CONATIVE DYSFUNCTION IN SCHIZOPHRENIA: A NEW EMPIRICALLY-DERIVED FRAMEWORK

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ABSTRACT

Conative dysfunction, defined as deficits in performing motivated or volitional action leading to the functional outcome of reduced goal-directed activity (RGDA), is explored as a fundamental and highly impairing aspect of schizophrenia. It is proposed that conative dysfunction is multifaceted and may take different forms within different individuals. Although many such factors have already been studied in schizophrenia, this has been done in a piecemeal fashion, not permitting comparisons among multiple forms of conative dysfunction to determine which ones are most impacted by the disorder or which may cluster within individuals. Thus, the heterogeneity and interrelationships between these factors has not been adequately assessed.

A broad range of motivational and volitional tests, representing aspects of conative functioning drawn from a variety of fields including personality, neuropsychology, motivational psychology and psychopathology are administered to a sample of schizophrenia outpatients. Several of these have not previously been examined in the context of schizophrenia. Three research questions are addressed, including; 1) whether distinct conative "types," characterized by separable dysfunctions, exist; 2) whether some conative functions are more impacted than others in schizophrenia, and whether this depends upon the between-individual variability addressed in question one; and 3) which conative factors are most predictive of poor functional outcomes (i.e., RGDA) in schizophrenia. These questions are addressed via 1) cluster analysis, 2) a series of profile analyses, and 3) a series of regression analyses.

Findings support the existence of two distinct patterns of conative dysfunction within schizophrenia, each associated with a set of specific characteristics. One cluster is characterized by difficulty energizing (an executive function subserved by the superior medial prefrontal cortex) and reduced reward sensitivity, while the other is characterized by increased punishment sensitivity, boredom proneness, and various self-reported cognitive, volitional and emotional pathologies, in the context of intact motivation. Distinct aspects of conative dysfunction in each cluster contribute significantly to RGDA, especially boredom propensity, reward sensitivity, intrinsic motivation, and various executive functions. Comparisons are drawn between each cluster and existing clinical typologies. Implications of each of these findings for future research, clinical assessment and intervention are discussed.

DEDICATION

This dissertation is dedicated to Dr. David Gold.

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"Volition" is a quality that is ascribed to certain actions. There is no consensus about the properties that make action "volitional" but these actions tend to be consciously intended, goal-directed, internally or spontaneously generated, effortful and non-automatic. Kuhl (2009) suggests that the psychological study of volition "relates to four functions, which can be differentiated within various levels of control: (1) planning; (2) initiation of new behaviours that cannot be controlled on the basis of well-established and fully automatised schemas; (3) "impulse control", that is maintenance of an active intention against competing impulses; and (4) disengagement in terms of deactivating completed intentions or intentions that cannot be enacted in a given situation." Kornhuber, Deecke, Lang et al. (1989) describe volitional functions as concerning the "what," "how," and "when" of action (i.e., prioritizing, planning and initiating action in a given moment), and liken the relationship between volition and action to that between attention and thought. Prinz, Dennet and Sebanz (2006) offer a similar definition and, following most psychological theorists, distinguish between *volition* and *motivation*; noting that volition refers to the "how" of action, i.e., those processes that transform mental representations into intended action, while "motivation" refers to the "what" of action, i.e., those processes involved in determining or prioritizing what is intended. The term "volition" is less often used in contemporary psychology (Zhu, 2004), and has evidently been replaced by other terms that may be understood as cognitive or behavioural constituents of volitional processes, such as "executive functions" (Berrios & Gilli, 1995a).

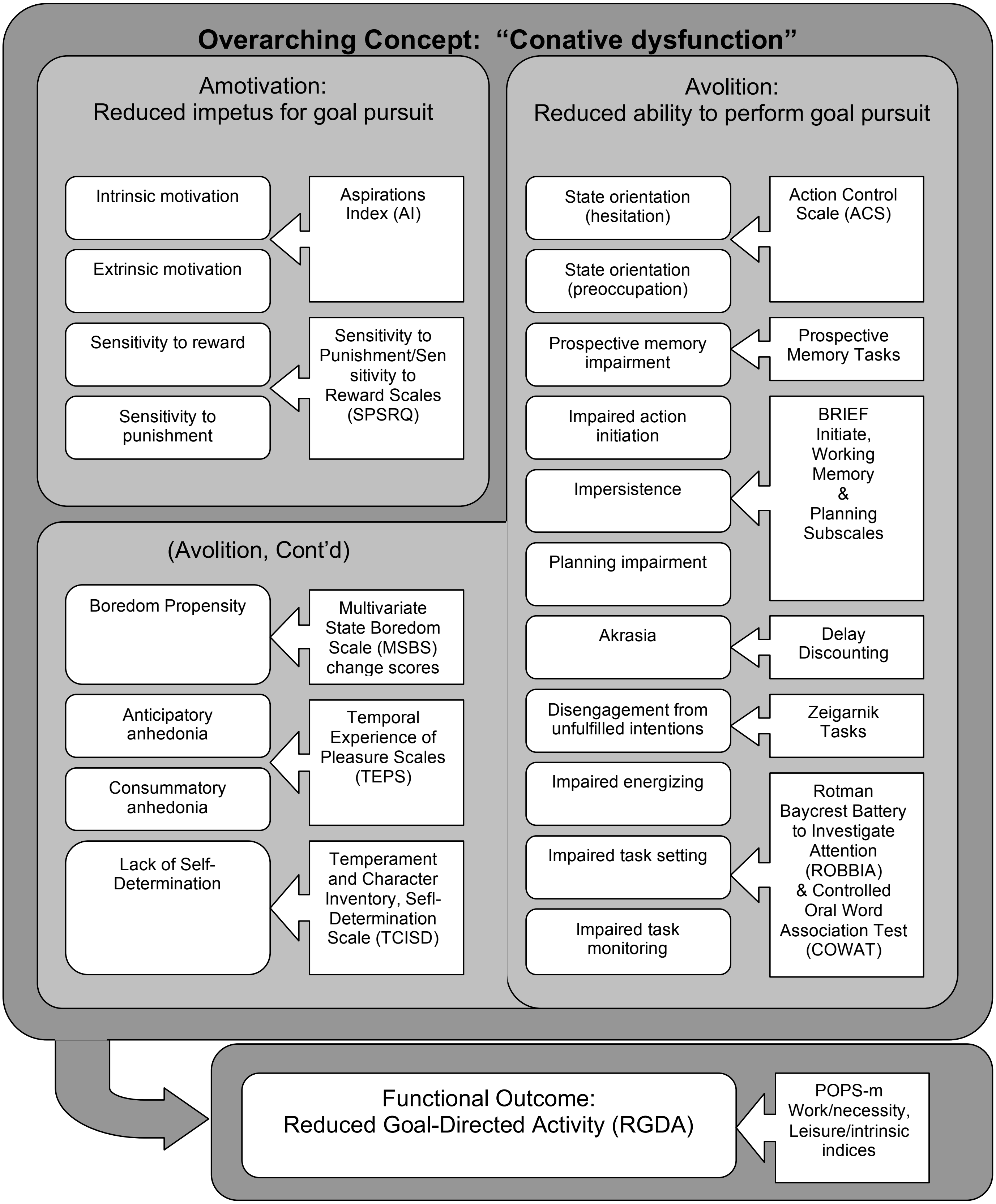
The term “avolitional” is used to describe individuals whose actions are said to lack volition, or who simply perform little volitional or motivated action. The concept of avolition has come to be considered crucial to the understanding of schizophrenia. Habib (2004) has asserted in a historical review of the schizophrenia diagnosis that, even at the time of its conception, schizophrenia was primarily considered a volitional disorder, and that avolition was among its most pathognomic symptoms; more so than the so-called psychotic symptoms. For example, the influential German psychiatric diagnostician Emil Kraepelin (1919) wrote: “Special importance in the establishing of dementia praecox [i.e., schizophrenia] has, not without justification, been attributed to the demonstration of the so-called “catatonic” morbid symptoms. Under this term must principally be understood the *volitional disorders* first described by [19th century psychiatrist Karl Ludwig] Kahlbaum… all these disorders in no other disease come under observation in such extent and multiplicity as in dementia praecox” (p. 257, italics in original). Kraepelin (1920) further notes that schizophrenia may best be understood as a disorder of volition and its “emotional precursors.” From a modern perspective, these “precursors” could be understood as “motives.” The early French psychiatrists Dide and Guiraud (1922) accorded with this view, characterizing schizophrenia as a weakening of the “élan vital,” grounding their understanding of the disorder in the popular conative philosophy of Henri Bergson (1907). “Conative” is an umbrella term that refers to both motivation and volition, and addresses the sum of those psychological (and, in its philosophical sense, physical) processes that determine the direction, vigour and vicissitudes of organismic movement – toward or away from external objects or states.

Given that "volition" and "motivation" are definitionally distinct, as will be explored below, and that some impairments observed in schizophrenia may implicate either process (or both), the term "conative dysfunction" will be employed herein to refer to phenomena that are ambiguous as to which specific process they implicate, whether motivational or volitional. The term "motivation" will be used to indicate processes that determine the quality and quantity of impetus or drive underlying goal-directed action, while "volition" will be used to describe the processes that determine its initiation, potency and actual execution. Cognitive processes that facilitate conative functioning, and which may be considered factors in volitional functioning, include "executive functions," which are involved in planning and initiating complex or novel action, maintaining action, and terminating action[1]. Although these cognitive processes facilitate conative functioning, they are not synonymous with it, as other processes including decision-making, emotion and personality factors all contribute to such action. Therefore, an individual may have intact executive functions, decision-making functions, etc. but still be "avolitional" for other reasons. This leads to an inherent ambiguity whenever an individual is observed to have conative dysfunction, as a large variety of constituent processes may be at the root of such difficulty. See Figure 1 for a schematic summarizing the terminology and concepts used in the current work.

Contemporary mental health professionals and theoreticians continue to refer to schizophrenia as a "disorder of volition" (e.g., Frith, 2006; Prinz, Dennett & Sebanz, 2006). Although conative dysfunction has lost the more central status it once held as a focus of diagnostic and psychopathological consideration, it is still considered

[1] "Action" in this sense may refer to mental or physical processes that are goal-directed.

Figure 1. Map of constructs and measures used in the current work. Rounded boxes indicate distinct constructs, with boxes nested within them indicating subordinate constructs. Arrow boxes list measures used to assess each construct.



pathognomic of schizophrenia, and appears in the DSM-5 criteria for the disorder (American Psychiatric Association, 2013). Despite the continuing status of conative dysfunction as a definitional feature of schizophrenia, research and clinical practice have tended to attend primarily to positive symptoms of the disorder, such as hallucinosis and delusions, at a cost to our knowledge about conative dysfunction and the other "negative" symptoms; such as flattened affect, social withdrawal, alogia, and poverty of speech. Negative symptoms have, however, received renewed research attention in more recent years, especially given their role in the functional decline often observed in schizophrenia. Some recent findings about the importance of understanding negative symptoms are reviewed below.

The Importance of Understanding Conative Dysfunction

The World Health Organization (WHO) examined the burden of various disease entities worldwide by estimating the number of years lived with each disease (YLDs; WHO, 2006). The YLD index reflects the total amount of time spent impaired by individuals worldwide due to disease. It thus operates as an index of disability-related disease burden, and constitutes a contributor the economic and human costs of disease. Schizophrenia was found to be the 9th and 10th leading cause of YLDs for females and males, respectively. This finding underscores the status of schizophrenia as a costly and relatively common disease and, further, suggests that a major negative outcome of schizophrenia on a global scale is its tendency to debilitate those suffering from it.

This observation begs the question; why is schizophrenia so debilitating, or, what is debilitating about schizophrenia? According to a growing corpus of research, conative dysfunction, in addition to the other negative symptoms of schizophrenia, may be the most debilitating aspects of the disorder. A variety of investigations into the relative costs of schizophrenia, using varying methodologies to ascertain functional outcomes, have revealed consistent findings that the leading predictor of impairment is negative symptomatology (Barch, Treadway & Schoen, 2014; Foussias, Mann, Zakzanis, et al., 2009; Ho, Nopoulos, Flaum et al., 1998; Milev, Ho, Arndt & Andreasen, 2005; Pogue-Geile and Harrow, 1985; Rabinowitz, Levine, Garibaldi et al. 2012; Rosenheck, Leslie & Keefe, 1998). Some investigations have singled out "apathy," a construct that is overlapping or synonymous with amotivation, as a particular contributor to negative functional outcomes (Evensen, Rossberg, Barter et al. 2012; Faerden, Friis, Agartz et al., 2009; Kiang, Christensen, Remington et al., 2003; Konstantakopoulos, Ploumpidis, Oulis et al., 2011). In keeping with these observations of the particularly pathological nature of conative dysfunction among the negative symptoms of schizophrenia, it has been suggested to be a core negative symptom, with the other negative symptoms listed above being highly correlated with it and possibly representing facets of it (Foussias & Remington, 2010).

In addition to the disproportionate contributions of negative symptoms to disease-related impairment in schizophrenia, these symptoms are considered less amenable to current drug therapies than positive symptoms (Dossenbach, Pecenak, Szulz, et al., 2008; Kirkpatrick, Fenton, Carpenter & Marder, 2006) and may be less amenable to existing psychotherapies as well (Jauhar, McKenna, Radua, et al., 2014). Taken together, these observations of significant functional impairment in schizophrenia, the importance of conative dysfunction as a central symptom of schizophrenia, the disproportionately large contribution of conative dysfunction and other negative symptoms to this impairment and the paucity of effective treatments for such symptoms all converge on the need for further delineation of processes related to conative dysfunction and their role in schizophrenia.

Conative Dysfunction, Volition and Motivation

Conflicting Concepts of "Avolition" and "Amotivation"

The term "avolition" as it is used in clinical literature about schizophrenia lacks a clear, consensual definition or description of the multiple conative functions it may include. It has often been used interchangeably with the term "amotivation" in clinical practice and in research (e.g., Foussias and Remington, 2010)[2]. A number of other terms from various fields of study are also used to describe reduced effort allocation, reduced efficiency in goal-directed action, reduced control of impulses or task-interfering behaviour and reduced motivation toward reward-related achievement (i.e., conative dysfunctions). Some of these constructs are derived from theories of underlying psychological mechanisms, such as the concepts of anergia, ego depletion (e.g., Baumeister et al., 1998), state orientation (Kuhl, 1981), apathy (e.g., Marin, 1991), akrasia (Ainslie, 1992), and anticipatory anhedonia (e.g., Gard, Kring, Gard et al., 2007). Other such concepts are defined according to known or hypothetical neurobehavioural mechanisms, such as abulia due to caudate lesioning (e.g., Bhatia & Marsden, 1994), various forms of executive dysfunction due to frontal lesioning (e.g., Miyake, Friedman, Emerson et al., 2000; Stuss et al., 2005; Stuss & Alexander, 2007) and psychic

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[2] The DSM-5 defines avolition as an "inability to initiate and persist in goal-directed activities" (American Psychiatric Association, 2013, p. 818), suggesting that the conative dysfunction being referred to is "avolitional" per se, in that it involves an impaired ability to enact motivated action (c.f. Liddle et al., 1992), rather than a deficit of motivation. However, the DSM-5 also describes avolition as "reduced drive to perform goal-directed behaviour" (p. 100), suggesting a lack of motivation, as well. The ambiguity of this two-pronged definition of avolition – as both a lack of ability and a lack of impetus – remains an unresolved empirical issue.

akinesia/athymhormia due to bilateral lesioning of the limbic loop of Nauta (e.g., Habib, 2004; Laplane et al., 1984). Some of these concepts are reviewed below.

A recurrent complication in the various literatures on conative dysfunction, then, is the multifaceted nature of conation and the question of the relationship between avolition and amotivation, terms that are, as noted above, not uncommonly used as synonyms in clinical settings. Although they may be considered as definitionally distinct entities, it is unclear how these two facets of goal directed action are implemented neurally and how they interact functionally.

Phenomenologically, it is certainly possible to have a desire (i.e., a motivation) to act without acting on it, or to fail to act for any number of reasons. In Lewins' (1946) psychology, the intention to act creates a state of "tension" within an individual, which is relieved via action. Internal impediments to action may be considered "volitional" to the extent that they do not reflect a simple lack of desire or motivation to act in the first place, or the presence of conflicting motivations (e.g., fear, or the motive to avoid harm).

The relationships between motivation and volition in neural substrates underlying these distinct phenomenological entities are complex, but dissociations between systems supporting separate functions have been made. For example, some forms of brain lesioning reduce or eliminate the spontaneous, self-motivated enactment of action while leaving procedural memory for action, and environmentally triggered enactment of action, intact; as is the case in psychic akinesia or "athymhormia" (e.g, Laplane et al., 1984; Habib, 2000). These include bilateral lesions involving various regions within of the limbic prefrontal-striatal loop (Nauta, 1986), which often eliminate any internal impetus for action whatsoever. Afflicted individuals deny any boredom or depression despite their total lack of goal-directed activity (Habib, 2004), supporting the view of such lesions as affecting motivation per se, rather than simply impairing volition and leaving the individual in a state of “tension” or dissonance, as would be indicated by boredom. Some case evidence even exists for disorders of inaction existing despite intact frontal executive functioning (e.g., normal findings on neuropsychological examination) and therefore, from a cognitive point of view, an intact ability to perform effortful cognitive action at a high level (e.g., Eslinger & Damasio, 1985; Habib, 2000; Vijayaraghavan, Vaidya, Humphreys et al., 2008).

In one athymhormic subject, behavioural indices of “wanting,” or, the attribution of incentive to a rewarding stimulus and accompanying effort allocation in its pursuit, were shown to be markedly reduced (Vijayaraghavan, Vaidya, Humphreys et al., 2008): interestingly, though, this subject showed an intact subjective report of “wanting” objects within seconds of being shown them. This suggests that perhaps the afflicted striatal structures – in this case, the globus pallidus bilaterally – may regulate a process that is intermediate between motivation and volition (e.g., the enactment of action based upon particular motivations, or the maintenance of motivation without external cuing). This view accords with Habib’s account of a distinct network of brain structures between the basal ganglia and frontal cortices responsible for “converting affective information into motivated acts” (Habib, 2000, p. 515). This view also echoes Knutson et al.’s (2001) view of the ventral striatum as responsible for the “interface” between emotion and action, and Kornhuber’s (1989) view of motivation as the affective “input” into the frontal, volitional action systems. Various early descriptions of schizophrenia involved a lack of such input (e.g., Dide and Giaraud, 1922; Kraepelin, 1919, 1920).

A further, double-dissociation between the brain structures responsible for motivating action and the structures responsible for actually executing action can be seen in that some brain lesions reduce the ability or tendency to act while leaving some aspects of motivation to act intact. Examples of this are seen in "dysexecutive" syndromes following frontal lesioning, as are reviewed below. Additional evidence for such a dissociation comes from the observation that effortful, volitional processes can in fact counteract specific motivations (e.g., urges to engage in addictive behaviours), and that some individuals report difficulty enacting behaviours despite a strong, felt motivation to act in a particular way. Examples of this phenomenon from research literature include "state-oriented" individuals (Kuhl, 1982), as reviewed below; those who experience "ego depletion" (Baumeister et al., 1998); and early clinical observations of abulia, in which some neurological patients were described as "able to experience the wish to do, but unable to act accordingly" (Guislain, 1852; translation in Berrios & Gili, 1995b). Another example is evident in individuals experiencing cognitive fatigue, a phenomenon that has been correlated with reduced activity of the anterior cingulate cortex (Lorist, Boksem & Ridderinkhof, 2005).

In summary, then, evidence and observations from neurological case studies suggest a theoretical perspective of multiple processes supporting or potentiating spontaneous, goal-directed action, some of which govern the motivational "inputs" for such action while others govern the initiation and control of such action.

Volition and Motivation in the Current Study

The multifaceted nature of conation and its disorders, then, is evident in the variety of distinct behavioural and neurophysiological functions that meet the definition of “volitional” or “motivational.” It is also evident in the fact that several schemes for understanding and defining both volition and motivation are themselves multifaceted, as reviewed below. Across the multiplicity of concepts and terms describing phenomena of conative dysfunction, there are several common definitional factors but a wide variety of causal mechanisms ranging from the neuroanatomical to the sociological, and it is unclear to what extent the overlap among these conceptions is purely behavioural or equifinal (i.e., whether distinct processes simply yield the same superficial phenomenon of reduced goal-directed activity), or whether there are deeper common elements among them.

An important question to ask of a given individual with reduced goal-directed behaviour, then, concerns the specific nature of this reduction and its specific source (or sources). The exact nature of conative dysfunction as it manifests in schizophrenia is underexplored and a wide variety of putative pathologies may characterize it. Rather than taking as its starting point any particular definition of conative dysfunction as it manifests in schizophrenia, then, the purpose of the current investigation is to establish a transtheoretical conception. Measures of conative functions that address specific, validated, underlying functions will therefore be chosen for the current study, such that the “building blocks” of conative dysfunction in schizophrenia can be ascertained. Measures addressing non-specific forms of conative dysfunction, such as the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1984) or Volitional Disturbance item in the Positive And Negative Syndrome Scale (PANSS; Kay, Fiszler & Opler, 1987), will be avoided as they may conflate several underlying mechanisms. In other words, test selection for determining the specific elements of conative function in schizophrenia in the current study will be based on the specificity of the construct measured and the ability to measure each construct using well-researched methods. Tests included in the current study will measure a broad range of functions putatively relevant to conative dysfunction, including any aspect of volitional or motivational functioning that may in some way impact one's goal-directed activity (See Figure 1). For example, executive functioning will be examined as impaired executive functioning may putatively have clear implications for one's ability to plan and initiate action.

Given that, at a behavioural level, reduced activity in pursuit of goals constitutes a common definitional factor among concepts of conative dysfunction, and that this reduction has direct implications for functional impairment, a broad variety of psychogenic or neurogenic[3] factors that may hypothetically produce reduction in goal-directed activity as a functional outcome in schizophrenia will be included for examination in the present study. This way, the current study will build upon what is currently known about conative dysfunction in schizophrenia by broadly sampling both established and exploratory hypothetical factors that may underlie this dysfunction. To avoid the problem of applying an existing outcome-related concept that carries theoretical assumptions about the underlying cause of reductions in goal-directed activity in schizophrenia, the behavioural, functional outcome of interest in the current study will be referred to as "reduced goal-directed activity" (RGDA). This label will serve to avoid the pitfalls of defining the nature of the dysfunction *a priori* as a pathology of motivation or volition, or some aspect of one or the other. RGDA will be used to indicate a purely

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[3] The terms "psychogenic" and "neurogenic" are applied here to separate these factors from other physical impairments that may also restrict goal-directed activity, such as orthopedic ailments, chronic pain disorders or obesity.

behavioural construct that represents the observable functional impact of “avolition” and “amotivation” as they are currently conceived. An outcome measure that assesses RGDA in purely behavioural terms has been selected for the current study and is described below. The individual conative factors included in the current study, as well as a rationale for the choice of each factor, is also given in the following sections.

Existing Theories of Volition and Motivation Applied in the Current Study

Several theories of conative dysfunction propose well-established methods for determining “how much” of a particular form of volitional or motivational function a person typically possesses or is capable of exerting. These have been selected for the current study as hypothetical accounts of conative dysfunction as it may pertain to schizophrenia in particular. They were selected for their feasibility, theoretical importance to schizophrenia, and breadth. Importantly, each factor represents a distinct and specific pathology with known psychological or neuropsychological properties.

The primary aim of the current study is, for the first time, to assess a number of such factors simultaneously, allowing an examination of the relationships among such factors to be made. It is hoped that this examination will shed light on the possibly multifaceted nature of conative dysfunction in schizophrenia without resorting to a priori schemes, and allow a direct comparison of the factors most responsible for the functional outcome of RGDA. The following sections provide a description of each research area from which the conative factors under investigation are drawn.

State Orientation. “State Orientation,” in the language of Kuhl (1982), refers to a trait-like tendency to not follow through on intended actions, and is opposed in his model to “action orientation.” Kuhl relates such failures of volition to a given individual’s characteristic emotion regulation processes, and divides them into two distinct forms related to the regulation of positive and negative affect, respectively (a third proposed factor has received less empirical support and is not included here). These two forms of state orientation Kuhl calls "hesitation" – caused by the downregulation of the positive affect required to initiate new actions, and "preoccupation" – caused by the dysregulation of negative affect (e.g., ruminative processing), which pre-empts the execution of new action plans. The distinctive nature of hesitation and preoccupation has been confirmed in factor analysis (Diefendorff, Hall, Lord et al., 2000), and each factor has been validated to predict a wide range of behaviours associated with volitional dysfunction (e.g., procrastination; Blunt and Pychyl, 1998; failure to remember to perform future intended action/"prospective memory;" Goschke & Kuhl, 1996; and "inaction inertia," or volitional decline following failures; van Putten, Zeelenberg, & van Dijk, 2009).

