OBJECTIVE. This study sought to determine the psychometric properties for the Loewenstein Occupational Therapy Cognitive Assessment–Second Edition (LOTCA–II) in a population of persons with schizophrenia.

METHOD. Sixty-four participants with schizophrenia were administered the LOTCA–II at baseline, and 43 of these were randomly selected to undertake four more standardized measures of cognitive and instrumental activities of daily living (IADL) functions to test convergent validity. One week later, 48 randomly selected participants from the total sample were readministered the LOTCA–II to determine test–retest reliability.

RESULTS. Substantial ceiling effects existed in 96% of LOTCA–II items. Cronbach’s alpha for all six subtests ranged from .20 to .91; the alpha for the global scale was .90. Intraclass correlation coefficients ranged from .49 to .89 for the subtests and .95 for the full LOTCA–II. Low to moderate correlations were found between LOTCA–II total score and scores on cognitive and IADL measures. No overall significant differences in subtest scores were found across participants differing in employment status.

CONCLUSION. LOTCA–II performance is best interpreted in the context of total score. Further revision of the test items is recommended for a more reliable and valid use of the LOTCA–II in persons with schizophrenia.


Cognitive dysfunction has been recognized as a core feature of schizophrenia (Palmer et al., 1997; Sharma & Antonova, 2003). In schizophrenia, different aspects of cognition are disturbed with varying degrees of severity, of which attention, memory, visuospatial ability, and executive functions are the key domains (Bilder et al., 2000; Bozikas, Kosmidis, Kiosseoglou, & Karavatos, 2006; Johnson-Selfridge & Zalewski, 2001; Keri, Kelemen, Janka, & Benedek, 2005; Keri, Kiss, Kelemen, Benedek, & Janka, 2005; O’Donnell et al., 1996; Tyson, Laws, Roberts, & Mortimer, 2005). For example, persons with schizophrenia have (a) difficulties with concentration and a short attention span; (b) impairments in verbal and visual memory functions, especially working memory; (c) problems in visuospatial processing (disrupted dorsal visual pathway in connection with parietal lobe) rather than discrimination of visual stimuli attributes (intact ventral visual pathway linking to temporal lobe); and (d) difficulties in problem solving and switching mental set when performing tasks. These cognitive disturbances are significantly associated with community integration, occupational functioning, and quality of life (McGurk, 2000; Prouteau et al., 2005; Sota & Heinrichs, 2004). Thus, validated measuring instruments are needed to quantify accurately the cognitive status of persons with schizophrenia, on the basis of which evidence-based interventions can be launched to improve functional outcomes.

The Loewenstein Occupational Therapy Cognitive Assessment (LOTCA; Itzkovich, Elazar, Averbuch, & Katz, 1990) was developed according to clinical experience as well as Luria’s neuropsychological and Piaget’s developmental theories and evaluation procedures (Inhelder & Piaget, 1964; Luria, 1980). The original
LOTCA contained four subtests: Orientation, Percepcion, Visuomotor Organization, and Thinking Operations. The LOTCA has been shown to have adequate psychometric properties in persons with brain damage (Katz, Itzkovich, Averbuch, & Elazar, 1989). In brief, estimates of internal consistency were high (85–95) for Percepcion, Visuomotor Organization, and Thinking Operations subtests (Katz et al., 1989). Interrater reliability ranged from .82 to .97 for the various items. As regards to the validity, none of the demographic variables was significantly related to LOTCA performance in persons with traumatic brain injury and stroke. A moderate correlation was found between the score on the Block Design subtest of the Wechsler Adult Intelligence Scale (Wechsler, 1981) and mean score of the Visuomotor Organization subtest of the LOTCA. Except for Orientation subtest, the remaining three subtests showed moderate to high correlations with measures of functional capacity (e.g., preparation of a sandwich and drink and use of phone) in persons with hemispatial neglect after having had a stroke (Katz, Hartman-Maeir, Ring, & Soroker, 2000). Recently, in response to the needs of refining the scoring system, allowing more accurate assessment, and clarifying administration instructions, a second edition (a battery of six subtests) has been published (LOTCA–II; Itzkovich, Elazar, Averbuch, & Katz, 2000). The major changes in the LOTCA–II included provision of multiple-choice questions in the Orientation subtest for persons with expressive language difficulties; division of the Perception subtest into three separate subtests, which were lengthened by the addition of new items; item revision and addition of a new item in the Thinking Operations subtest; and revised directions for test administration to ensure easy comprehension.

