Schizophrenia Research 241 (2022) 72–77

Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

Negative and depressive symptoms differentially relate to real-world anticipatory and consummatory pleasure in schizophrenia

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ARTICLE INFO

Keywords:
Schizophrenia
Anticipatory pleasure
Consummatory pleasure
Depression
Anhedonia
Ecological momentary assessment

ABSTRACT

It has been suggested that schizophrenia is associated with deficits in anticipatory but not consummatory pleasure, though there is mixed support for this hypothesis. As individuals with schizophrenia can experience both negative and depressive symptoms, symptom heterogeneity in this population could contribute to these mixed hedonic findings. Specifically, while some research suggests that negative symptoms of schizophrenia are related to reduced anticipatory but not consummatory pleasure, research on major depressive disorder suggests that depressive symptoms are associated with both decreased anticipatory and consummatory pleasure. Still, it is unclear whether depressive symptoms are associated with experiences of pleasure in schizophrenia as they are in major depressive disorder. Thus, the present study used Ecological Momentary Assessment (four prompts per day over one week) to investigate the unique relationships of negative and depressive symptoms with daily reports of real-world anticipatory and consummatory pleasure in 63 individuals with schizophrenia. Higher negative symptoms related to reduced anticipatory but not consummatory pleasure. On the other hand, higher depressive symptoms related to reductions in both anticipatory and consummatory pleasure. Overall, these results indicate that negative and depressive symptoms are differentially associated with hedonic experience in schizophrenia, and suggest the need to account for the severity of both these symptom types when examining pleasure in this population. Elucidating the nature of these symptom contributions to hedonic impairments could increase causal understanding of these deficits and contribute to the development of more targeted treatments to enhance motivation and pleasure in schizophrenia.

1. Introduction

1.1. Pleasure deficits in schizophrenia

Core symptoms of schizophrenia putatively include a diminished experience of pleasure (see Horan et al., 2006c). However, research suggests that individuals with schizophrenia report comparable levels of pleasure to healthy controls in response to emotion-eliciting stimuli (Kring and Moran, 2008). Thus, it has been hypothesized that individuals with schizophrenia have deficits in anticipatory but not consummatory pleasure (Kring, 1999). Still, there is mixed evidence for this hypothesis, which could be reflective of varying methods to assess pleasure and/or to symptom heterogeneity in schizophrenia. For example, deficits in anticipatory but not consummatory pleasure may be associated with the severity of negative symptoms (Moran and Kring, 2018). On the other hand, depressive symptoms, which are often elevated in people with schizophrenia-spectrum disorders, have been associated with both anticipatory and consummatory pleasure reductions in major depressive disorder (Wu et al., 2017). However, little work has addressed the potential relationship of depressive symptoms to pleasure in schizophrenia. Therefore, the goal of the current work is to examine the unique relationships of negative and depressive symptoms to real-world reports of anticipatory and consummatory pleasure in schizophrenia,

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

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https://doi.org/10.1016/j.schres.2022.01.012
Received 3 March 2021; Received in revised form 28 October 2021; Accepted 5 January 2022
Available online 25 January 2022
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suggested to well represent this symptom domain (Horan et al., 2011) and has been supported through confirmatory factor analyses (e.g., Richter et al., 2019). Another primary conceptualization of negative symptoms which proposes five core factors, also delineates anhedonia as one of these factors (Kirkpatrick et al., 2006). Importantly, research suggests that the experience of pleasure is comprised of two dissociable components: anticipatory and consummatory. Anticipatory pleasure, or "wanting", refers to predicting future experiences of pleasure or enjoyment, while consummatory pleasure, or "liking," refers to in-the-moment experiences of pleasure (Kring et al., 1999).

Although there is consistent evidence of diminished trait-level emotional experience in schizophrenia (see Horan et al., 2006b), laboratory-based studies using film clips (Kring et al., 1993), pictures (Herbener et al., 2008), and food (Berlin et al., 1998; Horan et al., 2006a) to induce state consummatory pleasure find that individuals with schizophrenia tend to report feelings of pleasure comparable in valence and intensity to those of healthy controls (Cohen and Minor, 2010; Kring and Moran, 2008). While this intact consummatory pleasure in schizophrenia is well replicated via participant self-report, neuroimaging studies indexing pleasure by brain responses to putatively rewarding stimuli show a mixed picture on the presence of consummatory pleasure deficits in this population (Barch and Dowd, 2010). However, they show fairly consistent evidence for deficits in reward anticipation, a form of anticipatory pleasure (Radua et al., 2015).

