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Sensitivity and Specificity of the UCSD Performance-based Skills Assessment (UPSA-B) for Identifying Functional Milestones in Schizophrenia

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Abstract

Schizophrenia is a highly debilitating illness that often results in disruption to independent living and employment. However, “gold standard” methods of assessing functional abilities to achieve these milestones are still lacking. In a sample of 367 individuals with schizophrenia, we examined the sensitivity and specificity of the Brief UCSD Performance-based Skills Assessment (UPSA-B) to predict both residential and employment status. Of all individuals residing independently, 75.9% scored 78 or above on the UPSA-B, and of all individuals not residing independently, 59% scored below 78 on the UPSA-B. Of individuals who were employed, 73.9% scored above 82 on the UPSA-B, and of those not employed, 57.8% scored below 82. These results expand upon both the population base and functional milestones with which the UPSA-B is validated, although future work should examine whether the UPSA-B can be used as a decision aid in the likelihood of success in a longitudinal study, such as at critical transitions (post-hospitalization, cessation of supported housing).

Keywords

Psychosis; Functional Capacity; Functioning; Employment; Independence; Well-being

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Conflict of Interest

The authors declare no conflict of interest.

Contributors

Dr Pulver designed the study and wrote the protocol. Drs Mausbach, Harvey, and Depp managed the literature searches. Dr Mausbach undertook the statistical analysis. Drs Depp, Bowie, Harvey, McGrath, Thronquist, Luke, Ms Wolyniec, and Dr Patterson wrote various aspects of the manuscript. All authors contributed to and have approved the final manuscript.

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1. Introduction

Schizophrenia is a highly debilitating illness that has a chronic course, and the high degree of disability adds greatly to its societal and treatment costs (American Psychiatric Association, 2004; Green, 1996). Functional deficits span a variety of areas of life-functioning including independent living, employment, and interpersonal skills (Bowie et al., 2006; Green, 1996; Green et al., 2000; Liberman, 1982).

Although functional limitations are notable aspects to the illness, “gold standard” methods of assessing functional abilities are still lacking. Over the years, methods of assessing functioning in patients with schizophrenia have varied from clinician assessments, direct observation, self-report, proxy report, and performance-based methods (Patterson and Mausbach, 2010). Of these methods, recent reviews have suggested that performance-based measures provide balance between ease of administration, reliability, and validity in relating to real world functional outcomes (Harvey et al., 2007; Mausbach et al., 2009). The UCSD Performance-based Skills Assessment (UPSA) has shown promise in terms of its ability to predict real-world functioning in middle-aged and older adults with schizophrenia. Specifically, the UPSA has demonstrated high correlations with measures of personal care skills, interpersonal skills, and community activities (Bowie et al., 2006; Twamley et al., 2002), was found to be most highly related to neuropsychological performance of an array of functional capacity measures (Green et al., 2011), and has demonstrated ability to predict residential independence (Mausbach et al., 2008a). Yet, ease of administration for the UPSA is a limitation given its relatively large number of props, which may make it a difficult test to administer in field settings (Mausbach et al., 2008a).