Akrasia. Ainslie's (1992) concept of "akrasia," or weakness of the will, traces its roots to the Plato's Protagoras and other texts. Ainslie conceives of volitional action as the cognitive overriding of what he describes as an irrationally steepened "discounting curve:" a function that relates the subjective value of a reward with the time that must elapse before the reward is given. When individuals exercise will, according to Ainslie, they are choosing what will represent a larger reward in the long-term despite their irrational discounting of that reward as a future occurrence (i.e., relative to smaller but more proximal rewards).

This construct has popularly been operationalized using the "delay discounting" paradigm. In this paradigm, participants are faced with a series of binary decisions between smaller, more proximal rewards and greater, more distal rewards, and the temporal rate at which they "discount" the value of future rewards is assessed. This discounting has been correlated with several "akratic" behaviours, such as drug use and gambling (for a review, see Reynolds, 2006). However, it has also been associated with lower levels of negative symptoms in schizophrenia (Heerey et al., 2007) and lower anhedonia (Lempert & Pizzagalli, 2010), suggesting that it may have a complex relationship with conative dysfunction in schizophrenia, which will be examined in the current study.

Self-Determination Theory. Deci and Ryan's (1980, 1985) Self-Determination Theory (SDT) is a model of the experience of effort expenditure. These authors propose that as various goals and habits are "internalized," either through enactment via one's intrinsic motives or under conditions that facilitate feelings of competence and autonomy, they require less felt effort (e.g., Deci & Moller, 2005). The theory focuses upon environmental or social conditions that allow intrinsic motivation to flourish within individuals, causing variability in the degree to which one acts according to their intrinsic motives. Individual difference in the relative strength of intrinsic (versus extrinsic) goals has been validated as a predictor of psychological wellbeing (Kasser & Ryan, 1993; 1996), with strongly intrinsically-motivated individuals characterized as more active and autonomous.

Sensitivity to Punishment and Reward. In Gray's (1981, 1982) "hypothetical nervous system," a model of CNS functioning derived from animal research, two antagonistic systems known as the Behavioural Activation System (BAS) and Behavioural Inhibition System (BIS) regulate, respectively, appetitive/approach-related responses and aversive/freezing-related responses to conditioned environmental stimuli (a third system is thought to regulate fight or flight responses to unconditioned aversive stimuli; e.g., Gray, 1987). The constructs of BIS and BAS comprise a well-validated parsing of basic motivation-related personality structure (e.g., Carver and White, 1994; Cloninger, 1987; Torrubia & Tobena, 1984). The BAS is thought to involve dopaminergic pathways (Depue & Collins, 1999) while the BIS involves the septohippocampal system, along with its brainstem afferents and frontal efferents (Gray, 1982). The emotional substrates underlying the functioning of the BAS and BIS are often thought of as positive affect (e.g., pleasure) and anxiety, respectively (e.g., Cacioppo, Gerdner & Berntson, 1999; Higgins, Shah & Friedman, 1997). However, recent findings suggest a more complex picture, with individual high in BAS also demonstrating increased trait anger (Harmon-Jones, Abramson, Sigelman et al., 2002) and frustration in response to thwarted effort (Corr, 2002), suggesting that the BAS is more generally an approach motivation system, governing all affect related to approach and effort and their possible sequelae (e.g., reward or thwarting), whether positive or negative.

Interestingly, Scholten, van Honk, Aleman et al. (2006) found significant elevations in BIS, but no significant difference in BAS, in a schizophrenia sample using a self-report measure by Carver and White (1994), suggesting that avolition in schizophrenia may best be thought of as resulting from an overabundance of anxiety and aversion, rather than a lack of impetus for approach. This possibility will be examined in the current research.

Maintenance of Internal Representations. Much research in cognitive neuropsychology has examined the overlap between cognition and volition. This research largely concerns the mental representation of goal states, intended actions, and reward.

For example, in the case of intended action that has not yet been initiated, an internal representation of the to-be-initiated action must be maintained. The ability to maintain such a representation and retrieve it in the appropriate context (e.g., to make note of a coming appointment and attend it at the correct time) is known as *prospective memory* (e.g., Burgess, Quayle & Christopher, 2001). Prospective memory is known to be impaired in schizophrenia, and this impairment is in turn likely connected to functional impairment (for a review, see Ordermann, Opper & Davalos, 2014), making prospective memory a candidate for a neuropsychological substrate for conative dysfunction in schizophrenia that will be examined currently.

In addition to the representation of future action, actions that have been initiated also require internal representation in order to be maintained and seen to completion. For example, the entire process of executing goal-directed action can been thought of in cognitive terms as a process of generating internal representations of desired external states, detecting mismatches between external reality states and these goal states, planning and executing action intended to reduce or eliminate this mismatch, and monitoring the consequences of this action. An interesting, relevant effect found in the literature on the representation of action is known as the *Zeigarnik effect*. In Zeigarnik's (1938) study, students were asked to complete a series of arbitrary tasks (e.g., math problems) and were prevented at random from completing half of them. It was found that, in a later incidental free recall task, the students were more likely to recall the uncompleted tasks than the completed ones. Zeigarnik interpreted this finding to indicate that incomplete intentions maintain more strongly activated representations in memory than completed ones, possibly as a mechanism to ensure their eventual completion (c.f.

Lewin, 1946). This effect is more pronounced in those with high need for achievement (Atkinson, 1953) and has been connected experimentally with intrinsic motivation – for example, showing a decline when external reward is introduced (McGraw & Fiala, 1982). The current study will seek to clarify its potential contribution to avolition in schizophrenia.

Frontal Executive Functions. The prefrontal cortex (PFC) governs the prioritization and allocation of cognitive resources and the initiation, switching and termination of action plans, both in cognitive activity and motor behaviour. These functions have clear overlap with volitional function, which by definition involves the higher-order control of action and thought, including planning, initiation and termination (e.g., Zhu, 2004). Cognitive functions related to this activity are collectively known as executive functions, and disturbance of their functioning has been referred to as the "dysexecutive syndrome." The overlap between executive and conative functioning is especially relevant to the examination of schizophrenia, in which avolition has been connected with executive task-specific frontal hypoperfusion in the PFC (Liddle et al., 1992), reduced resting-state connectivity in the PFC (Woodward, Karbasforoushan, & Heckers, 2012), and with a number of dysexecutive findings (e.g., Bozikas, Kosmidis, Kioperlidou et al., 2004; Fervaha et al., 2014).

Stuss and colleagues (e.g., Stuss et al., 2005; Stuss and Alexander, 2007; Alexander, Stuss, Picton et al., 2007) have proposed that, rather than a single "dysexecutive syndrome," there are multiple prefrontal functions subserved by discrete regions within the PFC (c.f. Miyake, Friedman, Emerson et al., 2000), and that focal lesioning of each of these regions will result in a distinct pattern of behavioural signs.

Their analysis of findings from multiple measures of attention, memory, task-switching, reaction time, and other neurocognitive indices has led them to propose that there are at least three major, regionally discrete PFC functions: “energization”, “task-setting” and “task-monitoring.” Energization, a process similar to Hockey’s (1993) concept of “effort,” refers to the process of initiating and sustaining neural activity despite a lack of (continuing) input from the external world. It involves the activity of superior medial (SM) cortical structures. Task setting refers to the establishment of relationships between particular stimuli and particular responses within a given task, and the concurrent suppression (where required) of competing or prepotent responses. This function involves the activity of the left lateral (LL) PFC, and especially its more ventral structures (see also Fletcher et al, 2001). Task monitoring refers to the process of examining ongoing action to ensure that responses and outcomes match desired end states, or “checking the task over time for ‘quality control’ and the adjustment of behaviour” (Stuss & Alexander, 2007, p. 909; see also Shallice, 2002). These functions involve the activity of right lateral (RL) PFC structures. Stuss’s scheme for dividing executive functions will be the focus of the current study, given its empirical derivation, its simplicity and specificity from an assessment point of view and its validation according to well-defined functional divisions of the PFC.

Recent Views on Conative Dysfunction in Schizophrenia

The recent research, reviewed above, demonstrating the particularly debilitating nature of the negative symptoms of schizophrenia has sparked renewed research and clinical interest in conative dysfunction, RGDA and related phenomena. Current models for conative dysfunction in schizophrenia tend to be neurocognitive in focus. For example, Mann, Footer, Chung et al. (2013) found evidence for abnormalities in the maintenance of the internal representation of reward in schizophrenia. These authors found that participants with schizophrenia failed to display expected performance-enhancing context effects observed in controls when non-rewarded trials were interspersed within-block with rewarded trials in a picture identification task. They interpreted these findings to indicate that the maintenance of dorsolateral and parietal activation leading to such context effects in controls (Beck et al., 2010; Jimura et al., 2010) are deficient in those with schizophrenia. However, these authors presented blocks of rewarded and unrewarded stimuli in a fixed order between subjects, and the attenuation of the context effect in their findings may be conflated with learning effects, which are also well established to be impaired in schizophrenia generally, and in the context of goal pursuit in particular (e.g., Reinen, Smith, Insel et al., 2014).

Several researchers have also highlighted the importance of the mesolimbic dopaminergic system in potentiating action via computation of the anticipated pleasure or reward a task offers, relative to the effort necessary in carrying it out. This role of the mesolimbic dopamine system was outlined by Schultz (2002) and accords with the findings of Salamone et al. (1994), who found that rats with reduced dopamine in the nucleus accumbens tended to make easier but less rewarding choices in a T-maze paradigm, supporting a role for nucleus accumbens dopamine in computing or exerting effort for reward. Similar findings have been made in humans in a computerized decision-making paradigm (Treadway, Buckholtz, Schwartzman et al., 2009). This effect in humans has been connected with striatal and ventromedial PFC dopamine functioning (Treadway, et al., 2012), anhedonia (Treadway et al., 2009; Treadway, Buckhotlz, Cowan et al., 2012; Treadway, Bossaller, Shelton et al. 2012) and poorer functional outcomes in schizophrenia (Barch, Treadway & Schoen, 2014).

In keeping with these findings, and the well-known hypothesis of reduced cortical dopamine in schizophrenia as a substrate for negative symptoms (e.g., Abi-Dargham, 2004), it has often been observed that those with schizophrenia have an intact capacity for experiencing pleasure in response to rewarding stimuli (e.g., Burbridge and Barch, 2007; Cohen & Minor, 2010; Strauss & Gold, 2012; Kring & Moran, 2008), but nonetheless fail to translate this capacity into impetus for future action (Fervaha, Foussias, Agid et al., 2013a; Gold, Strauss, Waltz et al., 2013; Ursu, Kring, Gard et al., 2011). Indeed, individuals with schizophrenia have shown greater levels of what is termed “anticipatory anhedonia,” or an inability to anticipate reward or pleasure, than in what is termed “consummatory anhedonia” or an inability to enjoy what one is doing in the moment in several studies (Chan, Wang, Huang et al., 2010; Favrod, Ernst, Giuliani et al., 2009; Gard, Kring, Gard et al., 2007). These concepts map closely onto Berridge and Robinson’s (2003; Berridge, 2004) concepts of “wanting” and “liking,” each of which have separable neural substrates, with “wanting” (or anticipating pleasure if a goal is pursued) uniquely involving the dopaminergic system (Berridge & Robinson, 1998). Training in anticipatory pleasure appraisal, furthermore, has efficacy in treating negative symptoms of schizophrenia (Favrod, Giuliani, Ernst et al., 2010), while typical antipsychotics, via their blocking of prefrontal dopamine D2 receptors, tend to exacerbate or further reduce brain responses to cues for future reward (Juckel, Schlagenhauf, Koslowski et al., 2006). Gold et al. (2013) synthesized these findings by showing that individuals with schizophrenia tend to make less effortful, less rewarding decisions in a computerized decision-making paradigm, a phenomenon these authors correlated with negative symptoms. They interpret their findings to indicate that negative symptoms may be associated with abnormal cost-effort computations that undermine the initiation of volitional action in schizophrenia.

Alternative views, however, exist in that reduced hedonic reactivity to some stimuli have also been observed in schizophrenia, suggesting that some instances of *consummatory* pleasure may indeed be affected. For example, hedonic reactions to odours have been found to be either impaired or inconsistent in schizophrenia (Crespo-Facorro, Paradiso, Andreasen et al., 2001; Hudry, Saoud, d'Amato et al., 2002; Kamath, Moberg, Kohler et al., 2013; Plailly, d'Amato, Saoud et al., 2006) and in schizotypy (Auster, Cohen, Callaway et al., 2014). Further, Gard, Sanchez, Cooper et al. (2014), using an experience sampling method, found that participants with schizophrenia actually anticipated *more* reward in-situ than controls in accomplishing daily goals, despite notable impairments in effort allocation. This finding is opposite the typical findings noted above. Similarly, Strauss et al. (2011) failed to replicate the typical finding of reduced self-reported anticipatory pleasure in schizophrenia, finding rather that consummatory pleasure was decreased in their schizophrenia-diagnosed sample, and that anticipatory pleasure was comparable to that of controls. These inconsistent findings remain unaccounted for, but may reflect the heterogeneity of schizophrenia and the variety of motivational and volitional impairments that it may entail across various individuals – an issue that the current study seeks to address.

Notably, in examining particular aspects of conative dysfunction in isolation, the above-reviewed studies do not permit comparison across multiple factors possibly contributing to the difficulties observed in schizophrenia.

The Current Study: Synopsis

The above-reviewed literature points toward a number of volitional and motivational functions that potentially underlie conative dysfunction in schizophrenia. Some of these facets have theoretical links with schizophrenia via the behaviours or brain structures that they impact, while others have been shown empirically to be impacted within schizophrenia. Despite the growing body of clinical research and theoretical work on volition and motivation in general, and of these faculties as they pertain to schizophrenia in particular, studies of conative dysfunction in schizophrenia have typically examined only one factor at a time, leading to fragmented and, at times, conflicting accounts of which conative functions are affected in schizophrenia. It is possible that several such functions are related to one another and are together impacted in schizophrenia, or that different individuals with schizophrenia show different patterns of conative dysfunction. It is also unclear, at present, which conative functions are most impacted in schizophrenia. As these functions are typically only examined individually, conclusions regarding their comparative deleterious impact are difficult to draw. Indeed, it is possible that all conative functions are more or less equally impaired in schizophrenia, or that groups of functions tend to be impacted together within heterogeneous groups of individuals, reflecting some underlying commonality.

The heterogeneity of conative dysfunction, in summary, is evident in the number and variety of distinct volitional and motivational factors reviewed above. The heterogeneity of schizophrenia is well established, and has recently been bolstered by genetic evidence for discrete genotypes with potential implications for corresponding schizophrenia phenotypes (Arnedo, Svrakic, del Val et al., 2014), making the possible heterogeneity of conative dysfunction within schizophrenia especially likely and relevant.

The current study addresses these issues using a novel approach. Conative dysfunction in schizophrenia will be examined as a potentially multifaceted phenomenon by examining a wide range of conative functions simultaneously; relating these functions to one another, to gross reductions in goal-directed activity (i.e., the primary behavioural outcome defined above; RGDA), as well as to potential subtypes of individuals with schizophrenia. These goals will be accomplished in a series of steps:

1) The exploration of potential conative “types” within schizophrenia. Are there meaningful groupings of individuals who differ in important regards according to conative functions? A cluster analysis will be performed to answer this question, through which new groupings of individuals within schizophrenia may emerge. All of the factors identified as volitional or motivational in Figure 1 will be entered into this analysis. Information about which specific variables discriminate these groupings from one another, and which functions are related within each grouping, will be generated. This new typology could potentially allow clinicians to more meaningfully distinguish the different kinds of conative difficulties that manifest within schizophrenia, providing opportunities for more targeted treatment planning.

Further data analyses will be based upon any typology that emerges from the cluster analysis to allow the examination of conative functioning within more homogeneous subgroups of individuals, with a view towards making empirically derived distinctions within what has been considered a remarkably heterogeneous population. This further analysis will also assist in avoiding the designation of subgroups that lack any discriminant validity; an important consideration given that cluster analysis can produce an arbitrary number of clusters with varying degrees of practical utility.

It is hypothesized that two clusters will emerge, reflecting the aforementioned division between motivation and volition – with one cluster showing decreased motivation and the other showing intact motivation but decreased volitional ability represented by poor frontal executive functioning, state orientation, increased delay discounting, or some combination of these. This hypothesis is based on clinical observation and the important distinctions between these two conative factors as described above.

2) The characterization of conative dysfunction within schizophrenia. This goal will be addressed by profile analysis. Specifically, the parallelness of profile plots created by the levels of each predictor measure will be contrasted between clinical and control samples to determine whether certain measures characterize schizophrenic conative dysfunction more so than others, or whether those diagnosed with schizophrenia are universally impaired across measures. Separately entering any clusters emerging from the cluster analysis in step one will assist in validating these clusters, as described above, and will shed light on any unique patterns of conative dysfunction expressed by subgroups within schizophrenia. It is hypothesized that specific conative functions will be impacted in different clusters, in line with the study's first hypothesis.

3) The prediction of RGDA in individuals diagnosed with schizophrenia via each conative function of interest. This aspect of the current study will examine the various factors in terms of their ability to account statistically for RGDA. Those variables that are most strongly predictive of RGDA, over and above other variables, will be considered ideal targets for intervention, given their contribution to impairing outcomes. Multiple regression techniques will be employed to this end. A parallel set of analyses will be conducted in the control sample to reveal which factors are related to RDGA in schizophrenia in particular, and which ones are more universal.

In summary, the overarching goal of the current study is to address the likely possibility that conative dysfunction in schizophrenia is multifaceted – that several distinct conative functions are impacted to a greater or lesser degree, while simultaneously addressing the possibility that the schizophrenia population is itself heterogeneous, with different individuals experiencing different patterns of conative dysfunction that may not be apparent when viewed as a group. This novel, compound approach of examining heterogeneity both across conative functions and across individuals, it is hoped, will produce a more nuanced view of how to best conceive of conative dysfunction within schizophrenia.

METHODS

Participants

Clinical Sample

Outpatient participants with diagnoses of schizophrenia were recruited for the study. Recruitment sites included the Centre for Addiction and Mental Health (CAMH) Schizophrenia Program and St. Joseph's Healthcare, Hamilton (SJHH).

CAMH is a large psychiatric research hospital located in Toronto, Ontario. Participants at this site were recruited by various means, including a registry of clients who had given consent to be approached for participation in research studies, lists of participants from prior research studies who had provided such consent, flyers distributed by researchers performing other research studies including details of the current study and the researchers' contact information, and by being approached by researchers while waiting to participate in other research studies. Flyers were distributed by various research staff at CAMH. All other potential participants were contacted by phone by members of the current study's research personnel. All CAMH participants were screened by phone or in person up to two weeks prior to participation by study personnel to confirm that they met inclusion criteria.

SJHH is a research and teaching hospital located in Hamilton, Ontario. Participants at SJHH were recruited from a registry of clients at a hospital-affiliated community treatment centre for schizophrenia (Community Schizophrenia Services: CSS). These clients had provided consent to be approached for participation and were contacted by a research coordinator at SJHH. These clients had previously been screened to confirm a diagnosis of schizophrenia or schizoaffective disorder in a separate testing session within 24 months of participation and were re-screened by phone by the SJHH research coordinator within one week of participating to ensure that they met the current study's inclusion criteria.

Inclusion/Exclusion Criteria. In order to be included in the clinical sample, participants had to carry a DSM-IV-TR diagnosis of schizophrenia or schizoaffective disorder, confirmed via the administration of the Mini International Neuropsychiatric Interview (MINI; LeCrubier, Sheehen, Weiller et al., 1997), and be 18 years of age or older. Exclusion criteria included; any history of traumatic brain injury with accompanying loss of consciousness lasting longer than five minutes or with accompanying cognitive symptoms, any clinical diagnosis of other ongoing neurological disorder, any history of substance or alcohol related disorder unremitted within one month of testing as assessed by the MINI, and any current major depressive episode.

Sample Characteristics. In the clinical sample, 63 chronic schizophrenia outpatients were recruited. Four of these were excluded from participation following the prestudy screen or administration of the MINI; two due to recent changes in medication regimen, one because of a questionable diagnosis (the participant made no endorsement of current or historical symptoms meeting DSM-IV-TR criteria for schizophrenia), and one because of a history of severe head trauma. Of the remaining 59 clinical participants, two withdrew from testing before completing the procedure and did not return for a follow-up appointment, resulting in a partial loss of data. 28 of the 59 clinical participants were recruited and tested at SJHH, and the remaining 31 were recruited and tested at CAMH. Six of the participants in this sample had a primary clinical diagnosis of schizoaffective disorder while the remainder carried a clinical diagnosis of schizophrenia.

The mean age of the clinical sample was 44.6 years. The sample was composed of 41 males (mean age = 44.6) and 18 females (mean age = 44.6), a 7:3 male to female ratio typical in outpatient schizophrenia settings (Usall, Araya, Ochoa et al., 2001). Full details on this sample's demographic and clinical characteristics, including medication data, are included in Tables 1 and 2.

Table 1. Clinical characteristics of clinical and control samples.

Variable	Clinical (n = 59)		Control (n = 63)	
	Mean	*SD*	Mean	*SD*
IQ (WASI-2 Two-Subscale Estimate)	94.3	16.7	107.7	16.3
Chlorpromazine Equivalent Dose (mg/d)	549.2	554.4	N/A	N/A
SCL-90-R Somatization	0.75	0.79	0.32	0.38
SCL-90-R Obsessive/Compulsive	1.16	0.82	0.49	0.45
SCL-90-R Interpersonal Sensitivity	1.06	0.78	0.41	0.45
SCL-90-R Depression	0.98	0.77	0.45	0.47
SCL-90-R Anxiety	0.72	0.67	0.27	0.42
SCL-90-R Hostility	0.50	0.61	0.27	0.46
SCL-90-R Phobic	0.67	0.82	0.11	0.27
SCL-90-R Paranoid	1.06	0.90	0.37	0.58
SCL-90-R Psychotic	0.87	0.82	0.23	0.43
POPS-m work/extrinsic activity (h/day)	5.0	2.6	9.6	4.0
POPS-m leisure/intrinsic activity (h/day)	1.5	1.3	1.7	1.0
Comorbid Diagnoses on MINI	*n*		*n*	
Depression (History)	22		6	
Manic or Hypomanic episode (History)	16		3	
Generalized Anxiety Disorder	1		2	
Panic Disorder	2		0	
Bulimia Nervosa	2		0	
Obsessive-Compulsive Disorder	1		0	
Posttraumatic Stress Disorder	1		0	
Social Phobia	1		0	
Dysthymia	0		1	

Table 2. Demographic summary of clinical and control samples.

Variable	Clinical (n = 59)		Control (n = 63)	
	Mean	*SD*	Mean	*SD*
Age	44.6	9.33	45.7	12.21
Disposable Income Per Month ($)	405.85	549.28	835.71	1,607.02
Education	%		%	
Some Secondary	18.6		4.8	
Finished Secondary	16.9		4.8	
Some Postsecondary	40.7		33.9	
Bachelor's or Equivalent	22.0		38.7	
Master's Degree	1.7		12.9	
Doctoral Degree/Postdoctoral	0.0		4.8	
SES – Family of Origin	%		%	
Lower Class	45.5		41.9	
Middle Class	41.8		37.7	
Upper-Middle Class	7.3		14.8	
Upper Class	5.5		4.9	
Ethnicity (Self-Identified)	%		%	
"White" (non-specified), "European"	55.9		52.4	
"East Asian," "Southeast Asian"	5.1		12.7	
"Black" (non-specified), "African"	8.5		6.3	
"Canadian"	10.2		3.2	
"South Asian"	1.7		6.3	
"Caribbean"	6.8		0.0	
"Hispanic," "Latin"	1.7		3.2	
"Native"	3.4		0.0	
"Mixed"	1.7		1.6	
Unspecified	5.1		0.0	
%Female	30.5		34.9	

Control Sample

Control participants without a history of any psychotic disorder were recruited from a number of sources. Community participants living in the Greater Toronto Area responded to ads posted on classified websites Craigslist and Kijiji, or were recruited by study personnel via word-of-mouth. Others were recruited at CAMH via a list of healthy control participants from other research studies who had consented to be contacted for future studies, and the remainder was recruited from the aforementioned research participant registry at CAMH. All control participants were phone-screened up to two weeks prior to participation by study personnel to confirm that they met inclusion criteria. The control sample was selected to match the clinical sample as closely as possible in mean age and gender.

Inclusion/Exclusion Criteria. In order to be included in the control sample, participants needed to demonstrate a lack of psychotic disorder diagnosis as assessed by the MINI and be 18 years of age or older. Exclusion criteria were otherwise identical to those applied to the clinical sample.