Although the LOTCA was initially designed to assess the basic cognitive abilities of persons with brain injury, it also was used by occupational therapists for evaluation of cognitive function in other diagnostic groups, such as mental illness and dementia (Averbuch & Katz, 1988; Bar-Haim Erez & Katz, 2003). However, as compared to the well-established psychometric properties for persons with brain damage, much less research has been done for the persons with psychiatric disabilities. It is of considerable importance that any instrument, when used as part of a clinical evaluation procedure, should be psychometrically sound and appropriate for use with the targeted client groups. To our knowledge, the work by Averbuch and Katz (1988) was the only relevant study in which LOTCA performance of 67 adults with psychiatric disabilities was investigated. The authors found that persons with personality disorder performed best on the LOTCA, followed by persons with paranoid schizophrenia, and the lowest performance was seen in those with disorganized schizophrenia. In addition, there were no age group differences in LOTCA scores, but the persons with shorter hospitalizations (1 month to 18 months) tended to perform better than those with longer periods of hospitalization (18 months to 5 years). In view of the fact that cognitive skills assessed by the LOTCA are relevant to persons with schizophrenia and that adequate occupational therapy cognitive assessment tools are few, we undertook a more rigorous evaluation of the psychometric properties of the measure.

Our aim in determining the reliability of the LOTCA–II was to evaluate the internal consistency and test–retest reliability over a 1-week period. The internal consistency is a measure of the homogeneity of test items. For a measure that has subtests to tap different domains of functioning, internal consistency is especially important, because it reflects the degree to which the item content is similar (Lemke & Wiersma, 1976). Estimates of test–retest reliability—an index of score consistency over some period of time—are required when the test is used as an outcome measure (Jensen, 1980). Construct validity refers to the extent to which a test measures the hypothetical trait (construct) it is intended to measure (Anastasi & Urbina, 1997). This type of validity addresses whether the test effectively measures skills comparable to those sampled by other standardized tests with similar constructs (convergent validity), whether changes in test scores reflect expected developmental changes, and whether the test is able to distinguish among groups that theory claims ought to be so distinguished (contrasted-group validity). In the present study, construct validity was evaluated by correlating LOTCA–II scores with scores on three measures of cognitive function and one measure of instrumental activities of daily living (IADL) function; by an analysis of demographic and clinical characteristics against LOTCA–II total and subtest scores; and by whether the LOTCA–II differentiates among different employment status subgroups. The tests that were selected for convergent validity were those commonly used in psychiatric practice in Taiwan to evaluate certain aspects of cognitive function, including intellectual abilities and executive functions, and degrees of independence in ADL. They were the Chinese version of the Wechsler Adult Intelligence Scale–Third Edition (WAIS–III; Wechsler, 1997), Wisconsin Card Sorting Test (WCST–64; Kongs, Thompson, Iverson, & Heaton, 2000), Allen Cognitive Level Screen (ACLS; Allen, 1996), and Daily Living Function Scale–Second Edition (DLFS–II; Chu, 1997).
Method

Participants

The sample included 64 adults with schizophrenia from the outpatient psychiatry clinics of a university medical center and a community general hospital in the Kaohsiung metropolitan area, Taiwan. The inclusion criteria for participants were the following: DSM–IV (American Psychiatric Association, 1994) schizophrenia as diagnosed by the treating physicians and recorded in the participants’ medical files and also ages between 18 and 60 years. The exclusion criteria were mental retardation, organic brain diseases, seizures, serious medical illness, and history of alcohol or drug abuse.

For between-group comparison purpose, we recruited a similar number of participants in each of the three subgroups classified on the basis of vocational status. The competitively employed group consisted of 21 persons who were employed full-time (minimum of 40 hr per week) in an integrated setting for at least 3 months at the time of the research and were compensated for at least minimum wage. The average number of hours worked per week in the competitively employed group was 47.24 hr (SD = 10.7, range = 40–84), and their mean job tenure was 47.5 months (SD = 81.91, range = 3–392). In regard to occupation category, a majority of participants were employed as clerks and service workers (36.4%, respectively), whereas a small percentage of cases were employed as business managers (9.1%), plant and machine operators and assemblers (9.1%), technicians and associate professionals (4.5%), and workers in elementary occupations (e.g., restaurant wait staff, domestic helpers) (4.5%). Participants in sheltered employment were placed in the hospital-operated settings to provide services in the community such as janitorial services, car washing, food preparation (beverage and bakery), or goods delivery. The average length of sheltered employment was 27.67 months (SD = 34.6, range = 1–120). The unemployed group comprised individuals who were dismissed from their jobs due to various reasons and remained unemployed at the time of the research. The mean duration of unemployment was 50.71 months (SD = 63.46, range = 1–264). Demographic and clinical characteristics for the total sample and three subgroups are detailed in Table 1. The three subgroups did not differ significantly in age ($F = .21, p = .82$), gender ($\chi^2 = 2.57, p = .28$), and education ($F = 2.89, p = .06$).

