# The OSOT Perceptual Evaluation: A Research Perspective

Marian Boys, Pat Fisher,
Claire Holzberg,
David W. Reid

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*Although the Ontario Society of Occupational Therapists (OSOT) Perceptual Evaluation has been widely used, it has never been standardized. A study was undertaken to examine the validity of the battery for differentiating neurologically normal persons from those who have been independently diagnosed as neurologically impaired. A group of 80 brain-damaged patients was compared with a matched group of 70 neurologically normal persons. Comparison of scores for the two groups supports the validity of the instrument for differentiating the neurologically normal from the perceptually impaired person. The distribution of scores suggests that the degree of impairment can be classified as mild, moderate, or severe. Finally, the OSOT Perceptual Evaluation is found to be a reliable procedure for the assessment of perceptual dysfunction.*

Marian Boys, OT(C), is Supervisor of Occupational Therapy, The Riverdale Hospital, Toronto, Ontario M4M 2B5, Canada.

Pat Fisher, Dip OT, OT(C), is Clinical Supervisor, The Queen Elizabeth Hospital, Toronto, Ontario.

Claire Holzberg, Dip OT, OT(C), is Senior Occupational Therapist, Department of Extended Care, Sunnybrook Medical Centre, Toronto, Ontario.

David W. Reid, PhD, is Associate Professor of Psychology, York University, and Geriatric Research Consultant, Sunnybrook Medical Centre, Toronto, Ontario.

*Authors' Note.* The first three authors were co-investigators, contributing equally to the research. The fourth author was a research consultant to the study.

One of the major challenges of our profession is the refinement of test instruments that will produce standardized, quantifiable, and valid methods of assessment. Such methods are necessary to assess degree of dysfunction, and in turn, to measure the efficacy of treatment. Furthermore, these methods are a prerequisite to the kind of research that will enable therapists to predict which patients will benefit from various treatment interventions and/or be successfully discharged. The theory and techniques of measurement development have now progressed to the point where accurate assessments which have widespread clinical application can be designed.

Occupational therapists are frequently asked to provide treatment for perceptual deficits that have resulted from acquired brain damage; however, perceptual function is complex, and the severity and nature of impairment can create a wide range in performance. Without a statistically sensitive assessment battery it is possible that patients with perceptual deficits may not be identified. Conversely, patients who are known to have sustained brain damage may be incorrectly assessed as also having perceptual dysfunction. These inaccuracies are likely to occur when only subjective judgment is used and no empirically derived measures. In addition, when subjective judgment is the only criterion of assessment, the possibility of discrepancies among therapists evaluating the same patient is increased, particularly when degree of impairment rather than mere existence of impairment is being determined. There is of course, a large body of work in this field published in the psychology, neurology, and neuropsychology literature. However, the use and applicability of tests from other disciplines is problematic, in Canada at least, for two reasons. First, to use the neuropsychology measures, for example, one must be a licensed, qualified psychologist. Second, most of these measures emphasize medical and diagnostic factors that are beyond the scope of occupational therapy practice. An objective, standardized assessment battery for evaluating perceptual problems that affect basic daily functioning would contribute towards establishing universal assessment criteria. The Ontario Society of Occupational Therapists (OSOT) Perceptual Evaluation is such an instrument. Its tests were based on known work in the field of perception (Critchley, 1953, Diller et al., 1974) and neurodevelopmental theory (Ayres, 1972, Frostig, 1961). The battery originated in 1972 when a study group was formed in Toronto to share knowledge and ideas relating to perceptual dysfunction in brain-damaged adults. The tests appear face valid and, having been developed by practicing therapists for use in the clinic, they focus on those areas of perceptual function that are most relevant to occupational therapy

practice. Despite its extensive use, the validity and reliability of the instrument had never been established. Therefore, in January 1982, a 2-year multisetting study was undertaken. Identical test kits were assembled for data collection in the three participating facilities, and a specially produced videotape of the test presentation was used in the training of therapists.