In 2007, the UPSA-Brief (UPSA-B) was developed as an abbreviated alternative to the full version of the UPSA (Mausbach et al., 2007). The UPSA-B contains 2 of the original 5 subscales of the full UPSA (i.e., finance and communications subscales), which allows for shorter administration time (10–15 minutes) and reduced reliance on testing props. These changes make the UPSA-B significantly easier to administer in a variety of treatment and field settings. While relatively few studies have examined the validity of the UPSA-B, early data suggest it is equally suited to the full UPSA as a test for predicting ability to reside independently (Mausbach et al., 2007) and to participate in community responsibilities (Mausbach et al., 2008b). Two studies of the UPSA-B found substantial evidence for validity of the measure in Western European (Harvey et al., 2009) and Chinese (McIntosh et al., In press) populations. Further, the UPSA-B was found to be substantially related to real-world functional ratings in a large-scale systematic study (Harvey et al., In press) and to be the most suitable short form for relationships to the MATRICS consensus cognitive battery (Green et al., In press). Specifically, we previously demonstrated that scores of 60 or above were most sensitive to identifying individuals residing independently in a sample of middle-aged and older adults with schizophrenia (Mausbach et al., 2007). However, this earlier study was not without limitations. First, the sample was limited by a relatively low base-rate of individuals residing independently in the community (i.e., <25%). Second, assessment of residential independence was limited to individuals residing completely independently or completely dependently. That is, participants who resided with others (i.e., family, friends, etc) were excluded because investigators could not determine how much assistance they needed in day-to-day functional tasks. Third, the study did not assess other functional milestones such as employment status. Finally, the prior study was limited to middle-aged and older adults, thereby limiting the generalization of findings to younger patients who may be more likely to reside independently or seek or maintain employment. Evidence from studies using the full version of the UPSA indicates a strong relationship between this measure of functional competence and work skills (Bowie et al., 2008; Bowie et al., 2006).

To date, however, the relationship between competence and work outcomes in the community has not been reported.

The purpose of this study is to examine the usefulness of the UPSA-B as a valid measure for assessing real-world functioning in a novel sample of patients with schizophrenia and with novel outcomes (i.e., employment status). In a sample of 367 individuals with schizophrenia or schizoaffective disorder representing a broad age range (21 to 78), we examined the degree to which the UPSA-B was able to predict both residential and employment status. Specifically, we utilized receiver operator characteristic curve analyses to determine the optimal cutoff for predicting residential independence and employment status. We hypothesized that the UPSA-B would be associated with acceptable sensitivity and specificity for both residential independence and employment milestones.

2. Methods

2.1. Participants

A total of 367 individuals with schizophrenia (including schizoaffective disorder) have participated thus far in this study of functional capacity and outcomes. These participants are part of a larger group which includes subjects with bipolar I disorder, all of whom had previously participated in genetic studies within the Epidemiology-Genetics Program in Psychiatry (Epigen) at the Johns Hopkins School of Medicine..

All genetics study participants were of full or mixed Ashkenazi Jewish (AJ) background, which was determined from ancestry of four grandparents. The restriction to AJ ancestry was made to take potential advantage of founder effects in this population (Bray et al., 2010). Participants were recruited nationally through advertisements in newspapers and Jewish publications, talks given at community centers and synagogues, and through the Epidemiology-Genetics Program website. Details of recruitment, assessment and consensus diagnostic procedures for the genetics studies are available in several publications (Chen et al., 2009; Fallin et al., 2005; Fallin et al., 2003; Fallin et al., 2004).

For the present functional capacity study, previous genetic study subjects were recontacted by letter and/or telephone to solicit their participation. Assessments were conducted at places chosen by the participants (for the most part, at their primary places of residence).

2.2. Measures

2.2.1. Functional outcomes—Participants were interviewed by research staff regarding their current living arrangement and were consequently coded by assessors into one of four residential statuses: a) head of household, independent (i.e., live alone or with others and have primary or co-equal financial and/or logistical responsibility for the household), b) head of household, semi-independent (bears only partial and not co-equal financial and/or logistical responsibility for the household, c) not head of household, but in community (i.e., living in a group home, or as a dependent in the home of their parents or children, etc.), and d) residential treatment facility (i.e., have a degree of community exposure but require residence in a treatment environment). For the purposes of our primary analyses, participants who were heads of household and either independent or semi-independent were classified as “independent”, and those who were not heads of household or were residing in a treatment facility were classified as “not independent.”

Similarly, assessors interviewed participants as to their current working status. From the interview three details regarding work status were determined: a) if they were currently working, b) if the work was sheltered, and c) the total number of hours per week they worked. From these data, participants were classified as either “working” or “not working”,

with working being defined as currently employed in a non-sheltered job for at least 20 hours per week.

2.2.2. Functional Capacity—Participants were administered the brief version of the UCSD Performance-based Skills Assessment (UPSA-B)(Mausbach et al., 2007). The UPSA-B assesses the participant's capacity to perform tasks similar to those encountered in daily life. Two domains are assessed on the UPSA-B: 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 functional capacity.