Measures

The LOTCA–II (Itzkovich et al., 2000) consists of 26 items grouped into six primary subtests: Orientation, Visual Perception, Spatial Perception, Motor Praxis, Visuomotor Organization, and Thinking Operations. The Orientation subtest is made up of two items that assess orientation to time and place, for example, “What day is today?” “How long have you been hospitalized?” and “Where are you now?” The abilities measured in the 4-item Visual Perception subtest include the identification of clear pictures of objects, identification of objects photographed from unusual angles, the distinction of overlapping figures, and recognition of spatial relations. The Spatial Perception subtest consists of 3 items that tap spatial relationships between objects or between objects and self. The Motor Praxis subtest is made up of 3 items concerning motor imitation, use of objects, and symbolic actions. The 7-item Visuomotor Organization subtest combines perceptual activity with motor responses, coupled with a spatial component. This subtest includes three large classes of activities: copying, drawing, and building or assembling. The 7-item Thinking Operations subtest involves not only the ability to identify discrete features of objects, to appreciate them hierarchically, and to classify them but also, on a more advanced level, the ability to apprehend sequence. Each item of the LOTCA is rated on a scale from 1 (low) to 4 (high), except for the Orientation subtest, which is scored on a scale from 1 to 8, and 3 items in the Thinking Operations subtest, which are scored on a scale from 1 to 5. Each item is graded according to criteria based on the degree to which the participant answers the questions or performs the task. Each subtest provides a domain-specific raw score. The total score ranges from 26 to 115. Higher scores represent less impairment in basic cognitive abilities. Published studies on the LOTCA–II’s psychometric properties are surprisingly scarce apart from those in which the test was initially derived. We have been able to identify only one study (Josman & Katz, 2006) reporting on the psychometric properties of the LOTCA–II. In Josman and Katz’s study, the categorization item from the Thinking Operations subtest—which examines the ability to establish categories and shift conceptual sets—was moderately correlated with the perseverative errors score on the WCST–64 (Kongs et al., 2000) in persons with schizophrenia. However, no significant relationships were found between performance on the categorization item and functional daily tasks that require categorization abilities.

The WCST–64 was designed to evaluate executive functions, specifically the ability to shift mental set in responding to the demands of a changing context. Participants are asked to match the 64 response cards with the stimulus cards and told only whether or not the match is correct. The test continues until the participant has successfully completed three categories (color, form, and number) or until the deck of 64 response cards has been used, whichever occurs first. For this
study; only the perseverative errors (PE) and conceptual level responses (CLR) scores were used. A lower number of perseverative errors and a higher number of conceptual level responses denote better performance on this test. The WCST has been used widely to explore executive functions in persons with schizophrenia. On the whole, persons with schizophrenia demonstrate a greater number of perseverative errors, which occur when the person continues to sort cards according to the same rule despite negative feedback (Ritter, Meador-Woodruff, & Dalack, 2003). These results, along with neuroimaging studies that implicate the frontal cortex in perseverative behaviors, suggest that an abnormality in frontal cortex may lead to perseveration, which is implicated in poor performance on the WCST in persons with schizophrenia (Joseph, 1999).

The WAIS–III (Wechsler, 1997) gives a full-scale IQ (FSIQ) and also two separate IQs for the two scales: verbal (VIQ) and performance (PIQ). There are 7 verbal subscales and 7 performance subscales. Four index scores also can be derived from the subtests of the WAIS–III: Verbal Comprehension, Perceptual Organization, Working Memory, and Processing Speed. Abundant empirical evidence supports the reliability and validity of the WAIS as a measure of general intellectual functioning in various diagnostic groups, including schizophrenia. Research has shown that global intellectual impairment was present at the onset of illness and that a model of WAIS–III performance with correlated factors for verbal comprehension, perceptual organization, working memory, and processing speed fitted the data from persons with schizophrenia (Dickinson, Iannone, & Gold, 2002; Hijman, HulshoffPol, Sitskoorn, & Kahn, 2003).