The dearth of standardized measures exclusive to occupational therapy is evident from a review of the literature. Siev and Freishat's (1976) landmark work "Perceptual Dysfunction in the Adult Stroke Patient" selected a number of evaluation tools from a variety of sources and attempted to match specific tests to specific deficits. However, the authors emphasized throughout their manual that most of the tests have not been validated, are usually descriptive, and are primarily subjective rather than objective and quantifiable.

Ottenbacher (1980) examined 35 evaluation forms that occupational therapists use to assess dysfunction in patients with cerebral vascular accident (CVA). His analysis revealed that the form of measurement most frequently used by occupational therapists to record evaluative findings was the (verbally) descriptive level, the least reliable form of measurement. He concluded, however, that existing occupational therapy assessments could provide the foundation for the development of more objective evaluation instruments.

Since Ottenbacher's report there have been very few published reports of perceptual evaluation instruments specifically for occupational therapy practice. Kaplan and Hier (1982) looked at the influence of visuospatial deficits on functional status in a group of 34 patients. Their results suggest that visuospatial problems are an important factor in predicting functional outcome and discharge disposition. However, the measures used to identify visuospatial dysfunction were standard psychological tests.

Fox and Harlowe (1984) described the development of a CVA evaluation battery based on factor analyses of the intercorrelations of 33 variables obtained on 100 acute CVA patients. There were five subsets of factors identified, including one consisting of five variables interpreted as measuring perceptual abilities. The results indicated that their battery had potential, but that further studies were required to corroborate its validity.

These same authors (Harlowe & Van Deusen [formerly Fox], 1984) also reported that of the original 100 patients, those 29 who were rated *impaired* on one or more of the five variables in the Perception factor were more likely to have been discharged with *home with support* or *institutionalized* designations than those who were intact on all five variables. But these analyses were based only on a chi-square test, and this test does not give the degree of association between the impairment and the discharge dispositions. In addition, the patients received only the designation *impaired* or *not impaired;* there was no examination of the degree of impairment. Thus, although this study provided further evidence that perceptual deficits work against successful rehabilitation, we have as yet little practical information on the accurate assessment of the perception factor.

Bhavnani, Cockburn, Whiting, and Lincoln (1982) reported on the reliability of the 27 tests that form the Rivermead Perceptual Assessment battery. They provided test–retest results for each test over a 4-week period in a group of 19 patients. They reported Spearman rank order correlations, which reflected changes in rank order of patients on repeat testing but gave no indication of changes in the individual patient scores and, therefore, did not reflect actual test score stability. Interrater reliability was tested by means of videotaping the assessment of 6 subjects and then having the videotapes scored by three therapists. By this method a significant level of agreement was reached for 20 of 26 subtests. Subsequently, in 1985, a revised version of the battery, in which the number of test items was reduced to 16, was published (Whiting, Lincoln, Bhavnani, & Cockburn, 1985). In this revision the authors provided correlations between their battery and certain psychological tests of perception. In conclusion, then, although several measures have been described, it appears that no single instrument has been developed for use by occupational therapists that has the broad practical application of the OSOT Perceptual Evaluation.

The purpose of this study was to test the validity of the OSOT Perceptual Evaluation for differentiating neurologically normal persons from those who have been independently diagnosed as neurologically impaired. At the same time the intent was to examine the reliability of the assessment battery and to establish cut-off scores that could be used to determine sensitivity and specificity indices (points above and below which it could be assumed the individual is perceptually intact or impaired for basic functioning). In addition, the authors were seeking ways to improve the instrument on the basis of the findings.

