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Assessing functional performance using computer-based simulations of everyday activities

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ABSTRACT

Current functional capacity (FC) measures for patients with schizophrenia typically involve informant assessments or are in paper and pencil format, requiring in-person administration by a skilled assessor. This approach presents logistic problems and limits the possibilities for remote assessment, an important issue for these patients. This study evaluated the feasibility of using a computer-based assessment battery, including simulations of everyday activities. The battery was compared to in-person standard assessments of cognition and FC with respect to baseline convergence and sensitivity to group differences. The battery, administered on a touch screen computer, included measures of critical everyday activities, including: ATM Banking/Financial Management, Prescriptions Refill via Telephone/Voice Menu System, and Forms Completion (simulating a clinic and patient history form). The sample included 77 older adult patients with schizophrenia and 24 older adult healthy controls that were administered the battery at two time points. The results indicated that the battery was sensitive to group differences in FC. Performance on the battery was also moderately correlated with standard measures of cognitive abilities and showed convergence with standard measures of FC, while demonstrating good test-retest reliability. Our results show that it is feasible to use technology-based assessment protocols with older adults and patients with schizophrenia. The battery overcomes logistic constraints associated with current FC assessment protocols as the battery is computer-based, can be delivered remotely and does not require a healthcare professional for administration.

1. Introduction

Schizophrenia affects about 1.1% of adults living in the United States (National Institute of Mental Health, 2015) and causes a substantial strain on the resources of the mental health delivery system and a staggering economic burden. Estimates suggest that total annual costs for schizophrenic population in the United States range from about $94 to $102 billion annually (Chong et al., 2015). Schizophrenia is associated with recurrent hospitalizations, low employment rate, poor social functioning and notable disability in everyday functioning and performance on tasks critical to independent living (Bartels and Pratt, 2009; Bowie and Harvey, 2005, Leifker et al., 2009). Currently, as few as 14% of people with schizophrenia receive any interventions to improve functional skills (West et al., 2005) or even a cognitive and functional assessment during the course of treatment (Medalia and Lim, 2004).

Developing effective intervention strategies to remediate difficulties encountered during the performance of everyday tasks is predicated on understanding the sources of the difficulty experienced by this patient population. Thus, there is an increasing interest in developing tools to detect the most important and potentially subtle manifestations of cognitive and functional decline in patients with schizophrenia in order to the develop pharmacological and non-pharmacological treatment approaches or to develop psychosocial treatments. In fact, the US Food and Drug Administration has stated a position that cognitive improvements are not sufficient to prove the efficacy of drug treatment and that approval of new treatments requires evidence of improvements in the patients' functioning beyond standardized measures of cognition (Laughren, 2001). In this regard, measures of functional capacity (FC) are generally considered to be sufficient with respect to demonstrating improvements in clinically meaningful outcomes (Buchanan et al., 2010; Marder and Fenton, 2004). FC refers to person's capability, under controlled conditions, to perform daily/routine tasks and activities (Patterson and Mausbach, 2010). Assessment of FC, although not

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perfectly correlated with real world performance of those activities, provides information on a person's ability to perform tasks in the real world and on the types of difficulties they might encounter during task performance. This type of information is helpful to identify remedial interventions and types of needed support/assistance.

Currently, common FC assessment protocols used with schizophrenic patients include informant-based reports of functional performance from a relative or friend or patient themselves (Keefe et al., 2006; Ventura et al., 2015), paper and pencil based assessments such as the UPSA (Patterson et al., 2001) and more recently computer-based performance assessments such as the Virtual Reality Functional Capacity Assessment Tool (VRFCAT; Keefe et al., 2016). Although these protocols have proven useful in terms of providing information about FC they also have some limitations.

For example self-report and informant-based assessments of functional performance can be useful with respect to providing insight into someone's functional ability but they also can be subject to biases. Patients with severe mental illness tend to greatly misestimate their functional abilities (Gould et al., 2015) while other informants such as family members may have positive or negative biases in their perceptions of different aspects of functional performance due to denial, minimization or oversensitivity to perceived impairments (Sabbag et al., 2011). This may result in inaccurate judgments regarding a patient's FC, and real world functioning (Bowie et al., 2008; Durand et al., 2015; Keefe et al., 2006; Arguelles et al., 2001). Other informants such as friends may not have a sufficient opportunity to observe the patient to make reliable functional judgments or may not be able to make reliable judgments themselves.

