



Modification and validation of a performance-based functional capacity instrument for individuals with schizophrenia

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ABSTRACT

Functional impairments are common in schizophrenia patients, but few performance-based instruments are available to evaluate their functional capacity, especially those that are culturally adapted for use in China. This study aimed to modify the items of the original Beijing Performance-based Functional Ecological Test (BJ-PERFECT) due to limited tasks in a particular scenario and examine the psychometric properties of the newly modified BJ-PERFECT in schizophrenia patients. Participants of the study comprised 105 schizophrenia patients and 45 healthy controls (HCs). All of them were administered the modified BJ-PERFECT, the University of California, San Diego, Performance-based Skill Assessment-Brief version (UPSA-B) and the Global Assessment of Functioning (GAF). The modified BJ-PERFECT retained seven original items and added 4 new items. The validity of the modified BJ-PERFECT was supported by its significant correlation with the UPSA-B but not the GAF and by the significant difference on the instrument's scores between the schizophrenia patients and HCs. The internal consistency reliability was found to be good. Level of education was found to have a significant relationship with functional capacity. The modified BJ-PERFECT was found to be psychometrically valid to assess functional capacity in schizophrenia patients.

1. Introduction

Schizophrenia is a severe and heterogeneous mental disorder that affects more than 24 million adults worldwide (Goldner et al., 2002). It is among the top ten medical disorders that cause disability in one or more major functional domains (WHO, 2004). Functional domains, including independent living, financial management, work ability, and social interaction, gradually decline in schizophrenia patients resulting in poor functional outcomes (Monte et al., 2008). In reality, the majority of patients cannot return to a state of desired and expected real-world function (Cardenas et al., 2013; Harvey et al., 2009). It has been proposed that functional capacity is a distinct dimension of schizophrenia (Foussias et al., 2011). Therefore, it is logical that one of the

primary treatment goals focuses on the restoration of independent function within the community (Fett et al., 2011; Green, 2016). To achieve this goal, reliable and valid measures are required to assess patients' functional capacity accurately.

Functional capacity and actual behavior consist of two distinct constructs (Best et al., 2014). The first refers to the capacity to perform a skill in a set environment, while the second refers to what people actually do in the real-world (Harvey et al., 2007; Best et al., 2014). Functional capacity has been shown to reflect real world functioning to a certain extent. It includes more extensive abilities and can be considered midway between complex real-world functioning and reductionist cognition (McLaughlin et al., 2016). However, the difference between functional capacity (someone's potential to do) and real-world

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functioning (what he or she actually does) remains to be discussed. Moreover, there has been no consensus on the definition of functional recovery, and as a result, developing suitable functional assessment tools for patients with schizophrenia may be challenging.

Although a “gold-standard” measure of functional capacity does not exist, a number of instruments that use self- and proxy-reports, clinician ratings, and performance-based assessments are available, each with respective strengths and weaknesses. Some instruments assess more than one level of function while others address one primary domain. Direct observation is the best way to assess functioning in naturalistic settings, however, can be time consuming. Around one third of schizophrenia patients do not have a caregiver or significant-other to provide proxy-ratings (Patterson et al., 1996), and for those that do, not all caregivers are equally informative, even those with levels of “high contact” (Sabbag et al., 2011). On the contrary, performance-based assessments require patients to perform a skill in a controlled environment designed to simulate and mirror the real-world. This approach relies on the observation of patients’ behavior, is less dependent on their insight, and does not require caregiver participation. The test results can also be used to evaluate the psychometric properties of the instrument (Patterson et al., 2001). Nevertheless, the props required in the assessment make the process more complex and test administrators need specific training in advance. Generally speaking, the use of performance-based instruments balances the need for standardization and ecological validity. In recent decades, research focusing on functional capacity using performance-based instruments has rapidly increased (Mantovani et al., 2015).