## Method

*Subjects.* The study, which was given a two-group, quasi-experimental design, was conducted at three Toronto facilities: The Queen Elizabeth Hospital, The Riverdale Hospital, and Sunnybrook Medical Centre. Experimental subjects (all of which were patients) were selected according to the following crite-

**Table 1**
**Composition of Subject Groups**

| | Experimental Subjects (N = 80) | Control Subjects (N = 70) |
|---|---|---|
| Age (years) | 42–70 | 40–69 |
| Sex | | |
| Male | 53 | 46 |
| Female | 27 | 24 |
| Education | | |
| Primary | 22 | 8 |
| Secondary | 42 | 42 |
| Postsecondary | 16 | 20 |

ria: They had to (a) be between 40 and 70 years old, (b) have a basic comprehension of English, (c) exhibit perceptual problems noted during routine occupational therapy assessment, and (d) have a diagnosis of one of the following: CVA, tumor, normopressure hydrocephalus, or anoxia. Excluded were patients with aphasia or traumatic head injury. Members of the comparison group (volunteers recruited from various hospital departments and the community) had no previous history of stroke or head injury or any illness involving loss of consciousness within the previous 10 years. The two groups were matched on the variables of age, sex, and level of education. Table 1 shows the composition of the two groups of 80 brain-damaged patients and 70 neurologically normal persons.

*Measures.* The OSOT Perceptual Evaluation consists of 28 tests organized under the following six functional areas: Sensory Function, Scanning and Spatial Neglect, Apraxia, Body Awareness, Spatial Relations, and Visual Agnosia. Table 2 shows examples of one test item in each functional area and the scoring method. Tests are in the form of behavioral performance tasks and test motor skills, eye–hand coordination, and visual recognition. A test manual describes each test item and provides instructions for the administration and use of a 4-point equal-interval scoring system. Also included are suggestions for a preliminary evaluation of mental status, vision, hearing, activities of daily living, and other relevant factors. The manual also contains a description of equipment and materials as well as a reference list.

*Procedure.* Data for the experimental group were accumulated from scores obtained on the Perceptual Evaluation when the evaluation was administered in the course of a normal delivery of service. Twelve occupational therapists, including the investigators (the first three authors of this study), provided their assessment results. Data for the normal control group were collected by the three investigators.

*Interrater Reliability.* To establish interrater reliability the test battery was administered by the attending therapist with one of the investigators present. The patient's performance was scored independently by both parties, on separate score sheets,

**Table 2**
**OSOT Perceptual Evaluation Sample Test Items and Scoring System**

| Functional Area | Test Item | Scoring |
|---|---|---|
| 1. Sensation | *Stereognosis*<br>Eight common objects identified by touch | 4 = 8/8 correct<br>3 = 5–7/8 correct<br>2 = 2–4/8 correct<br>1 = 0–1/8 correct |
| 2. Scanning | *Scanning*<br>Cancellation task (total possible cancellations = 105) | 4 = 0–3 errors<br>3 = 4–10 errors<br>2 = 11–25 errors<br>1 = 26 or more errors |
| 3. Apraxia | *Motor planning*<br>Manipulate 3 wire and grommet devices | 4 = 30 sec or less to complete 3 tasks<br>3 = 31–60 sec<br>2 = 61–90 sec<br>1 = unable to complete in less than 91 sec |
| 4. Body awareness | *Parts recognition*<br>Identify parts of body | 4 = 8/8 correct<br>3 = 5–7/8 correct<br>2 = 2–4/8 correct<br>1 = 0–1/8 correct |
| 5. Spatial relations | *Environmental*<br>Copy models of 4 pegboard designs | 4 = 4/4 correct<br>3 = 3/4 correct<br>2 = 2/4 correct<br>1 = 0–1/4 correct |
| 6. Visual agnosia | *Shape recognition*<br>Match 9 shapes to a form board | 4 = 9/9 correct<br>3 = 6–8/9 correct<br>2 = 2–5/9 correct<br>1 = 0–1/9 correct |

*Note.* The raw score data for each test item are recoded into the 4-point format for both clinical interpretation and statistical analyses, except for the test item *Tactile suppression,* which is scored in a bi-variate form of either 4 = *present* or 1 = *absent.*