2.2.3. Clinical Symptoms—All participants were administered the Positive and Negative Syndromes Scale (PANSS)(Kay et al., 1987). This 30 item scale 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. The research staff making this as well as all other assessments were psychologists who had also conducted many of the psychiatric direct assessment interviews in the original genetics studies.

2.2.4. Medications—Antipsychotic medication doses were converted to chlorpromazine equivalents using the formula provided by Andreasen et al (Andreasen et al., 2010).

2.3. Analyses

A series of Receiver Operating Characteristic (ROC) curves was plotted for the UPSA-Brief. The ROC curve shows the sensitivity versus one minus the specificity for every possible cutoff point; optimal cutoff points are determined by visually assessing which score combines maximum sensitivity and specificity. The area under curve (AUC) with 95% confidence intervals was used as an indicator of the ability of the UPSA-Brief to differentiate patients who were a) residing independently in the community vs those living with greater assistance, and b) those who were employed vs those who were not employed. Because residential independence and employment may occur simultaneously in some participants and independently in others, we also conducted a series of exploratory (secondary) analyses to determine the sensitivity and specificity of the UPSA-B for identifying the following groups: a) those who were residing independently but not employed, b) those who were employed but not residing independently, and c) those who were both residing independently and were employed. In all these analyses, participants who were neither residing independently nor employed were the reference group. We set the p-value to 0.05. All analyses were conducted with PASW Statistics version 18. In gauging the utility of the UPSA, we followed standard suggestions for level of sensitivity and specificity. Finally, we calculated the optimal cut-point via use of Youden's Index (J)(Youden, 1950) by summing the sensitivity and specificity – 1. In all our analyses, we calculated sensitivity, specificity, and both positive and negative predictive value (PPV and NPV, respectively). Briefly, sensitivity is the ability of the test to correctly identify individuals with a certain "condition". For example, of all people who reside independently, what percentage scored above a certain UPSA-B cutoff? Specificity is the ability of the test to correctly identify individuals without that condition (e.g., were not residing independently, were not employed). PPV refers to the percentage of participants who score above a cutoff who are correctly classified as having a condition. For example, of all participants who score above

an UPSA-B cutoff, what percent were actually residing independently? Similarly, NPV refers to the percentage of participants who score below a cutoff who are correctly classified as not having a condition.

3. Results

3.1. Participants

Characteristics of the sample are displayed in Table 1. All participants were either outpatients or residing in residential treatment settings, and none were acutely hospitalized. As seen in the table, 117 participants (31.9%) were employed in non-sheltered positions for an average of 26.2 hours/week. In addition, 245 (66.7%) participants were residing independently in the community as either the head or co-head of their households. Participants came from the full adult age spectrum, with a mean age of 50.5 years ($SD = 9.6$ years, range: 21 to 78). Also, the majority of participants was male (62.9%) and the mean level of educational attainment was at least some college education.

3.2. ROC Curve Analyses

Our first analysis examined the sensitivity and specificity of the UPSA-B for identifying residential independence. As described above, the base rate for residential independence in the current sample was 66.7%. The ROC curve for the UPSA-B is shown in Figure 1. The estimated AUC for the UPSA-B was 0.72 (95% CI: 0.66–0.77; $p < .001$). Maximum sensitivity and specificity was achieved at an UPSA-B cutoff of 78, at which sensitivity was 75.9% and specificity was 59.0%. That is, of all individuals residing independently, 75.9% scored 78 or above on the UPSA-B, and of all individuals not residing independently, 59% scored below 78 on the UPSA-B. Also, at a cutoff of 78, PPV was 78.8% and NPV was 55.0%. Of all individuals scoring 78 or above on the UPSA-B, 78.8% were actually residing independently, and of all individuals scoring below 78, 55.0% were not residing independently.