To date, a few instruments assessing function have been developed in western countries and introduced for use in China. These include the Global Assessment of Functioning (GAF; American Psychiatric Association, 2000), the World Health Organization Disability Assessment Schedule II (WHO-DASII; World Health Organization, 2000), the Personal and Social Performance (PSP) scale, and the University of California San Diego Performance-based Skills Assessment - Brief version (UPSA-B; Mausbach et al., 2007; Tianmei et al., 2011).

In terms of the epidemiology of schizophrenia, research conducted in multiple Asian countries have reported contrary findings to those of western countries (Holla and Thirthalli, 2015). The majority of performance-based instruments were developed in high-income and well-developed countries. Therefore, the environment or setting of these instruments may not be suitable for use in developing countries like China (Mantovani et al., 2015). So far, only a few of the previously mentioned instruments have been introduced into China. The UPSA is the first measure to be culturally adapted for use in China (Cui et al., 2012; Patterson et al., 2001). In recent years, the Beijing Performance-based Functional Ecological Test (BJ-PERFECT) was developed in China as a performance-based functioning instrument, employing culturally appropriate props and familiar settings for the Chinese population. The BJ-PERFECT has been shown to have good test-retest and inter-rater reliability, and high ecologically validity (Shi et al., 2013).

Based on both the existing literature and previous data, it can be concluded that limited research has been carried out using performance-based functional capacity instruments in China. (American Psychiatric Association, 2000; Cui et al., 2012; Mausbach et al., 2007; Tianmei et al., 2011; World Health Organization, 2000; Shi et al., 2013). The BJ-PERFECT is the only instrument developed for use in China, but it has not been widely applied and adopted because a relatively small sample of the original study has limited the evaluation of its validity. To promote research in this area, it is important and necessary to further revise the BJ-PERFECT. Based on preliminary results (Shi et al., 2013) and the consensus of experts, the current study refined the BJ-PERFECT by revising some existing items, adding additional items, and revising the scoring to extend and improve the instrument. It is hypothesized that the modified BJ-PERFECT will have satisfactory psychometric properties and could provide a better understanding of schizophrenia patients’ functional capacity.

2. Methods

2.1. Participants

Patients with schizophrenia were recruited from outpatient clinics of Peking University Sixth Hospital from August 2015 to June 2016. The inclusion criteria for the patients were: (a) a diagnosis of schizophrenia according to DSM-IV-TR (American Psychiatric Association, 2000); (b) a permanent resident of the Beijing community for more than one year; (c) between 18 and 60 years of age; (d) and received at least 6 years of education. The exclusion criteria were: (a) unstable medical condition; (b) a diagnosis of any other neurological or mental disease; (c) and not able to understand or complete the assessment battery.

The healthy controls (HCs) were recruited from the general Beijing community. The inclusion criteria for HCs were: (a) between 18 and 60 years of age; (b) had at least 6 years of education; (c) and a permanent resident of the Beijing community for more than one year. The exclusion criteria were: (a) a concurrent diagnosis or previous history of any other mental or neurological disease; (b) and not able to understand or complete the assessment battery.

A total of 105 schizophrenia patients and 45 HCs were enrolled in the study. This study was approved by the Institutional Review Board of the Institute of Mental Health, Peking University, and all participants provided written informed consent prior to their participation.

2.2. Assessment

2.2.1. Procedure of the modification of BJ-PERFECT

The modification of the BJ-PERFECT was based on the first edition (Shi et al., 2013). To revise the item pool of the BJ-PERFECT, a number of methods were used: (a) reviewing relevant literature; (b) examining the items of the BJ-PERFECT first edition; (c) examining the items of existing performance-based instruments including the UPSA and the Test of Adaptive Behavior in Schizophrenia (TABS; Patterson et al., 2001; Velligan et al., 2007); (d) and consulting specialists in the relevant field(s). In the end, 19 items were included in the revised version, belonging to one of three subdomains: transportation, financial management, and work ability.

For the revised version, the number of transportation items was expanded from four to eight, while the number of financial management items was expanded from four to nine. The number of work ability items remained unchanged, however, the score points were increased from 8 to 10 points.