Sample Characteristics. In the control sample, 66 individuals were recruited. Three of these were deemed ineligible following the prestudy screen or administration of the MINI due to recent histories of substance-related disorders and/or current major depressive episodes. Of the remaining 63, one withdrew before completing testing, resulting in a partial loss of data. 49 of the 63 control participants were recruited from the community via postering, internet and word of mouth, and were tested at York University. Eleven were recruited via the CAMH research participant pool and tested at CAMH. Three were recruited via word of mouth and tested in their homes. The mean age of the control sample was 45.7 years. The sample was composed of 41 males (mean age = 43.7) and 22 females (mean age = 49.5). Full details regarding the clinical and demographic characteristics of the control sample can be found in Tables 1 and 2.

Procedures

Potential participants were contacted by study staff and screened by phone or in person to ensure that they met the study's inclusion and exclusion criteria, listed above. Potential participants were not reimbursed for the screening procedure.

Participants were greeted at the study site by study staff, led to a private testing room and seated across a table from the experimenter. They were asked to provide informed consent according to the requirements of the research ethics board of the institution where the testing took place. They were told that testing would involve interviews, questionnaires administered on a computer, and some tests of mental functions such as memory and attention. If they inquired about the purpose of the procedures, they were told that the study concerned psychological factors involved in goal-directed behaviour and that they would be informed of the purpose of individual tests after the study's completion. After providing informed consent, participants were assigned to one of two conditions to ensure counterbalancing of the Zeigarnik tasks described above, and were assigned an identification code. They were then administered the study measures in a fixed order, as listed below.

Testing was conducted in a single session that lasted approximately three hours. One control participant and one clinical participant did not complete the testing in a single session and returned to the study site within one week to complete the procedure in a separate session. At the end of the session, participants were paid a $25.00 remuneration and debriefed fully on any aspect of the study procedure that they inquired about. Participants from the York University Undergraduate Research Participant Pool were not remunerated but were awarded three course credits at the end of the procedure.

Measures and Calculation of Study Variables

Each measure included in the current study is described in this section, along with a rationale for its inclusion and description of the volitional or motivational construct it assesses. For a graphic summary of the constructs measured by each test and their relationship to one another, see Figure 1. Measures are described in the same order in which they were administered.

Pre-Study Interview

This interview was administered at the beginning of the procedure and included questions assessing inclusion and exclusion criteria, the participant's current psychoactive medications, history of psychiatric diagnoses and medical diagnoses that may affect volitional or motivational functioning (including chronic fatigue syndrome, endocrine disorders, sleep disorders, attentional disorders and neurological disorders). Participants were also asked to provide demographic data such as age, education level, ethnicity, family-of-origin household income, and current disposable monthly income.

From the prestudy interview, several demographic and clinical variables were drawn. These are summarized in Tables 1 and 2. Chlorpromazine equivalents for the clinical sample were calculated according to formulae derived by Atkins, Burgess, Bottomley et al. (1997), Bazire (2005), Woods (2003), and the American Psychiatric Association (2007). Family of origin socio-economic status (SES) was defined using self-reported income bands, with lower class defined as an annual income lower than $40,000.00, middle class as an income up to $100,000.00, upper-middle class as an income up to $200,000.00, and upper class as income greater than this. Other clinical and demographic variables were taken directly from self-report.

Multidimensional State Boredom Scale (MSBS)

Boredom proneness was examined in the current study given its strong correlation with avolition as described in the introduction, its putative status as an indicator of intact motivation, and its clear implications for volitional action; i.e., individuals who are highly prone to boredom may fail to persist in necessary activities given the aversive nature of this state. The MSBS (Fahlman, Mercer-Lynn, Flora & Eastwood, 2013) was selected to measure this construct, as a well-validated and easy-to-administer measure that is sensitive to changes in an individual’s immediate experience of boredom. The MSBS contains 29 items designed to measure the current experience of boredom. Each item is responded to on a seven-point Likert scale. It consists of five factor analysis-derived subscales related to disengagement, inattention, low- and high-arousal negative affect and altered time perception. The time perception subscale measures the experience of slowed passage of time, a reliable and distinctive feature of the experience of boredom (Danckert & Allman, 2005). This subscale was combined with an additional, reverse-keyed item, “I feel happily engaged in activity,” to create a shortened version of the MSBS (hereafter MSBS-revised, or MSBS-r). It was administered via computer after the pre-study interview and participants were asked to read each item and rate their agreement with the item by making a key press. It was re-administered at the end of the experimental procedure (approximately 2.5-3.5 hours later) in order to measure change in each participant's level of boredom throughout the study. The difference between the two administrations of the MSBS-r constituted the Boredom Propensity variable. This difference score constitutes an in-situ measure of proneness to boredom via exposure to a repetitive task and immediate assessment of the change in an individual's boredom, which does not rely on memory and insight, as do purely self-report measures of boredom proneness. In the current study, the reliability of the MSBS-s was $\alpha = .89$. See Appendix A for a list of items appearing on the MSBS-r.

Mini International Neuropsychological Interview (MINI)

The MINI (Sheehan et al., 1997) is a brief, semi-structured interview assessing psychiatric symptoms contributing to a variety of diagnoses within the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR; American Psychiatric Association, 2000). It was included in the current study to assess diagnoses related to inclusion and exclusion criteria within each sample, and to obtain an estimate of the prevalence of other psychological disorders within each sample. For control participants, and for clinical participants recruited from CAMH, the MINI was administered after the initial administration of the MSBS-r. For clinical participants recruited at SJHH, the MINI was administered during the initial pre-screening of participants.

Wechsler Abbreviated Scale of Intelligence, 2nd Edition (WASI-2)

The WASI-2 (PsychCorp, 2011) is a brief assessment of cognitive functioning that includes subscales of the Wechsler Adult Intelligence Scales, 4th Edition (WAIS-IV; PsychCorp, 2008). It provides an estimate of an examinee's intelligence quotient (IQ) and was used to assess IQ in the current study given its brevity and well-established validity. The two-subscale version of the WASI-2 that was used in the current study includes a Vocabulary task, in which examinees are asked to provide definitions for words, and a Matrix Reasoning task, in which examinees are asked to choose among several visual images the one that best completes a pattern within a matrix. It was administered after the MINI (or MSBS-r, in the case of SJHH participants).

Frontal Executive Battery

After completing the WASI-2, participants performed four tasks designed to assess frontal executive functioning. These included three tasks from the Rotman-Baycrest Battery to Investigate Attention (ROBBIA; including Simple/Choice Reaction Time, Suppress, and Concentrate tasks), plus the Controlled Oral Word Association Task (COWAT).

The ROBBIA is a battery of computer-administered attentional tasks designed to assess the functioning of various frontal executive functions. Based upon a variety of existing anterior attentional network tasks, it was developed by Donald Stuss and colleagues based on their experiments with patients with focal PFC lesions (e.g., Stuss, Alexander, Floden et al., 2002; Stuss et al. 2005; Alexander et al., 2007). Indices of prefrontal executive functions identified by these authors were selected for the current battery according to their discriminant power and specificity to the brain regions underlying each function according to these authors' architectonic localization procedure (details in Stuss et al., 2005). These include the superior medial areas underlying energizing (including the anterior cingulate cortex and supplemental motor area), left lateral (especially ventrolateral) areas underlying task setting, and right lateral areas underlying task monitoring. The COWAT, a component of the Halstead-Reitan test battery, was likewise included in the battery given the findings of Stuss & Alexander (2007) that it discriminated patients with superior medial PFC lesions.

Each of the three frontal functions (energizing, task setting and task monitoring) was defined operationally by an index score (i.e., the Energizing Index, Task Setting Index and Task Monitoring Index). These scores were composed of multiple measures assessing the same function, and were employed to generate more stable and normally distributed estimates of functioning within each PFC region than individual measures might. The calculation of each component score (e.g., the Energizing Index was composed of components labeled E1, E2, and E3) is described under the heading of the executive battery task from which it was derived. The calculation of index scores is described after the task descriptions.

The tasks included in the battery were as follows:

Simple/Choice Reaction Time. (Stuss et al., 2005). This task involves reacting to an onscreen stimulus under two conditions: one in which identification of a stimulus is required (Choice RT), and one in which no such decision is required (Simple RT). The stimuli were the letters A, B, C and D in the Choice RT task, and the participant was asked to identify the stimulus with a key press ("1" in response to an "A", and "2" in all other cases). The stimulus in the Simple RT task was always an "A", and the response always a "1". Stimuli in each condition were displayed onscreen until a response was made. The interstimulus interval (ISI) varied semi-randomly between three and seven seconds, in full-second increments (randomization was conducted so that each ISI would be presented an equal number of times within each block). Blocks of fifty trials of each task were presented in a fixed order: Simple RT – Choice RT – Choice RT – Simple RT. Ten practice trials were presented prior to the first block of each task.

Data from the simple and choice reaction time tasks were incorporated into the first Energizing measure (E1) as follows. First, outliers were removed from the RT data following Stuss et al. (2005) by eliminating any RTs <150ms (given that this is insufficient time for the basic discrimination and motor response required in this task) and any RTs more than four standard deviations above the mean for that observation's condition (choice versus simple) and sample (clinical versus control). RTs for inaccurate responses on the choice RT task were also eliminated. Approximately 1% of observations were thus eliminated. Stuss et al. (2005) found a much-greater increase in reaction time (RT) for the more complex choice RT task than the simple RT task among those with superior medial (SM) PFC lesions. E1 was therefore calculated to reflect the increase in choice RT relative to simple RT, by dividing each participant's median RT in the choice task by their median RT in the simple task. Median RTs were used because of their stability and robustness (relative to mean RTs) to the skewed RT distributions typically observed in RT tasks.

The Task Monitoring measures, TM1 and TM2, were also calculated from scores in the simple/choice reaction time tasks. Stuss and Alexander (2007) found that, among right lateral (RL) PFC lesioned patients, a reversed foreperiod effect (Niemi and Naatanen, 1981) was observed in both the simple and choice RT tasks, whereas all other patient groups and controls in their analysis showed a robust, normal foreperiod effect. The foreperiod effect is the finding that, with increasing interstimulus intervals (ISIs), RTs in a variety of simple cognitive tasks tend to decrease. This is interpreted to indicate that a typical participant's readiness to respond to a stimulus increases as they must wait longer for the stimulus to appear. A reversed foreperiod effect, conversely, indicates that as ISI increases, RT also increases suggesting that the subject has failed to maintain readiness to respond over time. Vallesi, Shallice & Walsh (2007) confirmed the specific role of the RLPFC in producing the negative foreperiod effect in an rTMS study, and, interestingly, Mo & Kersey (1980) found no foreperiod effect in a schizophrenia sample. To measure these effects, TM1 and TM2 were calculated as follows. First, outliers were removed by eliminating any RTs <150ms and any RTs more than four standard deviations above the mean for that observation's sample (clinical versus control), task (simple versus choice RT) and ISI (short versus long). RTs for inaccurate responses on the choice RT task were also eliminated. Approximately 1% of observations were thus eliminated prior to analysis. TM1 and TM2 were then calculated as the difference in median RTs between long and short ISI trials in the simple and choice RT tasks, respectively. Long ISIs were defined as six and seven second ISIs while short ISIs were defined as three and four second ISIs.

Suppress. (Stuss et al., 2002; Alexander et al., 2007). In this task, participants were again asked to make a key press response to a stimulus shown on screen. The stimuli were letters of the alphabet and were coloured red or blue. Participants were asked to press the “1” key when the stimulus was a red “X” or a blue “O” (the “target” stimuli), and to press the “2” key for any other stimulus (including a blue “X” or red “O”; the “distractor” stimuli). They were first given ten practice trials with corrective feedback, then ten additional practice trials without corrective feedback, then two blocks of 102 trials each. In these two blocks, stimuli were shown in random order such that approximately 25% of stimuli within each block were targets, 25% were distractors, and 50% were other stimuli (i.e., letters others than “X” and “O”). Stimuli remained visible until a response was made and were presented at a randomized ISI of either 3 or 4 seconds.

The first task setting measure (TS1) was calculated based on performance in this task. Alexander et al. (2007) and Stuss and Alexander (2007) found that an increased rate of false negative responses to targets in the suppress task was specific to their LL lesioning patients. The total number of false negative responses to distractor stimuli made by each participant in this task was thus used to index task setting. Prior to calculating TS2, outliers were removed by eliminating any RTs <150ms and any RTs more than four standard deviations above the mean for that observation’s sample (clinical versus control). Approximately 1% of observations were thus eliminated prior to analysis. Data from one participant were missing due to computer error. Two participants yielded extreme outliers ($z > 5.0$) in this task, which were eliminated prior to calculating the overall Task Setting Index (described below) by resetting their values to equal the value of the next-highest observation, plus one, thereby retaining their rank order but eliminating any undue influence on the standardization.

Concentrate. (Stuss & Alexander, 2007). In this task, participants were seated in front of a serial response box (Psychology Software Tools, Inc.) with five buttons, each with a small lamp situated immediately above it. Participants were asked to depress each button as the lamp above it illuminated. Each response was followed immediately by the illumination of another lamp and another response. Participants were instructed to perform the task as quickly as they could and, in the event of an error, to continue on to the next trial without self-correction. Participants received 20 trials for practice, followed by 100 experimental trials.

The second energizing measure (E2) was calculated based on performance in this task. Stuss and Alexander (2007) found that RTs across all blocks of trials in the concentrate task were significantly were more elevated among patients with SM lesions than among any other patient group. To index this effect, median RTs from the concentrate task (excluding practice trials) were calculated for each participant. Prior to calculation, RTs greater than four standard deviations above the mean and RTs of zero were eliminated as outliers. Approximately 1% of observations were thus eliminated prior to analysis. Data from two participants were missing due to computer error.

The second task setting measure (TS2) was also calculated based on performance in this task. Stuss and Alexander (2007) found that the commission of errors in the concentrate task was predictive of left lateral (LL) PFC lesioning, and was not significantly elevated in any other patient group. The number of errors committed in the concentrate task by each participant was thus used to index task setting. Data from two participants were missing due to computer error.

Controlled Oral Word Association Task (COWAT). In the COWAT, examinees are asked to name as many words as they can that begin with a certain letter within one minute. The letters F, A, and S are provided in consecutive administrations and examinees are asked not to repeat words or roots with altered suffixes or to give proper nouns or names of numbers.

The third energizing measure (E3) was calculated based on the COWAT. Stuss, Alexander, Hamer et al. (1998) and Stuss & Alexander (2007) found that, among patients with focal SM lesions, performance in the latter 45 seconds of the verbal fluency task of the COWAT was significantly decreased relative to performance in the first 15 seconds of the same task. In order to index this relative decline, E3 was calculated as each participant's total correct responses in the first 15 seconds of each trial of the COWAT divided by their total correct responses in the latter 45 seconds.

Calculating Frontal Executive Indices. To create overall indices of functioning within each of the three PFC functions of interest, composite scores were calculated for energizing, task setting and task monitoring. This was accomplished by first standardizing scores within each individual measure in the control sample into a z score. This provided a common metric for the unbiased combination of individual measures within each index. Z scores within the clinical sample were then calculated using the control means and standard deviations, based on the assumption that these are more accurate reflections of population parameters. Z scores were then averaged across the individual indices within each function to produce a composite z score for that function (e.g., the Energizing Index is the mean of the z scores for E1, E2 and E3 for a given participant).

Prospective Memory Assessment

A series of verbal cues were used to assess prospective memory, in a method similar to that employed by Adda, Castro, Alem-Mare Silva et al. (2008). This method was chosen for its brevity relative to other prospective memory assessments. At fixed points in the test battery, participants were asked to perform an action at a specific future point in the assessment. There were two such tasks embedded in the test battery: 1) After completing the COWAT, participants were asked to remind the experimenter to check the time once they were finished a certain interview (the Subjective Experience of Negative Symptoms interview); 2) After completing the Zeigarnik task (described below), they were asked to remind the experimenter to check their phone for a message after the Participation Objective/Participation Subjective interview (also described below). If, at the appointed recall time, the participant failed to perform their appointed task, they were given five seconds to do so while the experimenter apparently busied him- or herself. After this time, the experimenter cued recall by asking the participant if there was something they were to remind them of.

Zeigarnik Tasks

A series of brief tasks, followed after a delay by a prompt to assess incidental learning of those tasks, were employed to assess the magnitude of the Zeigarnik effect.

Zeigarnik (1938), as detailed above, found that tasks left uncompleted by participants were more likely to be remembered in free recall than tasks that were completed. Specific tasks were chosen to be simple enough that individuals with lower intellectual abilities could easily master them, while still requiring enough steps that they afforded opportunities for prolonged effort, even with interruption.

The Zeigarnik procedure was introduced by informing participants that they were to perform a series of different tasks that may or may not be interrupted at an arbitrary point, that their performance on each task was not being evaluated, and that the purpose of these tasks would be explained after the study was complete. These instructions are consistent with the “informal” instruction set that has been established to produce the normal Zeigarnik effect, as opposed to “formal” instructions emphasizing the importance of strong performance and the identification of the series of tests as parts of a cohesive, overarching test, that are known at times to produce a reverse Zeigarnik effect (e.g., Claeys, 1969). Each task was followed by the experimenter asking the participant how much they enjoyed the task and how much effort they felt they put into completing the task, using five-point Likert scales.

The tasks were presented in random order and each sample was divided into two conditions, under which the three specific tasks to be interrupted were counterbalanced so that each task was interrupted in 50% of each sample. If a participant had sufficient difficulty completing a task that it was evident that they would not be able to complete it regardless of the time allotted, they were given a hint that explained the general principle that they appeared to misunderstand, but direct assistance (i.e., collaboration) was not provided. If a participant expressed a wish to give up or doubt that the task could be completed, they were given reassurance that they could complete it and encouraged not to give up. In cases where a subject could evidently not complete a task despite assistance and regardless of the amount of time allotted, the task was interrupted and another task remained uninterrupted instead. If a participant was able to complete a task before the experimenter had an opportunity to interrupt it (e.g., if they completed a puzzle within seconds of being given the puzzle), another task was interrupted instead.

Six tasks were included in the Zeigarnik procedure. They were selected in a pilot study according to several psychometric criteria, including incidental recall rate for the task less than 100% and greater than 0%, optimal intertask variability in recall rates, and time to complete the task that varied within acceptable parameters (tasks were excluded if they were completed too rapidly by some participants or too slowly by other participants). The six selected tasks included the following:

Anagrams. Participants were given a word (“chameleon”) and asked to produce ten anagrams based on this word with at least three letters each. In interrupted trials, the task was terminated after the participant produced five anagrams.

Word Search. Participants were given a grid of letters and asked to search for a list of ten words within the grid, indicating them by circling them. In interrupted trials, the task was terminated after the participant had found five words.

Jigsaw Puzzle. Participants were asked to complete a 20-piece jigsaw puzzle depicting a family of lions. In interrupted trials, the task was terminated after the participant had put together any ten pieces.

Car Puzzle. In this task (the puzzle game, “Rush Hour® Jr.” by Thinkfun), a set of plastic movers (cars) was placed on a grid in a fixed arrangement. The grid contained a gap along the perimeter and the participant’s task was to move a particular car across the grid and through the gap by re-arranging the obstructing cars according to rules. In interrupted trials, the task was terminated once the participant was evidently within two or three moves of completing the task (which required a minimum of ten moves to complete), or after several minutes of unsuccessful attempts.

Football Puzzle. Participants were given a set of three plastic shapes that, when fit together correctly, make a Canadian football shape. A diagram of a Canadian football was provided if the participant was unsure what this was or to distinguish it from a circular football. In interrupted trials, the task was terminated after the participant was within one move of completing the task (which required a minimum of two moves to complete).

Brick Task. In this task, participants were given twenty loose pieces of Lego® brand plastic bricks and a model of a small Lego® lighthouse that they were to reproduce using the loose bricks. In interrupted trials, the task was terminated after the participant had pieced together any ten bricks.

Participants were not given any explanation or feedback regarding each task. Following the second probe from the prospective memory procedure, described above, participants were asked to list as many of the Zeigarnik tasks as they could, whether completed or uncompleted, in any order. In order to help participants distinguish these from other tasks in the test battery, they were reminded that these tasks were each followed by questions about how enjoyable they were and how much effort they required.

The measure of interest in the Zeigarnik procedure was calculated as follows. Free recall for each task in the Zeigarnik Procedure was recorded for each participant. In some cases, not all tasks could be completed by a participant (e.g., some participants had difficulty understanding the basic principle of a given task). In certain other cases, participants completed a task that was meant to be interrupted (e.g., some participants were able to perform a task within a few seconds, preventing the experimenter from interrupting it). Such anomalies occurred in 12 participants' Zeigarnik protocols (<10%). Recall rates for completed and uncompleted tasks therefore had to take into account the number of completed and uncompleted tasks actually attempted by each participant. The Zeigarnik index for each participant was calculated as the ratio of the proportion of interrupted tasks recalled to the proportion of uninterrupted tasks recalled. A higher score on this index reflected a stronger Zeigarnik effect (i.e., a stronger tendency to preferentially recall interrupted tasks).

Participation Objective/Participation Subjective Scales (POPS)

The POPS (Brown, 2006) is a measure of participation in activities of daily living (ADLs) developed to assess rehabilitation efforts in a traumatic brain injury (TBI) population. It is conducted in a structured interview format and provides the examiner with self-reported estimates of the examinee's daily, weekly or monthly participation in activities in a wide array of domains including community, occupational and social activities (this is the Participation Objective component). It also provides indices of the amount of each activity the examinee would like to be engaged in and how important each activity is to their satisfaction with life (the disparity between these factors and the examinee's actual participation in activity constitutes the Participation Subjective component). The POPS was designed by amalgamating domains of activity from multiple existing measures of engagement in activity and was designed to examine the degree to which examinees feel they are able to actualize their activity-related goals in the face of disability related to TBI. It was chosen as a measure of RGDA given that it samples individual differences across a very wide variety of common goal-directed tasks, and given that the POPS Objective scale's basic, quantitative nature provides a metric for RGDA that is not confounded with negative symptoms themselves. For example, measures of functioning that solely assess one's satisfaction with their daily-goal directed activity may fail to capture RGDA among amotivated individuals, who may report satisfaction with their daily lives despite sometimes dramatic decreases in goal-directed action[4].

[4] There remains an interesting and valid question as to whether individuals lacking in motivation, who are therefore content with their relative inactivity and not suffering as a result of it, may be considered "disordered" or in need of intervention. The intention of the current work is not to presume that these individuals require intervention, but rather to form a broad conception of those factors leading to RGDA, whether these can be considered pathological or otherwise.

In the current study, the POPS was modified by adding several domains of activity relevant to non-TBI and chronic psychiatric populations (henceforth, this measure will be referred to as POPS-m). Some items added to the POPS-m were drawn from Harvey, Fossey, Jackson et al. (2006), while others were generated based on an unpublished pilot study in which the original POPS was administered with two chronic schizophrenia outpatients and 40 undergraduate students. Areas of goal-directed activity relevant to these participants that did not appear on the original POPS were either added, or existing items were modified to better reflect activities that these participants engage in. Items included in the POPS-m are summarized in Appendix B.

The POPS-m was further modified by adding a brief survey of factors that the examinee feels are restricting their ability to meet activity-related goals in the home, work, social and leisure domains. A list of potential barriers was provided and an open-ended question about additional barriers was employed. Barriers included were drawn from the related research of Jacksonn and Rucks (1993) and Reichert et al. (2007). Each barrier was rated by the participant in terms of how often the barrier impedes their goal-directed activity on a Likert scale from zero to three, where zero indicates “never” and three indicates “almost always.” Participants were also asked to indicate which domains of functioning were impacted by each barrier (options included home, work, social and leisure).

RGDA as assessed by the POPS-m Objective scales was calculated in two separate domains: work/necessity and intrinsic/leisure. This was done to distinguish between those goal-directed activities that are typically undertaken out of necessity or for extrinsic motives, in the former case, and those that are typically undertaken for one's own intrinsic enjoyment in the latter case. Examples of work/intrinsic activities on the POPS-m include working for money, doing housework, and caring for children. Examples of intrinsic/leisure activities include engaging in hobbies, participating in clubs, and writing for pleasure. Items related to social activity were not included in either index, as these items were considered likely to be confounded by non-conative factors such as social phobia, social withdrawal and stigma.

Scoring the two POPS-m indices of RGDA was done according to two metrics; the first of which followed the method of Brown (2006), the developer of the POPS. This involved transforming each time-per-month or frequency rating into a z-score, standardized across the clinical and control samples, then weighting each z-score by a factor reflecting the mean importance score assigned to the factor by the control sample. The rationale for using control sample importance scores in this index was that importance attached to goal-directed activities may itself be impacted by conative difficulty (e.g., those experiencing amotivation may consider goal-directed activity itself to be less important), which may bias the outcome measure. Z-scores are then averaged following the weighting procedure. The other method simply involved summing the number of hours spent in each activity (or frequency of the activity) per month, to give an overall and intuitive index of total time spent in goal-directed activity.

