Researches and clinicians working with various adult populations have no practical, complete, reliable, and valid method of measuring the tactile and kinesthetic functions of their clients. This study gathers preliminary normative information on the performance of adults on the Southern California Kinesthesia and Tactile Tests.

Fifty-one normal men and women with a mean age of 26 years were administered the Kinesthesia, Manual Form Perception, Finger Indentification, Graphesthesia, Localization of Tactile Stimuli, and Double Tactile Stimuli Tests in the order in which they were standardized. Test-retest reliability was studied in 41 of these subjects. Results indicated that the assessment of normal adults was hampered by ceiling effects and by low reliability, but that these six tests might well serve a useful function in discriminating between relatively severe dysfunction and normal function in adults. Suggestions were made toward the development of new measurement instruments specifically designed for adults.

Occupational therapists frequently treat adult clients who have or who are at risk for somatosensory deficits. Evidence of kinesthetic or tactile dysfunction has been noted in a wide variety of clinical disorders including schizophrenia (1-3), hemiplegia (4), organic brain syndrome (5), and other kinds of brain dysfunction (6-7). Occupational therapy researchers need to study how somatosensory deficits impact upon occupational performance, how somatosensory deficits differ from population to population, and how to test the effectiveness of treatments. Occupational therapy clinicians need valid, reliable methods of evaluating somatosensory deficits, systematic methods for treating individuals with such dysfunctions, and effective ways to measure changes in their clients over time. For these reasons, both occupational therapy researchers and clinicians require valid and reliable measurement instruments of somatosensory functions.

The evaluation of the kinesthetic and tactile functions of children has been advanced through the Southern California Kinesthesia and Tactile Perception Tests (8). These include the Kinesthesia Test, the Manual Form Perception Test, the Finger Identification Test, the Graphesthesia Test, the Localization of Tactile Stimuli Test, and the Double Tactile Stimuli Perception Test. These tests have not been standardized on adults, although most of them are drawn from traditional neurological examination procedures often employed with adults (8, p 3). Although other systematic tests exist, none provide practical standardized procedures and norms on a broad range of kinesthetic and tactile functions. For example, Cohen (9) describes an experimental procedure to measure position sense in the shoulder, but the apparatus described is not commercially available. The current choices for the occupational therapy researcher or clinician who works with adults with somatosensory deficits are limited.

This study begins the investigation of the performance of adult subjects on the Southern California Kinesthesia and Tactile Perception Tests. Through the collection of preliminary normative information, it should be possible to suggest guidelines to occupational therapy...
researchers and clinicians in need of somatosensory tests for adults. Another matter of interest addressed by this study is the normal schedule for maturation of kinesthetic and tactile functions. Ayres has hypothesized that the maturation of tactile and kinesthetic perception is nearly complete by the time the child reaches the eighth or ninth birthday (10, p 169). Do tactile and kinesthetic functions continue to mature past childhood, or have they completed their development before adolescence?

Methods

Subjects. Fifty-one normal adults (25 males and 26 females) were tested. The subjects included graduate students, undergraduate students, and white collar workers at Boston University. Ages ranged from 19 to 34 years with a mean of 26 years. Six of the subjects were left-handed.

Procedure. The six tests studied were the Kinesthesia, Manual Form Perception, Finger Identification, Graphesthesia, Localization of Tactile Stimuli, and Double Tactile Stimuli Perception Tests of the Southern California Sensory Integration Tests (SCSIT) battery. The tests were administered in one session and in the recommended sequence. Standardized procedures were followed, except that the instructions for the Kinesthesia Test were modified to be appropriate for adults. As recommended, signs of tactile defensiveness were also evaluated during the administration of the tests. To test reliability, 41 subjects were retested after 5 to 14 days.

Results

Table 1 summarizes the results.

All but two subjects (96%) received the maximum score on the Double Tactile Stimuli Perception Test, and significant numbers of subjects received the maximum scores in the Manual Form Perception (11.8%), the Finger Identification (53.3%), and the Graphesthesia (13.7%) Tests.

Test-retest reliability was not calculable for the Double Tactile Stimuli Perception Test because of the very narrow range of scores (all subjects passed the test on its second administration).

In the course of the administration of the Graphesthesia, Localization of Tactile Stimuli, and Double Tactile Stimuli Perception Tests, 7 of 51 subjects demonstrated behaviors possibly indicative of tactile defensiveness. These included reports of feeling threatened, restlessness, complaints of itchiness, and scratching.