Subsequently, we used the results of the item-total correlations and exploratory factor analysis (EFA) of the 19 items were used to exclude any item or score that had a coefficient less than 0.3 on the item analysis or EFA coefficient less than 0.4.

The final revised version of the BJ-PERFECT is an assessment battery of functional capacity in which patients are required to complete performance-based role-play tasks in three functional areas: transportation, financial management, and work ability. Transportation includes five items and tests the patient's map reading ability and schedule management with score ranging between 0 and 10. Financial management includes four items and investigates the patient's ability to manage change and pay bills, with scores ranging between 0 and 8. Lastly, work ability includes two items which ask patients to prepare tableware and play the role of a cashier, with ranging between 0 and 12 (See Appendix for details).

The final score for each domain is calculated as percent correct, ranging between 0 and 100 [Final score = (actual raw score/maximum raw score) × 100]. The final global functioning score is the average of the final scores of all three domains ranging between 0 and 100. The modified BJ-PERFECT takes approximately 15–20 min to complete.

Table 1
Characteristics between schizophrenia patients and healthy controls.

	Schizophrenia patients (n = 105)	Healthy controls (n = 45)	t/Z/ χ^2	df.	p	Effect size (Cohen's d)
Gender			8.13	1	0.004	–
Male (%)	53(50.5)	34(75.6)				
Female (%)	52(49.5)	11(24.4)				
Age, years (SD)	37.37(6.72)	38.67(12.64)	0.82	148	0.415	0.13
Education, years (SD)	12.04(2.59)	11.36(4.85)	–1.12	148	0.264	–0.18
employment			38.15	3	<0.001	–
on the job	22	31				
dismission	1	1				
unemployed	82	11				
student	0	1				
(lack of info.)	0	1				
MBJ-PERFECT_T	67.88 (23.96)	76.91 (27.88)	2.01	148	0.046	0.35
MBJ-PERFECT_F	70.00 (19.58)	74.10(24.42)	1.09	148	0.278	0.19
MBJ-PERFECT_W	54.76(13.84)	65.60 (18.28)	3.98	148	<0.001	0.67
MBJ-PERFECT_G	64.22(16.70)	72.20 (21.84)	2.44	148	0.016	0.41
UPSA_F	39.80(9.59)	39.00(11.06)	–0.45	144	0.657	–0.08
UPSA_C	33.01(9.12)	35.73(12.98)	1.45	146	0.211	0.24
UPSA_G	73.09(16.34)	75.16(21.98)	0.63	142	0.576	0.11
GAF	65.68(11.75)	88.11(6.09)	12.11	148	<0.001	2.40

Note: MBJ-PERFECT = modified Peking University Performance-based Functioning Assessment for Schizophrenia; MBJ-PERFECT_T = MBJ-PERFECT Transportation domain; MBJ-PERFECT_F = MBJ-PERFECT Financial Management domain; MBJ-PERFECT_W = MBJ-PERFECT Work Ability domain; MBJ-PERFECT_G = MBJ-PERFECT Global Score; UPSA = University of California San Diego Performance-Based Skills Assessment; UPSA_F = UPSA Financial domain; UPSA_C = UPSA Communication domain; UPSA_G = UPSA Global Score; GAF = Global Assessment of Functioning.

2.2.2. University of California, San Diego, Performance-based Skills Assessment-Brief (UPSA-B)

The UPSA-B was used to measure current social functioning. It was developed after factor analysis of the original UPSA (Mausbach et al., 2007). The original UPSA is a performance-based measure of functional capacity and includes five domains: (a) household chores; (b) communication; (c) finance; (d) transportation; (5) and planning recreational activities, and requires approximately 30 min to complete (Patterson et al., 2001). The UPSA-B consists of 2 domains (communication and finance), and it requires approximately 10–15 min to complete. The overall score of the UPSA-B was found to correlate highly with scores on the full UPSA version ($r = 0.91$), and with overall cognitive functioning ($r = 0.57$). Cui et al. verified the reliability (test–retest coefficient = 0.75; inter-rater reliability coefficient = 0.91) and validity of the Chinese version of the UPSA-B. UPSA-B scores were significantly and positively related to caregiver reports of functioning in both daily living and work skills (Mausbach et al., 2009). The UPSA-B is also a test that predicts both residential and employment status among schizophrenia patients (Mausbach et al., 2011), now widely used in both clinical and treatment trials with demographically corrected T-scores and percentile ranks (Vella et al., 2017).