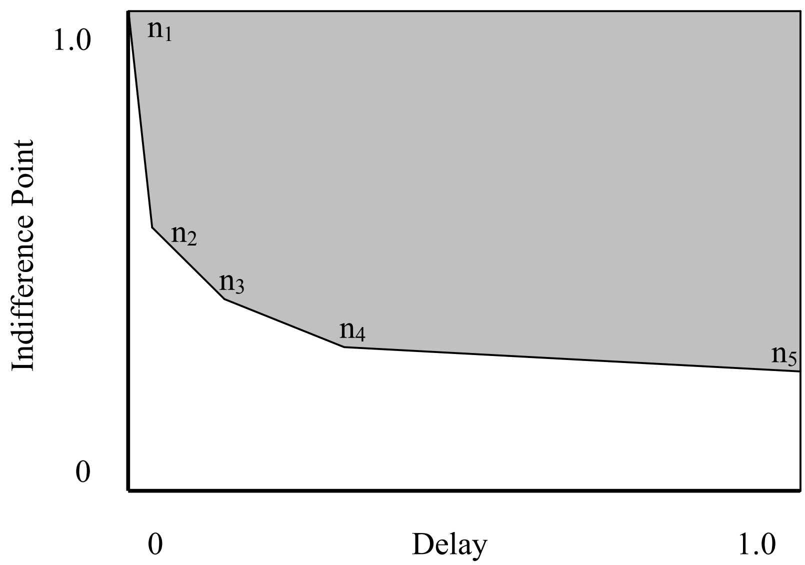
Finally, a measure of external barriers to goal-directed activity was calculated for each participant. This was done separately for barriers self-reported to impact functioning in domestic and work life (the "Extrinsic Barrier Index") and in leisure and recreation (the "Intrinsic Barrier Index"). Each index reflected the sum of self-rated barriers reported on the POPS-m resulting from disease-related stigma, physical disability, or "other" self-reported factors. These factors were chosen to reflect sources of RGDA that are clearly external to the negative symptoms of schizophrenia, as well as outcome variables, and not conflated with them (e.g., financial insolvency was not included in these indices as it is likely influenced by the presence of negative symptoms and also reflects an individual's amount of work activity). The purpose of the barriers measure was to control for factors influencing RGDA in regression models to achieve a measure more directly relevant to conative difficulty (i.e., to reduce error in these models).

Delay Discounting Task

A version of the delay discounting task created and validated by Basile (2012) was administered following the POPS-m interview and the aforementioned recall probes for the prospective memory and Zeigarnik tasks. In this task, participants were required to indicate whether they would prefer to receive a certain amount of money at a future time with variable delay, or some proportion of that amount immediately. This version of the task was chosen because it can be easily administered via computer, because it examines multiple reward values (as described below), and because it is typical of the tasks used most often in delay discounting paradigms.

This task involved 80 decisions, computer-administered in a binary, forced-choice format. Future (full) amounts presented in the task were $100.00 and $10,000.00. Immediate amounts varied from 10%-100% of the full amount and increased in increments of 10%. The temporal delays presented in the task included one month, six

Figure 2. Example of a temporal discounting curve. Each n corresponds to an observed data point. The shaded area corresponds to the 1-AUC value reported in the current findings. See text for details.



months, 10 years and 25 years. One trial each of the 80 crossings of these three conditions was presented in random order.

The dependent variable calculated from the delay discounting measure was one minus the area under the delay discounting curve (1-AUC). The delay discounting curve is a function consisting of each time delay examined in the procedure on the X axis, and "indifference points" for each delay on the Y axis (see Figure 2 for an example of a delay discounting curve). Indifference points indicate the proportion of the full amount that is equivalent in value to the future (full) amount: for example, if a participant selected the immediate amount when it was worth >50% of the future amount at a certain temporal delay, but selected the future amount when the immediate amount was worth <50% of the future amount, the indifference point for that temporal delay would be 50% or .5. Indifference points were thus calculated for each future amount × temporal delay crossing and plotted on a discounting function. The maximum delay in each function (25 years) and maximum (full) amount were standardized to 1.0. AUC thereby could vary between 0-1 and was calculated according to the following formula:

$$AUC = \sum_{n=1}^{n} (x_{n+1} - x_n) \bullet [(y_n + y_{n+1}) / 2]$$

where n = the number of each observed data point (in this case there were five points measured per discounting curve), and x and y are values in coordinate space, with x corresponding to delay and y corresponding to the value of the indifference point.

This method for calculating discounting was developed and validated by Myerson, Green & Warusawitharana (2001) as a theory-neutral method that requires no assumptions about the shape of the discounting function and produces normally-distributed output, as opposed to curve-fitting procedures (e.g., Mazur, 1987), which typically generate highly skewed data distributions. Smaller AUCs indicate greater delay discounting, therefore the final discounting measure was calculated by subtracting AUC from one. Discounting was calculated separately for each full amount due to evidence of varying rates for large and small future amounts (Green, Myerson & McFadden, 1997), and the median of the two values was used as the final measure of delay discounting. Participants who responded unreliably (e.g., by invariably selecting the immediate amount) were excluded from the analyses (n = 10).

Self-Report Battery

Following the Delay Discounting task, a series of thirteen self-report measures were administered by computer. Participants were given general instructions to read instructions for each section carefully and make their responses by making a keystroke. The measures were administered in the following order:

Aspirations Index (AI). The AI (Kasser & Ryan, 1996) was included because it measures motives according to one of the most significant distinctions in the motivational literature; that of intrinsic versus extrinsic motivation, central to Self Determination Theory as outlined in the introduction. The AI is an inventory that assesses the importance of various life goals to an individual. These are divided into seven broad areas, six of which were included in the current study: Wealth, fame, image, personal growth, relationships and community. These six specific goal categories, according to the authors, fit into two broader factors of three goal categories each, termed extrinsic and intrinsic aspirations, respectively. Each category contains five specific goals; for example, “to be a very wealthy person” and “to grow and learn new things”. Each goal in the AI is responded to on a seven-point Likert scale according to its importance to the examinee. These indices were calculated according to the authors’ instructions and provided the data for the Intrinsic Motivation and Extrinsic Motivation variables. In the original AI, examinees are also asked to indicate the likelihood with which they feel they will attain the goal and the degree to which they already have attained it, however these measures were excluded from the current study. In the current study, the reliability of the AI extrinsic and intrinsic aspirations scales were both $\alpha = .92$.

Sensitivity to Punishment/Sensitivity to Reward Questionnaire (SPSRQ). The SPSRQ (Torrubia, Avila, Molto et al., 2001) was included in the current study as a measure of motivation along the second major distinction drawn in the introduction from the motivational literature – that of behavioural inhibition versus activation. It is a 48-item inventory assessing these two aspects of Gray's (1981, 1982) motivational model. These systems are, according to the authors, the physical substrates that underlie individual sensitivity to reward and punishment, respectively. Each of these dimensions is assessed with 24 items, responded to in a yes/no format. Sample items include, "Does the good prospect of obtaining money motivate you strongly to do some things?" and "As a child, were you troubled by punishments at home or in school?" This measure was chosen due to its improved psychometric properties over pre-existing measures (Torrubia et al., 2001). In the current study, the reliability of the sensitivity to punishment and sensitivity to reward scales were α = .83 and .74, respectively.

Temporal Experience of Pleasure Scale (TEPS). The TEPS (Gard et al., 2006) is a measure that distinguishes hedonic responses to activities and stimuli from the expectation of such responses, assessed respectively by "consummatory" and "anticipatory" subscales. The relevance of these constructs to goal pursuit in schizophrenia (especially as measured by this specific tool) is well-established, as laid out in the introduction. It contains 18 items responded to on a six-point Likert scale, with 10 items in the anticipatory scale and eight in the consummatory subscale. Sample items include "when I think about eating my favourite food, I can almost taste how good it is" and "I love the sound of rain on windows when I'm lying in my warm bed". In the current study, the reliability of the consummatory and anticipatory hedonism scales were α = .75 and .76, respectively.

Symptom Checklist 90, Revised (SCL-90R). The SCL-90R (Pearson, 1994) is a self-report inventory that assesses symptoms in nine areas of psychopathology, including somatization, obsessiveness/compulsiveness, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. It also includes global indices of symptomatology and distress and validity indices. Examinees respond to ninety symptom-related items on a four-point Likert scale according to the severity of each symptom. This measure was included in the current test battery as an index of general psychopathology within each sample for the purposes of sample description.

Action Control Scale (ACS). The ACS (Kuhl, 1994) is an English translation of Kuhl's original scale, the "Handlungskontrolle nach Erfolg, Mißerfolg und Prospektiv" (HAKEMP-90; Kuhl, 1990). It was included in the current study as a well-validated measure of two distinct forms of avolition, referred to as "state orientation" as laid out in the introduction, which has not yet been applied to a schizophrenia sample. The ACS consists of 36 items assessing individual differences in psychological barriers to the completion of volitional action, following Kuhl's (1981) theory of action control. In this scheme, failures to initiate intended actions are parsed into three types, each measured by a 12-item subscale: hesitation, preoccupation, and volatility. In the current study, the revised 22-item version of Diefendorff et al. (2000) was employed given its brevity and validity, which these authors established via factor analysis and other techniques. Each item consists of a binary forced choice, with one alternative representing "action orientation" and the other representing "state orientation", Kuhl's terms for personality traits underlying successful volitional action versus avolition. Examples include: "when I am getting ready to tackle a difficult problem: (a) It feels like I am facing a big mountain that I don't think I can climb, (b) I look for a way that the problem can be approached in a suitable manner," and: "when I am told that my work has been completely unsatisfactory: (a) I don't let it bother me for too long, (b) I feel paralyzed." In the current study, the reliability of the hesitation and preoccupation scales were $\alpha = .78$ and .81, respectively. The volatility scale was not included due to its unclear empirical status and findings of poor reliability.

Temperament and Character Inventory, Self-Directedness Scale (TCI-SD). The TCI (Cloninger & Svrakic, 1994) is a personality inventory assessing four "temperaments" and three "characters". The Self-Directedness scale assesses one of these "characters", a personality trait related to self-determined action. This trait, a facet of volitional functioning, has been found to be low among those high in schizotypy (Laidlaw, Dwivedi, Nato et al., 2005) and was therefore included in the current study as an index of a form of volitional dysfunction that may have special relevance among those with schizophrenia. The TCI-SD consists of 44 items in a true/false format. Examples include "I have many bad habits that I wish I could break" and "Circumstances often force me to do things against my will." In the current study, reliability of the scale was $\alpha = .89$.

Behaviour Rating Inventory of Executive Functions-Adult Version (BRIEF-A). The BRIEF-A is a standardized measure designed to assess an adult's executive functions in his or her everyday environment (Roth, Isquith, & Gioia, 2014). It was included in the current battery to assess subjectively experienced executive difficulties with clear relevance to goal-directed functioning. It is composed of 75 items divided into nine clinical scales and two validity indices. Three of the clinical scales were included in the current study: Working Memory, Initiating, and Planning/Organizing. These scales were chosen to measure self-report of three aspects of volitional functioning as parsed by Kornhuber et al. (1989), as noted above: “what” is to be done, “when” it is to be done, and “how” it is to be done. In the current study, the reliability of the subscales were α = .87, .87, and .89, respectively.

Multidimensional State Boredom Scale (MSBS-r). The MSBS-r, described above, was administered again at the end of the test battery so that individual changes in state boredom could be measured. The difference score between the second and first administration constituted the boredom propensity measure used in analyses.

Data Analysis

Data were first scanned for outlying and out-of-range observations by looking at univariate histograms and descriptive statistics for each study variable. At this stage, only observations that resulted from data entry error, or outliers that resulted from inaccurate or inconsistent responding, were corrected or removed (e.g., some participants received maximal or minimal scores on self-report measures by making invariant responses across scales).

Different statistical strategies were employed to answer the study’s primary research questions, as laid out in the introduction. Missing data were handled in an analysis-by-analysis manner, given the varying constraints of the different analytic methods employed. In general, missing data management was conducted to maximize the number of observations contributing to each analysis without jeopardizing the test's validity.

Cluster Analysis

First, a hierarchical cluster analysis of the clinical sample was undertaken to determine if there are distinct clusters of individuals with schizophrenia who have specific areas of dysfunction. A hierarchical approach was chosen because no a priori evidence exists for any specific number of clusters that may be evident in the current data set. Each of the motivation and volition measures indicated in Table 3 were entered into the analysis in order to examine the heterogeneity of this sample along motivational and volitional lines.

Missing data in the analysis were handled by eliminating cases with missing cells. This approach was chosen because missing data imputation in cluster analysis may bias the formation of clusters by creating artificial mean centroids, imputed based upon grand means across observations that may not match empirically-derived cluster means (Everitt, 1993); also, in the current data set some individuals were missing large amounts of data, which may affect analysis regardless of the imputation method used. Ward's (1963) method for cluster formation was chosen given the continuous nature of all variables entered into the analysis and the goal of generating clusters with minimal within-cluster variability, which is expected to enhance the predictive value of cluster membership and

Table 3. Variables employed as independent/input variables in main data analyses.

Variable Name	Description
Energizing Index	Mean z-score of the three energizing tasks. Energizing refers to the superior medial PFC function of initiating and sustaining novel, effortful action. Higher scores indicate poorer energizing.
Task Setting Index	Mean z-score of the two task setting tasks. Task setting refers to the left lateral PFC function of establishing novel contingency relationships between signals and task-appropriate responses. Higher scores indicate poorer task setting.
Task Monitoring Index	Mean z-score of the two task monitoring tasks. Task monitoring refers to the right lateral PFC function of maintaining and, when necessary, correcting contingency relationships between signals and task-appropriate responses for the duration of a task. Higher scores indicate poorer task monitoring.
Delay Discounting	One minus area under the delay discounting curve. Delay discounting refers to the progressive devaluation of rewards as they occur further in the future. Higher scores indicate steeper discounting.
Zeigarnik Magnitude	Proportion of interrupted tasks recalled divided by proportion of uninterrupted tasks recalled. The classic Zeigarnik effect refers to better recall for interrupted tasks, hypothetically due to their lingering activation in memory. Higher scores indicate stronger Zeigarnik effect. Scores <1 indicate reversed Zeigarnik effect.
Prospective Memory	Sum of recall scores for the two prospective memory tasks. Prospective memory refers to the ability to remember to perform tasks at some future time or within some future context. Higher scores indicate better prospective memory (however, scores were reversed prior to profile analyses, wherein higher scores indicate poorer prospective memory, in accordance with other cognitive measures).
BRIEF Initiate*	Total score on the Behavioral Rating Index of Executive Functions (BRIEF) Initiation Subscale. Initiation refers to the self-reported ability to engage in novel, effortful tasks. Higher scores indicate greater difficulty initiating tasks.
BRIEF Working Memory*	Total score on the BRIEF Working Memory Subscale. Working memory, in this context, refers to the self-reported ability to maintain performance in a task amid distractions, to multitask, or to divide attention among tasks. Higher scores indicate greater difficulty maintaining attention and effort.
BRIEF Plan/Organize*	Total score on the BRIEF Planning and Organization Subscale. This subscale measures one's self-reported ability to sequence and prepare for novel activity. Higher scores indicate greater difficulty planning and organizing tasks.
Extrinsic Motivation	Total score across the Aspirations Index (AI) Extrinsic subscales. Extrinsic motivation refers to one's traitlike tendency to be motivated by externally-imposed reward, punishment, or perceived necessity. Higher scores indicate greater motivation by extrinsic goals (e.g., wealth).

Intrinsic Motivation	Total score across the AI Intrinsic subscales. Intrinsic motivation refers to one's traitlike tendency to be motivated by goals that are valued in and of themselves, without external imposition. Higher scores indicate greater motivation by intrinsic goals (e.g., growth).
Punishment Sensitivity	Total score on the Sensitivity to Punishment/Sensitivity to Reward Questionnaire (SPSRQ) Punishment Sensitivity subscale. Punishment Sensitivity refers to one's traitlike tendency to be motivated by fear and avoidance (i.e., away from negative outcomes). Higher scores indicate greater sensitivity to punishment or aversive outcomes.
Reward Sensitivity	Total score on the SPSRQ Reward Sensitivity subscale. Reward Sensitivity refers to one's traitlike tendency to be motivated toward objects or positive outcomes. Higher scores indicate greater sensitivity to reward or appetitive outcomes.
Anticipatory Pleasure	Total score on the Temporal Experience of Pleasure Scales (TEPS) Anticipatory scale. Anticipatory pleasure refers to the traitlike ability to anticipate rewarding outcomes, while anticipatory anhedonia refers to a deficit in this ability. Higher scores indicate greater anticipatory pleasure.
Consummatory Pleasure	Total score on the TEPS Consummatory scale. Consummatory pleasure refers to the traitlike ability to enjoy rewarding outcomes when they are incurred, while consummatory anhedonia refers to a deficit in this ability. Higher scores indicate greater anticipatory pleasure.
(Lack of) Self Determination	Total score on the Traits and Characteristics Inventory, Self Determination (TCISD) scale. Self Determination refers to one's traitlike appraisal of agency, meaningful action, and an internal locus of control, as opposed to control by negative habits or circumstances. Higher scores indicate greater feelings of *lack* of self-determination.
State Orientation: Preoccupation	Total score on the Action Control Scale (ACS) Preoccupation scale. Preoccupation refers to the inability to engage in novel action (i.e., avolition) due to failures to disengage from negative affect or ruminative processes. Higher scores indicate more state-orientation due to preoccupation.
State Orientation: Hesitation	Total score on the Action Control Scale (ACS) Hesitation scale. Hesitation refers to the inability to engage in novel action (i.e., avolition) due to low levels of positive affect. Higher scores indicate more state-orientation due to hesitation.
Boredom Propensity	Difference between total scores on the first and second administration of the Multidimensional State Boredom Scale, revised (MSBS-r). Boredom propensity refers to the traitlike vulnerability to the experience of boredom. Higher scores indicate greater increase in boredom. Negative scores indicate a decrease in boredom.

*Variables were collapsed before entering into regression analyses.

make it more practical to assess in a clinical setting. Squared Euclidian distance was used as a proximity measure given its satisfaction of the major assumptions underlying Ward's method and its performance in simulation studies (e.g., Scheibler & Schneider, 1985; Everitt et al., 1993). To determine the number of clusters that best fit the data, while avoiding making arbitrary decisions, the differences between the within-cluster error values at which each cluster was (a) formed, and then (b) combined into a larger cluster, were examined and the cluster number at which this value was largest was chosen, following the method recommended by Romesburg (1990).

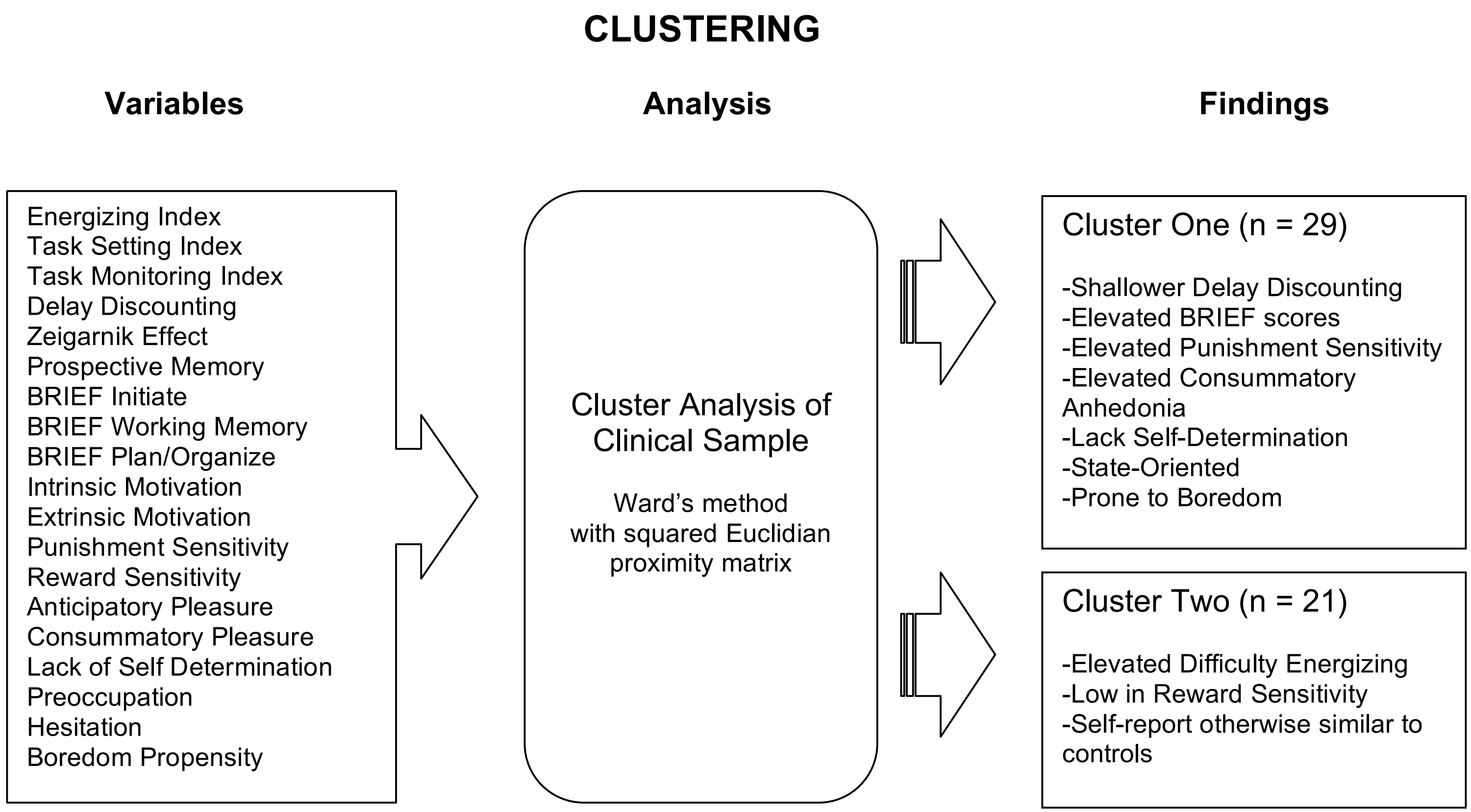
Differences between clusters, and the validity of the clustering procedure, were assessed by conducting a series of MANOVAs and follow-up contrasts, as part of the profile analysis detailed below. This way, cluster membership could be evaluated for its predictive value and its validity as a scheme for understanding the heterogeneity of conative dysfunctions in schizophrenia. Nonsignificant cluster differences across these variables may indicate that the clusters are spurious or clinically insignificant.

For a graphic summary of the cluster analysis procedure and its basic findings, see Figure 3.

Profile Analysis

In order to determine which of the variables in Table 3 best differentiate conative functioning in schizophrenia from conative functioning in controls, a profile analysis was conducted. Standardized mean scores on each variable were contrasted between the control and schizophrenia samples to determine areas of conative functioning that are

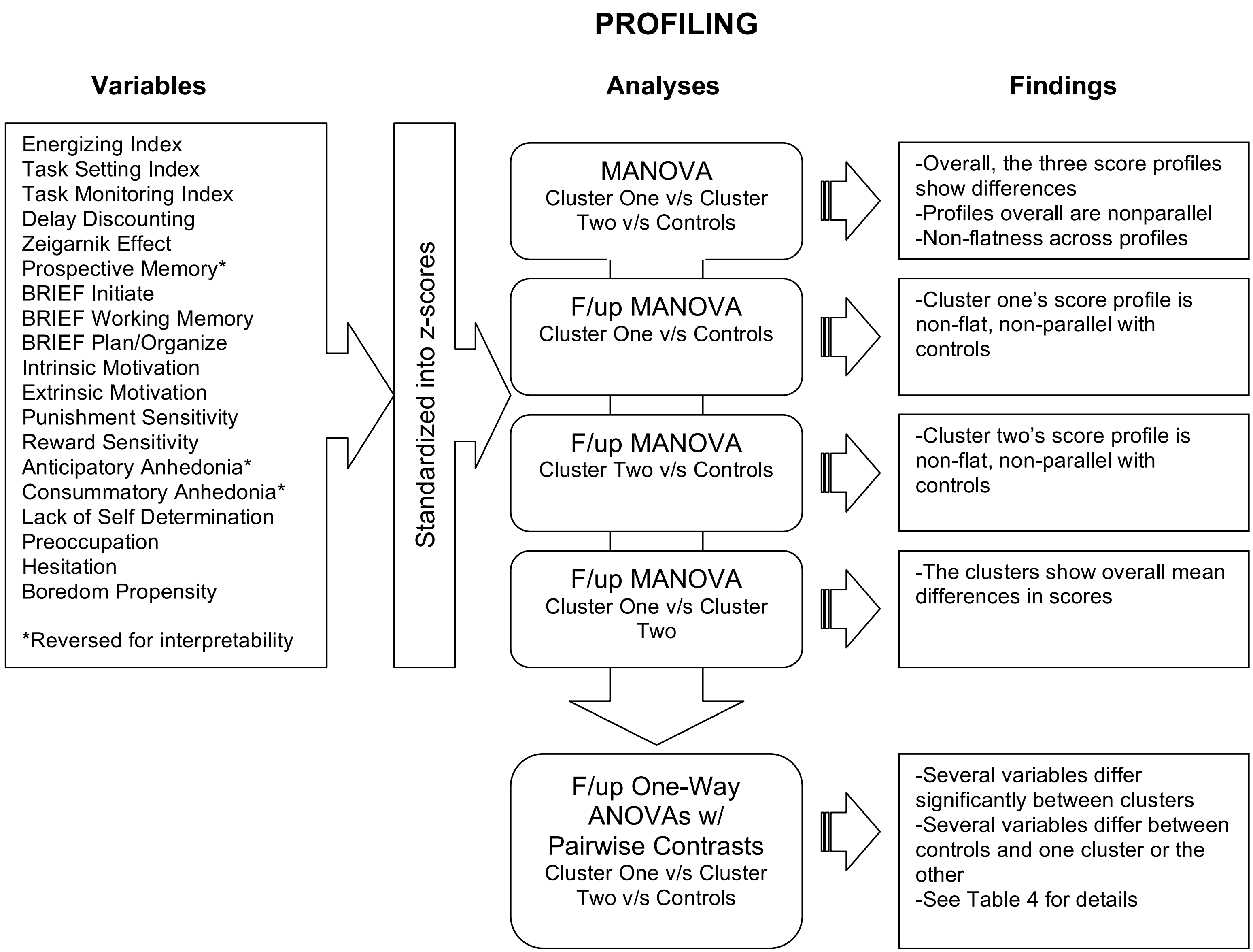
Figure 3. Summary of cluster analysis with input variables, procedures and findings.



especially impaired in schizophrenia. Further, it was decided that any clusters within the schizophrenia sample should be entered into profile analysis separately to determine if the clusters differ significantly in terms of their profiles and, if so, which variables uniquely distinguish each cluster from one another and from controls, as described in the introduction.