**Table 3**
**Test–Total Correlations for Tests Within Each of Six Functional Areas**

| Sensory Function | | Scanning Function | | Apraxia | | Body Awareness | | Spatial Relations | | Visual Agnosia | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Light touch | .91 | Scanning | .93 | Motor planning | 72 | Puzzle | 77 | Laterality | .46 | Shape recognition | 71 |
| Localization | .95 | Spatial Neglect | .85 | Ideomotor | .24 | Parts recognition | .23 | Clock face | .84 | Color recognition | .80 |
| Pressure | .90 | | | Ideational | .29 | Draw a person | .82 | Pegboard | .89 | Size recognition | .63 |
| Localization | .94 | | | Constructional 2-dimensional | .86 | | | Free drawing | 78 | Figure-ground discrimination | .80 |
| Pain | .73 | | | Constructional 3-dimensional | .83 | | | | | | |
| Proprioception | .91 | | | | | | | | | | |
| Two-point discrimination | .73 | | | | | | | | | | |
| Tactile suppression | .87 | | | | | | | | | | |
| (R) Stereognosis | .33 | | | | | | | | | | |
| (L) Stereognosis | .84 | | | | | | | | | | |

*Note.* Correlation coefficients listed under a functional area represent Pearson product moment correlation coefficients between scores on the identified test with the sum of test scores within the functional areas. R = Right; L = Left.

and discrepancies/agreements were tallied for each test item. Forty-six subjects were examined in this way, and agreement of 93.1% across items was obtained for all subjects in all three facilities.

## Results

Homogeneity or internal consistency as a form of reliability was particularly pertinent to this study because the six sections or functional areas of the battery imply that the tests classified within each section are measuring a more or less unidimensional phenomenon. Correlations between each test item and the total for that functional area were calculated. High item–total correlations were found for most items within their respective functional areas (see Table 3). The exceptions were Right Stereognosis, Ideomotor and Ideational Apraxia, and Parts Recognition.

Two kinds of validity were of importance in this study. The first determined whether the six sections of the test battery are either distinctive in measuring separate phenomena or so highly intercorrelated that they all measure the same areas of function. The second determined whether the battery, in terms of its 28 test items, six functional areas, and the total score can reliably differentiate the neurologically normal from those diagnosed as having some form of neurological damage. These two kinds of validity are not mutually exclusive. Together, they are concerned with whether each functional area is reasonably independent from the others while each makes a contribution towards differentiating experimental subjects (patients) from normal subjects. Therefore, the intercorrelations between the six functional areas were examined, as well as the correlation of each area with the total score (see Table 4). Moderate interarea correlations were consistent with the assumption that each area was somewhat distinctive, that is, each area indicated a degree of independence while still contributing to a global score of perceptual dysfunction. The *t*-test comparisons between experimental and normal groups for total scores and the scores for each of the six functional areas, as shown in Table 5, demonstrate the validity of the test battery for differentiating the neurologically normal from those diagnosed as having some form of neurological damage.

Validity was further examined by comparing respective means and standard deviations and conducting *t*-test comparisons on all 28 test items (see Table 6) The two groups differed significantly on all measures except Ideational Apraxia. In addition, Ideomotor Apraxia and Parts Recognition were barely significant at the $p < .05$ level. Since minimum to maximum scores range from 1 to 4, differences between means for the two groups on individual tests were small. However, these differences were consistent, and the

**Table 4**
**Intercorrelations Between Six Functional Areas and OSOT Total Score**

| | Functional Areas | | | | | |
|---|---|---|---|---|---|---|
| | Scanning Function | Apraxia | Body Awareness | Spatial Relations | Visual Agnosia | OSOT Total |
| Sensory function | .31 | .31 | .40 | .41 | .27 | .85 |
| Scanning function | | .64 | .51 | .65 | .66 | .65 |
| Apraxia | | | 75 | 77 | .65 | 71 |
| Body awareness | | | | 74 | .60 | .72 |
| Spatial relations | | | | | .68 | 77 |
| Visual agnosia | | | | | | .63 |