2.2.3. Global Assessment of Functioning (GAF)

The GAF is an interview-based measure used by mental health clinicians and doctors to evaluate an individual's overall functioning, including social, occupational, and psychological functioning. Scores range between 1 and 100 (American Psychiatric Association, 2000). The GAF is a reliable and valid measure of psychiatric disturbance (Jones et al., 1995), with scores highly related to social behavior. The GAF can be also rated reliably after minimal training (Startup et al., 2011).

2.3. Statistical analysis

The data collected were examined for normality and described using summary statistics. Summary statistics (mean and standard deviation) were presented for continuous variables. Counts and percentages were presented for categorical and binary variables. To determine group differences, *t*-tests were performed for continuous variables and χ^2 tests for categorical and binary variables.

2.3.1. Item analysis

Item-total correlations were calculated among schizophrenia patients. Items with correlation coefficients less than 0.3 or those that did not reach statistical significance were excluded from the total items.

2.3.2. Reliability

Internal consistency of the modified BJ-PERFECT was calculated using Cronbach's alpha.

2.3.3. Validity

First, to evaluate structural validity, Exploratory Factor Analysis (EFA) was conducted among patients. Components with initial eigenvalues of ≥ 1 were extracted. Principal axis factoring (PAF) and varimax rotation with Kaiser normalization were used on the extracted components. The exclusion criterion was a loading of less than 0.4 for related factors. Secondly, the correlations between the three subdomains of the modified BJ-PERFECT and the global functioning final score were calculated to evaluate construct validity. Thirdly, to estimate criterion-related validity, correlations between the global functioning final score and the final score of the three domains, the UPSA-B total score, the UPSA-B subdomain scores, and the GAF score were calculated using Pearson's correlation coefficient (if data were normally distributed) or Spearman correlation (if data were not normally distributed). To estimate the concurrent validity, the differences between patients with schizophrenia and HCs on the modified BJ-PERFECT were examined using Chi-Square Tests (binary variables), independent-*t*-tests (if data were normally distributed), or Mann-Whitney *U* tests (if data were not normally distributed). To examine the convergent validity, correlations between the subdomains of the modified BJ-PERFECT and UPSA-B were conducted using Pearson's correlation coefficient (if data were normally distributed) or Spearman correlation (if data were not normally distributed). All statistical analyses were performed using SPSS statistics software (SPSS 24.0).

3. Results

3.1. Characteristics and comparison of participants

The demographics and functional performance of schizophrenia patients and HCs are presented in Table 1. The two groups did not differ

significantly in age and years of education, but they differed in sex composition ($p < 0.01$) and employment status ($p < 0.01$). Schizophrenia patients scored significantly lower than HCs on the modified BJ-PERFECT ($p < 0.05$, Cohen's $d = 0.41$) and GAF ($p < 0.01$, Cohen's $d = 2.40$), but no difference was found on the UPSA-B. When comparing the subdomains, the groups showed significant difference only on work ability of the modified BJ-PERFECT ($p < 0.01$, Cohen's $d = 0.67$). When gender and employment were entered as covariates, there was a significant difference between the two groups on the transportation ($F = 10.676, p < 0.05$, partial eta squared = 0.069), financial management ($F = 15.871, p < 0.05$, partial eta squared = 0.039) and work ability ($F = 30.440, p < 0.01$, partial eta squared = 0.174) subdomains of the modified BJ-PERFECT, as well as the total scores of the modified BJ-PERFECT ($F = 15.768, p < 0.01$, partial eta squared = 0.098) and the GAF ($F = 117.074, p < 0.01$, partial eta squared = 0.447). However, no significant differences between the groups were found for the subdomains and total score of UPSA-B.