Our next analysis examined the sensitivity and specificity of the UPSA-B for determining employment (i.e., working ≥ 20 hours/week). The base rate for employment was 24.0%. The ROC curve for employment is presented in Figure 2. The estimated AUC for this analysis was 0.71 (95% CI: 0.65–0.77, $p < .001$). Maximum sensitivity and specificity was achieved at an UPSA-B cutoff of 82, at which sensitivity was 73.9% and specificity was 57.8%. Specifically, of all individuals who were employed ≥ 20 hours/week, 73.9% scored 82 or above on the UPSA-B, and of all individuals not employed ≥ 20 hours/week, 57.8% scored below 82 on the UPSA-B. Also, PPV and NPV for a cutoff of 82 were 35.7% and 87.4%, respectively. Of all individuals scoring 82 or above on the UPSA-B, 35.7% were actually employed ≥ 20 hours/week, and of all individuals scoring below 82, 87.4% were employed < 20 hours/week.

3.3. Exploratory Analyses

Our first exploratory analyses examined the sensitivity and specificity of the UPSA-B to predict varying levels of real-world functioning by examining various combinations of residential independence and employment. As mentioned above, in all of these analyses, our reference group included individuals who neither resided independently nor were employed. The first exploratory analysis consisted of our reference group ($n = 109$) and individuals who were residing independently but who were not employed at least 20 hours/week ($n = 168$). Results of our ROC curve analysis indicated an AUC of 0.71 (95% CI: 0.64–0.77, $p < .001$). Maximum sensitivity (70.8%) and specificity (62.4%) was found at an UPSA-B cutoff of 76. PPV and NPV were 74.4% and 58.1%, respectively.

Our next analysis consisted of our reference group and individuals who were employed at least 20 hours/week but not residing independently ($n = 13$). Results indicated an AUC of 0.77 (95% CI: 0.66–0.87; $p = .002$). Maximum sensitivity (92.3%) and specificity (55.0%) was achieved at a cutoff of 74, and PPV and NPV were 19.7% and 98.4%, respectively.

Our third analysis consisted of our reference group and those who both resided independently and were employed at least 20 hours/week ($n = 75$). The AUC for this analysis was 0.83 (95% CI: 0.77–0.88), with maximum sensitivity (90.7%) and specificity (62.4%) at a cutoff of 78. PPV and NPV for a cutoff of 78 were 62.4% and 90.7%, respectively. Results for all of our exploratory analyses are presented in Figure 3.

We next sought to examine AUC for less stringent levels of work attainment, as indicated by hours worked per week. These analyses were conducted so as not to set criteria for employment that were too stringent for rehabilitation programs or patients to achieve. We conducted two additional analyses with cutoffs for 10 and 15 hours of work per week. Results of our first analysis, which used 10 hours of work as our dependent variable, indicated an UPSA-B AUC of 0.69 (95% CI = 0.63–0.75). Our second analysis, which used 15 hours per week, also resulted in an UPSA-B AUC of 0.69 (95% CI = 0.63–0.74). Thus, results of these analyses suggest the UPSA-B is capable of predicting employment status regardless of the stringency with which “part-time” employment is defined.

4. Discussion

In a large sample of outpatients with schizophrenia and schizoaffective disorder, we found strong support for the UPSA-B as a test for predicting both residential and employment status among individuals with schizophrenia. Despite differences in sample composition and base-rates for functional milestones from our prior study, the performance of the UPSA, as indicated by receiver operator characteristic curves (ROC), was nearly identical. Moreover, extending prediction to another functional milestone, employment status, revealed a similar level of accuracy in prediction. The results of ROC analyses revealed trends in both functional domains for greater sensitivity than specificity – in other words, in this sample the UPSA-B appeared better at finding employed individuals and those who reside independently than at finding those not employed or living independently. However, when examining PPV and NPV, the residential independence and employment predictions diverged. Specifically, the UPSA-B demonstrated strong PPV for residential independence (PPV = 78.8%) but modest NPV (55%). For employment, the UPSA-b demonstrated low PPV (35.7%) but strong NPV (87.4%). These results suggest the UPSA-B might be more effective in predicting who among patients *could* reside independently, and who could *not* secure employment.