**Table 5**
**Comparisons Between Patient and Normal Groups for Six Functional Areas and Total Score**

| | Patients | | Control Subjects | | |
|---|---|---|---|---|---|
| Functional Area | Mean | (*SD*) | Mean | (*SD*) | t Test |
| Sensory function | 28.5 | (10.01) | 38.5 | (.95) | 9.01* |
| Scanning function | 6.3 | (1.92) | 7.9 | (.20) | 7.65* |
| Apraxia | 16.5 | (2.53) | 19.0 | (1.07) | 8.02* |
| Body awareness | 10.1 | (1.58) | 11.6 | (.61) | 7.59* |
| Spatial relations | 12.5 | (2.65) | 15.6 | (.78) | 9.66* |
| Visual agnosia | 14.1 | (1.67) | 15.5 | (.55) | 7.10* |
| Total score | 88.1 | (13.58) | 108.38 | (2.38) | 13.12* |

* $p < .0001$.

totals gave a much greater magnitude of difference than did the individual scores. Therefore, selection of one or two test items to evaluate perceptual function will not give as sensitive a result as will the total battery score.

Our data analyses are based on *t* tests that are (a) robust in meeting assumptions of normal distribution and homogeneity of variance and (b) appropriate for interval data. In the OSOT scoring system the frequency data are transformed into interval data on a 1–4 scale. The *t*-test analyses indicated that persons with relatively low total scores are likely to be impaired and that persons with relatively high scores are not impaired. Figure 1 gives the distribution of total scores: It is apparent that scores at or below 100 were obtained only by impaired patients whereas scores at 110 and above were achieved only by normal subjects. For persons with scores between 101 and 109 there is the possibility that they might be perceptually impaired, but the certainty is less than 100%.

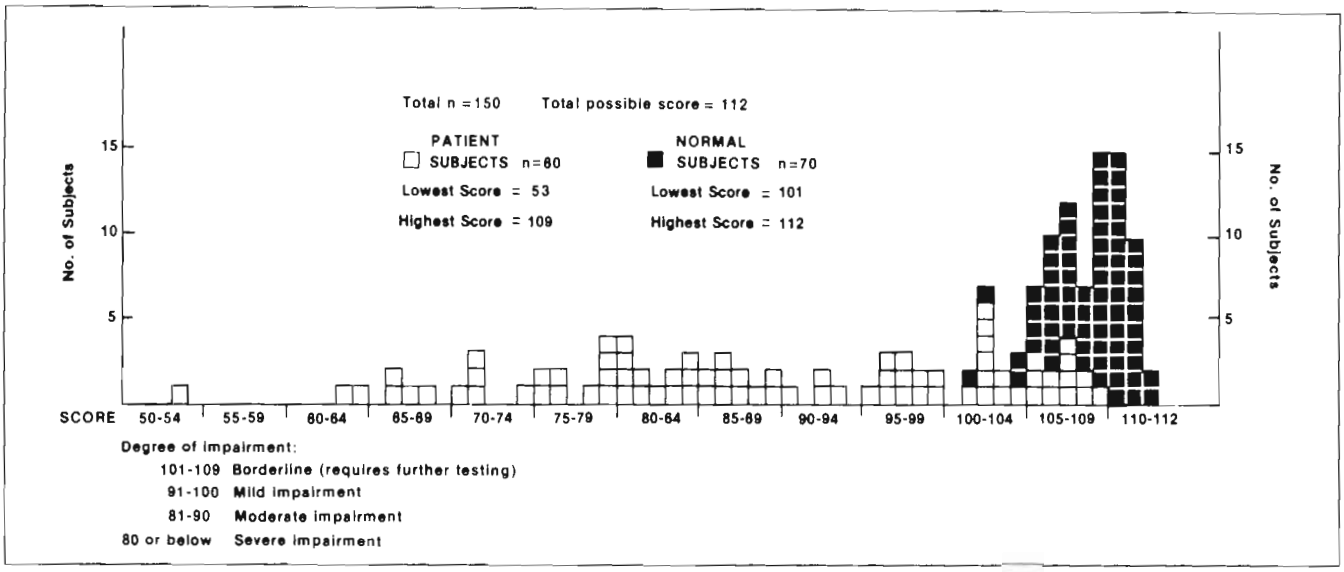
Figure 1 also shows that if we chose a cut-off score of 100 to indicate impairment, there would be a number of patients with scores between 100 and 110 who could not be considered impaired. Similarly, if we chose a cut-off score of 110, there would be a number of normal subjects who would be inaccu-

