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Assessing Functional Performance using a 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.

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Contributors

Czaja, and Harvey were involved in the project conceptualization and oversight, preparation of the manuscript. Loewenstein was involved in data analysis and manuscript preparation. Lee was involved in project management, participant recruitment, data analysis, and manuscript preparation. Fu was involved in data management and manuscript preparation. All authors contributed to and have approved the final manuscript.

Conflict of Interest

None

Keywords

functional capacity; simulations; computerized assessment battery

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 U.S. 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 & Pratt, 2009; Bowie & 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 & 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 & Fenton, 2004). FC refers to person's capability, under controlled conditions, to perform daily/routine tasks and activities (Patterson & Mausbach, 2010). Assessment of FC, although not 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 examine 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 be may not be able to make reliable judgements 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) has 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 & Sharit, 2003).

The aforementioned measures also require specialized personnel for valid administration. They are typically performed in clinic settings and can require 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 our 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.

Methods

Sample

Participants met DSM-IV criteria for Schizophrenia meeting, which was confirmed by certified assessors, using the Structured Clinical Interview for DSM-IV (SCID; First et al., 1995). Patient participants were also required to have: 1) have no history of head trauma with loss of consciousness for > 30 minutes or a history of other significant pre-existing brain disease including includes 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, Folstein & McHugh, 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.

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 a 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 and the forms task paralleled the form required by UMMSM clinics. The prescription refill task was a simulation of a local chain pharmacy. The tasks are in a multi-media format and include graphic representations, video, text and concurrent speech instructions. They are delivered in person on a touch screen or mouse format in a PC environment. Sample screens for the ATM and Prescription tasks are presented in Figure 1. Each task consisted of subtasks with sequential demands. For the ATM task participants were sequentially instructed to check the balance in their savings account, transfer money between checking and savings accounts and to withdraw cash from their savings account. For the Prescription task they had to call the pharmacy (using a telephone keypad on the screen), refill two different prescriptions (the pill bottles appeared on the screen) and request a pickup time and date. For the forms task they had to complete the form entering basic demographic information as they would in a clinic office. Performance metrics for the ATM and Prescription Refill tasks include a rate measure (total correct/time), which reflected a measure of task efficiency and a ratio measure (total correct score achieved/total correct score possible), which reflected a measure of accuracy. We also include task completion time for each of these tasks. For the forms completion task we included a measure of time to complete the forms completion task as the task required filling in a form with demographic data (e.g., gender, age).

Other Measures

Positive and Negative Syndromes Scale (PANASS)—Patients were administered the Positive and Negative Syndromes Scale (PANSS) (Kay et al., 1987), a 30 item scale that assesses positive (7 items) and negative (7 items) symptoms of psychosis, as well as general symptoms of psychopathology (16 items), with a *PANSS total* score reflecting the sum of all 30 items.

Functional Capacity (Convergent Validity Task)—The UPSA-B (Mausbach et al., 2007), a paper and pencil measure of FC, was administered to all participants. The UPSA-B assesses two domains: 1) *Financial skills*, in which participants are required to count change, make change from an item purchased at a store, and write a check for a utility bill, and 2) *Communication skills*, in which participants are asked to demonstrate how to use a telephone to dial emergency services, call information to ask for a telephone number, and call a physician to reschedule a medical appointment. For each domain, the total percent correct is calculated and converted to a standardized score ranging from 0–50. A summary score is then calculated by summing the two domain scores (range = 0–100), with higher scores indicating better FC.

Cognitive Abilities—Cognitive abilities were assessed using selected paper and pencil tests from the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008) and included the Trial Making Test Part A; Animal Fluency Test, Hopkins Verbal Learning Test (HVLT); Letter-Number Span Test and the BACS Symbol Number Code Test (Table 2).

Protocol

Participants were screened via telephone for the basic inclusion criteria (e.g., age; able to speak and read English) and scheduled for the baseline assessment. Participants completed the assessment on an individual basis. They were given a verbal description of the study and then asked to read and sign an IRB approved informed consent. Participants then completed a demographic questionnaire and the WRAT-3 and those who met the inclusion criterion completed the cognitive assessment battery and then proceeded to complete the UPSA. As noted, patients also administered the PANASS. The PANASS was administered by raters who were trained in the administration of the measure and had prior experience administering the PANASS. Participants then proceeded to complete the computer-based functional measures. They repeated the assessments at 4–6 weeks following the initial assessments.

