



## An investigation into the drivers of avolition in schizophrenia

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### ABSTRACT

Over a century of research has documented that avolition is a core symptom in schizophrenia. However, the drivers of avolition remain unclear. Conceptually, there are at least two potential mutually compatible drivers that could cause avolition in schizophrenia. First, people with schizophrenia might have differences in preferences that result in less goal-directed behavior than non-clinical populations (preference-differences). Second, people with schizophrenia might have difficulty translating their preferences into manifest behavior at rates similar to non-clinical populations (psychological-inertia). In the present work, we modified and validated a well-validated paradigm from the motivation/decision making literature to compare levels of preference-differences and psychological-inertia. To measure preference-differences, people with and without schizophrenia choose between a lower-valenced and higher-valenced image. We measured the rate at which the normatively lower-valenced image was preferred. To measure psychological-inertia, both groups were given the opportunity to volitionally switch from a lower-valenced image and view a higher-valenced image. Contrary to expectations, people with schizophrenia did not differ on either preference-differences or psychological-inertia. Statistical analysis revealed that the possibility of a Type II error for even a weak effect was small. The present data suggest new avenues for research investigating mechanisms underlying avolition and clinical interventions targeting avolition in schizophrenia.

### 1. Introduction

The very earliest writing on schizophrenia considered avolition – defined as a decrease in spontaneous, self-initiated and purposeful behaviors – to be a central symptom of the condition (Bleuler, 1911; Kraepelin, 1919; Trémeau et al., 2012). Describing people with schizophrenia, Bleuler (1950) noted a characteristic difficultly initiating goal-directed behavior. Modern schizophrenia researchers have repeatedly confirmed the prevalence of avolition and now conceive of it as being a fundamental underlying process that is central to the pathology (e.g., Foussias and Remington, 2010).

Despite the crucial role of avolition in schizophrenia, its underlying causes are not well understood. Prior avolition research has often focused on establishing the prevalence and functional outcomes of avolition, rather than elucidating its underlying causes. This research has often been conducted using structured clinical interviews and scales. For example, Andreasen's Scale for the Assessment of Negative Symptoms (SANS) (Andreasen, 1982) has a subscale for avolition/apathy that includes items related to grooming, non-persistence at work/school, level of asociality, and physical anergia. Other well-

accepted rating scales include the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987), the Brief Psychiatric Rating Scale (Overall and Gorham, 2004), and the Schedule for the Deficit Syndrome (SDS) (Kirkpatrick et al., 1989). All of these have included similar life-outcome measures to assess the degree of avolition in individuals with schizophrenia. Studies based on these scales have consistently shown that avolition (rated by clinicians) is correlated with lower levels of functioning (e.g. Kiang et al., 2003).

These scales along with structured clinical interviews have been invaluable in characterizing the every-day life consequences of avolition in schizophrenia. However, since these studies have (appropriately) focused on qualitative measures of life-outcomes, it is difficult to use them, or their methods, to examine the underlying drivers of avolition. Such assessments require laboratory studies with tightly controlled contexts.

Conceptually, there are at least two separable drivers that may underlie avolition. First, it is possible that people with schizophrenia have different preferences than individuals who do not have schizophrenia. For example, in some cases people with schizophrenia may prefer normatively negatively valenced images over normatively

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positively valenced images. Non-clinical populations largely prefer normatively positively valenced images over normatively negatively valenced images (Suri et al., 2013a, 2013b). Such affect-related preference differences between schizophrenia and non-clinical populations could drive avolition. Second, it is possible that people with schizophrenia are less able than individuals who do not have schizophrenia to translate preferences – based on anticipated rewards and punishments – into actions. They may have an increased tendency to persist with a current state even when they attach greater value to an option available via volitional action. This may result in these individuals with schizophrenia exhibiting higher levels of *psychological inertia* – defined as a tendency to remain in a current state of (in)action, even though they are inferior to other available options (Gal, 2006; Suri et al., 2013a, 2013b) – compared to non-clinical populations. Since psychological inertia may preclude action, its presence may drive avolition and, therefore, may be one cause of avolition. It is crucially important to understand the extent to which preference differences and psychological inertia are drivers of avolition or differentially contribute to clinical and nonclinical populations because of the current lack of knowledge concerning the causes of avolition.

The possibility of preference differences being a driver of avolition is supported by a meta-analysis (Cohen and Minor, 2010) that has shown that while the hedonic ratings of individuals with schizophrenia do not differ from healthy control participants (Gard et al., 2006), people with schizophrenia do report experiencing some aversion when processing stimuli considered by others to be positive or neutral. Such aversive reactions may lead to preference differences in schizophrenia that are manifested as avolition – specially in contexts involving approaching positive stimuli. Further, emerging evidence suggests that people with schizophrenia may demonstrate inconsistent and unstable preference judgments for affective and non-affective stimuli (Strauss et al., 2011), and people with schizophrenia may show the most discrepant preferences for low arousal or neutral stimuli (Strauss et al., 2017). This further implies that it is possible that preference differences, particularly for future rewards, could drive avolition despite intact hedonic emotional processing of experienced events in schizophrenia.