Notably, some of these inconsistent findings could be due to varying laboratory-based methods to induce emotional states (e.g., pictures, film clips), which may not always be reflective of emotional experiences in individuals' daily lives. Although laboratory studies have the beneficial ability to experimentally control for a variety of external factors, it is also important to understand pleasure as it occurs outside the laboratory. Ecological Momentary Assessment (EMA) is a method that assesses pleasure in everyday life by prompting users to report on their daily experiences and reactions as they arise naturally. The pioneering EMA study on pleasure in schizophrenia found anticipatory but not consummatory pleasure deficits in this population (Gard et al., 2007). However, 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 they generally overestimate the intensity of their emotions (Brenner and Ben-Zeev, 2014).

As outlined above, there is a mixed support for the presence of anticipatory but not consummatory pleasure deficits in schizophrenia. Importantly, several studies have linked this anticipatory (but not consummatory) pleasure deficit to clinician-rated motivation and pleasure (MAP) negative symptoms (e.g., Moran et al., 2019a; Moran and Kring, 2018). This raises the possibility that inconsistent findings across studies could reflect variations in negative symptom severity across studies. Notably, most work that has examined negative symptom relationships to pleasure in schizophrenia has assessed pleasure via laboratory-based behavioral or clinical measures rather than via momentary assessments of real-world pleasure. Of work that has used EMA to assess the relationship between negative symptoms and real-world pleasure in schizophrenia, one study found that clinician rated negative symptoms were related to daily reports of anticipatory pleasure (Moran et al., 2019b) while one study did not find this association (Gard et al., 2014). This highlights the need to further examine whether MAP negative symptoms uniquely relate to daily experiences of anticipatory but not consummatory pleasure in schizophrenia.

1.2. 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 (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 et al., 2010), when presented with pleasure-eliciting stimuli (Bylsma et al., 2008; Sloan et al., 2001; Wexler et al., 1994), and in daily reports of experiences (Barge-Schaapveld et al., 1999; Bylsma et al., 2011; Wu et al., 2017). There is also evidence that people with MDD experience decreased anticipatory pleasure both in the lab (MacLeod and Salaminiou, 2001; Sherdell et al., 2012) and by daily report (Wu et al., 2017).

Importantly, individuals with schizophrenia also commonly experience depressive symptoms, which studies have found to be dissociable from negative symptoms (Häfner et al., 1999; Kitamura and Suga, 1991; Kulhara and Avasthi, 2003; Rey et al., 1994). As both negative 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. In fact, Campellone et al. (2016) indicated that depressive symptoms could serve as a pathway for pleasure impairment in individuals with schizotypy (Campellone et al., 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 variations in the level of depression across study samples may contribute to mixed findings in the literature. Specifically, individuals (or samples) with schizophrenia higher 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.

1.3. Aims and hypotheses

The reviewed literature highlights the possibility that differing symptom profiles in schizophrenia, along with varying laboratory-based methods to examine pleasure could contribute to mixed findings on possible anticipatory but not consummatory pleasure deficits in schizophrenia. Thus, there is a need to examine the unique relationships of negative and depressive symptoms to real-world experiences of pleasure in this population. This research aims to investigate differential symptom relationships to daily anticipatory and consummatory pleasure in schizophrenia to test the hypotheses that: 1) MAP negative symptoms negatively relate to anticipatory but not consummatory pleasure when controlling for depression, and 2) depressive symptoms negatively relate to both anticipatory and consummatory pleasure when controlling for MAP negative symptoms.

2. Material and methods

2.1. 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 (years: 2015 and 2016) investigating negative symptoms of SCZ using EMA. Study exclusion criteria included: (1) DSM-IV (American Psychiatric Association, 2000) 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. All participants provided written informed consent to the protocol approved by the Washington University Institutional Review Board. Consistent with prior EMA research (Myin-Germeys et al., 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.

2.2. 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 use of the provided Android-enabled smartphones for the EMA portion of the study. Training involved instructing participants on device use, and review of the EMA survey prompts to ensure comprehension and ability to answer questions. Participants then underwent the EMA week, further detailed below. After completion of the EMA protocol, participants returned to the laboratory to complete clinical assessments regarding their symptoms during the week of EMA. Participants were compensated $1.75 per EMA survey completed and $40 per laboratory visit.