Statistical Analyses

All analyses were conducted using SPSS (Version 22). As noted the performance metrics for these tasks include indices of accuracy (total correct score, errors) and efficiency (task completion time). Descriptive statistics were computed for all of the variables using ANOVA and Chi-square procedures. Group comparisons were done with F-tests and magnitude of associations between the computerized performance-based tasks and scores on traditional neuropsychological tasks and UPSA-B were calculated using the Pearson Product Moment (PPM) procedures. Test-retest reliability for each of the functional tasks was computed with the PPM r statistic.

Results

Sample Demographics

The sample included 77 patients and 24 healthy non-impaired older adult control participants. The healthy control participants ($M = 64.8$ yrs.; $SD = 8.3$) were intentionally selected to be older than the patients ($M = 54.2$ yrs.; $SD = 7.6$) ($p < .001$). The healthy control participants included more females, and had higher levels of education and income (all $ps < .01$). The patient sample was more ethnically diverse and included more minorities. As expected the patients were more likely to be unemployed ($p < .001$). Fifty-eight percent of the patients lived independently and 32% lived in supervised residential settings (Table 1). Twenty-one percent of the patient sample were on first generation anti-psychotics and 79% were on second generation antipsychotics. The healthy control participants also performed better than the patients on the cognitive ability measures at baseline (all $ps < .05$) except for the Category Fluency Test.

Group Differences on the UPSA-B and the Computerized Battery Functional Tasks

The healthy controls performed at a higher level than the patients on the overall UPSA-B and on both domains of the UPSA-B. The healthy controls also performed better than the patients on all three FC tasks (ATM, Prescription Refill and Forms Completion). As shown in Table 2, it took the patients significantly longer to complete all three tasks, especially the

ATM and the Forms Completion Task. In addition, they had a lower efficiency score and lower accuracy on the ATM task and the Prescription Refill task.

Associations Between the Performance on the Computerized Battery Functional Tasks and Performance on the UPSA-B

Patient Sample—As indicated in Table 3, among the patient participants, all of the performance metrics for the functional battery tasks were significantly correlated with the UPSA-B total score. The highest associations between performance on the tasks and the UPSA-B total score were for task completion time for the forms task and ATM rate accounting for 25% of the explained variance, followed by the ATM ratio and ATM time. With respect to the UPSA-B financial domain, all of the task performance metrics were significantly associated with the UPSA-B financial score except for the ratio and time measures for the Prescription Refill Task. Not surprisingly, the highest degrees of association between performance on the tasks and the UPSA-B financial score were found for the ATM measures. For the UPSA-B communication domain, the correlations between the task performance metrics and the UPSA-B financial score were lower. Task performance metrics significantly correlated with the UPSA-B communication score were ATM rate and ratio, Prescription Refill ratio and Forms Completion time.

Healthy Control Sample—In the healthy control sample, the correlations between UPSA-B scores and the functional task measures were generally lower than those found in the patient sample. Only the Prescription Refill rate was significantly correlated with the UPSA-B total score. This is not surprising given the relatively modest number of subjects (see supplemental table 1).

Associations Between Performance on the Computerized Battery Functional Tasks and the Cognitive Ability Measures

Patient Sample—As seen in Table 3, for the patients, there were some different patterns of association between the task performance metrics and the cognitive ability metrics. ATM rate and ATM time were significantly correlated with all of the cognitive ability measures with the highest degree of association with the BACS Digit Symbol measure. ATM ratio was also significantly correlated with all of the neuropsychological measures except for Trails A. For the Prescription Refill task, the rate score was significantly correlated with all of the cognitive ability measures except for Animal Fluency and the highest degree of association was for the HVLT-R. The Prescription Refill ratio measure was significantly correlated with all of the cognitive ability measures except for Trails A and Animal Fluency and the time measure was only correlated with the BACS Digit Symbol and Trails A. Time to complete the Forms task was significantly correlated with all of the cognitive ability measures except for the HVLT-R with the highest degree of association with the BACS Digit Symbol measure.