The estimated AUC for residential independence of 72% (95% CI = 0.66–0.77) was almost identical to our prior study (0.73; 95% CI = 0.67–0.78) involving only middle-aged and older adults with schizophrenia. The latter study sample differed substantially in terms of base rate for residential independence (<25% vs. 67% in the present study) and age range (3% were less than 40 years of age vs. 13% in the present study). By expanding the population base with which the UPSA-B is validated, we expand the confidence that researchers and clinicians have to predict residential independence in patients with schizophrenia. In our current study predicting residential independence in a relatively functional population, the UPSA-B achieved maximum sensitivity and specificity at a cutoff of 78. The current findings also expand those of our previous study to predicting “part-time” employment status. Specifically, we found that the UPSA-B achieved maximum sensitivity and specificity for predicting employment at a cutoff of 82. Also, with regard to employment status, the NPV was quite high (87.4%) at a cutoff of 82, but the PPV was low

(35.7%). This suggests that the UPSA-B is better equipped to identify individuals not capable of working 20 hours/week than those who are. In recognition that achievement of functional milestones do not occur in isolation, we sought to examine the sensitivity and specificity of the UPSA-B for predicting multiple functional states. We found that the UPSA-B was particularly strong (83% AUC) at differentiating individuals who both reside independently and maintain at least part-time employment relative to those who have achieved neither of these milestones. Further, as would be expected, we observed incremental AUCs for individuals achieving only one of these functional milestones.

There are a number of reasons why specificity may be lower than sensitivity. Attaining residential independence or >20 hours/week employment for any population, much less schizophrenia, is determined by multiple factors inclusive of capacity, including (but not limited to) motivation to work, financial need, opportunities present in one's community, insurance or disability-based incentives (Rosenheck et al., 2006), and opportunities within one's skill set (e.g., skilled labor). Among those with schizophrenia, stigma may play a role in employment opportunities, in which employers may be less likely to employ someone with a known serious mental illness despite capacity to perform the work duties. As such, diminished functional capacity, as measured by the UPSA, may be a rate-limiting factor in enabling attainment of >20 hours/week of work or residential independence. Once sufficient capacity is attained, other factors such as stigma, motivation, and opportunities may affect employment status.

A few limitations of our study include the homogenous nature of our sample, the high levels of educational attainment of our participants, and the relatively low levels of psychosis (i.e., PANSS scores). As described above, all participants in this sample were of Ashkenazi Jewish ethnicity and it is unclear to what extent the current findings extend to individuals of other ethnic and racial backgrounds. Further, our sample had a high degree of educational attainment, both in relation to other samples of patients with schizophrenia but also to the U.S. population in general. Specifically, a high proportion of the current sample had at least some college education, with a substantial portion achieving a professional degree relative to the general population. Given UPSA-B scores are associated with educational attainment ($r = .39$ in the current sample), performance on the UPSA-B in our sample may be inflated over more representative samples of schizophrenia patients. The mean PANSS Positive and Negative scores were approximately 16, indicating low levels of psychotic symptoms. How these results apply to individuals with moderate symptoms of psychosis is therefore unknown. Thus, use of cutoffs presented in this manuscript should be undertaken with caution, and future research should replicate these findings with samples more representative of patients with schizophrenia and of greater racial/ethnic diversity.

Our sample also had higher employment rates than found in the greater mental health system, with 39% of our sample having either sheltered (7.1%) or non-sheltered (31.9%) employment. By way of comparison, Rosenheck and colleagues (2006) reported 14.5% of patients had engaged in competitive employment, 12.6% non-competitive, and 72.9% no employment activity. Similarly, Salkever et al. (2007) found 17.2% employment among a large, community-based national sample of individuals with schizophrenia. Thus, in addition to other sample limitations mentioned above, future research should replicate our findings in samples with more representative employment rates of the broader population of individuals with schizophrenia.