3.2. Item analysis

Item-total correlations were completed for the items and score points of the revised instrument. Correlations between the transportation item scores and the total score ranged from 0.437 to 0.721 ($p < 0.01$). There were no significant correlations between the total score and the first finance item score, as well as the second, third, and fourth work ability scores. However, the other finance and work ability item scores significantly correlated with the total score ($p < 0.01$), with coefficients ranging from 0.329 to 0.624.

3.3. Reliability

Cronbach's alpha coefficient was used to examine the internal consistency of the modified BJ-PERFECT. Internal consistency for the total scale was high, with a Cronbach's alpha of 0.814. Cronbach's alpha coefficients for the transportation, financial management, and work ability domains were respectively 0.793, 0.615, and 0.864.

3.4. Validity

3.4.1. Construct validity

It was suggested that the initial extraction process could be continued with the result of the Kaiser-Meyer-Olkin (KMO = 0.842) measure of sampling adequacy and the Bartlett test ($p < 0.01$). The factor loadings of the three domains are presented in Table 2. Factors with eigenvalues above 1 and factor loadings less than 0.4 were extracted. The effective loadings of the three factors range from 0.555 to 0.809. Item analysis and EFA were used to exclude some items of the assessment and form the final assessment battery. The patients' final BJ-PERFECT score was positively correlated with the three domain scores

Table 2
EFA of modified BJ-PERFECT in patients with schizophrenia.

Factor 1 (trans)	Loading	Factor 2 (finance)	Loading	Factor 3 (work)	Loading
trans1	0.555	finance2	0.315	work1	0.581
trans2	0.638	finance3	0.669	work5	0.761
trans3	0.802	finance4	0.360	work6	0.809
trans4	0.764	finance5	0.142	work7	0.720
trans5	0.747	finance6	0.211	work8	0.791
trans6	0.030	finance7	0.674	work9	0.809
trans7	0.333	finance8	0.568	work10	0.250
trans8	0.058	finance9	0.652		

Note: trans = transportation; finance = financial management; work = work ability.

Table 3
The criterion related validity of modified BJ-PERFECT.

	MBJ-PERFECT_T	MBJ-PERFECT_F	MBJ-PERFECT_W	MBJ-PERFECT
UPSA_F	0.525**	0.600**	0.364**	0.585**
UPSA_C	0.423**	0.498**	0.268**	0.471**
UPSA_G	0.539**	0.625**	0.388**	0.607**
GAF	-0.027	-0.049	0.042	-0.021

Note: MBJ-PERFECT = modified Peking University Performance-based Functioning Assessment for Schizophrenia; MBJ-PERFECT_T = MBJ-PERFECT Transportation domain; MBJ-PERFECT_F = MBJ-PERFECT Financial Management domain; MBJ-PERFECT_W = MBJ-PERFECT Work Ability domain; MBJ-PERFECT_G = MBJ-PERFECT Global Score; UPSA = University of California San Diego Performance-Based Skills Assessment; UPSA_F = UPSA Financial domain; UPSA_C = UPSA Communication domain; UPSA_G = UPSA Global Score; GAF = Global Assessment of Functioning.

** $p < 0.01$.

($r = 0.749-0.920, p < 0.01$). The three domain scores were also significantly correlated with each other ($r = 0.488-0.753, p < 0.01$).

3.4.2. Criterion validity

The correlations between the modified BJ-PERFECT and other widely used functional assessments are summarized in Table 3. Of 105 schizophrenia patients, 100 patients completed the UPSA-B, and 101 and 104 patients completed the UPSA-transportation domain and finance domain, respectively. The correlational analyses were performed on the sub-group that finished the corresponding test.