The ACLS (Allen, 1996) is a brief evaluation of planning, problem solving, and deduction abilities in which participants are required to replicate three different stitches with leather lacing materials. Levels 3 to 5 of the six Cognitive Disabilities Model (Allen, 1985) levels are represented in the ACLS. The ACLS yields a global score based on error frequency and type, ability to recognize and correct errors, and the level of assistance demanded on a 15-point ordinal scale. Scores range between 3.0 and 5.8, with higher scores indicating higher cognitive levels. The psychometric properties of the ACLS have been evaluated in a variety of psychiatric and geriatric populations. Interrater reliability was excellent (above .90) (Penny, Musser, & North, 1995). With regard to validity, the ACLS has been found to converge with scales measuring related constructs, for example, fluid intelligence, executive functions, perceptual organization, perceptual motor skills, classification abilities, and general cognitive abilities, as well as ADL skills (David

### Table 1. Demographic and Clinical Characteristics by Employment Status

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total Sample (N = 64)</th>
<th>Competitive Employment Subgroup (n = 22)</th>
<th>Sheltered Employment Subgroup (n = 21)</th>
<th>Unemployment Subgroup (n = 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean ± SD</td>
<td>32.92 ± 8.02</td>
<td>32.09 ± 8.08</td>
<td>33.05 ± 8.07</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>19–55</td>
<td>20–54</td>
<td>19–49</td>
</tr>
<tr>
<td>Gender</td>
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<td>Male</td>
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<tr>
<td>Female</td>
<td>29</td>
<td>9</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Education (years)</td>
<td>Mean ± SD</td>
<td>12.36 ± 2.29</td>
<td>13 ± 2.49</td>
<td>11.43 ± 1.96</td>
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<tr>
<td></td>
<td>Range</td>
<td>6–16</td>
<td>9–16</td>
<td>6–14</td>
</tr>
<tr>
<td>Illness duration (months)</td>
<td>Mean ± SD</td>
<td>127.88 ± 92.52</td>
<td>112.91 ± 95.99</td>
<td>139.48 ± 94.24</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>2–394</td>
<td>3–392</td>
<td>5–394</td>
</tr>
<tr>
<td>Age at onset (years)</td>
<td>Mean ± SD</td>
<td>22.8 ± 5.51</td>
<td>23.32 ± 3.98</td>
<td>20.1 ± 6.4</td>
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<tr>
<td></td>
<td>Range</td>
<td>13–36</td>
<td>17–30</td>
<td>13–36</td>
</tr>
<tr>
<td>Frequency of hospitalization</td>
<td>Mean ± SD</td>
<td>3.02 ± 3.87</td>
<td>2.14 ± 1.61</td>
<td>5.05 ± 6.05</td>
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<tr>
<td></td>
<td>Range</td>
<td>0–25</td>
<td>0–7</td>
<td>0–25</td>
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<td></td>
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<td>Paranoid</td>
<td>60</td>
<td>22</td>
<td>18</td>
<td>20</td>
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<tr>
<td>Disorganized</td>
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<td>0</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Catatonic</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Classical</td>
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<td>7</td>
<td>6</td>
<td>5</td>
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<tr>
<td>Atypical</td>
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<td>15</td>
<td>15</td>
<td>16</td>
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<tr>
<td>Residential setting</td>
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<td></td>
<td></td>
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<tr>
<td>At home</td>
<td>62</td>
<td>20</td>
<td>21</td>
<td>21</td>
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<tr>
<td>Halfway house</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. SD = standard deviation.
The DLFS–II (Chu, 1997) is a self-report measure intended for persons with psychiatric disabilities, ages 14 to 60 years, to quantify a person's level of independence. The scale consists of two parts: Personal Independence and Community Involvement. The first part is an 8-item checklist with a total of 100 subitems that evaluate skills and habits in five behavior domains regarded as important in the development of personal independence in daily living: hygiene and grooming, general health, independent functioning, leisure activities, and perceived quality of life. Part 2 contains 38 questions organized under five domains that relate to the individual’s skills and knowledge pertinent to community living: basic reading and math skills, awareness of current events, money management, and use of public transportation and telephone, together with social/community problem solving. The scale generates a total score (0–100). High scores on this measure reflect a high level of community integration. Test–retest reliability within a 1-week period was .85 for persons with psychiatric disabilities. Correspondence between informant reports of everyday performance and performance obtained on the DLFS was moderate (.56).

Procedure
This study was approved by the hospital’s institutional review board, and written informed consent was obtained from all participants. To recruit cases, we contacted directors of psychiatric departments at each participating organization, explained the study, and asked them to nominate persons with schizophrenia who qualified for inclusion in the present study. Details of demographic, diagnostic, and work information were abstracted from medical records or interviews.