Healthy Control Sample—Among healthy controls, as shown in supplemental table 1, the ATM rate measure was statistically significant correlations with all of the cognitive ability measures with highest associations found for the BACS Digit Symbol, and Letter-Number Span measures. ATM time was significantly correlated with all of the cognitive

ability measures except for Animal Fluency. Prescription Refill Rate was significantly correlated with all of the cognitive ability measures except for HVLT-R and Animal Fluency and time to complete the Prescription Refill task was only correlated with the BACS Digit Symbol measure and time to complete the Forms Completion task was only correlated the Letter-Number Span measure. As noted, the healthy control sample was small.

Test-Retest Reliability of the Computerized Battery Functional Tasks

We obtained test-retest reliabilities for our novel functional tasks on 56 of patient sample (74% males) with a mean age of 54.5 years ($SD=3.6$). The test-retest interval ranged from 6–18 weeks with a mean interval of 9.0 weeks ($SD=2.7$). As depicted in Table 4, the highest test-retest reliabilities were for forms completion time ($r=.77$), ATM completion time ($r=.74$). There was also moderate test-retest reliability for the other task metrics ($r=.40 - r=.59$). There was less test-retest stability for the Prescription Refill task time measure ($r=.31$).

Discussion

Despite their correlations with both everyday functioning and neuropsychological test performance, current measures of FC that are used with Schizophrenic patients such as the UPSA and UPSA-B still have limitations. They fail to capture the complexity of current everyday tasks important to independent living and have logistic constraints, in that they are typically administered in clinical settings by trained specialists or require an interview with an informant. Further, the manner in which the tasks are presented does not reflect how the tasks are performed in today's technology driven world. This paper reports on a new FC computer-based functional assessment battery that includes an assessment of money management skills (completing transactions using an ATM), a medications prescription refill task and a forms completion tasks (a replica of a task performed in a clinical office setting). The tasks capture the real world complexity of everyday tasks and reflect current protocols for task completion. For example, recent survey data (~ 3000 consumers) from the Board of Governors of the Board of the Federal Reserve (Board of Governors of the Board of the Federal Reserve, 2016) indicated the 75% of the survey respondents use an ATM machine to access their financial accounts. Similarly, consumers commonly use automated telephone voice interactive systems to refill prescriptions and in fact, medical specialists the use of paper prescriptions has been eliminated in the University of Miami Medical Group (the care provider for the current subject sample) and some states such as New York are requiring that all prescriptions be created electronically.

This paper examined the psychometric properties of the battery. The data indicated that the battery is sensitive to between group differences and patients performed lower on all three tasks than the older adult healthy control participants. Our study also shows that it is feasible to use technology-based assessment protocols with older adults and patients with schizophrenia. Our participants had limited computer experience but were able to complete the functional tasks. These results support the notion that some of the logistic problems associated with paper and pencil clinic based assessments can be circumvented through the use of technology.

Our results also indicate the functional assessment battery is a valid measure of functional capacity, as evidenced by convergent validity with the standard paper and pencil measure of functional capacity (UPSA-B). The measures were also moderately correlated with standardized measures of cognition, which confirms other findings (e.g., Czaja & Sharit, 2003) that cognitive skills are important to the performance of everyday living tasks, including in patients with schizophrenia (Keefe et al., 2016). However, the fact that the correlations were moderate indicates that the measures capture other aspects of performance that do not fully overlap with standardized measures of cognition. This is likely due to the fact that the computerized tasks are more complex and more interactive than neuropsychological test performance. Finally, the tasks were also sensitive to within group variability and ceiling effects were not found even in the small sample of healthy adults.

The data from this study point to avenues for intervention. Clearly these tasks are important for independence and it is very possible that direct training on the tasks would improve performance. The fact that the patients took twice as long to complete the ATM as the non-impaired adults suggests a substantial lack of efficiency performing this task that might also be a source of distress, as this type of task is performed in a public domain where there may be other people waiting to complete the same activity.