Correlations between the demographic information and the global functioning final score of the modified BJ-PERFECT, final scores of the three domains, scores of UPSA-B, and the GAF are presented in Table 4. As presented in Table 4, the modified BJ-PERFECT global function score, and the three domain sub-scores were positively correlated with education ($r = 0.368-0.500, p < 0.01$). The global score of the UPSA-B and its two domain sub-scores were also positively correlated with education ($r = 0.219 - 0.336, p < 0.05$). However, no significant correlations were found between the GAF and demographic variables of age, education, and employment.

4. Discussion

This study described the modification of the BJ-PERFECT, a performance-based assessment of functional capacity originally designed for schizophrenia patients in China. The psychometric properties of the modified version were examined and the instrument was found to have

Table 4
Correlations among functional assessments and age, education, and employment in schizophrenia patients.

	Age	Education	Employment
MBJ-PERFECT	-0.093	0.500**	0.106
MBJ-PERFECT_T	-0.026	0.480**	0.089
MBJ-PERFECT_F	-0.087	0.433**	0.092
MBJ-PERFECT_W	-0.167	0.368**	0.094
UPSA_G	0.212*	0.336**	-0.121
UPSA_F	0.160	0.335*	-0.069
UPSA_C	0.218*	0.219*	-0.198*
GAF	0.087	-0.120	-0.112

Note: MBJ-PERFECT = modified Peking University Performance-based Functioning Assessment for Schizophrenia; MBJ-PERFECT_T = MBJ-PERFECT Transportation domain; MBJ-PERFECT_F = MBJ-PERFECT Financial Management domain; MBJ-PERFECT_W = MBJ-PERFECT Work Ability domain; MBJ-PERFECT_G = MBJ-PERFECT Global Score; UPSA = University of California San Diego Performance-Based Skills Assessment; UPSA_F = UPSA Financial domain; UPSA_C = UPSA Communication domain; UPSA_G = UPSA Global Score; GAF = Global Assessment of Functioning.

good reliability and validity when assessing patients with schizophrenia.

The original version of the BJ-PERFECT was developed with a three-factor structure consisting of 10 items and a total score of 16. Four transportation (corresponding to items 1, 2, 4, and 6 in the originally modified transportation domain), five financial management (corresponding to items 1, 2, 4, 6, and 8 in the originally modified financial management domain), and two additional score points (corresponding to score point 2 and 3 of item 1 in the originally modified work ability domain) in work ability were initially added to the modified assessment. The results of the item analysis and EFA helped to eliminate several items and score points (transportation items 6, 7, and 8; financial management items 1, 2, 4, 5, and 6; and score point 2 and 3 of item 1 and score point 4 and 10 of item 2 in work ability) to improve the consistency of the measurement. The largest effect size between the two groups was found for the BJ-PERFECT work ability sub-domain. This finding is consistent with the original version (Shi et al., 2013) and similar results have been reported for another performance-based instrument (TABS; Velligan et al., 2007).

Consistent with the results of the original BJ-PERFECT (Shi et al., 2013), schizophrenia patients performed worse than HCs on both the transportation and work ability domains and global function of the modified instrument, especially in work ability when gender and employment were controlled for. Previous research has reported that the capacity for competitive employment is influenced most by cognitive impairment in people with schizophrenia (Mcgurk et al., 2018). When combined with the results of the current study, work ability may be the most sensitive measure in distinguishing schizophrenia patients from HCs in functional assessment and serve as a good link to cognition.

However, some results of the current study differ to prior studies (Shi et al., 2013; Cui et al., 2012). Particularly that there were no significant differences between the schizophrenia patients and the HCs in financial management when measured by the modified BJ-PERFECT, as well as the two domains and general results of the UPSA-B. This may be partly due to the various influential factors of the UPSA, such as symptoms of psychosis and residential state (Mausbach et al., 2011; Patterson et al., 2001) which were not assessed in the current project.

The Cronbach's alpha coefficients of the three domains and the modified instrument total were high (0.615–0.864), and comparable to that of the UPSA-B (Cui et al., 2012), indicating relatively good internal consistency and reflects the reliability of the measure to some extent.