The LOTCA–II was translated into Chinese and translated back into English to create semantic equivalence (a complete account of the translation procedures can be found in Su, Lin, Chen-Sea, & Yang, in press). All participants were administered the Chinese version of the LOTCA–II. Among them, due to time and money restraints, only 48 persons were randomly asked to complete the test again after 7 days. To be eligible for retest, participants must have had no change in therapeutic regimen or medication during these 7 days. With respect to convergent validity, a random sample of 43 persons from the initial sample of 64 was selected to receive the other four measures. These participants were typically evaluated in a single session, which lasted 3 or 4 hours, and breaks were given where appropriate to minimize the effects of fatigue on performance. All tests and retests were given individually to each participant in quiet locations identified at the participants’ respective home or facility by a graduate student in the master’s-degree program in behavioral science. The tests were administered according to the standardized procedures described in each test’s manual, except for the pictorial sequence B item of the Thinking Operations subtest in the LOTCA–II. All participants completed this item regardless of their responses to the previous item (i.e., Pictorial Sequence A). This change was made in an attempt to maximize the variance in participants’ scores on the LOTCA–II.

The examiner attended a 2-day training session led by the principal investigator. During training, particular attention was drawn to the tests’ explicit nature, administration, and scoring. To meet the competency requirement in test administration, the examiner completed a case under the supervision of the principal investigator to ensure correctness and appropriateness in administering and scoring before formal testing. To decrease a possible experimenter bias, the examiner did not reacquaint herself with the participant’s scores from the first assessment when conducting the retest.

Data Analysis
Individual item score distribution of the LOTCA–II was analyzed by calculating the mean, standard deviation, skewness, ceiling effect (percentage of participants achieving the highest scores), and floor effect (percentage of participants achieving the lowest scores). The internal consistency reliabilities of the LOTCA–II subtest and total scores were calculated using the Cronbach’s alpha coefficient. An intraclass correlation coefficient (ICC) was applied to measure test–retest reliability. The ICC chosen for this study used single measurement and was based on Model 2 (i.e., two-way random effect model) of Shrout and Fleiss’s (1979) three-model proposition. In general, a reliability coefficient of .90 is considered to be high, .80 moderate, .70 low, and .60 generally unacceptable for clinical use (Murphy & Davidshofer, 1991). Pearson correlation coefficients were carried out to assess the strength of the linear relationship between the LOTCA–II total and subtest scores obtained from the first administration; perseverative errors and conceptual level responses on the WCST; and three IQ scale scores and four index scores from the WAIS–III, ACLS, and DLFS–II. The associations of LOTCA–II with demographic and clinical parameters were evaluated by means of Pearson’s correlation. A Pearson correlation coefficient $r$ below .3 means no association; an $r$ value falling in the interval from .3 to .7 indicates a weak to moderate association; and the association is supposed to be strong if $r$ is larger than .7 (Cohen, 1988).
Finally, contrasted-group validity of the LOTCA–II was tested by a multiple analysis of variance (MANOVA). Significant MANOVA findings were followed by univariate and post hoc pairwise tests to compare the mean levels of performance on the six subtests across three subgroups classified by employment status.

Results

Item Performance

Table 2 outlines a listing of items, mean scores, skewness, and floor and ceiling effects for the entire sample. No missing values for any of the variables in the analysis were found. Skewness summarizes the extent to which a distribution of scores is non-normal. Skewness values < −1 or > +1 imply substantially non-normal distributions. As can be seen, all of the items except for item TO1 (categorization) were skewed negatively (the scores were clustered on the right of the curve), indicating a tendency for persons with schizophrenia to score toward higher cognitive functioning. Moreover, all but four items revealed a substantial degree of skewness, ranging from −1 to −5.5. The negative skewness value of the total score was −2.3. We decided not to transform this data, because data transformations can alter the fundamental nature of the data, which makes the interpretation of the results difficult (Osborne, 2002).

Floor and ceiling effects were considered present when more than 20% of the participants had the lowest or highest possible score on an item (Holmes, Bix, & Shea, 1996). Low ceiling suggests that the scale may limit a person’s opportunity to demonstrate improvement over time, whereas high floor denotes that the scale may limit a person’s opportunity to demonstrate worsening over time. Prominent ceiling effects, ranging from 25% to 96.9%, occurred in all items with the exception of item TO1, making it clear that these items provide little room to demonstrate improvement. On the other hand, floor effects were negligible for all but items TO6 and TO7 (geometric sequence and logic questions). No ceiling or floor effects were associated with the total LOTCA–II. Taken together, these results indicated that the majority of the LOTCA–II items were too easy for our sample with schizophrenia.