2.3. Clinical assessments

Diagnoses of schizophrenia or schizoaffective disorder were confirmed using the Structured Clinical Interview for DSM-IV-TR (American Psychiatric Association, 2000) administered by a master's or PhD level clinician. 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 et al., 2013), which comprises a Motivation and Pleasure scale (CAINS MAP) and an Expression scale (CAINS EXP). We used the CAINS MAP scale, which includes sections related to motivation and frequency of pleasure for social relationships, work and school, and recreation to provide overall ratings of MAP negative symptoms. State depression symptoms for the past week were also assessed at this second laboratory visit using the Beck Depression Inventory—Second Edition (Beck et al., 1996) self-report measure. Higher scores on both the CAINS and BDI indicate increased impairment.

2.4. EMA

2.4.1. 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 h between 10:00 AM and 7:00 PM. 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.

2.4.2. 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 (“right now”) and anticipated (“in the next 2 h”) behavior. Anticipated behavior prompts asked about expectations for the next 2 h to focus on time window with a high likelihood of occurrence before the next prompt (~3 h later). Participants were asked to indicate their current or anticipated activities by selecting “as many as apply” from a drop-down list of options (e.g., TV/Reading/Computer, Running an Errand, Cleaning/Hygiene/Chores). Of these selections, participants were to indicate which current activity they were most enjoying and which anticipated activity they predicted most enjoying. They then rated their anticipatory (predicted) or consummatory (current) enjoyment of that activity on a 5-point Likert scale, with higher scores indicating greater enjoyment. From this information we computed variables for anticipatory and consummatory pleasure as follows:

Anticipatory pleasure: Individuals' reported anticipated enjoyment (1–5) of the activity they predict most enjoying in the next 2 h.

Consummatory pleasure: Individuals' reported current enjoyment (1–5) of the activity they report currently most enjoying.

2.5. Statistical analysis

All analyses were conducted using R statistical software (v 4.0.4; R Core Team, 2021). We conducted hierarchical linear models (HLMs) using the lme4 package (Bates et al., n.d.) and the lmer function to assess the unique relationships of negative and depressive symptoms to daily experiences of pleasure. Each model included both negative and depressive symptom scores (entered simultaneously) as fixed, between-subjects variables in Level 2 to predict either participants' repeated reports of anticipatory or consummatory pleasure in Level 1.

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 et al., 1992) by creating average scores of each measure per individual in order to compute the correlations.

3. Results

3.1. Participant demographics

As reported above, participants who completed fewer than 33% of the EMA surveys ($n = 3$) were excluded from our study, yielding a final sample size of 63 participants. This sample meets or exceeds the range of ~63% of EMA studies in schizophrenia (Vachon et al., 2019). The mean response rate for the EMA surveys in the current study was 80.5% with a standard deviation of 19.07% (including the response rates of the excluded participants). This represents high EMA compliance, as response rates in schizophrenia average approximately 70%, even in studies that exclude low responders (Vachon et al., 2019). Participant demographics and clinical characteristics are reported in Table 1.

3.2. Zero-order correlations

Table 2 outlines the zero order correlations between our measured variables (BDI, CAINS MAP, anticipatory pleasure, and consummatory pleasure). BDI and CAINS MAP scores were not significantly correlated, suggesting that negative symptoms and depression are dissociable in schizophrenia. In addition, BDI showed negative zero-order correlations with both anticipatory and consummatory pleasure, whereas CAINS MAP scores were significantly negatively associated with anticipatory but not consummatory pleasure.

Table 1
Demographic, clinical and behavioral characteristics.

		Mean (SD)
Characteristic	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%
Employment status	Employed (part or full time)	20.63%
	Unemployed	79.37%
Living situation	Alone	37%
	Family (e.g., parents, spouse, dependents)	52%
	Friends/roommates	10%
	Boarding home	<1%
Clinical ratings	CAINS MAP	17.79 (5.44)
	BDI	11.86 (10.09)
EMA pleasure ratings	Anticipatory pleasure	3.64 (0.68)
	Consummatory pleasure	3.41 (0.68)

Table 2
Zero order correlations of all variables.

	BDI	CAINS MAP	Anticipatory pleasure	Consummatory pleasure
BDI	1			
CAINS MAP	0.05	1		
Anticipatory pleasure	−0.45***	−0.31*	1	
Consummatory pleasure	−0.42***	−0.21	0.88***	1

Note: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$.