Prior to profiling, data were re-standardized according to the observed control sample means and standard deviations, with their values set to zero and one, respectively. This was done to improve the interpretability of the profile plot and accompanying findings, and resulted in distributions of z-scores for each variable among clinical clusters relative to control sample norms. Profile analysis involved mixed-model MANOVAs to assess profile parallelness and the flatness of each clinical sample profile, conducted using the SPSS General Linear Model (GLM) package. Main effects of group across variables were not assessed, as the variables of interest had no common metric according to which higher or lower levels may indicate the same construct (i.e., main effects could be considered to reflect the arbitrary summation of heterogeneous constructs). The flatness of the control sample, furthermore, was not assessed, as it was assumed given the re-standardization of all scores according to control sample norms. Follow-up tests to the overall profile analysis were conducted to determine, on a variable-by-variable basis, where group mean differences were significant. Individuals with missing data were excluded from these analyses because, in the clinical sample, such individuals were not classified by the clustering scheme and were therefore ambiguous as to cluster membership. For a graphic summary of the profile analysis procedures and their basic findings, see Figure 4.

Figure 4. Summary of profile analysis with input variables, procedures and findings.



Multiple Regression

In order to determine which measured variables uniquely predicted RGDA in each sample, a series of multiple regressions was conducted. Heirarchical, simultaneous regressions were performed to examine the predictive strength of each measured conative factor on each RGDA index (work/necessity and leisure/intrinsic) within each sample. Stepwise regression was then used to determine those predictors most impacting RGDA within each cluster, to assess whether different factors produce impairment within each cluster. Missing data in these analyses were imputed based on sample means, given the robustness of regression analysis to data imputation.

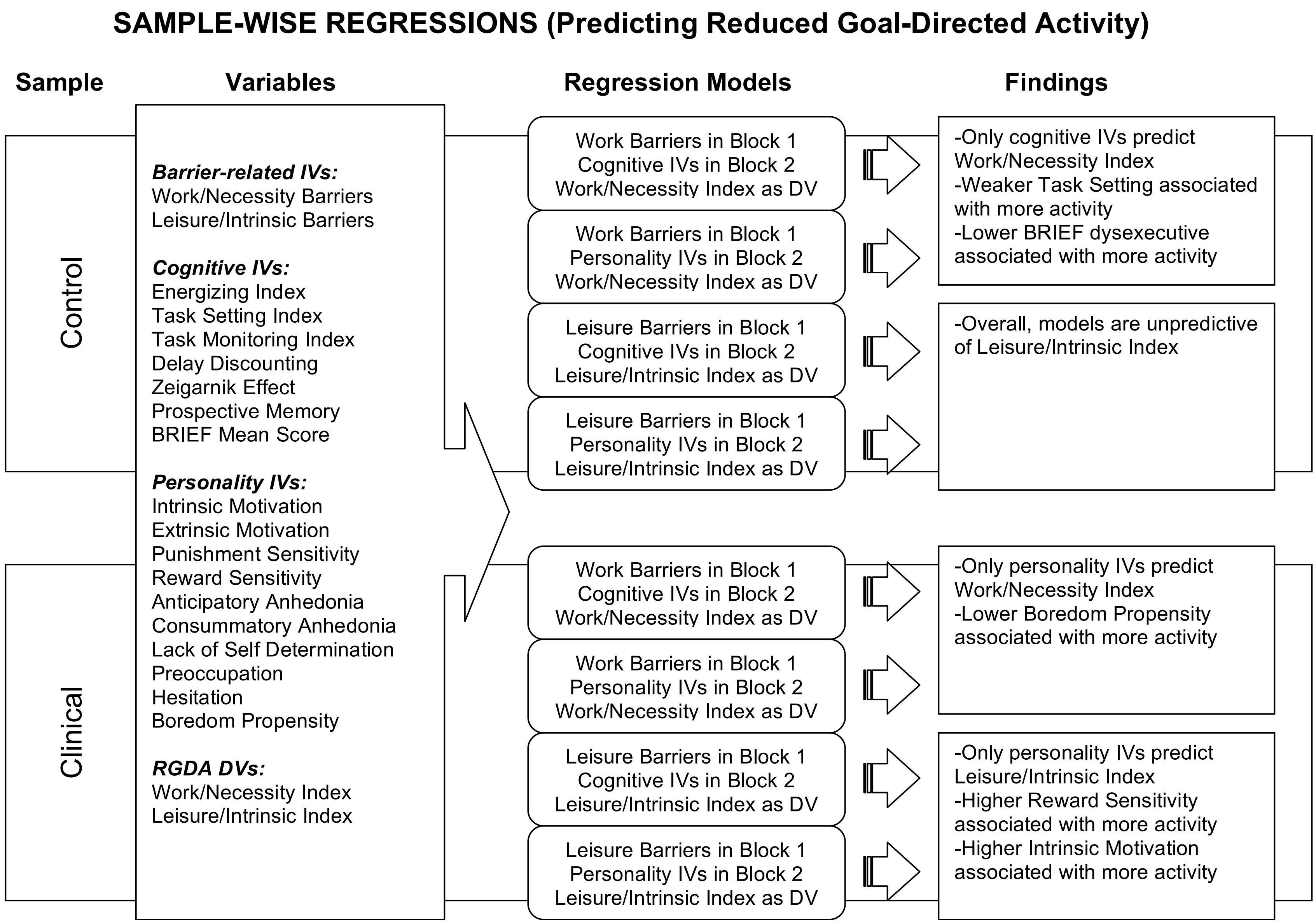
In preparation for the regression analyses, data were first examined for univariate outliers. Values with z-scores exceeding 4.0 were reduced to the value of the next-most-eccentric observation plus or minus one, in order to retain the rank order of observations without unduly influencing regression models. Bivariate scatterplots were next inspected to ensure that data were distributed in approximately elliptical distributions for each predictor-dependent variable pairing. The AI Intrinsic Motivation variable was found to violate this assumption and was transformed using a reflected natural logarithmic transform. The transformed variable was highly correlated with the original variable, r = .94, and satisfied distribution normality assumptions. The weighted, standardized version of the POPS-m objective measures were used as outcome variables as they were more normally distributed than the summated versions of these measures, used elsewhere in the current study (see the description of these measures in the section entitled “Definition and Calculation of Study Variables”). Variable inflation factors were examined to assess multicollinearity in each regression and were kept below 4.0 for each predictor variable in each model. Finally, the standardized residuals for each model were examined to ensure that the assumption of homoscedasticity was met.

Sample-wise Regressions. Hierarchical multiple regressions were conducted for each RGDA index (work/necessity and leisure/intrinsic) within each sample. Rather than performing simultaneous regressions with all 19 predictors within each sample, which would lack power and likely provide unstable estimates of R^2 and *t* values, between eight and eleven predictors were entered into each regression model. This reduced the predictor to observation ratio and thereby ensured that the independence of residuals assumption was met within each model and improved the stability of R^2 estimates. To accomplish this, separate regression models were run for the cognitive and personality factors hypothesized to underlie each form of RGDA. Power analysis revealed that, given eight predictor variables, n = 59, and $p = .05$, the power to reveal an effect size of $f^2 = .25$ ($R^2 = .20$) is .72. With 11 predictor variables, the corresponding power is .63.

Predictor variables were entered hierarchically into each model, with the appropriate barrier index (as described in the methods section) entered in the first block and all other variables entered in the second block. This was done to ensure that predictors were accounting for variance in RGDA above and beyond any disabling factors external to conative dysfunction.

For a graphic summary of the sample-wise regression analysis procedures and their basic findings, see Figure 5.

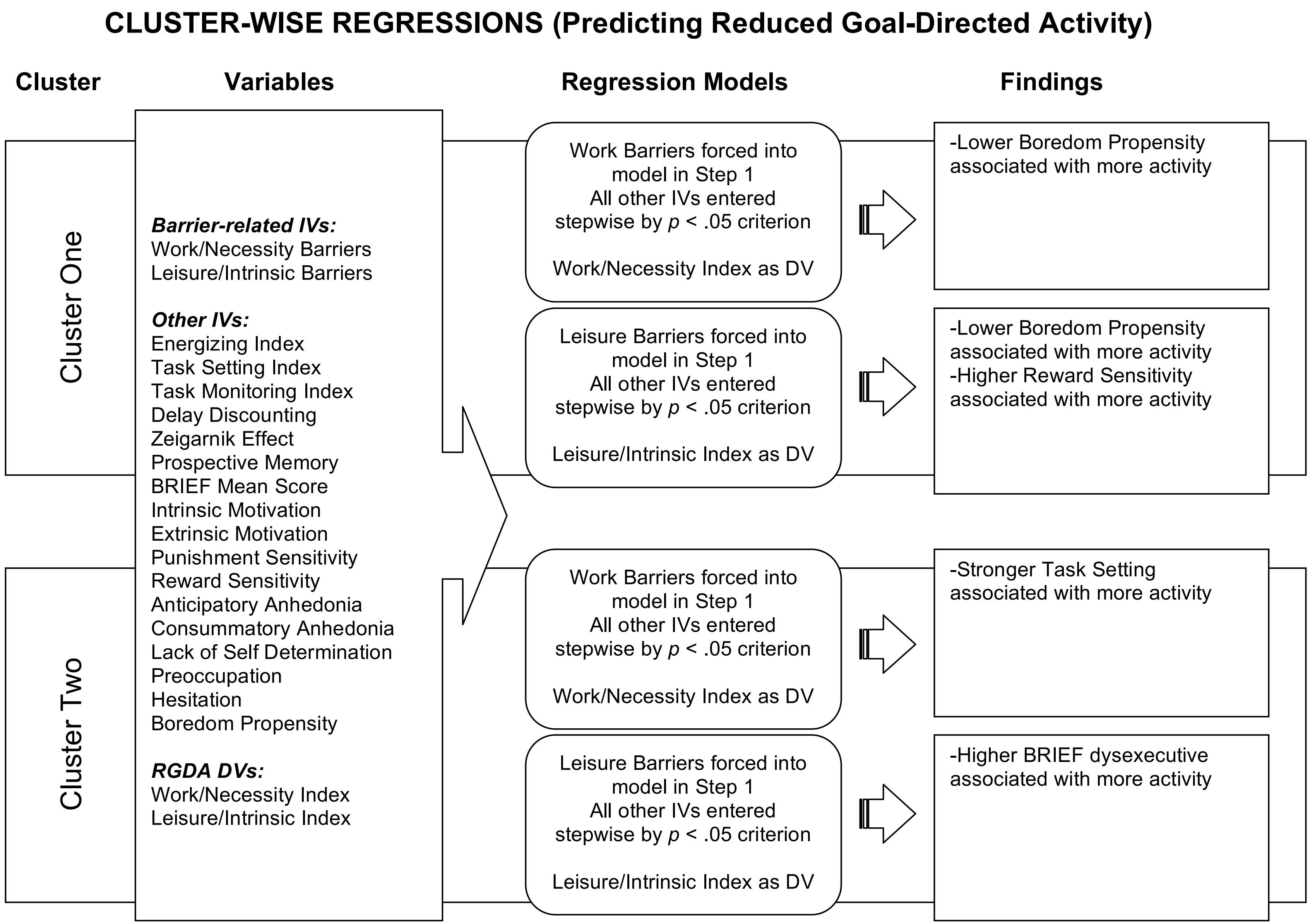
Figure 5. Summary of sample-wise regression analyses with input variables, procedures and findings.



Cluster-wise Regressions. Lastly, stepwise multiple regressions were conducted to identify those factors most impacting RGDA within each cluster. Simultaneous regression was not possible within these samples, as their lower numbers (n = 21, 29) did not permit simultaneous examination of a large number of variables, necessitating the use of stepwise methods. Barrier indices were, again, forced into these models on step one to ensure that predictors were accounting for variability in RGDA above and beyond external disabling factors. Variables were then entered according to *p* values, lowest-first, with a maximum entry value of .05 and exit value of .10.

For a graphic summary of the cluster-wise regression analysis procedures and their basic findings, see Figure 6.

Figure 6. Summary of cluster-wise regression analyses with input variables, procedures and findings.



RESULTS

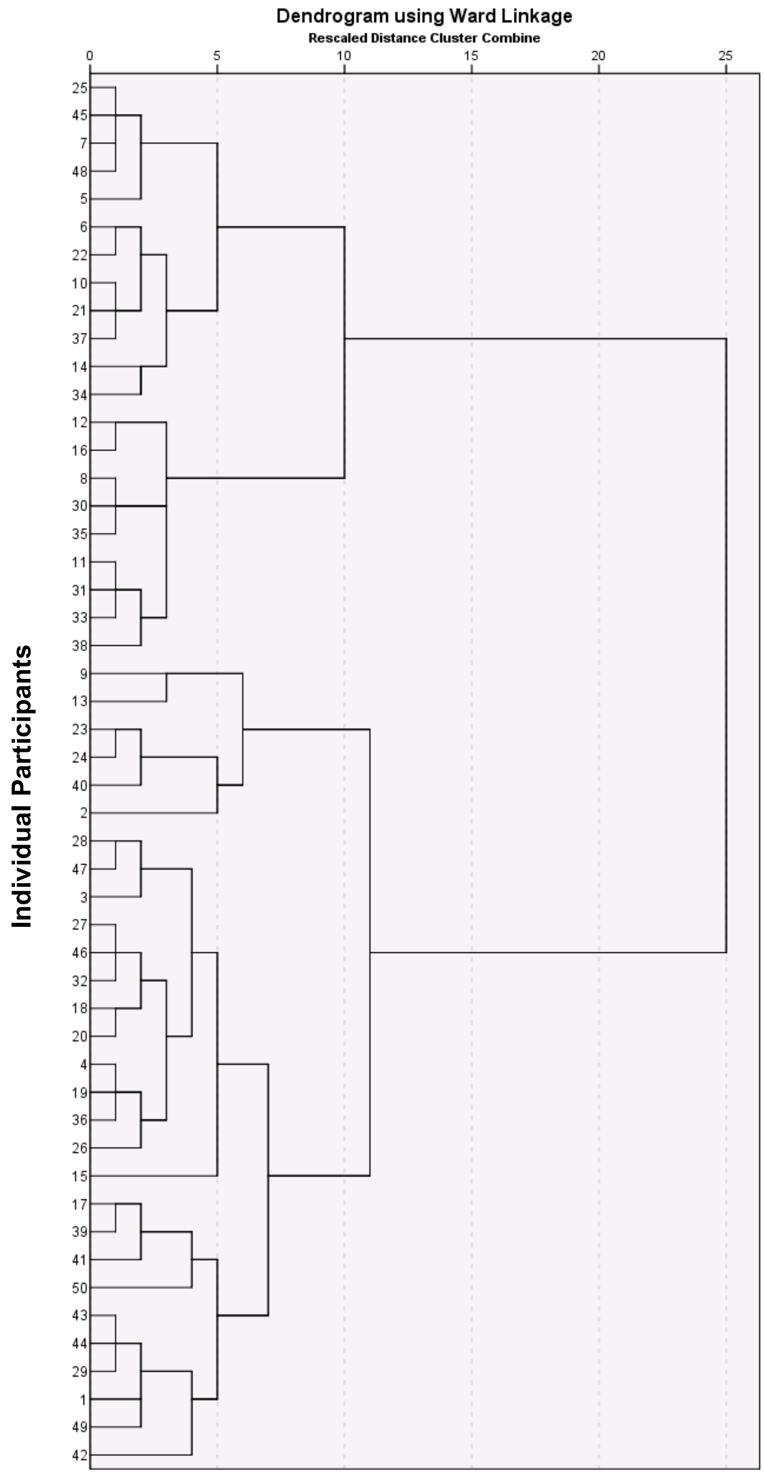
Cluster Analysis

The data from the clinical sample (n = 59) were entered into a cluster analysis employing Ward's (1963) method, as detailed in the methods section. Nine participants had missing data in one or more of the variables of interest and were excluded from the analysis (final n = 50).

From the remaining 50 participants, a strong, two-cluster solution emerged, containing 29 participants in cluster one and 21 in cluster two. The within-cluster error coefficient at which the two-cluster solution emerged was 775.0, and the two clusters merged at a within-cluster error coefficient of 931.0 (range = 156.0). The solution with the next highest range was a three-cluster solution, which formed with within-cluster error coefficients between 706.7 – 775.0 (range = 68.3). The two-cluster solution was therefore chosen as the best fit to the observed data. See the dendogram in Figure 7 for a representation of the agglomeration of these clusters.

The validity of the cluster solution was supported by a number of significant between-cluster contrasts, with medium to large effect sizes. A summary of the differences between the two clusters follows: Cluster two showed significantly greater cognitive pathology on objective testing, including greater difficulty with energizing than cluster one ($p = .02$) and steeper delay discounting than cluster one ($p = .01$). Cluster two also showed lower reward sensitivity than cluster one ($p = .02$). In contrast, cluster one showed significantly greater self-report of dysexecutive symptomatology on all three BRIEF subscales (all $p < .001$), as well as greater punishment sensitivity ($p < .001$), greater lack of self-determination ($p < .001$), and greater state orientation on both

Figure 7. Dendogram depicting cluster analysis of clinical sample, n = 50, using Ward's method.



subscales of the ACS (both $p < .001$). Furthermore, cluster one showed significant elevations relative to controls in consummatory anhedonia ($p = .004$) and boredom propensity ($p = .002$), whereas cluster two did not (both $p > .10$). All contrasts between the clusters, and between each cluster and the control sample, are summarized in Table 4 as well as in the section below, entitled "Profiling Conative Dysfunction in Schizophrenia." Findings from the between-cluster MANOVA, conducted as part of the profile analysis, are also detailed in that section. Cluster means and standard deviations for each variable are provided in Table 5.

Additional analyses were conducted to assess the clinical utility of the cluster scheme by examining the severity of functional outcomes within each cluster. In terms of the study's two RGDA outcome measures, cluster one showed significantly less monthly self-directed leisure/intrinsic activity than cluster two (cluster one mean = 34.35, cluster two mean = 61.81, $t(25.6) = -2.20$, $p = .04$). Self-directed work/necessity activity did not significantly differ between the clusters (these outcomes were examined according to the summated values for each outcome, as described in the methods section).

In terms of general psychiatric symptomatology, the clusters were contrasted on the General Symptom Index of the SCL-90-R. Cluster one endorsed significantly greater psychopathology on this measure (M = 1.11) than cluster two (M = 0.39), $t(45.8) = 5.69$, $p < .001$. The SCL-90-R subscale showing the greatest difference between the two clusters was the Obsessive-Compulsive subscale, with cluster one showing greater elevations on this subscale (cluster one mean = 1.40, cluster two mean = 0.58, $t(48) = 4.93$, $p < .001$).

Table 4. Follow-up tests for profile analysis. See text for details.

Variable	Follow up one-way ANOVA	Follow up significance[a]	Pairwise contrasts	Contrast significance[a]	Between-cluster Cohen's d
Energizing Index	$F(2,109) = 11.02$	$p < .001$**	Cluster 1 > Control Cluster 2 > Control Cluster 1 < Cluster 2	$p = .08$† $p < .001$** $p = .02$*	0.53
Task Setting Index	$F(2,108) = 1.19$	$p = .37$	N/A		
Task Monitoring Index	$F(2,109) = 1.72$	$p = .25$	N/A		
Delay Discounting	$F(2,105) = 5.53$	$p = .01$*	Cluster 1 < Control Cluster 2 > Control Cluster 1 < Cluster 2	$p = .01$* $p = .56$ $p = .01$*	0.70
Zeigarnik Effect	$F(2,109) = 0.69$	$p = .56$	N/A		
Prospective Memory[b]	$F(2,109) = 1.42$	$p = .31$	N/A		
BRIEF Initiate	$F(2,108) = 47.71$	$p < .001$**	Cluster 1 > Control Cluster 2 < Control Cluster 1 > Cluster 2	$p < .001$** $p = .83$ $p < .001$**	1.39
BRIEF Working Memory	$F(2,108) = 58.22$	$p < .001$**	Cluster 1 > Control Cluster 2 > Control Cluster 1 > Cluster 2	$p < .001$** $p = .15$ $p < .001$**	1.32
BRIEF Planning and Organization	$F(2,107) = 40.37$	$p < .001$**	Cluster 1 > Control Cluster 2 < Control Cluster 1 > Cluster 2	$p < .001$** $p = .98$ $p < .001$**	1.31
Intrinsic Motivation	$F(2,109) = 2.47$	$p = .13$	N/A		
Extrinsic Motivation	$F(2,109) = 0.22$	$p = .85$	N/A		
Punishment Sensitivity	$F(2,108) = 13.64$	$p < .001$**	Cluster 1 > Control Cluster 2 > Control Cluster 1 > Cluster 2	$p < .001$** $p = .99$ $p < .001$**	1.12
Reward Sensitivity	$F(2,108) = 3.12$	$p < .08$†	Cluster 1 > Control Cluster 2 < Control Cluster 1 > Cluster 2	$p = .26$ $p = .15$ $p = .02$*	0.70

Variable	Follow up one-way ANOVA	Follow up significance*	Pairwise contrasts	Contrast significance*	Between-cluster Cohen's *d*
Anticipatory Anhedonia[b]	$F(2,108) = 3.12$	$p > .99$	N/A		
Consummatory Anhedonia[b]	$F(2,108) = 5.15$	$p = .01$*	Cluster 1 > Control Cluster 2 > Control Cluster 1 > Cluster 2	$p = .004$** $p = .26$ $p = .24$	ns
(Lack of) Self Determination	$F(2,108) = 20.65$	$p < .001$**	Cluster 1 > Control Cluster 2 > Control Cluster 1 > Cluster 2	$p < .001$** $p = .75$ $p < .001$**	1.07
State Orientation: Preoccupation	$F(2,108) = 24.50$	$p < .001$**	Cluster 1 > Control Cluster 2 > Control Cluster 1 > Cluster 2	$p < .001$** $p = .98$ $p < .001$**	1.17
State Orientation: Hesitation	$F(2,108) = 16.42$	$p < .001$**	Cluster 1 > Control Cluster 2 < Control Cluster 1 > Cluster 2	$p < .001$** $p = .33$ $p < .001$**	1.16
Boredom Propensity	$F(2,108) = 5.40$	$p = .01$*	Cluster 1 > Control Cluster 2 > Control Cluster 1 > Cluster 2	$p = .002$** $p = .42$ $p = .13$	ns

[a]All follow-up tests were controlled to maintain an experiment-wide false discovery rate of 0.05 using the Benjamini (1994) procedure. Reported *p* values are adjusted. [b]These scales were reverse-keyed for the purpose of readability in the profile analysis; higher values reflect greater pathology. †p < .10. **p* < .05. ***p* < .005.

Table 5. Cell means and standard deviations for each cluster and sample in the profile analysis. Unstandardized values are shown.