Internal Consistency

Internal consistency was satisfactory for Orientation, Visuomotor Organization, and Thinking Operations subtests, with values of Cronbach’s alpha ranging from .77 to .91 (see Table 2). However, low internal consistency, ranging from .20 to .45, was observed for the Visual Perception, Spatial Perception, and Motor Praxis subtests, indicating that item quality and content sampling of these subtests needed revision. The entire LOTCA–II had a reliability of .90, which is a suggested minimum score for analyzing an individual’s result (Polgar, 2003). This also proved that the underlying cognitive abilities measured by the items of the LOTCA–II as a whole were similar.

Test–Retest Reliability

The ICC calculated for a subsample of 48 persons with schizophrenia was .95 for the summary score. For orientation subtest, the ICC was .63; for Visual Perception subtest it was .77, for Spatial Perception subtest it was .49, for Motor Praxis subtest it was .67, for Visuomotor Organization subtest it was .87, and for Thinking Operations subtest it was .89. On the basis of these results, it would be advisable to exercise caution in interpreting Orientation, Spatial Perception, and Motor Praxis subtest scores when used in the context of monitoring cognitive changes across time.

Convergent Validity

As can be seen from Table 3, weak to moderate correlations were found between the LOTCA–II total score and scores on the four tests (WAIS–III, WCST, ACLS, and DLFS),
with absolute values of the Pearson’s $r$ ranging from .37 to .69. In terms of LOTCA–II subtests, correlations of Visuomotor Organization and Thinking Operations subtest scores with the WAIS–III IQ and index scores were consistently higher than were correlations between the WAIS–III IQ and index scores and the remaining four LOTCA–II subtests, with the exception of Processing Speed Index. On this index, both Visual Perception and Spatial Perception subtests showed higher correlations. A plausible explanation might be that successful completion of these two subtests required a considerable amount of perceptual differentiation skills tapped by the Processing Speed Index. As anticipated, Orientation subtest did not corroborate with any of the WAIS–III scores, because no corresponding subtests measuring a similar underlying construct were found in the WAIS–III. On the other hand, all of the LOTCA–II subtests were significantly and negatively related to perseverative errors on the WCST, whereas four subtests (Visual Perception, Motor Praxis, Visuomotor Organization, and Thinking Operations) were significantly associated with WCST conceptual-level responses. As expected, only Visuomotor Organization and Thinking Operation subtests showed moderate relationships to the ACLS scores.

**Construct Validity**

Years of education were positively and moderately related to the overall score of the LOTCA–II. Age, gender, age at onset, duration of illness, and antipsychotic medications (classical vs. atypical) had no significant effects on the LOTCA–II (Table 4), however.

**Contrasted-Group Validity**

Means and standard deviations for the six subtests of the LOTCA–II by group (employment status) are described in Table 5, which clearly shows that the competitively employed group performed only slightly better than the other two groups in mean scores on each subtest. The lack of distinction between the three groups was further confirmed by a MANOVA of the LOTCA–II subtest scores that showed no significant effect of group (Wilks’s lambda $= .74$, $F_{[12, 112]} = 1.52$, $p = .13$). In light of the number of univariate analyses conducted, the Bonferroni alpha level was set at .008 (.05/6) for all follow-up analyses to maintain a family-wise error rate of .05. The results for the univariate ANOVA disclosed no statistically significant differences among groups on each of the LOTCA–II subtests as well. Post hoc multiple comparisons of marginal means using the Bonferroni test yielded only one significant difference, which occurred between competitively employed and unemployed groups on Visual Perception subtest (mean difference $= .72$, $p < .05$).

**Discussion**

Performed psychometric evaluation of the LOTCA–II showed that the total score has acceptable metric characteristics. The internal consistency and test–retest reliability of

