Content Validity of the In-Hand Manipulation Test

Charlotte E. Exner

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Object manipulation skills are a vital area for client assessment in occupational therapy, but in-hand manipulation skills are not specifically included in any standardized tests of hand function for children. The In-Hand Manipulation Test (IMT) was developed for use by occupational therapists with preschool and young school-age children. Assessment of the IMT's content validity was an important precursor to further development of the test. Twenty-four certified occupational therapists rated young children's performance during administration of the IMT before completing a content validity survey about the test. Overall, the IMT's content validity was supported by the feedback from the raters. A final test length of 50 items with two trials per item was considered acceptable, provided that the test takes no longer than 20 to 30 minutes to administer. The therapists were positive about the content and structure of the rating scale and the approach used in presenting activities to the children. Some issues related to functional validity of some skills or the proportions of in-hand manipulation skills were raised. Further development of the IMT for clinical and research use seems warranted. Revisions to the test will be made, and another pilot study will be conducted before normative data collection. Training for administering and scoring the test will incorporate the recommendations on the basis of this study's results.

Occupational therapists have few standardized tests that are based on occupational therapy theories and that are useful in assessing clients to develop or modify treatment programs for them. Many tests of motor or visual-motor functions commonly used by pediatric occupational therapists, such as the Bruininks-Oseretsky Test of Motor Proficiency (Bruininks, 1978), the Peabody Fine Motor Scales (Folio & Fewell, 1983), and the Test of Visual-Motor Integration (Beery, 1989), do not, in their standardized format, allow for notations of problems with quality of performance or do not specifically assist the therapist in delineating the areas that contribute to the child's problem. Developmental tests have similar limitations in terms of providing information useful to occupational therapists regarding the quality of children's fine motor skills.

An outcome of this frustration with standardized tests is that many therapists develop checklists that lack normative data and usually have not had studies of their reliability or validity. Another strategy used is modification of a standardized test so that it can be administered to a child with a disability. Obviously, when this strategy is used a standardized test has not been given to the child, and data cannot be interpreted according to the published scoring standards. To meet their needs for assessment of the quality of the child's performance, therapists typically make notations during testing regarding the child's difficulties and the factors that apparently affect the child's performance. Although these types of data are important and helpful, relying only on narrative descriptions of the quality of a child's performance can present difficulties when a child's therapist changes, as the areas commented on and the terminology used to describe the problems can vary substantially.

Standardized tests for measuring constructs important to occupational therapists in ways that are useful to occupational therapists need to be developed, and these tests need to be applicable to both clinical and research situations. Fortunately, a few tests that meet these criteria have recently been developed by occupational therapists; these tests include the Sensory Integration and Praxis Tests (Ayres, 1989), the Miller Assessment for Preschoolers (Miller, 1988), the Erhardt Developmental Praxis Assessment (Erhardt, 1982), and the DeGangi-Berk Test of Sensory Integration (Berk & DeGangi, 1983). However, none of these tests is specifically designed to measure the quality of hand function in preschool or older children who have mild motor disabilities.

Effective hand function in object handling plays a vital role in a person's ability to engage in purposeful activities, and is, therefore, a vital area for client assessment in occupational therapy. Reilly's (1962) statement that "man, through the use of his hands, as they are energized by mind and will, can influence the state of his own health" (p. 2) indicated a fundamental belief of occupational therapists that hand function is key to participa-
tion in activities that enhance or maintain health. These activities include those necessary for independent living, work, and play and leisure. When a person is impaired in use of one or both hands, adaptations in methods or equipment or both are usually needed so that he or she can perform daily life tasks independently. The greater the deficit in hand function, the more substantial the adaptations that are required to make independence in these activities possible. Even a mild disability in hand function can greatly affect a child’s performance in daily life skills.

A problem with testing (and therefore remediating) the quality of more complex fine motor skills used in object manipulation, such as those seen in children with mild motor impairment, is that such skills have received much less focus in the literature than have grasp patterns, particularly the pincer grasp. The term manipulation is often used to mean that an object is moved by the hands to carry out an activity; it could mean that the object is being moved within or between the hands or that the hands are holding an object that is moving in space. Landsmeer (1962) used the term precision handling to refer to changes in object position in the hand after grasp; these movements were described as being produced by small movements of the fingers. I have used the term in-hand manipulation to mean object movement in one hand (Exner, 1989). In-hand manipulation is the process of using movements within one hand to adjust an object for more effective object placement in that hand before use, placement, or release (Exner, 1990a); during in-hand manipulation the object remains in that hand and usually does not come in contact with a surface.