Variable	Control sample M (SD)	Clinical sample M (SD)	Cluster one M (SD)	Cluster two M (SD)
Energizing Index	-0.21 (0.36)	0.22 (0.75)	0.04 (0.79)	0.43 (0.60)
Task Setting Index	-0.06 (0.61)	0.04 (0.82)	0.13 (0.92)	-0.16 (0.55)
Task Monitoring Index	0.08 (0.66)	-0.09 (0.97)	-0.13 (0.94)	0.27 (0.76)
Delay Discounting	0.77 (0.12)	0.72 (0.17)	0.67 (0.19)	0.79 (0.11)
Zeigarnik Effect	-0.01 (0.30)	-0.03 (0.40)	0 (0.43)	-0.11 (0.34)
Prospective Memory*	1.63 (2.23)	2.47 (2.17)	2.45 (2.50)	2.10 (1.67)
BRIEF Initiate	2.15 (2.34)	5.32 (3.99)	7.48 (3.30)	1.95 (1.88)
BRIEF Working Memory	2.26 (2.19)	6.32 (3.72)	8.21 (2.90)	3.29 (2.59)
BRIEF Planning and Organization	2.79 (2.78)	6.46 (4.83)	9.00 (4.14)	2.76 (2.68)
Intrinsic Motivation	91.63 (10.96)	83.36 (14.55)	88.69 (13.19)	84.71 (15.81)
Extrinsic Motivation	58.37 (17.13)	60.43 (19.57)	60.72 (19.11)	60.67 (21.86)
Punishment Sensitivity	7.77 (5.14)	10.8 (4.85)	13.10 (4.32)	7.67 (4.05)
Reward Sensitivity	8.84 (3.98)	8.72 (4.03)	10.00 (3.77)	7.19 (3.98)
Anticipatory Anhedonia*	21.16 (9.00)	21.30 (9.36)	21.21 (8.19)	21.38 (10.80)
Consummatory Anhedonia*	13.56 (7.91)	17.98 (8.14)	19.34 (7.28)	16.19 (9.40)
(Lack of) Self Determination	7.70 (6.38)	13.51 (7.60)	16.52 (6.50)	8.38 (5.37)
State Orientation: Preoccupation	1.93 (1.78)	3.60 (2.53)	4.86 (2.23)	1.90 (1.97)
State Orientation: Hesitation	2.03 (2.10)	3.21 (2.60)	4.45 (2.41)	1.43 (1.69)
Boredom Propensity	-1.79 (6.18)	2.46 (9.25)	3.93 (10.63)	0.05 (6.97)

*These scales were reverse-keyed for the purpose of readability in the profile analysis; higher values reflect greater pathology.

Profile Analysis

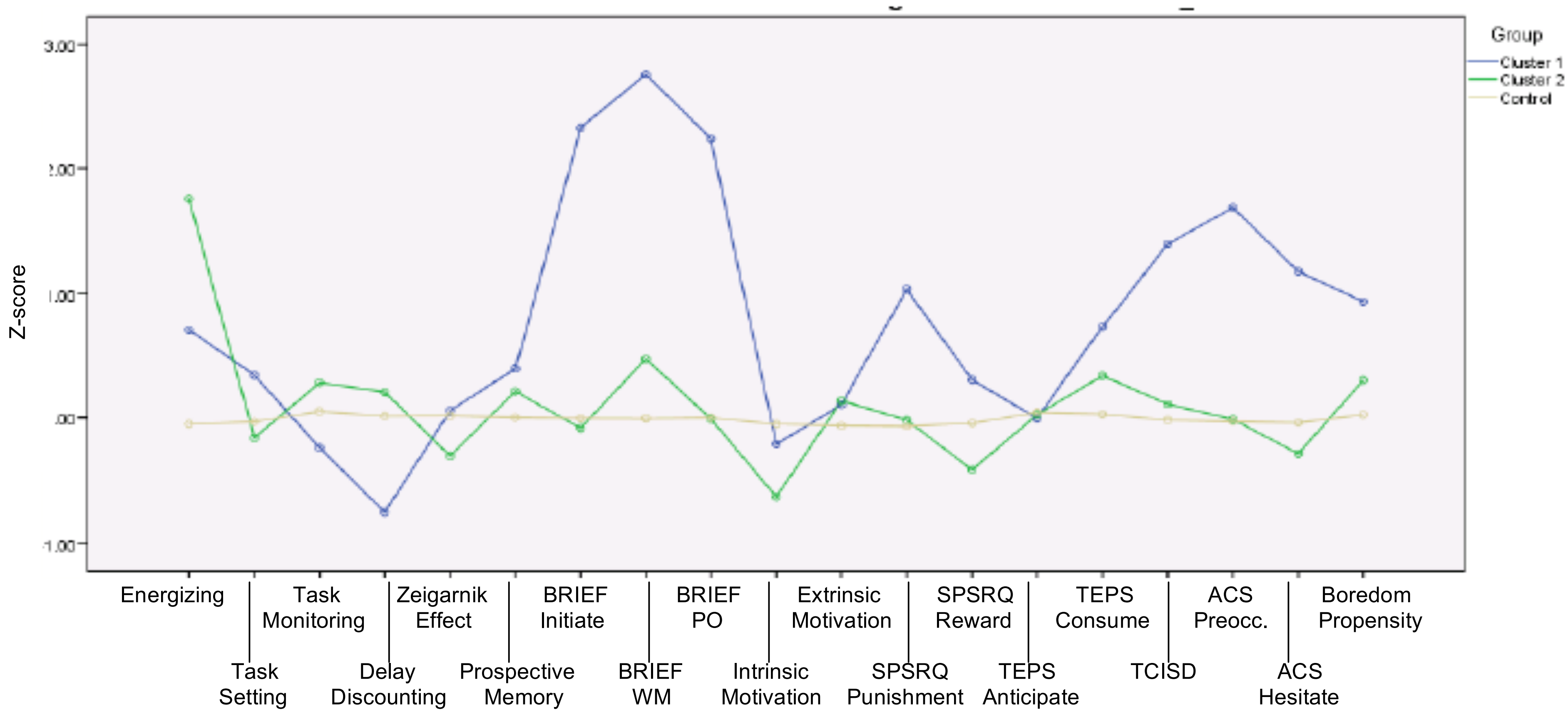
Given the finding of a two-cluster solution, the two clusters of the clinical sample were entered separately into profile analysis to contrast the possibly heterogeneous clinical sample means with those of controls. Mixed-model MANOVAs were tested with the individual conative factors as the within-subjects factor, and sample (in the case of control participants) or cluster membership (in the case of clinical participants) as the between-subjects (fixed) factor. Four MANOVA models are summarized below (See Figure 4): the overarching model including both clinical clusters and the control sample, models testing each clinical cluster's relationship with the control sample, and a model contrasting the two clinical clusters with one another. For a detailed synopsis of the results of the profile analysis, see Table 4. For a list of all unstandardized cell means (these were standardized prior to being entered into the profile analysis), see Table 5.

In the overarching model testing relationships between both clinical clusters and the control sample, significant non-flatness and non-parallelness in profiles was observed (see Figure 8). These tests yielded significant non-flatness as assessed in the overall within-subjects model; $F(11.8, 1213.2)$[5] = 10.80, $p < .001$, partial $\eta^2 = .095$, and non-parallelness as assessed by the interaction term between variable and group; $F(23.6, 1213.2) = 9.73$, $p < .001$, partial $\eta^2 = .159$.

These findings were further examined in a series of follow-up analyses. Each cluster was first entered into a separate MANOVA along with the control sample to determine whether each cluster deviated significantly from the control sample in its

[5] Given significant non-sphericity, a Greenhouse-Geisser correction was applied to all MANOVA tests in this section, producing non-integer degree of freedom values.

Figure 8. Profile plot for standardized study variables. Variables were standardized according to control sample means and SDs. Variablitity of control sample scores are due to rounding. Values on the Y axis are z-scores. See text for details.



profile. This yielded significant deviations from parallelness with the flat control sample profile for each of cluster one; $F(11.7, 970.8, 1213.2) = 15.12$, $p < .001$, partial $\eta^2 = .154$, and cluster two; $F(11.0, 834.9) = 3.76$, $p < .001$, partial $\eta^2 = .047$. Each cluster was furthermore shown to produce a non-parallel profile relative to the other, $F(10.0, 468.9) = 8.68$, $p < .001$, partial $\eta^2 = .156$. These findings support the observation that the two profiles do not simply reflect constant increments of severity across several indices, but rather they reflect distinct patterns of pathology.

Given significant findings of non-parallelness and non-flatness between the two clinical cluster profiles relative to both one another and controls, individual variables were further assessed in follow-up analyses to determine where group differences lay. This was done via one-way ANOVAs within each variable, to assess the significance of variability between the two clusters and control sample. In order to maintain the experiment-wide False Discovery Rate (FDR) equal to alpha (.05), p values were corrected according to the Benjamini & Hochberg (1995) procedure. Significant one-way ANOVAs were followed up with pairwise contrasts. FDR was likewise maintained at the .05 level across all pairwise contrasts using the Benjamini & Hochberg procedure.

The one-way follow-up ANOVAs revealed significant differences in the Energizing, Delay Discounting, the three BRIEF subscales, Sensitivity to Punishment and Reward, Self-Determination, and the two State Orientation scales. Each of these is described in the following text. A summary of all post-hoc analyses can be found in Table 4.

For the Energizing variable, the one-way ANOVA revealed overall significant differences, $F(2,109) = 11.02$, $p < .001$. Pairwise contrasts revealed significantly greater difficulty with energizing in cluster two relative to the control sample ($p < .001$) and to cluster one ($p = .02$). Cluster one showed a trend towards elevated difficulty with energizing relative to controls ($p = .08$).

For the Delay Discounting variable, the one-way ANOVA revealed overall significant differences, $F(2,105) = 5.53$, $p = .01$. Pairwise contrasts revealed significantly steeper delay discounting in the control sample ($p = .01$), and in cluster two ($p = .01$), than in cluster one, but no significant difference between cluster two and the control sample ($p = .56$).

For the BRIEF Initiate subscale, the one-way ANOVA revealed overall significant differences, $F(2,108) = 47.71$, $p < .001$. Pairwise contrasts revealed significantly greater self-reported difficulty initiating action in cluster one than in the control sample ($p < .001$) and cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .83$).

For the BRIEF Working Memory subscale, the one-way ANOVA revealed overall significant differences, $F(2,108) = 58.22$, $p < .001$. Pairwise contrasts revealed significantly greater self-reported difficulty with working memory in cluster one than in the control sample ($p < .001$) and cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .15$).

For the BRIEF Planning and Organization subscale, the one-way ANOVA revealed overall significant differences, $F(2,107) = 40.37$, $p < .001$. Pairwise contrasts revealed significantly greater self-reported difficulty with planning and organization in cluster one than in the control sample ($p < .001$) and cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .98$).

For the Sensitivity to Punishment variable, the one-way ANOVA revealed overall significant differences, $F(2,108) = 13.64$, $p < .001$. Pairwise contrasts revealed significantly greater punishment sensitivity in cluster one than in the control sample ($p < .001$) and cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .99$).

For the Sensitivity to Reward variable, the one-way ANOVA revealed a trend towards significant differences, $F(2,108) = 3.12$, $p < .08$. Pairwise contrasts revealed significantly greater reward sensitivity in cluster one than cluster two, $p = .02$. No significant differences were found between cluster one and the control sample ($p = .26$) or between cluster two and the control sample ($p = .15$).

For the Consummatory Anhedonia variable, the one-way ANOVA revealed overall significant differences, $F(2,108) = 5.15$, $p = .01$. Pairwise contrasts revealed significantly greater consummatory anhedonia in cluster one than in the control sample ($p = .004$), but no significant difference between clusters one and two cluster two ($p = .24$) or cluster two and the control sample ($p = .26$).

For the Self Determination variable, the one-way ANOVA revealed overall significant differences, $F(2,108) = 20.65$, $p < .001$. Pairwise contrasts revealed significantly greater self-reported difficulty with self-determination in cluster one relative to the control sample ($p < .001$) and to cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .75$).

For the State Orientation: Preoccupation variable, the one-way ANOVA revealed overall significant differences, $F(2,108) = 24.49$, $p < .001$. This test was followed with a series of pairwise contrasts, which revealed significantly greater self-reported difficulty with preoccupation in cluster one relative to the control sample ($p < .001$) and to cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .98$).

For the State Orientation: Hesitation variable, the one-way ANOVA revealed overall significant differences, $F(2,108) = 16.42$, $p < .001$. Pairwise contrasts revealed significantly greater self-reported difficulty with hesitation in cluster one relative to the control sample ($p < .001$) and to cluster two ($p < .001$), but no significant difference between cluster two and the control sample ($p = .33$).

For the Boredom Propensity variable, the one-way ANOVA revealed overall significant differences, $F(2,108) = 5.40$, $p = .01$. Pairwise contrasts revealed significantly greater boredom propensity in cluster one relative to the control sample ($p = .002$), but no significant differences between clusters one and two ($p = .13$) or between cluster two and the control sample ($p = .42$).

All other follow-up tests revealed non-significant differences (see Table 4 for details regarding non-significant findings).

Multiple Regression Analyses

Several simultaneous multiple regression analyses were conducted to examine the unique contributions of hypothesized predictors of each form of RGDA in each of the clinical and control samples, and within each clinical cluster. Separate regression models were tested for each of the two indices of RGDA (work/necessity and leisure/intrinsic). Cognitive and personality variables were tested separately (except in the case of each cluster). This yielded a total of four regression models per sample, plus two for each individual cluster (See Figures 5 & 6). Missing values were replaced with sample means.

Results from the multiple regression analyses are detailed in Tables 6 through 9 and are summarized below.

Clinical Sample

In the schizophrenia sample, the work/necessity index of the POPS-m-objective was not predicted significantly by any of the cognitive variables. R^2 for the model was .12, adjusted R^2 = -.02, $F(8, 50) = .84$, $p = .57$.

Of the personality variables examined with regard to the work/necessity index, Boredom Propensity significantly predicted index scores, $\beta = -0.32$, $t(57) = -2.32$, $p = .03$, indicating that those with less propensity to experience boredom perform more activity on this index. R^2 for the whole model was .36, adjusted R^2 = .20, $F(11, 57) = 2.93$, $p = .02$. This model predicted the work/necessity index above and beyond barriers to work, $\Delta R^2 = .31$, $F_{change}(10,46) = 2.20$, $p = .04$.

The intrinsic/leisure index of the POPS-m-objective was likewise not predicted significantly by any of the cognitive variables. R^2 for the model was .01, adjusted R^2 = -.01, $F(8, 50) = 0.78$, $p = .62$.

Of the personality variables examined, Intrinsic Motivation significantly predicted intrinsic/leisure index scores, $\beta = 0.35$, $t(57) = 2.10$, $p = .04$, indicating that those with higher intrinsic motivation spent more time engaged in such activity. Reward Sensitivity also predicted this index, $\beta = 0.40$, $t(57) = 2.60$, $p = .01$, indicating that those more sensitive to reward spent more time engaged in such activity. R^2 for the whole model was .33, adjusted R^2 = .17, $F(11, 46) = 2.06$, $p = .04$. This model predicted the intrinsic/leisure index above and beyond barriers to leisure, $\Delta R^2 = .32$, $F_{change}(10,46) = 2.23$, $p = .03$.

See Table 6 for a summary of these findings.

Table 6.
Results of regression analyses: RGDA indices regressed on cognitive and personality predictors for the schizophrenia sample.

		Necessity/Work Index						Intrinsic/Leisure Index					
Model	Variables in Equation	*B*	*SE*	β	*t*	*F* (F_{change})	Adj R^2	*B*	*SE*	β	*t*	*F* (F_{change})	Adj R^2
	Cognitive												
1	Barriers	-0.09	0.05	-0.22	-1.73†	2.99†	.03	-0.02	0.03	-0.08	-0.62	0.38	-.01
2	Barriers	-0.13	0.06	-0.30	-2.10*	0.84 (.56)	-.02	-0.02	0.04	-0.07	-0.48	0.78 (0.84)	-.03
	Energizing Index	0.04	0.19	0.03	0.19			0.11	0.11	0.14	0.97		
	Task Setting Index	-0.17	0.16	-0.15	-1.08			-0.06	0.10	-0.09	-0.64		
	Task Monitoring Index	-0.04	0.14	-0.04	-0.28			-0.02	0.08	-0.03	-0.19		
	Delay Discounting	-0.22	0.83	-0.04	-0.26			-0.63	0.51	-0.18	-1.25		
	Zeigarnik Effect	0.35	0.33	0.14	1.03			-0.23	0.20	-0.16	-1.12		
	Prospective Memory	0.02	0.07	0.05	0.30			-0.01	0.04	-0.05	-0.33		
	BRIEF (mean)	0.05	0.04	0.20	1.35			-0.02	0.02	-0.14	-0.93		
	Personality												
1	Barriers	-0.09	0.05	-0.22	-1.71†	2.93†	.03	-0.02	0.03	-0.08	-0.61	0.38	-.01
2	Barriers	-0.03	0.06	-0.08	-0.50	2.32* (2.20)*	.20	-0.02	0.04	-0.08	-0.50	2.06* (2.23)*	.17
	Extrinsic Motivation	0.01	0.01	0.20	1.12			-0.01	0.01	-0.22	-1.23		
	Intrinsic Motivation‡	0.22	0.15	0.25	1.49			0.19	0.09	0.35	2.10*		
	Punishment Sensitivity	0.01	0.04	0.06	0.32			-0.02	0.03	-0.13	-0.64		
	Reward Sensitivity	0.02	0.04	0.07	0.46			0.06	0.02	0.40	2.60*		
	Anticipatory Pleasure	-0.04	0.02	-0.32	-1.75†			-0.01	0.01	-0.11	-0.59		
	Consumatory Pleasure	-0.001	0.02	-0.01	-0.06			0.01	0.01	0.10	0.64		
	(Lack of) Self Determination	-0.02	0.02	-0.15	-0.86			-0.01	0.01	-0.12	-0.65		
	State Orientation: Preoccupation	-0.08	0.09	-0.20	-0.86			0.02	0.06	0.08	0.34		
	State Orientation: Hesitation	0.13	0.09	0.34	1.50			-0.05	0.06	-0.23	-0.96		
	Boredom Proclivity	-0.04	0.02	-0.32	-2.32*			-0.01	0.01	-0.13	-0.94		

†p < .10; *p < .05; ‡Variable was transformed with a reflected natural logarithmic transform.

Clinical Sample by cluster. Within cluster one, the work/necessity index was predicted, in the final model, only by Boredom Propensity; $\beta = -0.43$, $t(27) = -2.40$, $p = .02$, indicating that those more prone to boredom spent less time performing work and other necessary activity. R^2 for the model was .18, adjusted $R^2 = .12$, $F(2, 26) = 2.93$, $p = .07$. This model predicted the work/necessity index above and beyond barriers to work, $\Delta R^2 = .18$, $F_{change}(1,26) = 5.74$, $p = .02$.

The leisure/intrinsic index in cluster one was predicted, in the final model, by Boredom Propensity; $\beta = -0.47$, $t(27) = -2.94$, $p = .01$, indicating that those more prone to boredom spent less time engaged in such activity, and by reward sensitivity; $\beta = 0.66$, $t(27) = 4.09$, $p < .001$, indicating that those more sensitive to reward spent more time engaged in this type of activity. R^2 for the final model was .44, adjusted $R^2 = .37$, $F(3, 25) = 6.49$, $p = .002$. This model predicted the leisure/intrinsic index above and beyond barriers to work and reward sensitivity alone, $\Delta R^2 = .19$, $F_{change}(1,25) = 8.62$, $p = .01$. Reward sensitivity, likewise, predicted the leisure/intrinsic index above and beyond barriers to work alone, $\Delta R^2 = .24$, $F_{change}(1,26) = 8.35$, $p = .01$. See Table 7 for a summary of these findings.

Within cluster two, the work/necessity index was predicted, in the final model, only by Difficulty Task Setting; $\beta = -0.48$, $t(19) = -2.46$, $p = .02$, indicating that those with greater difficulty task setting performed less work and other necessary activity. R^2 for the model was .35, adjusted $R^2 = .28$, $F(2, 18) = 4.85$, $p = .02$. This model predicted the work/necessity index above and beyond barriers to work, $\Delta R^2 = .22$, $F_{change}(1,18) = 6.07$, $p = .02$.

Table 7.
Results of regression analyses: RGDA indices regressed stepwise on all predictors for cluster one.

		Necessity/Work Index					
Step	Variables in Equation	*B*	*SE*	β	*t*	*F* (F_{change})	*Adj* R^2
1	Barriers	1.82	5.83	0.06	0.31	.10	-.03
2	Barriers Boredom Propensity	4.62 -3.10	5.50 1.29	0.15 -0.43	0.84 -2.40*	2.93† (5.74)*	.12
		Intrinsic/Leisure Index					
Step	Variables in Equation	*B*	*SE*	β	*t*	*F* (F_{change})	*Adj* R^2
1	Barriers	-0.34	1.92	-0.03	-0.17	.03	-.04
2	Barriers Reward Sensitivity	0.13 3.39	1.71 1.17	0.01 0.50	0.08 2.89**	4.20* (8.35)**	.19
3	Barriers Reward Sensitivity Boredom Propensity	.83 4.50 -1.15	1.52 1.10 0.39	0.08 0.66 -0.47	0.55 4.09** -2.93**	6.49** (8.62)**	.37

†p < .10; *p < .05; **p < .01.

The leisure/intrinsic index in cluster two was predicted, in the final model, only by BRIEF Dysexecutive Symptoms; $\beta = 0.49$, $t(19) = 2.33$, $p = .03$, indicating that those self-reporting greater dysexecutive symptomatology performed more of this type of activity. R^2 for the final model was .24, adjusted $R^2 = .16$, $F(2, 18) = 2.87$, $p = .08$. This model predicted the leisure/intrinsic index above and beyond barriers to such activity, $\Delta R^2 = .23$, $F_{change}(1,18) = 5.44$, $p = .03$. See Table 8 for a summary of these findings.

Table 8.
Results of regression analyses: RGDA indices regressed stepwise on all predictors for cluster two.

		Necessity/Work Index					
Step	Variables in Equation	*B*	*SE*	β	*t*	*F* (F_{change})	*Adj* R^2
1	Barriers	-17.01	10.05	-0.36	-1.69	2.86	.09
2	Barriers	-21.01	9.08	-0.45	-2.31*	4.85*	.28
	Task Setting	-123.6	50.17	-0.48	-2.46*	(6.07)*	
		Intrinsic/Leisure Index					
Step	Variables in Equation	*B*	*SE*	β	*t*	*F* (F_{change})	*Adj* R^2
1	Barriers	-2.49	4.99	-0.11	-0.50	0.25	-.04
2	Barriers	-4.32	4.56	-0.20	-0.95	2.87†	.16
	BRIEF Mean	10.55	4.53	0.49	2.33*	(5.44)*	

†p < .10; *p < .05

Control Sample

In the control sample, the work/necessity index was predicted significantly by two cognitive variables: Task Setting, $\beta = 0.30$, $t(61) = 2.23$, $p = .03$, indicating that those with greater difficulty task setting performed more work and other necessary activity; and BRIEF mean executive dysfunction, $\beta = -0.34$, $t(57) = -2.68$, $p = .01$, indicating that those self-reporting more executive dysfunction performed less of this activity. R^2 for the whole model was .25, adjusted $R^2 = .13$, $F(8, 53) = 2.18$, $p = .04$. This model predicted the work/necessity index above and beyond barriers to work, $\Delta R^2 = .25$, $F_{change}(7,53) = 2.48$, $p = .03$.

Of the personality variables examined with regard to the work/necessity index, Reward Sensitivity significantly predicted index scores, $\beta = 0.33$, $t(61) = 2.08$, $p = .04$, indicating that those more sensitive to reward engage in more of this activity. Anticipatory Pleasure also significantly predicted index scores, $\beta = -0.39$, $t(61) = -2.44$, $p = .02$, indicating that those who anticipate more pleasure perform less of this activity. Consummatory Pleasure also significantly predicted index scores in the other direction, $\beta = 0.33$, $t(61) = 2.18$, $p = .03$, indicating that those who experience more immediate pleasure perform more of this activity. R^2 for the whole model was .25, adjusted $R^2 = .08$. The model was non-significant; $F(11, 50) = 1.51$, $p = .16$.

The intrinsic/leisure index was marginally significantly predicted by one cognitive variable; Task Setting, $\beta = 0.29$, $t(61) = 2.01$, $p = .05$, indicating that those with greater difficulty task setting perform more of this activity. R^2 for the model was .13, adjusted $R^2 = -.004$. The model was, however, non-significant; $F(8, 53) = 0.97$, $p = .47$.