<table>
<thead>
<tr>
<th>Measures</th>
<th>LOTCA–II Measures</th>
<th>Total</th>
<th>OR</th>
<th>VP</th>
<th>SP</th>
<th>MP</th>
<th>VO</th>
<th>TO</th>
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<tbody>
<tr>
<td>WAIS–III FSIQ</td>
<td></td>
<td>.69**</td>
<td>.21</td>
<td>.55**</td>
<td>.47**</td>
<td>.49**</td>
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<td>.64**</td>
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<tr>
<td>WAIS–III VIQ</td>
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<td>.63**</td>
<td>.13</td>
<td>.49**</td>
<td>.44**</td>
<td>.39*</td>
<td>.60**</td>
<td>.59**</td>
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<tr>
<td>WAIS–III PIQ</td>
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<td>.64**</td>
<td>.25</td>
<td>.52**</td>
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<td>.56**</td>
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<tr>
<td>WAIS–III VCI</td>
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<td>.41**</td>
<td>.35*</td>
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<td>.42**</td>
<td>.32*</td>
<td>.21</td>
<td>.48**</td>
<td>.53**</td>
</tr>
<tr>
<td>WAIS–III PSI</td>
<td></td>
<td>.37*</td>
<td>.17</td>
<td>.43**</td>
<td>.37*</td>
<td>.14</td>
<td>.34*</td>
<td>.30*</td>
</tr>
<tr>
<td>WCST PE</td>
<td></td>
<td>-.56**</td>
<td>-.30*</td>
<td>-.41**</td>
<td>-.30*</td>
<td>-.32*</td>
<td>-.45**</td>
<td>-.55**</td>
</tr>
<tr>
<td>WCST CLR</td>
<td></td>
<td>.42**</td>
<td>.29</td>
<td>.39*</td>
<td>.12</td>
<td>.38*</td>
<td>.30*</td>
<td>.41**</td>
</tr>
<tr>
<td>ACLS</td>
<td></td>
<td>.55**</td>
<td>.15</td>
<td>.17</td>
<td>.26</td>
<td>.29</td>
<td>.51**</td>
<td>.58**</td>
</tr>
<tr>
<td>DLFS</td>
<td></td>
<td>.55**</td>
<td>.21</td>
<td>.41**</td>
<td>.29</td>
<td>.35*</td>
<td>.42**</td>
<td>.57**</td>
</tr>
</tbody>
</table>


**Table 4. Correlations Between LOTCA–II Summary Score With Demographic and Clinical Variables (N = 64)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>LOTCA–II Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-.23</td>
</tr>
<tr>
<td>Gender</td>
<td>-.06</td>
</tr>
<tr>
<td>Education</td>
<td>.49**</td>
</tr>
<tr>
<td>Age of Onset</td>
<td>-.04</td>
</tr>
<tr>
<td>Duration of Illness</td>
<td>-.16</td>
</tr>
<tr>
<td>Medication</td>
<td>.18</td>
</tr>
</tbody>
</table>

the total LOTCA–II score were adequate, suggesting that
the items collectively measure the same underlying con-
struct (i.e., basic cognitive abilities) and that the total score
can be used to make significant decisions about an individual
such as establishing discharge planning (Polgar, 2003).
Less favorable results were obtained for the subtests. Reliability estimates for the Visual Perception, Spatial
Perception, and Motor Praxis subtests were reported below
a level of minimum internal integrity. Several possible
sources of errors could contribute to these low alpha coef-
cients, including a restricted range of scores with our sam-
ple, too few items in each of these subtests, and inadequate
coverage of cognitive skills purported to be measured by the
individual subtests. Our results in this area contrasted with
Katz et al.’s (1989) report of high internal-consistency reli-
bility of scores on the subtests in persons with neurolog-
ical disorders, with alpha coefficients ranging from .85 to
.95. As for temporal stability, of particular concern was the
low test–retest reliability for the Spatial Perception,
Orientation, and Motor Praxis subtests. On the basis of
these results, reasonable caution must be exercised with
respect to the usefulness of all but Visuomotor Organiza-
tion and Thinking Operations subtests in making clinical
evaluations and decisions.

Another concern raised was that ceiling effects were
large for 96.2% of the items. Such a disposition of scores
suggested that a vast majority of the LOTCA–II items were
less capable of discrimination in the upper band of the con-
structs where the scores indicated better performance. The
presence of ceiling effects also can lead to a false-negative
interpretation of the individual’s current cognitive status.
Therefore, further refinement of this instrument, using a
large sample of persons with different subtypes of
schizophrenia and a large array of cognitive abilities, would
increase its value as a tool for assessing cognitive distur-
bances in persons with schizophrenia who are cognitively
heterogeneous.

In addition to reliability, this study also examined the
construct validity of the LOTCA–II by investigating its cor-
relations with demographics, clinical parameters, four well-
established cognitive and IADL measures, and employment
status. The finding of a significant positive effect of educa-
tion on the LOTCA–II performance was at variance with the
study by Katz and colleagues (1989) in that none of the
demographic variables was significantly related to LOTCA
performance in persons with neurological disorders.