3.3. 3.3. Negative and depressive symptom relationships to anticipatory and consummatory pleasure

To test our hypotheses, we examined the unique relationships of negative and depressive symptoms to anticipatory and consummatory pleasure in daily life. As shown in Table 3 and Fig. 1a, consistent with our hypothesis, CAINS MAP negatively related to anticipatory, but not consummatory pleasure, when controlling for BDI. In contrast, and also in line with our hypothesis, BDI negatively related to both anticipatory and consummatory pleasure when controlling for CAINS MAP (Table 2 and Fig. 1b). In follow-up analyses comparing correlated correlation coefficients, CAINS MAP scores were significantly more associated with anticipatory than consummatory pleasure ($Z = -1.66, p = 0.048$), while BDI scores were significantly more associated with consummatory than anticipatory pleasure ($Z = 1.86$, $p = 0.031$).

4. Discussion

The goal of the current study was to examine the unique relationships of MAP negative symptoms and depressive symptoms to daily experiences of pleasure in individuals with schizophrenia. Our results demonstrated that these symptoms differed in their relationships to anticipatory and consummatory pleasure in this population. Specifically, MAP negative symptoms negatively related to anticipatory but not consummatory pleasure, while depressive symptoms negatively related to both anticipatory and consummatory pleasure. This indicates that, among individuals with schizophrenia, MAP negative symptoms and depressive symptoms may differentially relate to real-world experiences of pleasure. These findings support previous literature that suggests that MAP negative symptoms are related to deficits in anticipatory pleasure (Moran and Kring, 2018) but not consummatory pleasure, and provide further evidence of this pattern when examining this association via momentary reports of naturally occurring pleasure in the daily lives of those with schizophrenia. They also extend beyond prior literature that indicates that depressive symptoms in MDD are related to deficits in both anticipatory and consummatory pleasure (Wu et al., 2017) by demonstrating this same pattern in a schizophrenia population. Our findings that depressive symptoms consistently predicted both anticipatory and consummatory pleasure, even when controlling for MAP negative symptoms, are especially relevant given that anybody with a current major depressive episode was excluded from the study. The strong relationship of these symptoms to both of forms of pleasure, even in our sample with less severe state depression, speaks to the importance of accounting for depression symptom severity in future work on pleasure in schizophrenia.

Table 3
HLMs of MAP negative symptom and depressive symptom relationships to anticipatory and consummatory pleasure.

	β	t	p
Anticipatory pleasure			
BDI depression (controlling for CAINS MAP)	−0.23	−3.15	0.003**
CAINS MAP (controlling for BDI depression)	−0.19	−2.55	0.013*
Consummatory pleasure			
BDI depression (controlling for CAINS MAP)	−0.22	−3.14	0.003**
CAINS MAP (controlling for BDI depression)	−0.11	−1.64	0.107

Since individuals with schizophrenia may experience both MAP negative symptoms and symptoms of depression, the mixed literature on pleasure in schizophrenia could be a product of differing symptom profiles in schizophrenia participants 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 for both MAP negative symptom and depressive symptom severity when making statements about the nature of pleasure deficits in schizophrenia may fail to account for these differential symptom relationships to pleasure.

This work should be interpreted in the context of its limitations. First, our study did not have a healthy control group, as this was not necessary to our goal to investigate symptom relationships within a schizophrenia population. However, without this comparison, we cannot speak to the question of whether individuals with schizophrenia (or those higher in negative symptoms) do, in fact, show *deficits* in anticipatory pleasure compared to healthy controls. Future research would benefit by replicating these research questions with a healthy control comparison to examine varying symptom profiles in schizophrenia as they may show differential deficits in anticipatory or consummatory pleasure compared to healthy controls. Second, we only collected EMA data for one week. Future research should collect EMA data for a longer period of time to assess for potential shifts in experienced anticipatory and consummatory pleasure with lifestyle variations or as symptoms of depression fluctuate. Lastly, our sample consisted of patients with chronic schizophrenia. Investigating whether the findings from this study would replicate in those with first-episode psychosis or even in those at clinical high risk for psychosis, would allow us to better understand whether this pattern is present before psychosis onset, begins at conversion, or increases with the chronicity of the illness.