There are some limitations with this study. First the sample of healthy non-impaired adults is relatively small, and differed in age, educational attainment and gender. However, we included for comparison purposes to determine if the performance on the task battery was sensitive to group differences and to determine if there were potential ceiling effects with non-impaired populations. The battery needs to be administered to large samples of both non-impaired and patient populations including other types of patients for normative purposes. We also need to develop alternative forms of the tasks to minimize practice effects in intervention trials. In addition, the battery of tasks needs to be expanded to include a wider variety of tasks. In this regard, we have developed a doctor's visit/medication management task and a ticket kiosk task, which need to be evaluated with diverse populations. We also acknowledge that the battery does not include any assessment of social competence, which is a key component of functional recovery in patients with Schizophrenia. Performance on the tasks battery also needs to be compared to actual performance on the tasks in real world setting. For example, is performance on the battery prescription refill task associated with the record of an actual pharmacy? Clearly examination of these types of associations is an important next step in the development and evaluation of our battery.

As with other measures of FC there are also some limitations with this type of battery. For example, study participants may be motivated to perform better in a research study as compared to the "real world" as they are being compensated for their participation in a study. Also, the battery is being administered in a research context, which does not capture the contextual elements of the "real world." Limited insight into the importance of performing a task may also influence performance. For example, in real world contexts individuals may not refill their prescriptions as they lack the understanding of the importance of the activity and the consequences of nonadherence or they may fail to remember to refill their prescriptions in a timely manner. Finally, currently the tasks are

available in both English and Spanish and they would need to be translated into other languages so they could be administered to other cultural/ethnic groups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Sample screens for the ATM and Prescription tasks

Table 1
Demographic Information and Cognitive Ability Measures for the Patient Sample and the Healthy Controls

	Healthy control (n=24)	Patients (n=77)	F-Value or χ^2	p-value
Age (mean, SD)	64.8 (SD=8.3)	54.2 (SD=7.6)	34.49	p<.001
Gender % Female	72.7%	26.9 %	13.54	p<.001
Educational Attainment	<HS= 0% HS=22.7 % College+=77.3 %	<HS=28.2 % HS=43.6 % College+=28.2 %	18.71	p<.001
% Primary English-Speaking	95.8%	89.7%	.26	p=.61
Race (%)	Caucasian-62.5% African American-29.2% American Indian-0% Multi-racial-0% No Group Identified-0% Other-8.3%	Caucasian-25.6% African-American 52.6% American Indian-2.6% Multi-racial-2.6% No Group Identified-3.8% Other-12.8%	9.38	p=.14
Health Rating (%)	Poor-0% Fair-16.7% Good-43.3% Very Good-26.7% Excellent-13.3%	Poor-4.7% Fair-27.9% Good-45.3% Very Good-16.3% Excellent-5.8%	5.43	p=.25
Employment Status (%)	Unemployed-16.7% Retired-66.7% Full Time-6.7% Part Time-10.0%	Unemployed-72.1% Retired-18.6% Full Time-1.2% Part Time-8.1%	31.08	p<.001
Living Arrangement (%)	Independent-100%	Independent-58.1% Supervised Residential-32.4% Other 9.5%	NA	NA
PANISS Positive Symptoms	NA	15.38 (SD=10.4)	NA	NA
PANISS Negative Symptoms	NA	15.60 (SD=10.4)	NA	NA
PANISS Total Score	NA	54.56 (SD=14.7)	NA	NA
HVLT-R Total Range (mean, SD)	23.9 (SD=4.6)	18.4 (SD=5.9)	17.28	p<.001
Letter-Number Span (mean, SD)	13.7 (SD=3.2)	10.68 (SD=4.2)	10.38	p=.002
Trails A (mean, SD)	35.3 (SD=16.2)	46.0 (SD=23.7)	4.22	p<.05
BACS Digit Symbol (mean, SD)	46.8 (SD=10.8)	33.5 (SD=11.9)	23.72	p<.001
Animal Fluency (mean, SD)	18.5 (SD=4.9)	17.4 (SD=6.1)	.74	.39
UPSA-B Overall (mean, SD)	84.3 (SD=10.9)	70.2 (SD=17.3)	16.07	p<.001

