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Objective investigation of activity preference in schizophrenia: A pilot study

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ABSTRACT

Amotivation and reduced goal-directed activity engagement are prominent features of schizophrenia. Previous investigations of patients' activities have relied on accounts of daily living activities, rather than objective measures. This study used wireless motion capture to objectively evaluate activity preference when individuals are provided an explicit choice between an active versus passive engagement option. Twenty outpatients with schizophrenia and twenty matched healthy controls completed the Activity Preference Task, in which participants play a motion-based game (active) or watch a film (passive), and were administered clinical and cognitive assessments. Schizophrenia participants' duration, intensity, and persistence of active engagement were associated with apathy and community functioning. No group differences emerged from comparisons of task measures; however, exploratory cluster analysis identified a distinct subgroup of schizophrenia patients with reduced engagement and increased apathy compared to other patients and controls. The Task provides a means of quantifying activity engagement, which may be particularly valuable given the lack of objective measures for intrinsically motivated behaviours. Our initial findings suggest that schizophrenia patients as a group are equally inclined as healthy individuals towards actively engaging activities when presented an explicit choice, but such provision may be insufficient for initiation and maintenance of functional behaviours among amotivated patients.

1. Introduction

Motivation deficits are a critical component of the negative symptoms of schizophrenia (Foussias and Remington, 2010; Messinger et al., 2011), and have a direct impact on concurrent and longitudinal functional outcome (Fervaha et al., 2015b; Foussias et al., 2011), and potential influence on other important symptomatic features, such as cognition (Fervaha et al., 2014b; Foussias et al., 2015; Strauss et al., 2015). To date, objective task-based investigations in schizophrenia have characterized specific aspects of motivation, particularly aspects of reward processing, such as effort-based decision making (i.e., weighing the benefits of actions against degree of effort required), reinforcement learning (i.e., learning to pursue or avoid actions based on relative likelihood of obtaining rewards), reward anticipation (i.e., recognizing and responding to cues that precede rewards or penalties), and value representation (i.e., subjective internalized valuation of experiences and decisions) (Green et al., 2015; Horan et al., 2015; Reddy et al., 2015; Strauss et al., 2014). However, there have been scarcer investigations of how such impairments determine individuals' preferences for activities requiring dedicated engagement versus those experienced passively.

Activity choices for patients with schizophrenia outside laboratory settings have previously been quantified by chronicling their daily real-world activities using retrospective self-reports or in-the-moment experience sampling, and categorizing said activities as goal-directed or non-goal-directed (or by similar classification). Such classifications have segregated activities aimed towards a larger goal (e.g., working, completing an errand, and commuting) from those not (e.g., eating, sleeping, and watching television) (Gard et al., 2007). First-episode patients have been found to spend less time on goal-directed activities

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than controls, and this has been associated with poor community functioning (Agid et al., 2012; Fervaha et al., 2014a). Similar findings have been reported for more chronically ill patients, who engage less in goal-directed activities than controls (Gard et al., 2007), spend more time "doing nothing" (Oorschot et al., 2012), and whose activities and goals are less effortful and less beneficial long-term (Gard et al., 2014a). Objective investigations of gross motor activity using actigraphy in schizophrenia, although lacking capacity to distinguish activity choices, have consistently identified lower activity in schizophrenia patients compared to controls (Berle et al., 2010; Bracht et al., 2013; Chen et al., 2016; Docx et al., 2017; Fasmer et al., 2016; Sano et al., 2012; Walther et al., 2011a, 2011b; Wichniak et al., 2011). Further, activity levels have been associated with negative symptoms (Docx et al., 2017; Walther et al., 2015, 2014, 2009b; Wichniak et al., 2011), including amotivation specifically (Docx et al., 2013). Altogether, these findings suggest that schizophrenia patients generally tend towards non-goal-directed activities and less effortful engagement. However, it remains unclear whether such activity preference patterns persist when individuals are provided an explicit dichotomous choice between actively versus passively engaging activities. Investigation of activity engagement within such a context may be valuable considering that individuals' activity choices on typical day-to-day bases may be influenced by numerous contending factors (e.g., availability of activities and opportunities to partake therein), beyond innate predisposition towards effortful engagement or lack thereof.

To bridge the gap between laboratory-based tests of motivation and real-world assessment of activity engagement in schizophrenia, we developed the Activity Preference Task (APT) that utilizes wireless motion capture in an open-field setting to objectively measure preference between active and passive engagement. We hypothesized that patients with schizophrenia would demonstrate reduced preference for active engagement compared to healthy controls, based on duration of engagement and propensity to switch between activity options. Further, we predicted that APT performance would correlate specifically with clinical measures of amotivation and community functioning.