Figure 1 graphically compares the adult data gathered in this study to the data collected on children in the standardization of the SCSIT tests.

$t$-tests were conducted in order to determine whether significant differences existed between adult performance and the performance of the 90 children aged from 8 years, 6 months to 8 years, 11 months who participated in the original standardization. The adult sample scored significantly higher on the Kinesthesia Test, $t(139) = 18.5, p < .01$, the Manual Form Perception Test, $t(139) = 4.7, p < .01$, the Finger Identification Test, $t(139) = 10.0, p < .01$, and the Graphesthesia Test, $t(139) = 8.1, p < .01$. No differences were found on the Localization of Tactile Stimuli Test, $t(139) = -1.4, p > .05$, and a $t$-test for the Double Tactile Stimuli Perception Test was impossible.

Discussion

Test Development. These data have important implications for occupational therapists and others who wish to develop standardized instruments for measuring kinesthesia and tactile functions in adults. First, there is strong evidence that maturation of kinesthetic and tactile perception is not complete by the time the child reaches the eighth or ninth birthday and that older individuals need to be compared to age mates. The possibility that the adults in this study were not representative of adults in general because of their university affiliation remains; however, kinesthetic and tactile perception are generally not thought to be closely related to intelligence or social status. Therefore, the strong showing adults made in this study probably indicates a clinical need for adult norms.

A second implication is the need to develop testing procedures oriented to adults that adhere to the minimax principle: minimize error and maximize variance. Low test-retest reliability might be overcome by adding more test items that consistently discriminate between subjects' performance and by decreasing the number of items that almost all normal subjects pass. For example, Item Number 7 of the Finger Identification Test, in which the left ring and left middle fingers are touched, has far more discriminative power than any other item in that test. This finding, consistent with earlier findings that the ring finger tends to be the most difficult one to identify (11), suggests an approach to improving test reliability that can be generalized to some of the other tests, all of which must be adapted in order to avoid ceiling effects.

Clinical Evaluation. This study also has implications for therapists who treat adult subjects and clinically evaluate their somatosensory functions. Because of ceiling effects.
Figure 1: Performance of adults and children on the Southern California Kinesthesia and Tactile Tests (means and variability from -1 SD to +1 SD).
and low test-retest reliability, the Southern California Kinesthesia and Tactile Perception Tests probably have little utility in the evaluation of adults with minor somatosensory impairments. However, occupational therapists often treat clients whose scores would repeatedly fall below the lowest normal subjects' scores, as given in Table 1. Such a finding would be a conservative indicator of somatosensory dysfunction, as long as the evaluator is assured of the client's cooperation and understanding of instructions. For example, the Double Tactile Stimuli Perception Test discriminates very poorly between normals, but the basic procedure of applying two simultaneous tactile stimuli is a traditionally useful way to discriminate between function and dysfunction when screening for organic brain syndrome (5).

A final implication for occupational therapists relates to the finding of defensive responses to the tactile tests on the parts of seven of the normal adults tested. This percentage (14%) appears even greater than the 5 percent of 5-year-old normal children who demonstrated defensive behaviors during the standardization of the Southern California battery. It is possible that defensive responses are more typical of normal adults than of normal children, and clinicians are urged to be cautious in assigning the label of tactile defensiveness to adults.

The major limitation of this study is in its sample selection. The future development of a standardized instrument for adults should depend upon a more representative sample.

Conclusions
Several adult disorders (e.g., organic brain syndrome, hemiplegia, and schizophrenia) often entail somatosensory deficits, and occupational therapists working with these populations need to evaluate these deficits in order to facilitate their clients' occupational performance. This study suggests a need to devise measuring instruments designed specifically for adults and suggests some guidelines by which this might be done. However, the Southern California Kinesthesia and Tactile Tests as presently constructed might be useful to therapists who currently need to discriminate between relatively severe somatosensory dysfunction and the normal condition.

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Table 1
Raw Scores and Test-Retest Reliability (Spearman correlation coefficient) of Adults on the Southern California Kinesthesia and Tactile Tests

<table>
<thead>
<tr>
<th>Test-Retest Correlation (n = 41)</th>
<th>KIN</th>
<th>MFP</th>
<th>FI</th>
<th>GRA</th>
<th>LTS</th>
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<td>r = .28</td>
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