The use of paper and pencil assessments of FC is also quite common. For example, the UPSA (Patterson et al., 2001) is the most widely used measure of FC for schizophrenia patients. The full UPSA includes tasks such as: counting currency, paying a bill and making change; using a bus schedule in planning a trip, understanding related charges and obtaining needed travel information and reading and planning a recreational outing based on scenarios about a trip to the beach on a hot sunny day and the zoo on a cold rainy day. The UPSA and shorter versions of the instrument, the UPSA-B (Mausbach et al., 2007) have provided invaluable information related to real-world outcomes such as vocational potential and the ability to live independently outside of psychiatric institutions. The association between the UPSA and neurocognitive performance in individuals with schizophrenia has also been quite robust (see Loewenstein et al., 2012 for an example and Leifker et al., 2011 for a review). However, the UPSA is a paper and pencil measure and requires individuals to perform in tasks in a role-play format that does not capture the complexities that exist in the everyday world. Further, it does not reflect how many of the tasks assessed by the measure are currently performed in today's technology oriented world (Czaja and Sharit, 2003).

The aforementioned measures also require specialized personnel for valid administration. They are typically performed in clinic settings and can requires the use of cumbersome stimuli that are not common to the experience of all potential participants. This limits the utility of these assessments for large segments of the patient population, especially those typically underserved such as minority and older patients who often have problems with mobility or transportation.

In response to the weaknesses associated with commonly used FC measures noted above, Keefe and colleagues developed the VRFCAT, a computerized measure of FC that measures four different functional abilities embedded in a virtual reality shopping experience: preparing a shopping list, taking a bus, shopping in a store and managing currency. The psychometric properties of the VRFCAT were evaluated with a sample of schizophrenic patients and healthy adults and the measure was found to be sensitive to diagnosis, highly reliable and to demonstrate convergence with the UPSA.

Similar to Keefe, we also developed a computer-based measure of FC. Our battery includes an: ATM Banking/Financial Management, Prescriptions Refill via Telephone/Voice Menu System, and Forms Completion (a clinic and patient history form). We chose these tasks as refilling prescriptions and completing patient forms are common activities completed by both older adults and patients. In addition, using ATM's for financial management tasks is very common and in fact many financial institutions encourage these types of electronic as opposed to face-to-face transactions. Our battery has the following advantages in comparison to the VRFCAT. The tasks are veridical representations of real world systems that are actually used to perform financial management, prescription refill and forms completion tasks whereas the VRFCAT is based on a virtual reality simulation and thus does not fully capture the complexity of the real world. In addition, the VRFCAT has subtasks that are contained within a continuous task whereas our tasks are distinct and modular and thus we can easily expand our battery to include additional tasks. Finally, our tasks are tap into the current "technology-based" world where the use of technology such as that represented in our tasks is ubiquitous with respect to everyday activity performance.

This study evaluated the psychometric properties of a new battery. Specifically, we compared our battery to in-person standardized assessments of cognition and a commonly used standard paper and pencil measure of FC (UPSA-B) with respect to baseline convergence, sensitivity to group differences between patients with schizophrenia and non-impaired older adults, and test-retest reliability.

We hypothesized that the computerized task battery would be sensitive to group differences in FC such that the schizophrenic patients would perform at lower levels on all three tasks than the healthy non-impaired adults. We also hypothesized that there would be associations between performance on the task battery and performance on the UPSA-B and the measures of component cognitive abilities.

2. Methods

2.1. Sample

Participants met DSM-IV criteria for Schizophrenia meeting, which was confirmed by certified assessors, using the Structured Clinical Interview for DSM-IV (First et al., 1995). Patient participants were also required to have: 1) have no history of head trauma with loss of consciousness for >30 min or a history of other significant pre-existing brain disease including cerebrovascular accident, seizure disorder, or central nervous system infections; 2) be clinically stable; 3) have a stable community residence other than a shelter at the time of enrollment; 4) have no history of Bipolar I or II Disorder or other major psychiatric disorder involving psychosis that would rule out the diagnosis of schizophrenia; 5) no evidence of acute intoxication at the time of the outcomes assessments; 6) be English speaking and 7) able to read at the 6th grade level (score of ≥45 on the Wide Range Achievement Test, 3rd Edition (WRAT-3; Wilkinson, 1993). The healthy control participants were required to: 1) live in the community; 2) aged 50 and older; 3) be English speaking; 4) be non-cognitively impaired (≥26 on the Mini Mental Status Exam (MMSE; Folstein et al., 1975) and 5) able to read the computer screen. All participants were paid $30.00 per assessment session and $5.00 for parking (if needed). The University of Miami Institutional Review Board approved the study. All participants signed an informed written consent. The consent was also verbally summarized and read to participants who appeared to have difficulty with comprehension of the written form.

2.2. Description of the assessment battery

The functional tasks developed for the project included a: money management (Automatic Teller Machine); telephone menu/prescription refill task; and forms completion task that mirrors online completion of demographic information typically requested in a physician clinics. The ATM task was a replication of an operational ATM machine

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