2. Methods

2.1. Participants

Twenty outpatients with schizophrenia (SZ) and 20 healthy control subjects (HC), group-matched for age and sex, completed the study. The study was conducted at the Centre for Addiction and Mental Health and approved by the local Research Ethics Board. All participants provided written informed consent. SZ participants met the following inclusion criteria: DSM-IV schizophrenia diagnosis (and no other concurrent Axis I disorder) based on the Mini International Neuropsychiatric Inventory (MINI) (Sheehan et al., 1998), stable dose of antipsychotic medications for at least four weeks, capable to consent, and absence of significant akathisia (global item > 2 on the Barnes Akathisia Rating Scale (Barnes, 1989)) or extrapyramidal symptoms (ratings > 2 on > 2 items on the Simpson Angus Rating Scale (SAS) (Simpson and Angus, 1970)). HC participants did not meet criteria for any Axis I disorder, and had no family history of schizophrenia or related psychotic disorder in a first-degree relative. All participants were aged 18 to 55 years, with no history of active substance abuse or dependence in the past 3 months (except for nicotine) or neurological disease.

2.2. Clinical measures

All participants were administered the Apathy Evaluation Scale–clinical version (AES) (Marin et al., 1991) and the Brief Assessment of Cognition in Schizophrenia (BACS) (Keefe et al., 2004). BACS composite *Z*-scores were determined using age and sex normative data. SZ participants were also evaluated with the Scales for the Assessment of Positive Symptoms and Negative Symptoms (SAPS and SANS) (Andreasen, 1984, 1982), the Calgary Depression Scale for Schizophrenia (CDSS) (Addington et al., 1990), and the SAS, to assess overall positive and negative symptom severity, depression, and medication-induced motor side-effects, respectively. For the SANS, we computed subdomain scores for Diminished Expression (sum of Affective Flattening subscale and Poverty of Speech items) and Amotivation (sum of Avolition-Apathy and Anhedonia-Asociality subscale items) (Foussias et al., 2009). The Personal and Social Performance Scale (PSP) (Morosini et al., 2000) and the Social Functioning Scale (SFS) (Birchwood et al., 1990) (mean of the scaled scores of the seven SFS subscales) respectively served as clinician-rated and self-report measures of community functioning. These measures were administered by trained personnel over the course of approximately two hours, typically in the following order: SAPS, SANS, AES, CDSS, PSP, BACS, SFS. A subsample of 29 participants (14 SZ and 15 HC) completed a computerized Finger Tapping Task (FTT), adopted from the Halstead-Reitan Neuropsychological Test Battery to allow administration by repeated pressing of a keyboard key over 10-second trials. Chlorpromazine dose equivalents were calculated for SZ participants' antipsychotic medications (Gardner et al., 2010).

2.3. APT design

Participants were provided the option of watching a portion of a film or playing a simple computer game while alone in a room for 15 minutes. The former was categorized as the passive engagement (PE) option, as participants could watch the film seated, without providing any behavioural response. The latter was the active engagement (AE) option, as the game incorporated a Kinect motion sensor (Microsoft Corp., Redmond, WA) and required physical movements and gestures for more dedicated engagement. Each activity was left to run continuously at opposite ends of the room. Participants were informed that they could engage in either activity at any time, and could switch between activities as they pleased. The task duration was not disclosed, and no specific objective was implied or associated with either activity to avoid incentivization. Participants indicated their level of fatigue, a potential factor in task performance, prior to and after task completion on 4-point Likert scales. The APT was administered following a 15-minute familiarization period within the room to ameliorate potential confounding of outcome measures by behaviours that may be invoked by unfamiliar surroundings (e.g., exploratory behaviour).

2.4. APT data collection and processing

Behaviour during the APT was recorded using the LIBERTY LATUS (Large Area Tracking Untethered System) (Polhemus Inc., Colchester, VT), an electromagnetic motion capture system which collected the positions and orientations of three wireless makers worn by participants: one on each wrist (estimating hand position), and one attached to a hat (estimating head position and orientation). Motion data were processed using R version 3.3.2 (R R Core Team, 2016). For each of the 900 seconds of task duration, a combination of spatial proximity and gaze direction relative to the two activities and hand motion were used to designate whether subjects were engaged on the AE option, PE option, or neither (or ambiguous–e.g., gaze directed towards the PE option, but substantial hand motion suggesting AE). The per-second activity classifications were used to compute two primary APT performance measures: duration of time in seconds spent on the AE option (AE-time), and number of switches between the AE and PE options (Switches-count).

Two secondary measures were computed to further characterize participants' AE. Intensity of AE (AE-intensity) was indexed by average hand speed during periods of AE. Tendency for sustained continuous AE (AE-persistence) was computed based on methods previously used to quantify persistence of "active periods" in actigraphy data (Sano et al., 2012), by estimating an exponential model fit for the cumulative