Of the personality variables examined, State Orientation (Preoccupation) marginally significantly predicted intrinsic/leisure index scores, $\beta = -0.36$, $t(61) = -2.05$, $p = .05$, indicating that those higher in state orientation of this type perform less such activity, while State Orientation (Hesitation) significantly predicted intrinsic/leisure index scores, $\beta = 0.62$, $t(61) = 3.05$, $p = .004$, indicating that those higher in state orientation of this type perform more such activity. R^2 for the whole model was .24, adjusted $R^2 = .07$. The model was non-significant; $F(11, 50) = 1.41$, $p = .20$.

See Table 9 for a summary of these findings.

Table 9.
Results of regression analyses: RGDA indices regressed on cognitive and personality predictors for the control sample.

		Necessity/Work Index						Intrinsic/Leisure Index					
Model	Variables in Equation	*B*	*SE*	β	*t*	*F* (F_{change})	Adj R^2	*B*	*SE*	β	*t*	*F* (F_{change})	Adj R^2
	Cognitive												
1	Barriers	0.02	0.10	0.02	0.16	0.03	-.02	-0.03	0.05	-0.07	-0.56	0.32	-.01
2	Barriers	-0.02	0.10	-0.02	-0.17			-0.05	0.05	-0.14	-1.02		
	Energizing Index	0.64	0.33	0.27	1.96†			0.31	0.22	0.20	1.39		
	Task Setting Index	0.43	0.19	0.30	2.23*			0.27	0.13	0.29	2.10*		
	Task Monitoring Index	0.15	0.17	0.11	0.87	2.18* (2.48)*	.13	-0.01	0.12	-0.01	-0.09	0.97 (1.07)	.00
	Delay Discounting	0.56	0.92	0.08	0.61			-0.59	0.62	-0.13	-0.95		
	Zeigarnik Effect	-0.36	0.37	-0.12	-0.97			-0.05	0.25	-0.02	-0.18		
	Prospective Memory	-0.04	0.05	-0.10	-0.77			-0.001	0.04	-0.004	-0.03		
	BRIEF (mean)	-0.14	0.05	-0.34	-2.68*			0.003	0.04	0.01	0.09		
	Personality												
1	Barriers	0.02	0.10	0.02	0.16	0.03	-.02	-0.03	0.05	-0.07	-0.56	0.32	-.01
2	Barriers	0.07	0.10	0.09	0.71			-0.04	0.06	-0.09	-0.67		
	Extrinsic Motivation	0.01	0.01	0.10	0.63			0.01	0.01	0.26	1.59		
	Intrinsic Motivation‡	0.004	0.13	0.01	0.04			-0.02	0.08	-0.04	-0.29		
	Punishment Sensitivity	-0.01	0.03	-0.05	-0.27			-0.02	0.02	-0.19	-1.13		
	Reward Sensitivity	0.07	0.04	0.33	2.08*			0.02	0.02	0.14	0.90		
	Anticipatory Pleasure	-0.04	0.02	-0.39	-2.44*	1.51 (1.66)	.08	-0.002	0.01	-0.03	-0.15	1.41 (1.52)	.07
	Consumatory Pleasure	0.04	0.02	0.33	2.18*			0	0.01	0.01	0.04		
	(Lack of) Self Determination	-0.02	0.03	-0.11	-0.55			-0.02	0.02	-0.24	-1.21		
	State Orientation: Preoccupation	-0.15	0.09	-0.29	-1.64			-0.12	0.06	-0.36	-2.05*		
	State Orientation: Hesitation	0.04	0.08	0.08	0.41			0.17	0.06	0.62	3.05**		
	Boredom Propensity	0.001	0.02	0.004	0.03			0.001	0.01	0.01	0.08		

†p < .10; *p < .05; ‡Variable was transformed with a reflected natural log transform

DISCUSSION

The current research set out to examine and characterize avolition in a way that evaluated the contributions of multiple basic psychological and neuropsychological factors that may account for avolitional symptomatology, and reduced goal-directed activity (RGDA) as an outcome, in a schizophrenia sample. It was highlighted in the introduction that “avolition” is a term used to refer to decrements across several basic functions; including those related to volition per se, as well as those related to motivation. Thus, the construct under examination in current study was referred to as “conative dysfunction,” an umbrella term. A series of statistical analyses was conducted to examine conative dysfunction, using empirical approaches that might permit explication of its possibly multifaceted nature – as well as uncover possibly distinct patterns of dysfunction between individuals with schizophrenia.

The three primary research aims included 1) the exploration of potential conative “types” within schizophrenia; 2) the characterization of conative dysfunction within schizophrenia; and 3) the prediction of RGDA by each conative function of interest. Each of these will be addressed in the following sections.

Conative “Types”

Hierarchical cluster analysis is an exploratory method that may yield any arbitrary number of clusters (between one and the number of observations entered into the analysis). Several measures were therefore taken in the current analysis to generate an empirically valid clustering scheme, which was then further validated in post-hoc analyses.

The analysis revealed a strong, two-cluster model for the current data. This solution was supported by several findings. The two clusters emerged from smaller, more multifarious solutions with a small increase in within-cluster variance – relative to the increase in variance accompanying the merging of the two clusters themselves. The two clusters demonstrated significant between-cluster differences on several measures of conative dysfunction, including both subjective (self-reported) and objective (cognitive functioning) measures, with medium to large effect sizes. They furthermore differed significantly in level of RGDA, specifically of the intrinsic/leisure type, and in the patterns of predictor-RGDA relationships examined within each cluster. In other words, the clusters showed different levels of activity, and different conative factors were associated with this phenomenon within each cluster. From a clinical perspective, the differences among these clinically relevant measures, as well as the observed differences in functional outcomes (RGDA), makes this clustering scheme especially relevant to client care. The observation of differences between the clusters in the SCL-90-R, a clinically relevant measure not entered into the cluster analysis, further bolsters the typology as a valid predictive scheme rather than simply an artifact of the specific measures entered into it. Finally, the inclusion of a broad range of conative measures into the analysis a priori supports its construct validity.

A cluster structure underlying conative dysfunction in schizophrenia may account for inconsistencies in some previous findings. For example, as reviewed by Cohen and Docherty (2004), findings of correlation between the negative syndrome in schizophrenia and neuropsychological impairment have been observed in some studies, but not in others. Kirkpatrick and Galderisi (2008) further note several inconsistencies in the literature relating frontal dysexecutive symptoms to the deficit syndrome in schizophrenia. It is possible that the differing patterns of cognitive symptomatology observed in the present study account for such inconsistencies. Studies failing to account for heterogeneity within negative symptoms, such as those explored currently, may produce inconsistent findings depending on the characteristics of any given sample. In addition, studies using classic neuropsychological tests may produce inconsistent findings given the multidetermined nature of many of these tests. The ROBBIA tasks included in the current study avoid many of these problems by employing more specific, homogeneous functions derived from lesioning studies.

The findings of Scholten et al. (2006), reviewed above, are also supported and further clarified by the current findings: these authors' observation of increased BIS activity, but no difference in BAS activity in schizophrenia, is surprising given models of schizophrenia that suggest decreased impetus for goal pursuit. In the current study, some participants (those in cluster one) showed a much-increased level of punishment sensitivity (an indicator of BIS) without any decrease in BAS, in congruence with the findings of Strauss et al. (2011). Others (i.e., cluster two), conversely, showed a decline in reward sensitivity (an indicator of BAS) without any increase in punishment sensitivity. This latter source of conative dysfunction was observed only in the minority of clinical participants in the current study (42%) and may not be detectable when heterogeneous groups are clustered together. In summary, the current clustering scheme highlights the importance of recognizing and typologizing individual differences a priori when examining conative dysfunction in schizophrenia in order to avoid inconsistent findings that may be artifacts of heterogeneity within samples.

Characteristics of the Two Clusters

It was hypothesized in the study's introduction that any typology of conative dysfunction within schizophrenia would reflect the primary distinction drawn in the literature review – that of motivation versus volition. This hypothesis was partially supported, although some properties of the clustering scheme did not conform to this distinction, suggesting a more complex clinical picture.

An adumbrated version of the properties of the two clusters may be stated as follows: according to the self-report measures included in the analysis, a more "amotivated" cluster emerged (cluster two). This cluster demonstrated greater frontal executive dysfunction (specifically, energizing difficulty) on objective testing. Cluster one, by comparison, expressed greater avolitional and dysexecutive symptomatology by self-report, contradicting any interpretation based on overall disease severity (i.e., the two clusters did not emerge simply as opposite ends of an overall severity dimension). Rather, distinctive patterns of weaknesses and strengths emerged within each cluster. This cluster, in contrast with cluster two, demonstrated intact reward sensitivity and intrinsic motivation.

The finding that cluster one revealed more dysexecutive symptoms via self-report, while cluster two alone demonstrated frontal impairments on objective testing, may be accounted for within a theoretical framework that acknowledges the inherent differences between objective testing and testing via self-report, especially with regard to functions related to executive attentional control. For example, Lehtonen (2008) found no significant correlations between objective attentional performance in the Attentional Network Task (ANT), and self-reported inattentiveness symptoms. Shuster and Toplak

(2009) reached similar conclusions comparing objective versus self-reported performance in inhibitory control tasks. These findings suggest a high degree of dissociation between symptoms detected in cognitive paradigms and symptoms that can be reported via insight, where executive control functions are concerned. It is evident that these two forms of testing each uniquely capture different processes and may be considered complimentary. Observations and interpretations regarding each cluster, with respect to this distinction between objective and self-reported findings, follow.

Cluster One. Cluster one may best be understood as a reward-motivated, but distressed and conflicted, subgroup of individuals demonstrating high self-report of pathology and impairment in terms of outcomes without strong accompanying executive control deficits. Self-reported volitional difficulties (e.g., as measured by the TCISD and ACS subscales) and executive difficulties (as measured by the BRIEF subscales) were greatly increased within cluster one despite the finding that they did not differ from controls in any objective cognitive test included in the current battery apart from a decrease in delay discounting; this is opposite to what is commonly thought of as "pathological" and may constitute a relative strength in this group (a finding addressed below). This suggests that some factor outside of the cognitive functions examined in the current study is responsible for reduced task adherence, organization, and so-on reported by these individuals. This cluster was also more impaired in self-directed, intrinsically motivated activity (per the intrinsic/leisure index of RGDA on the POPS-m) despite significantly greater reward sensitivity and no indication of lowered intrinsic motivation (in fact, intrinsic motivation was non-significantly greater in cluster one relative to cluster two). In other words, neither frontal executive dysfunction (within the current scheme), nor a lack of motivation or "impetus" for action, account for these individuals' self-reported symptoms, nor their overall reductions in goal-directed activity.

These findings together beg the question of what is impairing and distressing these individuals, who possess intrinsic motivation and reward sensitivity but fail to translate these into action. Among the variables included in the current analyses, punishment sensitivity stands out as a plausible impairing factor in cluster one. It is well-established that personality and psychopathological factors associated with high punishment sensitivity can be impairing and lead to reduced ability to exert and maintain effort, concentrate on a task and maintain a sense of having the "energy" to continue under difficult task demands. Such factors include depression and neuroticism (e.g., Fetterman, Robinson, Ode et al., 2003; Brinkmann & Gendolla, 2008); in fact, difficulty concentrating and anergia are considered definitional of major depression and appear in the DSM-5 criteria for this disorder (APA, 2013). This interpretation accords with increased self-report of general psychopathology within this cluster on the SCL-90-R[6], and the especially marked elevation on the obsessive-compulsive subscale in particular; much of the content of which is related to nonspecific cognitive complaints such as difficulty with attention and memory.

The finding of lower delay discounting in this cluster replicates the findings of Heerey et al. (2007), and also accords with this view. It is possible that these individuals

[6] In order to ensure that cluster one did not simply reflect the over-reporting of psychiatric symptomatology, data from the SCL-90-R Positive Symptom Total scale were examined. Symptom endorsement greater than 2.5 standard deviations above the mean for psychiatric normative samples on this index was chosen as an indicator of possible symptom over-endorsement. Only four participants in cluster one, and one participant in cluster two, showed elevations in this range, suggesting that the majority of participants in each cluster (86.2% in cluster one and 95.2% in cluster two) responded within normal limits.

take on a more prudent, careful approach to risk given their punishment-aversion and therefore make decisions less impulsively when such impulsivity may represent a net loss. Interestingly, individuals with Obsessive-Compulsive Personality Disorder also demonstrate decreased delay discounting – a finding related to the personality dimensions of rigidity and perfectionism (Pinto, Steinglass, Greene et al., 2014). Obsessiveness, it is therefore proposed, may be a central trait contributing to the pattern of findings observed in this cluster. This cluster's greater elevation on the preoccupation subscale of the ACS, in relation to the hesitation subscale, further supports this interpretation, as this subscale indicates avolition related to the interference of cognitive activity related to negative affect, as opposed to a lack of positive affect.

The findings of a) a significant elevation in boredom propensity in this cluster, and b) unique predictive power of boredom propensity in predicting RGDA in this cluster alone, accord with a recent review of boredom propensity (Eastwood, Frischen, Fenske et al., 2012) suggesting that it reflects a state of wanting, but being unable to engage in, meaningful activity. This cluster, in line with this view, evidences intrinsic and reward-driven motivation, but conflicting personality factors contribute to impairments in goal-directed action. Increased boredom may therefore be anticipated in these individuals, whereas those who are low in such motivation may be predicted to lack boredom proneness despite inactivity; similarly to those diagnosed with athymhormia, a profound lack of internal impetus for action, as was outlined in the introduction. Additional support for the view that increased boredom proneness in this cluster is associated with elevations in punishment sensitivity can be seen in Mercer-Lynn, Flora, Fahlman et al. (2011), who uncovered a subvariety of boredom propensity that appears to be determined by punishment sensitivity, in the context of intact reward sensitivity. The current findings also support the use of self-reported boredom as a clinical marker of extant, but unfulfilled or conflicted motivation among individuals with schizophrenia, as outlined by Gerritsen, Goldberg & Eastwood (2015). Such a use of boredom as a clinical marker within schizophrenia may be seen as particularly empowering by clients with schizophrenia, as boredom is subjectively distressing and its alleviation may represent the enactment of unfulfilled desires.

Cluster Two. Cluster two, on the other hand, more closely matches traditional conceptions of the apathetic, amotivated individual, as per descriptions of “negative” schizophrenia (Andreasen & Olsen, 1982), “Type II” schizophrenia (Crow, 1985) or the “deficit syndrome” (Carpenter, Heinrichs & Wagman, 1988). Cluster two was low in intrinsic motivation and reward sensitivity and showed energizing difficulties in objective frontal executive testing. However, they did not show elevated self-report of dysexecutive symptoms or avolitional personality traits. This pattern of observations would be expected in individuals low in Gray’s (1981) BAS construct, in light of literature reviewed above (e.g., Corr, 2002) demonstrating lower frustration in these individuals and the possibility that they pursue goals that are easier to attain. In other words, individuals low in drive for reward exert less effort in goal pursuit and experience less subjective distress when thwarted. This may result in individuals low in such motivation to self-report little difficulty in goal pursuit (i.e., little “avolition” within the current definition) despite prefrontal impairment on objective testing; an account that accords well with the findings of Tek, Kirkpatrick & Buchanan (2001) of lower self-reported distress in patients with the deficit syndrome despite increased objective negative symptomatology.

The pattern of neurocognitive impairment in cluster two – affecting the energizing system of the PFC in particular – also accords with prior findings. For example, Walton, Groves, Jennings et al. (2009) have shown decreased effort allocation among those with lesions of the anterior cingulate cortex (ACC), a region identified by Stuss and Alexander (2007) as a primary correlate of energizing. The computation of effort expenditure is a complex process involving PFC structures such as the ACC as well as subcortical structures involved in reward motivation (e.g., Bardgett, Depenrock, Downs et al., 2009; Gan, Walton & Phillips, 2010), with projections to the PFC (for a review, see Fervaha, Foussias, Agid et al., 2013a). Dopaminergic projections to the PFC, in schizophrenia in particular, have been shown to play a role in the activation of the ACC (Dolan, Fletcher, Frith et al., 1995). This system therefore plays a well-established role in motivated behaviour and its disruption may lead to both the amotivation and related energizing difficulties observed in cluster two.

The pattern of findings in the current study's cluster two therefore supports the view that, in a subset of those with schizophrenia, decreased reward motivation is associated with accompanying decreases in PFC functioning, especially those related to superior medial functioning or energizing. These findings do not extend to cluster one, which showed a complimentary pattern of pathology. The primary research implication of this finding is that future studies may increase their power considerably by typologizing participants according to the nature of their conative dysfunction – i.e., whether it is related primarily to amotivation and PFC impairment, without accompanying self-report of distress or difficulty, or primarily related to punishment sensitivity and personality factors related to subjective report of avolition.

Profiling Conative Dysfunction in Schizophrenia

The profile analyses supported several primary hypotheses of the current study: that there are distinct forms of conative dysfunction within schizophrenia; that schizophrenia does not reflect increased conative dysfunction "across the board," but rather that some factors are impacted more than others; and that these patterns of impairment vary according to the subtypes, which do not simply reflect different levels of severity within the same pathologies.

As a result of the finding of markedly different profiles of conative dysfunction between the two clusters in the clinical sample, results from many of the follow-up tests of individual variables within the profile analysis were discussed above with respect to the characteristics of each cluster. Some additional, more general findings are discussed next.

The measures from the ROBBIA included in the current study represent a novel method of assessing frontal executive dysfunction, which has not yet been applied to schizophrenia. Findings from the ROBBIA showed significant elevations only on the energizing index – in particular in cluster two. This finding supports the possibility of a special role for the functioning of the superior medial PFC in schizophrenia. The particular regions identified by Stuss and Alexander (2007) to yield energizing impairments in their lesioning studies included the anterior cingulate cortex (ACC), supplementary motor areas and presupplementary motor areas. Several studies have shown relevance of this region to schizophrenia, in particular the ACC. For example, Goldstein, Goodman, Seidman et al. (1999) found that the volumetric reductions in the ACC were among the largest across any brain region examined in their broad neuroanatomical study of schizophrenia. Szeszko, Bilder, Lencz et al. (2000) found significant correlations between such reductions and dysexecutive symptoms in a first-episode psychosis sample, in congruence with the current study's model of brain-behaviour relations in schizophrenia, while Pantellis, Velakoulis, McGorry et al. (2003) found that such reductions predict the progression into a first psychotic episode among those at ultra high risk for psychosis (see Fornito, Yücel, Dean et al., 2009 for a review of related findings). The current study provides further support for a focal role of the functioning of the ACC in schizophrenia, especially among those high in amotivation.

The ROBBIA tasks, conversely, did not reveal evidence for dysfunction in the task setting and task monitoring functions, corresponding to the functioning of left- and right-lateral regions of the PFC, respectively. This does not constitute a rule-out of such dysfunctions, which may be revealed via other tasks and methods. Liddle et al. (1992), for example, demonstrated via positron emission tomography a hypoperfusion effect in the left lateral PFC during a word-generation task in a schizophrenia sample. As the ROBBIA tasks continue to be refined as psychometric measures, it is possible that new findings will emerge. Findings from these purely behavioural methods, derived from lesioning (as opposed to imaging) studies, may be further refined by examining the functioning of these regions in non-lesioned, but functionally affected brains (e.g., in schizophrenia).

Classical findings of increased anticipatory anhedonia in schizophrenia (Gard et al., 2007; Favrod et al., 2009; Chan et al., 2010; Loas et al., 2009) were not replicated in the current study, which instead reflected the more recent finding of Gard et al. (2014) in showing increased consummatory anhedonia in the schizophrenia sample and no difference in anticipatory anhedonia. The cluster solution in the current study did not address the variability in the research in this area according to heterogeneity, since each cluster was elevated in consummatory anhedonia (although only cluster one was significantly elevated) and neither showed any elevation in anticipatory anhedonia. It is possible (or likely) that some heterogeneity in conative dysfunction in schizophrenia exists outside of the current cluster scheme, with some variety of conative dysfunction being associated with anticipatory anhedonia. However, this was not observed in the current research. A larger study exploring those elements identified as critical to conative dysfunction in the two clusters observed presently, as well as anticipatory anhedonia, may shed light on these contradictory findings.

Nonetheless, the current findings of increased consummatory anhedonia in schizophrenia, without elevations in anticipatory anhedonia, add to the growing evidence contradicting the model of anticipatory anhedonia being exclusively responsible for conative dysfunction in this disorder, as reviewed in the introduction. A more complex understanding of these phenomena is therefore warranted. Several sources of conative dysfunction, unique within each cluster derived from the current data, evidently interact to constitute conative dysfunction in schizophrenia outside of anticipatory anhedonia. The roles of both consummatory and anticipatory anhedonia must therefore be considered in further studies, and may best be understood using methods that go beyond the self-report measure used in the current study. For example, the use of experience sampling methods may assist in understanding real-world contextual factors that may influence the immediate experience and anticipation of various rewarding stimuli in different individuals within specific contexts.

The Zeigarnik procedure did not reveal any between-group differences in the current study. Although the instruction set used currently was designed to yield an overall positive Zeigarnik effect (i.e., better recall for unfinished tasks), the control sample in the current study failed to produce such an effect, with recall ratios close to 1:1. It is possible therefore that the novel procedure used currently, although validated in an unpublished pilot study, was underpowered and therefore cannot conclusively address the question of recall for unfinished tasks in schizophrenia. Future examination of the Zeigarnik effect in schizophrenia using other techniques may be warranted.

The prospective memory task used currently likewise failed to yield significant between-group differences. The finding of impaired prospective memory in schizophrenia is well established (Orderman et al., 2014) and was reflected in both clusters observed currently, however these findings did not achieve significance. The task used to assess prospective memory currently may therefore also lack discriminatory power, and the use of more formalized tasks may be warranted in further research.

The Prediction of RGDA

Variables Predicting RGDA in Schizophrenia

Work/Necessity Index. Of the conative factors predicting the work/necessity index in the clinical sample, only boredom proclivity predicted significant variability. As a factor related to conative functioning, boredom propensity is poorly understood, but it is correlated with other conative phenomena such as state orientation (Blunt and Pychyl, 1998), lapses in attentional control (Carriere, Cheyne & Smilek, 2008), decreased self-directed activity in psychiatric inpatient units (Newell, Harries and Ayers, 2011), apathy (Goldberg, Eastwood, LaGuardia et al., 2011), and self-reported experiences of dysexecutive symptoms, inattentiveness, and hyperactivity (Gerritsen, Goldberg, Sciaraffa et al., 2014). As noted above, boredom reflects an impetus (i.e., a motivation) to act, without an opportunity or ability to engage in meaningful activity, with two distinct varieties of boredom propensity including one type associated with increased BIS activity or sensitivity to punishment (Mercer-Lynn et al., 2011). This observation is especially relevant given the increased boredom propensity observed in cluster one, which showed accompanying elevations in sensitivity to punishment. The importance of boredom propensity in this cluster is especially salient given its unique predictive power of RGDA.

The construct of boredom propensity is growing as an important clinical consideration, and predictor of functional outcomes, in schizophrenia; as is suggested in several recent studies and reviews (e.g., Todman, 2004; Todman, Sheypuk, Nelson et al., 2008; Newell, Harries and Ayers, 2011; Gerritsen et al., 2015). The current findings, especially those related to cluster one, underscore the importance of assessing boredom propensity in schizophrenia. While the current regression analyses do not support the irrelevance of other factors in the functional outcome of RGDA, given their potentially limited power, the finding of predictive validity of boredom propensity over and above several other factors warrants this construct greater attention in future research. Furthermore, boredom propensity can be easily and quickly assessed in clinical settings and provides a subjective marker of untapped motivation – an inherently distressing factor that clients may be intrinsically motivated to address. It may therefore represent a powerful marker for desire for change that may be capitalized upon in psychotherapy by both client and therapist.

The cognitive predictors examined in the current research did not predict significant variability in the work/extrinsic index across the clinical sample. However, difficulty task setting did predict this index within cluster two, when examined alone. Although this index was not elevated in this cluster, it is possible that it interacts with other factors to yield RGDA in this sample. At this point, the mechanism underlying the relationship between these two factors is unclear, especially since no other conative factor significantly predicted this RGDA index within this cluster, making interaction effects impossible to assess. While this observation therefore requires further study, it highlights the potential role of frontal executive dysfunction in the psychopathology of this cluster in particular.

Leisure/Intrinsic Index. RGDA of the leisure/intrinsic type was predicted across the clinical sample by the Intrinsic Motivation and Reward Sensitivity variables. The finding of unique predictors for this index supports the distinction made a priori between these two forms of goal-directed activity, as laid out in the methods section. The distinct patterns of predictive power suggest that reductions in intrinsically motivated and non-essential/leisure-related activity primarily occur due to lack of impetus or motivation for such activity in the first place, whereas work and necessity-related activity is primarily impaired due to boredom propensity, a factor highly associated with avolition and executive dysfunction (e.g., Blunt and Pychyl, 1998, Gerritsen et al., 2014) rather than a lack of motivation per se. In other words, individuals with schizophrenia appear to experience difficulties with externally-imposed, necessary or work-related functions due to volitional disturbance, whereas they may not engage in more intrinsically-motivated leisure functioning due to a lack of motivation to perform such activities in the first place.