Previous studies investigating the potential relationship
between duration of illness, age at onset, medication type,
and cognitive performance in persons with schizophrenia
reported conflicting results (Bellino et al., 2004; Cuesta,
Peralta, & Zarzuela, 1998; Fagerlund, Mackeprang, Gade,
& Glenthoj, 2004; Keefe et al., 2004; Verdoux & Liraud,
2000). In our study, none of these clinical variables corre-
lated with LOTCA–II scores. Several methodological issues,
such as heterogeneous diagnostic samples (e.g., inclusion
of persons with schizoaffective disorder), incomparable drug
doses, varying degrees of participants’ chronicity and sever-
ite of illness, and reliability and validity of the neuropsy-
chological measures, may confound most results and the
comparability between studies.

LOTCA–II correlated moderately with measures that
share conceptual affinity with corresponding LOTCA–II
subtests. Overall, the LOTCA–II was related to intellectual
abilities, mental flexibility, concept formation, problem
solving, planning, perceptual motor skills, and daily func-
tion. The LOTCA–II, however, did not function well when
used as a tool to differentiate among persons with different
types of employment status. Given the substantial ceiling
effects observed among the items of the LOTCA–II, this
result is not surprising. Moreover, the LOTCA–II did not
contain items that tap verbal learning and memory, which
were identified as important cognitive domains that were
significantly associated with vocational outcome in
schizophrenia (Evans et al., 2004; McGurk, 2000).

Several sampling issues may have influenced the results
and limited the generalizability of our findings. First,
93.8% of our sample was persons with paranoid
schizophrenia, which is the commonest type of schizophre-
nia in most parts of the world. Debate arose over the cog-
nitive superiority of the paranoid subgroup relative to
other subgroups of schizophrenia. For example, one line of
research suggested that persons with paranoid schizophre-
nia were not cognitively superior to those with nonpara-
noid schizophrenia, when the effects of symptom severity

<table>
<thead>
<tr>
<th>Table 5. Mean and Standard Deviation of LOTCA–II Subtest Scores for Employment Status Subgroups</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOTCA–II Subtests</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Orientation</td>
</tr>
<tr>
<td>Visual Perception</td>
</tr>
<tr>
<td>Spatial Perception</td>
</tr>
<tr>
<td>Motor Praxis</td>
</tr>
<tr>
<td>Visuomotor Organiz</td>
</tr>
<tr>
<td>Thinking Operations</td>
</tr>
</tbody>
</table>

and drug level were statistically controlled (Bornstein et al., 1990; Kremen, Seidman, Goldstein, Faroane, & Tsuang, 1994). Another line of research found that persons with paranoid schizophrenia outperformed those with disorganized or undifferentiated subtypes in several cognitive domains, especially learning and memory (Hill, Ragland, Gur, & Gur, 2001; Seltzer, Conrad, & Cassens, 1997). Taking into account the discrepant findings, future studies are advised to investigate the clinical use of the LOTCA–II in measuring cognitive deficits of nonparanoid schizophrenia. Second, most of our participants with schizophrenia lived independently in the community. Prior research has shown that persons with schizophrenia living in the community had higher cognitive functioning than those who were institutionalized (Auslander et al., 2001; Bartels, Mueser, & Miles, 1997). Thus, replicating this study is recommended, involving persons with schizophrenia living in the residential-care facilities. Third, our sample was biased toward younger persons, with 81.3% younger than age 40, which may have inflated the LOTCA–II scores. Nonetheless, an extensive literature search suggested that a substantial portion of persons with schizophrenia do not decline beyond an initial deterioration of cognitive function that occurs within the first 5 years of illness (Friedman et al., 2001; Heaton & Drexler, 1988; Rund, 1998). Only a few studies observed a significant decline in abstraction ability among older persons with schizophrenia (Fucetola et al., 2000).

The results carry implications for practitioners and researchers in occupational therapy. The favorable psychometric properties of the LOTCA–II total score endorsed the adequacy for the use of a global score to summarize the results of the evaluation for persons with schizophrenia. However, the poor reliabilities of the subtests—especially Orientation, Visual Perception, Spatial Perception, and Motor Praxis—restrict their clinical usage. Additional research is recommended to evaluate the psychometric properties of the LOTCA–II in persons with various types of psychiatric disorders, so that empirical evidence might be accumulated. This evidence can serve as the groundwork for future revision of the LOTCA appropriate for persons with psychiatric disabilities.

Conclusion

The results of this study found limited evidence of reliability and validity for the LOTCA–II in adults with schizophrenia. Occupational therapists should bear in mind the strengths and limitations of the LOTCA–II when interpreting the test results and making significant decisions for persons with schizophrenia.