**Table 6**
**Comparisons Between Experimental and Normal Groups on Each OSOT Battery Test**

| | Patients | | Control Subjects | | |
|---|---|---|---|---|---|
| Test | Mean | (*SD*) | Mean | (*SD*) | t Test[a] |
| Light touch | 3.06 | (1.31) | 4.0 | (0.00) | 6.37*** |
| Localization | 2.82 | (1.37) | 4.0 | (0.00) | 7.63*** |
| Pressure | 3.20 | (1.18) | 4.0 | (0.00) | 6.04*** |
| Localization | 2.90 | (1.36) | 4.0 | (0.00) | 7.20*** |
| Pain | 3.08 | (1.17) | 3.8 | (0.44) | 5.23*** |
| Proprioception | 2.87 | (1.25) | 4.0 | (0.00) | 8.00*** |
| Two-point discrimination | 2.01 | (1.17) | 3.1 | (0.70) | 6.96*** |
| Tactile suppression | 2.67 | (1.48) | 4.0 | (0.00) | 7.99*** |
| (R) Stereognosis | 3.23 | (1.04) | 3.8 | (0.40) | 4.44*** |
| (L) Stereognosis | 2.51 | (1.26) | 3.8 | (0.40) | 8.63*** |
| Scanning | 2.78 | (1.23) | 3.9 | (0.20) | 8.31*** |
| Spatial neglect | 3.51 | (0.94) | 4.0 | (0.00) | 4.63*** |
| Motor planning | 3.48 | (0.74) | 3.9 | (0.16) | 5.63*** |
| Ideomotor | 3.95 | (0.21) | 4.0 | (0.00) | 2.03* |
| Ideational | 3.96 | (0.24) | 4.0 | (0.00) | 1.34 |
| Constructional 2D | 2.23 | (1.12) | 3.38 | (0.87) | 7.01*** |
| Constructional 3D | 2.86 | (1.09) | 3.64 | (0.59) | 5.50*** |
| Body puzzle | 3.26 | (0.95) | 3.77 | (0.45) | 4.25*** |
| Parts recognition | 3.91 | (0.32) | 4.00 | (0.00) | 2.40* |
| Draw a person | 2.96 | (0.94) | 3.87 | (0.44) | 7.65*** |
| Laterality | 3.60 | (0.56) | 3.97 | (0.16) | 5.60*** |
| Clock face | 3.08 | (0.87) | 3.88 | (0.32) | 7.60*** |
| Pegboard | 2.70 | (1.29) | 3.84 | (0.50) | 7.28** |
| Free drawing | 3.20 | (0.83) | 3.90 | (0.45) | 6.49*** |
| Shape recognition | 3.68 | (0.46) | 3.97 | (0.16) | 5.08*** |
| Color recognition | 3.58 | (0.66) | 3.97 | (0.23) | 4.79*** |
| Size recognition | 3.88 | (0.31) | 4.00 | (0.00) | 3.16** |
| Figure–Ground | 3.03 | (0.64) | 3.60 | (0.57) | 5.67*** |

[a] t-tests are for unequal sample variances.
* $p < .05$, two-tailed. ** $p < .002$, two-tailed. *** $p < .0001$, two-tailed.