This work demonstrated a differential relationship of negative and depressive symptoms to the experience of real-world pleasure in schizophrenia. Most work on hedonic experience in schizophrenia has used laboratory-based methods to assess for overall deficits in anticipatory or consummatory pleasure without controlling for the symptom heterogeneity that could influence differing outcomes. Our findings indicate that it is especially important to account for depressive symptoms, which have largely been overlooked in this research, before making broad statements about the overall nature of pleasure deficits in schizophrenia. An increased understanding of the possibly differing pathways that contribute to these impairments could inform treatment decisions. For example, patients higher in depressive symptoms who demonstrate a lack of motivation for an upcoming event may benefit from a distinct treatment protocol from those high in MAP negative symptoms who report this same reduction. As diminished motivation and pleasure in schizophrenia is closely linked to poor functional outcomes (Barch et al., 2014; Fervaha et al., 2014; Foussias et al., 2011) and is especially difficult to treat (Aleman et al., 2017), a better understanding of differential symptom contributions to these deficits could increase our causal understanding and lead to the development of treatment methods with increased specificity and functional benefit.

CRediT authorship contribution statement

JTM was responsible for generating the research questions, conducting the analyses, and drafting the paper. EKM managed study data collection. EKM and DMB were both involved in study design and providing critical feedback at every step of the process.

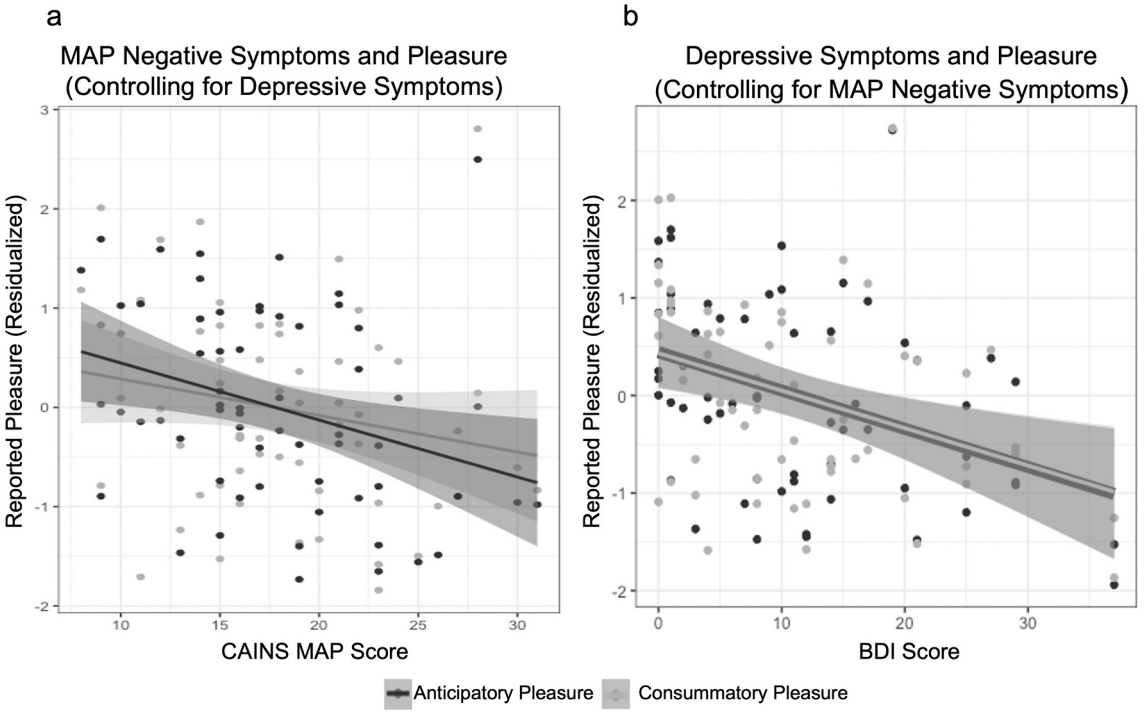

Fig. 1. A) BDI scores (controlling for MAP negative symptoms) negatively predicted both anticipatory and consummatory pleasure in daily life; B) CAINS MAP scores (controlling for BDI) negatively predicted anticipatory but NOT consummatory) pleasure in daily life.

Role of the funding source

The funding source had no role in the design, analysis or interpretation of the data.

Declaration of competing interest

The authors declare there is no conflict of interest for this study.

Acknowledgements

This work was supported by National Institute of Mental Health Grant R37-MH066031 and the Gregory Couch Professorship held by DMB. NIMH Parts of this data were presented virtually at the Schizophrenia International Research Society (SIRS) conference 2020.

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