Fewer studies have addressed the prediction of independent living in schizophrenia than vocational status. Although the UPSA-B was able to predict independent living status with similar or greater degree of accuracy than vocational status, future research would be needed to determine how clinicians might use capacity measures such as the UPSA-B in informing

decisions about residential placement, particularly in light of contextual factors such as variation in the availability of housing and support services.

McGurk and Mueser (2004) found that the value of cognitive tests for predicting vocational outcomes was weakened when psychosocial support and work history are considered. Thus, although we find that the UPSA-B has predictive validity for work outcomes, it is unclear how the UPSA-B would perform when participation in vocational rehabilitation is considered. Performance-based measures of functioning, while associated with cognition, are likely more proximal to real world outcomes and thus might add incremental predictive ability. Their ability to selectively contribute across stages of vocational readiness and training will need to be determined in future work.

To our knowledge, no other study has established clinically meaningful cutoffs for any other measure of functional outcomes. In conjunction with our prior study, we now provide cutoffs for predicting functional milestones from two unique schizophrenia populations with disparate base rates for a variety of functional outcomes. As indicated by Deeks (2001) and Fan et al (2006), pooling the results of several studies using the same diagnostic test in different situations (e.g., populations) provides the the most useful information in terms of establishing true validity of the UPSA-B for predicting functional milestones. There are several practical challenges in determining how best to use the UPSA and cut-offs in routine clinical practice. Future work should examine whether the UPSA can be used as a decision aid in the likelihood of success in a longitudinal study, such as at critical transitions (post-hospitalization, cessation of supported housing). By using the UPSA as a decision aid, the balance must be struck between withholding certain programs (e.g., vocational rehabilitation) and allocating services to patients who are unlikely to benefit at their current level of functional capacity. It may be possible, for individuals who fall below the cut-off on the UPSA-B yet are interested in work or independent living, to enroll individuals in functional rehabilitation so as to increase functional capacity. Once these issues are addressed, the UPSA-B may provide for an empirically validated tool to increase the likelihood of success in programs that promote the functional recovery of the large population of patients with schizophrenia.

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Figure 1. ROC analysis predicting residential independence. The UPSA-B AUC estimate was 0.72 (95% CI: 0.66–0.77).

Figure 2. ROC analysis predicting employment. The UPSA-B AUC estimate was 0.71 (95% CI: 0.65–0.77).

Figure 3.

Panel A = ROC analysis including reference group (neither residing independently nor working) and those residing independently but not employed. Panel B = ROC analysis including reference group and those who were employed but not residing independently. Panel C = ROC analysis including reference group and those both residing independently and employed.

Table 1

Characteristics of the Sample

	Range	
Age, M (SD)	21–78	50.5 (9.6)
Sex, N (%)		
Male		231 (62.9)
Female		136 (37.1)
Education *, n (%)		
< High School		25 (6.9)
High School or equivalent		66 (18.3)
Some College		123 (34.2)
College Graduate		92 (25.6)
Professional Degree		54 (15.0)
Residential Status, n (%)		
Head of Household, Independent		192 (52.3)
Head of Household, Semi-independent		53 (14.4)
Not Head of Household, in community		83 (22.6)
Residential Treatment Facility		39 (10.6)
Employment Status, n (%)		
Not Employed		224 (61.0)
Sheltered Employment		26 (7.1)
Employed		117 (31.9)
Hours worked/week, M (SD)		
Sheltered	3–40	17.9 (19.5)
Non-sheltered	3–50	26.2 (12.2)
PANSS, M (SD)		
Positive	7–34	15.6 (6.4)
Negative	7–45	16.1 (7.7)
General	16–72	30.2 (8.6)
Total	30–127	61.7 (17.9)
Chlorpromazine Equivalents ^a , M (SD)	0–1500	527.2 (443.7)
UPSA-B, M (SD)	14–100	77.5 (17.7)
UPSA-B Finances, M (SD)	9–50	41.1 (9.2)
UPSA-B Communication, M (SD)	0–50	36.4 (10.5)

Note.

* Education data not available for 7 participants.

^a Antipsychotic medication data not available for 29 participants.