**Figure 1**
**Distribution of Total Scores**




rately identified as being functionally impaired. Hence, at 110, the sensitivity of the instrument in identifying functional impairment is 100% whereas the specificity (the percentage of identified normal subjects) is only 40%. At a cut-off of 100, the sensitivity is 63.7% and the specificity is 100% (see Table 7). Thus a cut-off score of 100 optimizes the specificity whereas a cut-off of 110 optimizes the sensitivity of assessment decision-making for these subjects. Therefore, if one wanted to be certain that a patient was impaired before providing an intensive or expensive therapeutic intervention, a cut-off 100 or less should be used to assure the high likelihood that the person had perceptual impairment. Similarly, if one wanted to be sure that an individual was actually unimpaired before making decisions regarding treatment or discharge, a cut-off of 110 should be used. Patients whose scores fall between the cut-off scores should be considered for further investigation. By using the cut-off scores targeted, the battery has a high degree of accuracy, demonstrating its utility in occupational therapy assessment.

The stability of these cut-off scores awaits replication on further samples of subjects. However, the distribution of scores given in Figure 1 suggests that the degree of impairment could be classified as follows: *mild,* 91–100; *moderate,* 81–90; *severe,* 80 and below. Such classifications are, of course, somewhat arbitrary, but they serve to encourage an empirically based ranking of severity which reflects the fact that impaired persons can differ greatly in performance decrements.

**Table 7**
**Distribution of Neurologically Impaired and Normal Subjects According to Cut-off Scores on the OSOT Battery**

| | Cut-off Scores for Neurologically Impaired Patients | | Cut-off Scores for Neurologically Normal Subjects | |
|---|---|---|---|---|
| | 100[a] | 110[b] | 100[c] | 110[d] |
| No. of subjects below cut-off | 59 | 80 (A) | 0 | 42 (B) |
| No. of subjects above cut-off | 21 | 0 (C) | 70 | 28 (D) |

[a] Sensitivity level = 63.7%. [b]Sensitivity level = 100% (Sensitivity $= \frac{A}{A + C} \times 100$). [c]Specificity level = 100%. [d]Specificity level = 40% (Specificity $= \frac{D}{B + D} \times 100$).

## Discussion

One of the most important findings of this study is the instrument's ability to differentiate the impaired patient group from the neurologically normal group on (a) the total score on the battery, (b) all six subtests or functional area scores, and (c) 24 of the 28 test items. The test–total correlations given in Table 2 indicate good homogeneity of the six subtests except for Ideomotor and Ideational Apraxia, Parts Recognition, and Right Stereognosis. It is notable that the two tests lowest in discriminating between the two subject groups were Ideomotor and Ideational Apraxia, the same tests that demonstrated poor item–total correlations. Consideration will be given to incorporating these findings into a revised edition of the battery. However, the overall consistent pattern of differences between the two groups demonstrates the validity of the evaluation in differentiating between the neurologically normal and those diagnosed as having some form of neurological damage.

## Conclusions and Recommendations

The results represent only one study on one sample of neurologically impaired patients (the experimental group) and a matched group of volunteer normal subjects (the control group). Thus the interpretation of these results must be qualified. First of all, the designation of *experimental* and *normal* samples depended on our set of inclusion–exclusion criteria. As data collection took place in the course of the normal delivery of service, the experimental sample included those with the most frequently seen diagnoses: right CVA (42 patients); left CVA (21); bilateral CVA (3); meningioma (3); and other diagnoses, such as subdural hematoma, anoxia, and normopressure hydrocephalus (12). Had different diagnostic conditions been included, the distribution of test scores might have varied. However, the study was designed to be as representative as possible of the population most frequently seen in occupational therapy practice. Furthermore, the data were collected by a representative sampling of occupational therapists at three different facilities. How replicable the normative data are must be left to future studies.

The following variations are recommended for future consideration:

1. A replication of the study with other groups of subjects, for example, with an older population or a diagnosis-specific population.
2. An examination of the correlation between OSOT Perceptual Evaluation scores and activities of daily living performance.
3. The development of profile analyses to determine whether certain combinations of scores will yield a more precise definition of dysfunction.

It is emphasized that the OSOT Perceptual Evaluation should never be used for making diagnoses because it was not intended for that purpose. It was developed to provide a quantifiable, objective measure for identifying deficits in six areas of basic perceptual functioning. The project has demonstrated that the battery can be used reliably for the assessment of perceptual dysfunction.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