The possibility that psychological inertia is a driver of avolition is supported by studies that have noted abnormal cost-effort calculations in schizophrenia (Gold et al., 2013). People with schizophrenia were noted to have abnormalities in estimating the “cost” of effortful behavior, which could lead to increased psychological inertia and increased avolition. Other potential drivers for differences in psychological inertia include attention deficits and action-readiness deficits (Suri and Gross, 2015; Suri et al., 2015) which have been noted in schizophrenia (Heinrichs and Zakzanis, 1998).

It is unknown whether preference differences and psychological inertia are in-fact potential drivers of avolition and actually implicated in schizophrenia. To our knowledge, few such studies have been attempted, particularly studies that provide the option of moving away from negative stimuli and moving towards positive stimuli. A notable exception is a study by Heerey and Gold (2007) in which the researchers compared the extent to which people with schizophrenia (compared to controls) repeatedly pressed a button to increase the duration of viewing a positive image or to decrease the duration of viewing of a negative image. People with schizophrenia were found to make fewer button presses per second (in a five second response window) than comparison participants. While suggestive of an avolition deficit, the repeated-button-pressing-measure is not conclusive since differences in pressing rates could be, in part, ascribed to psychomotor slowing in schizophrenia (Brébion et al., 2000). Such psychomotor slowing is more likely to be present at higher rates of pressing (i.e. in the presence of valenced stimuli) than at lower rates of pressing (i.e. in the presence of neutral stimuli). Thus, the fact that people with schizophrenia pressed at an equivalent rate compared to controls for neutral stimuli, does not disprove a psychomotor attribution.

In the present work we sought to adapt a task used in basic science research with healthy individuals, focused on motivation and decision making (Suri et al., 2013a, 2013b, 2015; Suri and Gross, 2015) that can test for differences in levels of preference differences and for differences in levels of psychological inertia between individuals. In the first part of this experiment, individuals are asked to view images of differing valence for 1 s, and then asked to choose one image to view for a longer time (we will refer to this task as the Forced choice task). The percentage of time an individual selects the lower-valenced image for longer viewing is a measure of preference differences (relative to normative ratings). In this sense, preference differences refer to participants' viewing preferences (whether they prefer lower valenced or higher valenced images). Low valence (negative) images generally depict aversive wounds and/or scenes of violence, neutral images often depict everyday items such as umbrellas, and high valence (positive) images usually depict beautiful scenes of nature.

In the second part of this experiment, participants start trials by viewing a default image. If they do nothing, they continue to view the default – but could view a better (i.e. higher valenced) image if they volitionally pressed a button (we will refer to this task as the Volitional choice task). The percentage of time an individual persists with viewing the (lower valenced) default image is a measure of psychological inertia.

In the Forced choice task, when asked to choose between viewing one of two stimuli, (non-clinical) participants reliably choose (~ 85% of all trials) to later view the more positive (or less negative) stimulus for a longer time. Comparing this rate to choice-rates in schizophrenia could indicate whether there are stable preference differences between the two groups. If so, preference differences may be a potential driver of avolition in schizophrenia.

In the Volitional choice task, (non-clinical) participants often persisted with viewing the lower valenced image and switched to the ‘better’ image infrequently (~ 30% of all trials), despite the presence of a caption underneath the default image reminding them that they had an option to switch (Fig. 1). This pattern of results has been replicated in multiple studies (Suri and Gross, 2015; Suri et al., 2015). The difference in outcomes between participant preferences in Forced choice trials and Volitional choice trials indicated the presence of psychological inertia, which involves remaining in a current state of (in)action despite this state being inferior to alternative options. Since discrepancies between the Forced choice and Volitional choice versions of this task reveal the presence of psychological inertia among non-clinical individuals, these tasks may also be suited to detect avolition, in the form of psychological inertia, in patients with schizophrenia.

Transdiagnostic approaches suggest that mental disorders are characterized by a dynamic set of biological and contextual variables that are reliably found – albeit at a subthreshold level – in the general population (van Os and Reininghaus, 2016). If this perspective is applicable in the case of psychological inertia, we might expect that people with schizophrenia would display higher levels of psychological inertia in this Volitional choice context compared to non-clinical

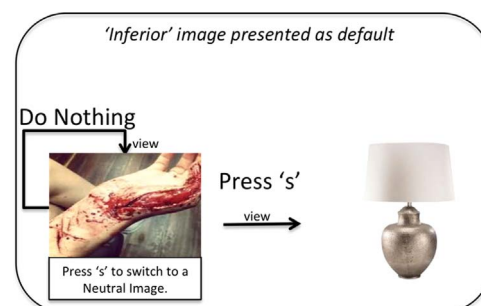


Fig. 1. In Volitional choice trials participants frequently failed to switch to a higher valenced image and persisted with the (lower valenced) defaults.

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