Interestingly, when examined within each cluster separately, the leisure/intrinsic index was predicted by different factors, much like the work/necessity index discussed above. In cluster one, it was predicted by Boredom Propensity, again highlighting the importance of this variable within this cluster in particular. The finding of a relationship between decreased Reward Sensitivity and functional outcomes in this cluster is interesting, in that this cluster as a whole did not exhibit lower levels of reward sensitivity. It appears that, among these individuals, reward motivation is comparable to that observed in controls; however, when it is compromised it might have special implications for RGDA. In cluster two, by contrast, this index was uniquely predicted by BRIEF executive dysfunction – albeit in a *positive* direction, with greater executive dysfunction predicting *higher* activity levels. This counterintuitive finding may be interpreted in several ways. Those with poorer executive functioning may perform tasks less efficiently and therefore spend more time executing them. Alternatively, it is possible that those who engage in more self-directed activity have more opportunities to observe their own executive functioning in action, thereby self-reporting greater impairment than those who are less active and may therefore lack insight into their own executive functioning (i.e., their self-report may be determined primarily according to the availability heuristic).

Variables Predicting RGDA in Controls

Of the regression models tested in the control sample, only the model regressing work/necessity-related RGDA on cognitive predictor variables predicted significant overall variability. Of these predictors, difficulty task setting predicted functioning in a *positive* direction (i.e., greater difficulty with these executive functions predicted *more* hours spent performing work- and necessity-related functions). This result is opposite that found in cluster two of the clinical sample, and may be interpreted within the framework laid out above, in terms of less efficient activity performed by those with executive impairment (i.e., more hours spent working as a result of less efficient, less planful work). It may also be that, once individuals reach a certain activity level, their executive functions decline due to fatigue. This interpretation fits the "ego depletion" model of Baumeister (1998), as well as the findings of Stuss et al. (2005), which evidence poorer performance on the ROBBIA when it is administered towards the end of the day. This interpretation may also explain why the opposite finding was observed in cluster two of the clinical sample, since these individuals perform less work per day, on average, than those in the control sample, and may not experience the criterion level of fatigue that can impair task setting.

Self-reported executive dysfunction on the BRIEF, on the other hand, predicted functioning in a negative direction, i.e., greater self-reported dysexecutive symptoms predicted less work-related activity. This finding of objectively measured and subjectively reported executive dysfunction predicting RGDA in opposite directions within the same sample further supports the dissociation between executive functions as assessed objectively via neuropsychological testing and those reported subjectively, by suggesting that factors reported subjectively may not be well-captured by objective testing and vice-versa. As the strongest predictor of RGDA in this model, it may be valuable to explore what underlying cognitive functions these measures assess, which may not be captured by brief, micro-level assessments such as the ROBBIA.

Other regression models run within the control sample yielded small, nonsignificant predictivity. While some individual predictors within each of these models were significantly predictive, the small overall R^2 values that these predictors together account for suggest that these predictions might be unstable. Larger studies may be necessary to examine any conative factors that determine RGDA in healthy individuals, especially since those selected for the current research were selected due to their hypothesized role in schizophrenia specifically. These findings suggest that other factors are primarily responsible for RGDA in healthy individuals.

The greater predictive power of cognitive predictors of RGDA in the control sample in contrast to the clinical sample, and the greater predictive power of personality predictors in the clinical sample, cannot be accounted for simply in terms of increased levels of personality as opposed to cognitive predictors in the clinical sample reaching some threshold at which functioning becomes impaired, given that significant predictors in each model show no clear relationship with that predictor's overall level. Rather, more complex patterns of relationship between the various forms of conative dysfunction and RGDA outcomes must exist. Understanding the nature of these is difficult within the current study, given the ambiguities noted above regarding direction of causality, among other factors. Some of these measurement issues are explored next.

Measurement Considerations and the Current Findings

The current regression analyses did not reveal strong patterns of influence on functional outcomes by factors underlying conative dysfunction. Nonetheless, some personality variables predicted RGDA significantly, and support the clinical importance of evaluating such factors. In the clinical sample, personality variables predicted 20% and 17% of the variability in RGDA in the work/necessity index and leisure/intrinsic indices, respectively. These values are modest relative to than those observed when the mid-level construct of apathy, as assessed by the Apathy Evaluation Scale (Marin, Biedrzycki & Firinciogullari, 1991) was used to account for self-reported functioning (Fervaha, Foussias, Agid et al., 2013b). However, the measures of conative dysfunction employed currently are "molecular" measures, designed to examine components of such pathologies as opposed to the pathologies per se. Similarly, the outcome measure used in the current study is novel, and examines a purely behavioural construct that represents the more "molar," ultimate outcome of functioning in everyday activity. The possibility of numerous intervening, mediating variables between the molecular and molar variables examined currently, as well as the multiple possible reasons that individual with schizophrenia may engage in more or less activity of various kinds, may limit predictive power within the current models. Clearly, many factors beyond conative dysfunction, some of which are difficult to measure, impact work- and leisure-related functioning in schizophrenia. These include social stigma, overall symptom severity, internalization of discriminatory ideas about schizophrenia and reduced self-confidence. These additional factors do not invalidate RGDA as a measure, but highlight the fact that a large amount of measurement "noise" can be expected when it is examined as a functional outcome.

By contrast, though, in a similar study examining relationships between schizophrenia symptoms as defined in the DSM and time use among schizophrenia outpatients (a similar metric to the one used currently), Harvey et al. (2006) found no such relationships. The finding that some factors in the current analysis were related to this important outcome measure, while general symptomatology may not show such relationships as in Harvey et al., supports further the examination of conative factors as opposed to more general symptoms in studying functional outcomes. In other words, conative functions may outperform existing symptom measures when predicting impact on daily activities – a distal but highly ecologically valid and clinically and personally relevant functional measure.

An additional complication in interpreting regression models using the POPS-m as an outcome measure lies in its purely quantitative, as opposed to qualitative, nature. It is possible that individuals with schizophrenia "titrate" the difficulty of some tasks according to their abilities; in other words, they may gravitate towards tasks that are easy, rather than engaging in fewer tasks overall, making the POPS-m insensitive to some potential behavioural outcomes of conative dysfunction. Therefore, qualitative measures of functional impairment may possess an advantage over quantitative ones, such as the POPS-m in addressing these phenomena. However, self-reported measures of the quality of goal-directed functioning may inadvertently re-measure the constructs with which they are attempting to predict these outcomes, generating inflated correlations. This is likely the case when scales such as the Heinrichs Quality of Life Scale (Heinrichs, Hanlon & Carpenter, 1984) are used to assess outcomes of negative symptoms, since this scale in itself was designed to assess negative symptoms (formalized in terms of the "deficit syndrome"). As a further example, regardless of the qualitative outcome measure selected, individuals low in BAS motivation may express much lower distress and therefore lower difficulty related to RGDA than their highly motivated, yet distressingly impaired counterparts – a hypothesis in keeping with the aforementioned findings of Tek et al. (2001), Corr (2002) and the relationship between decreased reward motivation and decreased self-reported distress seen in the current findings. Therefore, measures of dysfunction in goal pursuit relying on self-reported difficulty or distress may be conflated with amotivation itself. The pros and cons of measuring RGDA as a more objective, behavioural construct versus a more subjective, qualitative construct may be a valuable subject of future research.

The limited effect sizes observed in the regression models examining the entire clinical sample may also reflect the heterogeneity underlying conative dysfunction within this sample, as revealed via the cluster analysis. As noted in the methods section, these analyses were undertaken given their increased power and validity in examining a large number of predictors simultaneously. The cluster-wise regression analyses lacked this power and were therefore performed stepwise. These latter analyses, however, revealed somewhat different patterns of RGDA prediction when compared with the sample-wise regressions, and also generally produced models with greater predictive strength (as indicated by R^2 values), which may correspond with their improved homogeneity. Larger studies, incorporating greater numbers of participants within more homogeneous samples are required to more fully explore the predictive value of individual conative factors.

Some further potential issues of measurement in the current regressions are alluded to above. Measuring RGDA in a purely quantitative way leads to interpretive ambiguities given that disorganization, fatigue, dysexecutive symptoms and so on may contribute to less efficient work and therefore an *increase* in time spent performing goal-directed tasks, contrary to the assumption implicit in this model that RGDA always reflects poorer functioning. In addition, as is always the case in regression models, the direction of causality is ambiguous. This may account for the findings of poorer frontal executive functioning among those who perform more work, as noted above. It may also, in principle, account for other findings within the current regression models – such as the finding of a positive relationship between boredom proclivity and RGDA in the clinical sample. This could simply indicate, for example, that boredom propensity increases when an individual hasn't worked extensively over some period of time, meaning that RGDA leads to sensitivity to boredom, rather than vice-versa. This interpretive ambiguity is inherent to all correlational models but may serve as a caution against drawing strong conclusions. Rather than a conclusive model of factors causing impairment in schizophrenia, then, the current regressions may provide hypotheses for future research in the area.

Summary of regression findings

In summary, the POPS-m outcome measure used currently may reduce the amount of variability explainable by the low-level conative functions explored as predictors due to the causal "distance" between putative, molecular conative predictors and molar, purely behavioural outcomes, accounting for their modest predictive values. However, these conative predictors may outperform symptom measures in predicting daily activity-related outcomes Furthermore, the possibility that "more" activity may, in some cases, reflect "inefficient" activity must be considered. The strength of the outcome measures used currently lies in the lack of confounding factors related to self-report of subjective difficulty in executing goal-directed activity.

The current regressions may provide hypotheses for future research. These include increased attention to the evident importance of boredom proneness as a factor in schizophrenia (especially with regards to functioning), the distinctions that may be drawn between externally-imposed and intrinsically-generated goal-directed activity as distinct phenomena, and the role of intrinsic motivation and reward sensitivity – especially as they relate to the latter form of goal-directed activity in schizophrenia.

Clinical Implications

Assessment

Among the conative factors examined in the current analysis, those showing the greatest elevations in schizophrenia included the objectively measurable, but subjectively unreported, energizing factor in cluster two, and subjectively reported or personality-related avolitional factors in cluster one. This pattern of findings highlights the importance of attending both to objective testing and subjective report in clinical assessment, an observation made several times in the preceding discussion. Subjective report is sometimes taken to be less valuable in clinical practice, or else "trumped" by objective testing. However, despite the subjectivity of the reported conative dysfunctions in cluster one in the absence of deficits on the ROBBIA or other cognitive tests, for example, this cluster showed greater RGDA on the leisure/intrinsic index of the POPS-m. These two approaches to assessment must therefore be viewed as complimentary, with each approach providing important clinical information that the other may miss.

The current findings further indicate that that a client denying any difficulties with goal-directed activity in self-report may in fact be amotivated, and show (for example) impaired frontal functioning on objective testing. A client who self-reports severe executive difficulties, boredom proneness, problems of self-determination and subjective indices of avolition but shows no accompanying signs of executive dysfunction on neuropsychological testing, similarly, may nonetheless be hampered by personality factors that conflict with their intrinsic desire to accomplish more. Such factors may include punishment sensitivity (and its attendant pathologies) and state orientation causing a distressing inability to carry out plans and accomplish goals. Clinicians working with those diagnosed with schizophrenia are likely familiar with both of these presentations the apathetic, emotionally flat, “deficit syndrome” client who nonetheless reports little distress or difficulty related to inactivity, and the more neurotic, distressed individual who has goals and desires but cannot execute them due to a feeling of overwhelming “lack of energy” or some other blocking factor.

The finding of lower goal-directed activity in cluster one, despite this cluster’s not matching typical descriptions of apathetic, negative- or deficit-syndrome clients further underscores the importance of looking beyond these typical conceptions. Apathy and amotivation are often considered definitive of conative dysfunction in schizophrenia. However, assessments that discount the clinical significance of clients’ conative dysfunction if they do not fit this well-defined subtype may underestimate the level of impairment clients are in fact experiencing. Assessments may therefore benefit significantly by examining other factors, which may be subjectively reported, hampering goal-directed action. Given these findings, a clinician observing that a client with intact executive functions and motivational indices may be advised to attend closely to their client’s own reports of avolition, distress and boredom, as these factors may in fact contribute more to difficulties in daily life.

The current findings are also relevant to clinical assessment in that they support the view that boredom may represent an important clinical marker of the presence of intrinsic motivation to act, coupled with some impairing factor, as discussed above. This marker is easy to assess, is elevated in schizophrenia, and is uniquely connected to functional outcomes, per the current findings and others reviewed above.

Intervention

Each of the two conative subtypes derived from the current data carries separate implications for treatment in psychotherapy. The motivated but boredom-prone, distressed, subjectively avolitional individual will likely benefit from therapy addressing the conflicting factor in accomplishing what they are otherwise intrinsically motivated to do. If it is the case that an individual is hampered by traits related to punishment sensitivity, therapies targeting this underlying factor (such as exposure techniques) may be of most help. Individuals whose action is hampered by ruminative or depressive thought (as per the state orientation: preoccupation model) might best be helped by addressing these processes. As a cluster of individuals who experience subjective distress, boredom, and "avolition" per se (a frustrated ability to engage in desired activity), this cluster may find therapy especially empowering in accomplishing their intrinsic desires and could be predicted to benefit the most from, and be most motivated to pursue and remain in, psychological treatment tailored to address their subjective needs.

Such an approach would clearly be contra-indicated for those who lack strong intrinsic motivation to begin with. As was alluded to in the introduction, from a person-centred point of view, it is unclear what role a helping professional can or should take in approaching individuals who are highly inactive but do not report subjective distress as a result (e.g., as per the deficit syndrome and some individuals within the current cluster two). Addressing concerns that these individuals do express subjectively may be a more valuable target in psychological therapy than inactivity per se. However, an interesting therapeutic and philosophical question remains as to why these individuals show (at times profound) lack of intrinsic motivation to perform goal-directed activity; it may be the case that this represents a loss or alienation of previously held desires and motives that the individual could recover if they so wished. This question is beyond the scope of the current study, but constitutes an important avenue for future research.

Limitations of the Current Study

The current study carries several limitations. Some of these are specific to individual methods and analyses, and are discussed above. These include the problems of inferred causality and problems of purely quantitative measurement of outcomes in the regression models. These limitations restrict the conclusions that may be drawn from the current regression analyses, despite the aforementioned benefits of using a purely behavioural, quantitative outcome measure. Evidence for limited discriminatory power in the novel Zeigarnik and prospective memory tasks included in the study was also discussed above, and suggests that these factors cannot be ruled out by the current analyses as important factors affecting goal-directed activity in schizophrenia.

Other limitations exist in the current research. This research examined only outpatients with chronic schizophrenia or schizoaffective disorder, medicated with antipsychotics. It is likely that conative dysfunction in this population is clinically very different from that seen in first episode schizophrenia, untreated schizophnrenia, affective psychoses, brief psychosis, and other such clinical groupings. The study further excluded those with any current mood episode or recent history of substance-related diagnoses, factors with obvious implications for goal-directed functioning. This was done to ensure that factors specifically related to schizophrenia-spectrum disorders could be examined. However, individuals with these commonly comorbid diagnoses may not fit into the pattern of results obtained currently. Thus, the generalization of these findings should be made with caution.

An additional statistical concern with regard to the current data relates to missing data. Nine of the 59 participants in the clinical sample had at least one cell with missing data in their datasets, with six of these missing data from the majority of their self-report measures due to inconsistent or incomplete responding. In the regression analyses, which are inherently more robust to missing data imputation, this was addressed by imputing sample means into missing data cells. In the cluster analysis, this was dealt with by excluding these participants given the sensitivity of cluster analysis to data imputation. Although this was necessary to limit the possibility of spurious findings, the exclusion of these participants may have reduced the power of the cluster analysis to reveal the full extent of the heterogeneity of this population. This is due to the likely non-random nature of the data missing from the analysis: those who responded inconsistently or incompletely to self-report measures may have done so *because* they are more prone to boredom or have more difficulty with attentional control than completers. They may therefore have been more representative of one of the two clusters, or may have represented a separate cluster with interesting clinical properties and implications. This possibility further highlights the need for larger, more inclusive studies with potential to further specify the heterogeneity of conative dysfunction.

Future Directions

The classification scheme developed currently is not intended to replace classical distinctions among the different negative symptoms, or concepts such as "deficit" or "negative" syndromes within schizophrenia, despite some indications of similarities between the latter syndromes and the current study's cluster two. Rather, the current study examined only conative dysfunction as a superordinate concept that may help clarify discussions of amotivation and avolition, without regard to other negative symptoms such as affective flattening or social withdrawal, which other syndrome models take into account. Further research is therefore required to fully describe the relationship between the current scheme and constructs such as the deficit syndrome, as well as the relationship between this scheme and other negative symptoms. As delineated in the introduction, the current study did not include commonly used, and clinically useful, measures of avolition or amotivation (such as the SANS; Andreasen et al., 1984, and the PANSS; Kay, Fiszbein & Opler, 1987), since the specific dysfunctions together referred to under these labels were clustered together based on clinical observation and theory, rather than empirical evidence, which was the purpose of the current study. However, the examination of the constructs derived from the current research may benefit from further study to determine their relationships with these current conceptions of conative dysfunction. These may all constitute topics for further research.

Additional research stemming from the current findings may further serve to extend their clinical implications, as discussed above. From an assessment point of view, the value of using multiple methods to assess heterogeneous forms of conative dysfunction was discussed. However, the battery used in the current study was lengthy and experimental. In some areas, its psychometric properties are not yet fully explored. The development of brief assessment tools examining conative dysfunction may have high clinical value, given the highly impairing and, at times, distressing nature of conative dysfunction and the current finding of multiple, distinct patterns of such dysfunction within schizophrenia. Those factors that best discriminate the two clusters derived from the current study could contribute to a short battery assisting classification in future clinical work and research. Developing such a set of tools with sound psychometric properties and determining its clinical utility may be a promising avenue of future research.

Treatment implications of the distinct patterns of dysfunction examined currently are also, at this point, speculative. Clinical studies of psychotherapy for schizophrenia are growing, however interventions specifically targeting negative symptoms are few in number (though some have been described; Johns, Sellwood, McGovern et al., 2002; Klingberg, Wolwer, Engel et al., 2011). Such studies may benefit from the current findings and resulting classification scheme. Also, given the separate brain regions and neurotransmitter systems known to underlie several of the motivational and cognitive functions examined in the current research, the development of pharmacotherapies and other biological interventions may also benefit if they are matched to patients with deficits specific to their respective targeted brain systems.

As discussed above, future research in negative symptomatology in general may also benefit from the distinctions drawn in the current research. Whereas research in this area has, to date, typically examined avolition, apathy, the deficit syndrome, etc. as unitary constructs, the use of cluster analysis has demonstrated utility in producing subgroups of study participants with distinct and complimentary patterns of conative pathology. The application of the current cluster scheme may serve as a starting point for future examinations of these conative constructs. Further, as was also noted above, the current scheme may not represent the full heterogeneity of conative dysfunctions, and additional clusters may exist in different patient populations. It is also possible that conative dysfunction develops in a fluid manner across the span of an individual's life or course of disease. These possibilities all offer interesting subjects for future research.

CONCLUSIONS

Conative dysfunction in schizophrenia has been shown to be a multifaceted phenomenon that is associated with significant impairment. Although it is often discussed in terms of unitary concepts such as “avolition” and “amotivation,” these terms are poorly defined and their application in schizophrenia research and clinical practice is often arbitrary. The current research has provided a more nuanced understanding of these phenomena.

The hypotheses laid out in the introduction, of specific patterns of conative dysfunctions affecting distinct subgroups of individuals, were supported. The exact nature of each cluster at this point is based on the co-occurrence of each of these factors within, but not between, clusters. Two clusters emerged strongly from the data, which fit broadly into the two major classes of conative function laid out in the introduction, and in the literature at large: those of amotivation and avolition.

One cluster (cluster two) generally fit the traditional clinical archetype of the apathetic, amotivated individual demonstrating cognitive dysfunction, but nonetheless lacking in impairment-related subjective distress or boredom. This cluster may best be understood in terms of lack of motivation or reward sensitivity (what some may discuss in terms of “drive”). Another cluster also emerged, that may best be understood in terms of intact motivation and reward sensitivity that is hampered by personality factors such as state orientation, lack of a sense of self-direction and heightened punishment sensitivity. Boredom propensity and subjective complaints of dysexecutive functions were markedly elevated in this cluster. This was interpreted to indicate this cluster’s motivation to act is intact (an interpretation further supported by self-report motivation indices), but hampered, creating failed attempts to execute goal-directed action with accompanying distress and a subjective sense of cognitive and volitional impairment. This cluster may be especially motivated to seek treatment for their conative difficulties, and find such treatment particularly empowering.

With regard to the individual conative factors examined in the current study, several emerged as being especially affected in schizophrenia, either in one or both clusters. Among the frontal executive and other cognitive variables assessed, energizing was most impacted, especially in cluster two (the more “amotivated” cluster). This finding conforms to previous research demonstrating a relatively strong role of superior medial PFC functioning in schizophrenia. Delay discounting was also impacted, however only in cluster one, and in the direction of *lower* discounting. This finding supports the central role of punishment or loss aversion in this cluster and suggests a more “careful,” or obsessive cognitive style within this subgroup. Several self-reported volitional and dysexecutive symptoms were elevated markedly, but only in cluster one. These included state orientation (especially due to preoccupation), lack of a feeling of self-determination, and dysexecutive symptoms on the BRIEF. These findings underscore the importance of considering both subjective, self-reported data and objective test data in assessing clients with conative dysfunction. Finally, consummatory (but not anticipatory) anhedonia was elevated in the schizophrenia sample, a finding supporting recent challenges to the traditional view that reduced effort allocation in schizophrenia can be explained simply in terms of anticipatory anhedonia.

Future research, clinical assessment and treatment may benefit from these findings in several ways. The existence of distinct patterns of conative dysfunction may account for the inconsistency of several research findings related to negative symptoms. Future studies may improve their power and the specificity of their findings, therefore, by classifying participants according to the clusters observed currently, or according to new schemes that may further contribute to a nuanced understanding of conative dysfunction. Clinical assessment and treatment planning may benefit from this scheme by targeting specific conative functions impaired within a given individual, avoiding the misapplication of inappropriate interventions or those may not be warranted or wanted by an individual given their own experience of their symptomatology, while improving the power of intervention studies.

As a factor that was, in its inception, central to clinical descriptions of schizophrenia, it is suggested that conative dysfunction warrants an increased focus in research and clinical work with this population. Improved dialogue between the world of clinical research and the wealth of literature in motivational, volitional and personality psychology may also be of benefit, as the application of several conative concepts to schizophrenia in the current research has demonstrated. As attention gradually returns to conative functioning in schizophrenia, a more nuanced, multifaceted understanding of the factors underlying it will be essential to improve accuracy and power in both experimental and clinical work. The current empirical findings contribute to this understanding by distinguishing specific deficits underlying two distinct forms of conative dysfunction, and advance the almost century-old clinical observations of Kraepelin (1919), who described the great “extent and multiplicity” of the “disorders of volition” intrinsic to schizophrenia.

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APPENDICES

Appendix A. Multidimensional State Boredom Scale, shorter revised version (MSBS-r).

1. Time is passing by slower than usual.
2. I wish time would go by faster.
3. I feel bored.
4. Time is dragging on.
5. Time is moving very slowly.
6. I feel happily engaged in activity right now. (Reversed)
7. Right now it seems like time is passing slowly.

Appendix B. Items from the Participation Objective/Participation Subjective (POPS) interview appearing in each RGDA index.

Work/Extrinsic Index

1. Shopping for groceries, drugs and other necessities
2. Preparing meals
3. Cleaning the house
4. Caring for or supervising children or dependants
5. Paying bills, balancing checkbook, banking
6. Doing home repairs
7. Doing yard work
8. Working for pay
9. Doing volunteer work
10. Commuting
11. Exercise*

Leisure/Intrinsic Index

1. Playing sports (individual or team)*
2. Writing for pleasure*
3. Reading extracurricular materials (e.g., novels, newspaper)*
4. Engaging in other hobbies (e.g., modeling, crosswords, gardening)*
5. Participating in clubs (e.g., Rotary Club, Scouting, political party)*
6. Participating in recovery activities (e.g., smoking cessation, coffee house)*†
7. Playing a musical instrument*
8. Outdoor activities (e.g., hiking, skiing, sailing)*
9. Dancing*
10. Going to the movies
11. Going shopping (not for groceries or necessities)
12. Attending religious services or church social events
13. Attending sporting events as a spectator

*Items added to the original POPS (Brown, 2006)
†Not applicable/not asked of control sample