The validity of the modified BJ-PERFECT was supported by a significant difference between schizophrenia patients and HCs on the total score ($p < 0.05$, Cohen's $d = 0.41$). For construct validity, the remaining items and score points had good factor loadings when examined in the EFA. At the same time, the three domains were moderately to highly correlated with one another and highly correlated with the global result of the modified BJ-PERFECT, suggesting good construct validity.

For criterion validity, the total scores of the modified BJ-PERFECT have a moderate correlation with the UPSA-B, another widely used performance-based assessment of functional capacity with confirmed validity in China (Cui et al., 2012). On the contrary, low correlations were found between the total scores of the modified BJ-PERFECT and the results of the GAF, an interview-based instrument evaluating real-world functioning (Startup et al., 2011). Consistent with the outcome of the original BJ-PERFECT, this further indicates that functional capacity and real-behavior consist of two different functioning constructs (Best et al., 2014), and that performance-based instruments cannot measure real social functioning. The financial management domain of the modified BJ-PERFECT and the UPSA-B showed the highest correlation among the different subdomains of the two assessments, coinciding with the result of the original BJ-PERFECT (Shi et al., 2013), further illustrating good convergent validity.

According to previous literature, schizophrenia is a complex disease and many factors can influence functioning (Owen, 2016). Consistent

with recent evidence (Shi et al., 2013), level of education positively correlated with the three subdomains and the total score of the modified BJ-PERFECT, as well as the UPSA-B. This indicates that education may be an influential factor of functional capacity. However, inconsistent with some previous studies (e.g., Mantovani et al., 2015), the current study reported that age and the state of employment hardly correlate with the different domains and the general outcome of the modified BJ-PERFECT, as well as the outcome of the UPSA-B. As the state of employment reflects real-world function, such results may further demonstrate that functional capacity and real-world function are two different constructs of functioning (Best et al., 2014; Brune et al., 2011) and that the modified BJ-PERFECT assessment cannot fully predict and reflect real-world behavior.

It takes around 15–20 min to complete the modified BJ-PERFECT, which is slightly shorter than the original BJ-PERFECT and the UPSA full version (Patterson et al., 2001), but the modified BJ-PERFECT optimizes the instrument items ensuring good construct validity.

There are several limitations of the current study. Firstly, some of the demographic information could reflect the participants' real-world functional outcome (Gold et al., 2002; Jaeger et al., 2003; Gould et al., 2012). Meanwhile, information like IQ was verified to have an influence on functional capacity (McLaughlin et al., 2016), therefore, it would be better to include more demographic information in the research. This would help distinguish the influence of various factors on functional outcomes and provide a comprehensive understanding of the relationship between functional capacity and real-world functioning. However, basic demographic information was provided in the current study and the collection of more detailed information could be time-consuming and increases the difficulty of participant recruitment. Secondly, the demographic data of the two groups were different, leading to covariance analyses when making comparisons between the groups. Thirdly, only an EFA could be conducted due to the small sample size. More participants should be recruited in order to perform confirmatory factor analyses, which would provide a better understanding of the construct validity. Finally, the importance of the relationship between cognition and functional outcomes in patients with schizophrenia is being increasingly recognized (Mckibbin et al., 2004), but neuropsychological tests were not administered in the current study. In the future, a rigorous and comprehensive assessment battery should be employed. The results from such research would provide a clearer picture of the role of functional capacity in individuals with schizophrenia, particularly clarifying the inconsistent relationships between functional capacity and cognitive function (Keefe et al., 2006; Best et al., 2014).

In summary, the modified BJ-PERFECT instrument has been found to have good construct validity based on the retainment and optimization of satisfactory psychometric properties of the original version. Although the amount of time required is not reduced, props needed in the cash register task have been simplified, making the use of the measurement more efficient and convenient.

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Declaration of Competing Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Supplementary materials

Supplementary material associated with this article can be found, in

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