	Healthy control (n=24)	Patients (n=77)	F-Value or χ^2	p-value
UPSA-B Financial Score (mean, SD)	43.3 (SD=9.0)	36.2 (SD=10.7)	9.65	p=.002
UPSA B Communication Score (mean, SD)	38.5 (SD=9.0)	33.3 (SD=10.5)	5.38	p=.022

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Table 2
Performance of the Patients and Healthy Controls on the Computerized Functional Task Battery

	Healthy Control	Patients	F-value	p-value
ATM Time (mean, SD)	234.83 (SD=81.2)	438.88 (SD=295.0)	11.15	p=.001
ATM Rate (total Correct Score Obtained/Time) (mean, SD)	.04 (SD=.02)	.02 (SD=.02)	26.90	p<.001
ATM Ratio (Total Correct Score Obtained/Total Possible Correct Score) (mean, SD)	.77 (SD=.17)	.56 (SD=.24)	13.53	P<.001
Prescription Refill Ratio (total Correct Score Obtained/Time) (mean, SD)	.91 (SD=.10)	.85 (SD=.13)	4.16	p=.04
Prescription Refill Rate (total Correct Score Obtained/Total Possible Correct Score) (mean, SD)	.07 (SD=.02)	.05 (SD=.02)	11.38	p=.001
Prescription Refill Time (mean, SD)	221.50 (SD=74.5)	278.27 (SD=133.9)	2.63	p=.05
Forms Completion Task Time [#] (mean, SD)	117.73 (SD=35.3)	289.24 (SD=175.8)	24.25	p<.001

[#] Note that for the form completion task there were 75 patients and 26 healthy controls

TABLE 3

Correlations Between Performance on the Computerized Functional Tasks, the UPSA-B and the Cognitive Ability Measures for the Patient Sample

	HVLT-R Total	BACS Digit Symbol	Trails A	Letter- Number Span	Animal Fluency	UPSA-B Total Score	UPSA-B Financial Score	UPSA-B Communication Score
ATM Rate	.41 ***	.54 ***	-.28 *	-.36 **	.37 ***	.50 ***	.48 ***	.30 *
ATM Ratio	.38 ***	.46 ***	-.20	-.34 **	.25 *	.44 ***	.43 ***	.33 *
ATM Time	-.36 **	-.61 ***	.24 *	-.44 ***	-.40 ***	-.43 ***	-.45 ***	-.15
Prescription Refill Rate	.51 ***	.46 ***	-.21 *	.38 **	.26	.37 **	.32 *	.26 *
Prescription Refill Ratio	.50 ***	-.41 ***	-.10	.35 **	.12	.30 *	.18	.24
Prescription Refill Time	-.20	-.33 **	.31 *	-.19	-.17	-.26 *	-.21	-.17
Forms Completion Time	-.17	-.46 ***	.31 **	-.40 ***	-.26 *	-.50 ***	-.37 ***	-.35 **

* p<.05;

** p .01;

*** p .001

TABLE 4

Test-Retest Reliabilities For the Patient Sample

	Time 1 (mean, SD)	Time 2 (mean, SD)	Repeated Measures t-test	Test-Retest r
ATM Rate	.02 (SD=.02)	.06 (SD=.02)	-2.58 *	.59 ***
ATM Time	432.5 (SD=274.8)	370.6 (SD=214.6)	2.20 *	.74 ***
ATM Ratio	.56 (SD=.24)	.59 (.21)	-1.2	.53 ***
Prescription Rate	.05 (SD=.02)	.06 (SD=.02)	-1.48	.49 ***
Prescription Time	294.2 (SD=144.4)	269.3 (SD=134.9)	1.13	.31 *
Prescription Ratio	.85 (SD=.13)	.84 (SD=.13)	.83	.40 ***
Forms Completion Time	280.50 (SD=181.9)	217.20 (SD=114.9)	4.53 ***	.77 ***

* p<.05;
** p .01;
*** p .001