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Motivation and effort in individuals with social anhedonia

Julie M. McCarthy [a,*], Michael T. Treadway [b], Jack J. Blanchard [a]

[a] Department of Psychology, University of Maryland College Park, College Park, MD 20742 United States
[b] McLean Hospital/Harvard Medical School, Belmont, MA 02478, USA

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ABSTRACT

It has been proposed that anhedonia may, in part, reflect difficulties in reward processing and effortful decision making. The current study aimed to replicate previous findings of effortful decision making deficits associated with elevated anhedonia and expand upon these findings by investigating whether these decision making deficits are specific to elevated social anhedonia or are also associated with elevated positive schizotypy characteristics. The current study compared controls ($n = 40$) to individuals elevated on social anhedonia ($n = 30$), and individuals elevated on perceptual aberration/magical ideation ($n = 30$) on the Effort Expenditure for Rewards Task (EEfRT). Across groups, participants chose a higher proportion of hard tasks with increasing probability of reward and reward magnitude, demonstrating sensitivity to probability and reward values. Contrary to our expectations, when the probability of reward was most uncertain (50% probability), at low and medium reward values, the social anhedonia group demonstrated more effortful decision making than either individuals high in positive schizotypy or controls. The positive schizotypy group only differed from controls (making less effortful choices than controls) when reward probability was lowest (12%) and the magnitude of reward was the smallest. Our results suggest that social anhedonia is related to intact motivation and effort for monetary rewards, but that individuals with this characteristic display a unique and perhaps inefficient pattern of effort allocation when the probability of reward is most uncertain. Future research is needed to better understand effortful decision making and the processing of reward across a range of individual difference characteristics.

1. Introduction

Anhedonia refers to a lack of pleasure from physical experiences and/or social interactions (Chapman et al., 1976). Anhedonia has been of interest to researchers as this characteristic may be an important indicator of risk for particular forms psychopathology such as depression (Treadway and Zald, 2011), schizophrenia-related spectrum personality disorders, and psychosis (Kwapil, 1998; Gooding et al., 2005; Blanchard et al., 2011). Additionally, it is a prominent characteristic of schizophrenia (e.g., Andreasen, 1982; Blanchard et al., 1998) that may provide a promising target for translational research exploring the neural mechanisms underlying this disorder.

In considering the core deficit that contributes to anhedonia (physical and social), Treadway and Zald (2011) proposed that it is useful to distinguish between hedonic responses to rewards (consummatory anhedonia) and diminished motivation to pursue them (motivational anhedonia). On one hand, anhedonia may reflect a diminution of positive affect when encountering evocative stimuli or experiences consummatory anhedonia. Consistent with this perspective, at least in nonclinical samples, self-reported elevated anhedonia has been found to be related to diminished positive emotional responding to evocative stimuli in laboratory tasks (Kerns et al., 2008; Leung et al., 2010; Llerena et al., 2012) and to experiences individuals encounter in their daily lives (Brown et al., 2007; Kerns et al., 2008). However, this is not always the case, as individuals with elevated social anhedonia have also displayed normative startle responding to positive stimuli in a laboratory setting (Gooding et al., 2002). In addition to consummatory deficits, anhedonia may be associated with impaired reward-based decision making and motivational deficits to pursue rewards (Treadway and Zald, 2011). Considering this motivational aspect of anhedonia may be useful as consummatory pleasure deficits are not consistently associated with anhedonia, especially in clinical populations. In particular, self-reported anhedonia has been found to be unrelated to consummatory pleasure deficits in schizophrenia (e.g., Earnst and Kring, 1999; Trémeau et al., 2009; Cohen et al., 2012). Thus, it has been suggested (e.g., Barch and Dowd, 2010) that anhedonia in schizophrenia may not reflect an impairment in hedonic experience but rather be related to impairment in reward learning (Strauss et al., 2011), failure to represent expected rewards (Gold et al., 2012), and cost/effort computation deficits (Fervaha et al., 2013; Gold et al., 2013; Barch et al., 2014).

In addressing the possible role of impaired reward-based decision making in anhedonia, Treadway et al. (2009) developed a

* Corresponding author. Tel.: +1 301 405 1531; fax: +1 301 314 9566.
E-mail addresses: jmccarth@umd.edu (J.M. McCarthy), mtreadway@mclean.harvard.edu (M.T. Treadway), jblancha@umd.edu (J.J. Blanchard).

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translational measure of effort-based decision making, the Effort Expenditure for Rewards Task (EEfRT). Initial findings in a nonclinical sample indicated that greater anhedonia was related to less willingness to expend effort for rewards (Treadway et al., 2009). Specifically, compared to controls, those with greater anhedonia were less likely to choose 'hard' tasks requiring more effort when the potential reward was 'high' and the probability of reward was uncertain (Treadway et al., 2009). Self-reported depression in this nonclinical sample was also inversely related to willingness to expend effort for rewards.

