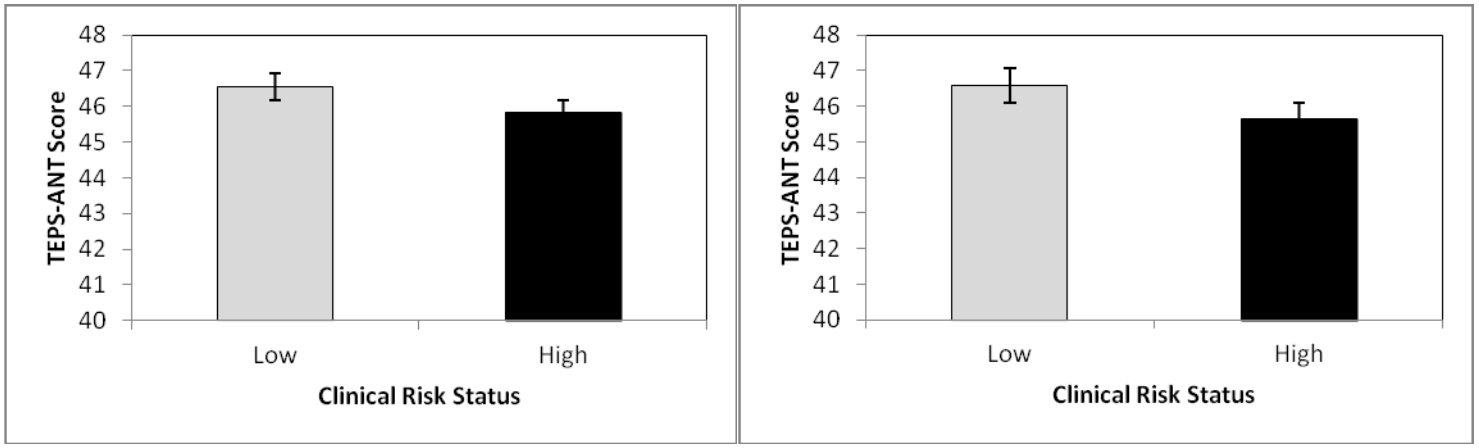

Figure 3. Anticipatory Pleasure Scores Presented as a Function of Clinical Risk Status and Adjusting for Gender. Mean values (left panel) and estimated marginal means (right panel) of anticipatory pleasure as a function of clinical risk status while adjusting for gender. Error bars represent standard error.

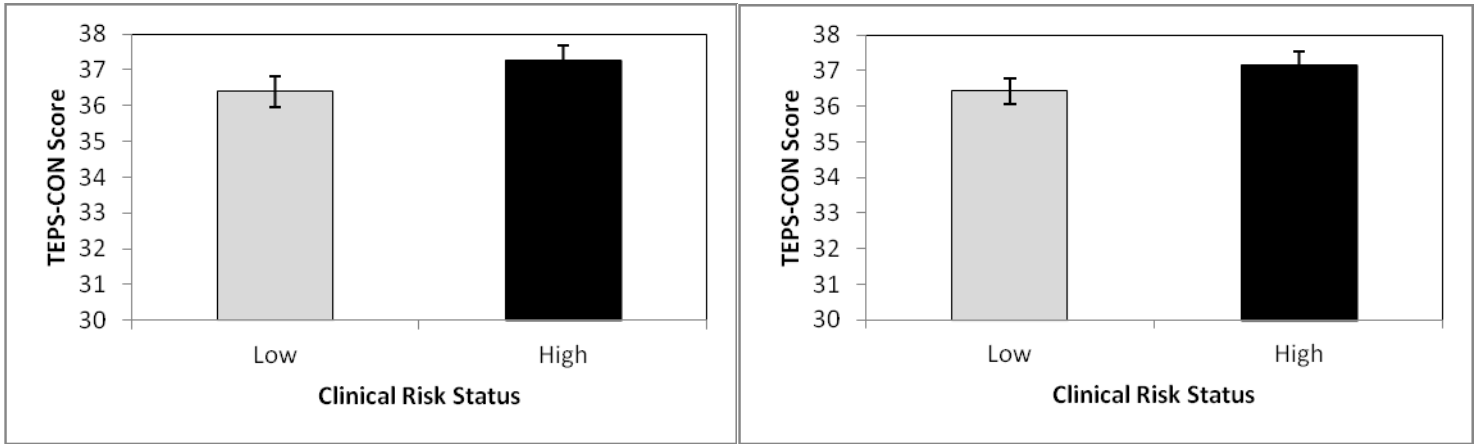

Figure 4. Consummatory Pleasure Scores Presented as a Function of Clinical Risk Status and Adjusting for Gender. Mean values (left panel) and estimated marginal means (right panel) of consummatory pleasure as a function of clinical risk status while adjusting for gender. Error bars represent standard error.