The above results regarding reward-based decision making and anhedonia are promising and suggest the potential use of a novel translational paradigm to better parse the underlying deficits associated with anhedonia. However, questions remain about the relationship between reward-based decision making and one specific type of anhedonia, namely, social anhedonia. Our interest in social anhedonia stems from research suggesting that this is a particularly important individual difference characteristic associated with schizophrenia-spectrum personality disorder symptoms and outcomes (Chapman et al., 1994; Kwapil, 1998; Gooding et al., 2005; Blanchard et al., 2011). Additionally, in nonclinical samples, elevated social anhedonia is an important research target because it is associated with clinical symptoms, decreased social support (Blanchard et al., 2011), and impaired social functioning (Diaz et al., 2003; Diaz, 2006). Moreover, cognitive deficits in executive functioning, working memory, and attention have also been implicated in individuals with elevated social anhedonia in nonclinical samples (Tallent and Gooding, 1999; Cohen et al., 2006; Diaz, 2006), and such impairments may compromise reward-based decision making. Prior studies of motivation and effort have generally utilized a summary measure of anhedonia, integrating both physical and social anhedonia (e.g., Treadway et al., 2009; Barch et al., 2014). Given potential differential correlates of physical and social anhedonia (e.g., Chapman et al., 1994; Blanchard et al., 1998; Gard et al., 2007), it would be important to examine social anhedonia independently to determine if the initial findings hold for this aspect of anhedonia. Furthermore, since some individuals high in social anhedonia manifest other positive schizotypal symptoms and characteristics (Kwapil, 1998; Gooding et al., 2005; Blanchard et al., 2011), it would be informative to determine whether the positive schizotypal characteristics of perceptual aberration (Chapman et al., 1978) and magical ideation (Eckblad and Chapman, 1983) contribute to decision making deficits related to reward. Finally, the replication of general anhedonia's relation to decision making deficits is important given findings from a recent study of clinical depression (Treadway et al., 2012): although the depression group evidenced less willingness to expend effort for rewards compared to controls, unexpectedly within the depressed group overall depressive symptom severity, and more specifically an item related to reduced enjoyment (anhedonia), were associated with *more* effortful decision making.

The purpose of the current study was to determine if reward-based decision making deficits were evident in nonclinical individuals high in social anhedonia. Identifying and exploring social anhedonia in nonclinical populations affords several advantages including minimizing factors that complicate research in schizophrenia such as medication effects, economic deprivation, severe cognitive decline, social stigma, and institutionalization (Blanchard and Neale, 1992; Lenzenweger, 2006). We also sought to examine if these deficits were unique to social anhedonia or if other schizotypal characteristics (perceptual aberration/magical ideation) might be tied to impaired reward-based decision making. Performance on the EEfRT was examined in three groups: high social anhedonia, high perceptual aberration/magical ideation, and a control group. We hypothesized that the social anhedonia group would demonstrate diminished effortful decision making compared to controls and those high in positive schizotypy traits.

2. Methods

2.1. Participants

One hundred participants were recruited from the University of Maryland at College Park (UMD) after completing online screening measures. Eligible study participants were between the ages of 17 and 40; individuals who were 17 years of age obtained parental consent and completed an assent form to participate. Participants were screened using the 17-item Social Anhedonia Scale–Brief (SAS-B; Reise et al., 2011) composed of the 17 most discriminating items identified by factor analyses of the Revised Social Anhedonia Scale (Eckblad et al., 1982), 7 items from the Perceptual Aberration Scale (PerAb; Chapman et al., 1978), and 8 items from the Magical Ideation Scale (MagicId; Eckblad and Chapman, 1983). Due to limitations in the length of screening instruments permitted in UMD mass testing, we relied on abbreviated versions of the scales. The latter two scales comprise what is referred to as the PerMag scale, which is used to identify positive schizotypal traits. Screening items for the abbreviated PerMag scale were those used in a prior study (Kerns et al., 2008) that selected items based on highest item-total correlation (J. Kerns, personal communication, August 1, 2011) for mass testing before administering the complete schizotypy scales in the laboratory. The present study administered the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) during the study visit to confirm group differences in schizotypal characteristics. Additionally, the 13-item Infrequency Scale (Chapman and Chapman, 1983) was used to measure invalid responding, and people who responded in the unexpected direction on three or more items were excluded (Kerns et al., 2008; Martin et al., 2011). The social anhedonia (SocAnh) and positive schizotypy (PerMag) groups consisted of individuals with scores falling within the top 10% of the collected SAS-B and PerMag scores, respectively. Individuals who met criteria for both groups were excluded from the study to establish an extreme-group design (Kerns et al., 2008). The control group was recruited from people who scored less than 0.5 standard deviations above the SAS-B and PerMag means (Chapman et al., 1994; Horan et al., 2007).

2.2. Measures

The Effort Expenditure for Rewards Task (EEfRT; Treadway et al., 2009) combines reward processing and effortful decision making to produce an objective assessment of effort. The EEfRT has been utilized in a range of sample to examine effortful decision making deficits in a range of sample including individuals with depression (Treadway et al., 2012) and schizophrenia (e.g., Barch et al., 2014). This computer task is 20 min in duration and consists of a series of trials with potential reward values ranging from $1 (easy task) to $1.24–$4.30 (hard task) and probabilities (low = 12%, medium = 50%, high = 88% chance) of receiving each reward. Participants chose to perform either an easy task (pushing a computer key 30 times in 7 s) or a hard task (pushing a computer key 100 times in 21 s). Following each task, participants viewed feedback about whether they won the reward; see Treadway et al. (2009) for a full description of the EEfRT. The proportion of hard tasks chosen was the dependent variable of effortful decision making. Participants also completed items from the Beck Depression Inventory-II (Beck et al., 1996) that measured depressive symptoms.[1]

[1] Due to the University of Maryland Institutional Review Board requirements and experimenter error, the first 14 items of the BDI-II questionnaire were collected from all participants, and the suicide item was excluded. Although using the incomplete set of 14 items is not ideal, these items demonstrated good internal consistency (Cronbach's $\alpha = .86$).