Long, Conrad, Hall, and Furler (1970) identified precision translation and precision rotation as types of precision handling. The types of in-hand manipulation I have defined (Exner, 1990b) are

1. finger-to-palm translation—moving an object from the finger pads to the palm of the hand
2. palm-to-finger translation—moving an object from the palm to the finger pads
3. shift—using the finger pads to produce a slight linear adjustment of the object
4. simple rotation—rotating an object by using the thumb in opposition to the fingers; the fingers usually act as a unit and the object is usually rotated less than 180°
5. complex rotation—rotating an object at least 180° by using differentiation of finger movements and active thumb movements.

One or more objects may be stabilized in the person’s hand during in-hand manipulation of an object (Exner, 1989, 1990a, 1990b). The ulnar fingers provide the object stabilization, and the radial fingers manipulate another object for placement or use (Exner, 1989, 1990a, 1990b).

Performance of complex fine motor tasks in an effective and efficient manner requires the use of in-hand manipulation skills, as well as the skills of mature grasp, controlled voluntary release, and integration of the hands in bilateral tasks (Exner, 1990b). Examples of daily life activities that require in-hand manipulation skills include picking up a pen and rotating it for placement in the hand before writing, holding several coins in one hand and bringing one out to the fingertips, separating thin pages in a book, and turning over a small bottle lid before placing it on a bottle.

Problems with these skills appear to contribute substantially to the difficulties encountered by children labeled as clumsy, as well as children who are identified as having greater fine motor problems due to overt neurological or muscular problems. However, before correlates of in-hand manipulation skills can be empirically assessed and before intervention strategies for children who have in-hand manipulation problems can be tested for their effectiveness, an appropriate tool for assessing these skills must be developed.

A test of in-hand manipulation skills for children would be useful for identifying children at a young age who have subtle problems that put them at risk for limitations in the more complex childhood tasks (such as learning fastener use, developing handwriting, doing craft projects). An occupational therapist who can identify such problems then can develop an intervention program that supports the child’s manipulative skill development and feelings of competence in age-appropriate fine motor activities. However, no tests of hand function for children or adults include assessment of specific in-hand manipulation skills. The Bruininks-Oseretsky Test of Motor Proficiency (Bruininks, 1978), a test for 4- to 14-year-olds, includes a substantial number of fine motor speed and dexterity tasks. These test items’ scores are based on time for task performance or for quantity of performance within a particular time period. No rating of the child’s quality of performance is made. The Rosenbusch Test of Finger Dexterity (Stein & Yerxa, 1990) is designed to test fine dexterity in adults. Speed of performance is scored, and quality is considered by rating overall performance on a scale of 1 to 3 and factoring this rating into the score. In this test, dexterity is treated as if it involves only one type of manipulative skill.

Therefore, developing a test for the assessment of in-hand manipulation skills is important. No method currently exists for determining to what degree and in what areas of in-hand manipulation a young child with fine motor problems is affected. Without a standardized test that has been carefully assessed for validity and reliability and that has norms, decisions regarding the presence and extent of problems in children of various ages and with various diagnoses cannot be made with confidence. Ultimately such a test would be useful in studying the relationship between in-hand manipulation skills and other age-appropriate skills, such as using scissors; coloring,
drawing, and writing; using fasteners on clothing; playing with toys that involve construction; and handling eating utensils. In addition, the tool may be useful in studying the relationship between manipulative skills and attention and cognitive development — areas that Ruff’s work (1986) and Piaget’s theory (Gallagher & Reid, 1981) have suggested are related.

The In-Hand Manipulation Test

To address this problem, the standardized In-Hand Manipulation Test (IMT) was developed for use by occupational therapists with preschool and young school-age children who have or are at risk of having fine motor problems. One purpose for this standardized test is to allow for more systematic assessment of this area of development. Another test purpose is to identify children who have fine motor control problems (e.g., clumsy children) versus those children who have adequate fine motor manipulative skills. In the process of developing the IMT, the tentative sequence of in-hand manipulation skill development (Exner, 1990a) can be refined.

The IMT is an individually administered test designed to assess the quality and efficiency of in-hand manipulation skills in children. Five types of in-hand manipulation are measured; each type is tested both with and without simultaneous stabilization of other materials in the hand, for a total of 10 test categories. Each type of skill is tested by more than one of the activities. Three object sizes are represented on the test: medium size (1 in. or more in one or more dimensions), small size (between 1/2 in. and 1 in.), and tiny (between 1/4 in. and 1/2 in.). The final version of the test is expected to have 50 items. The tasks on this test are those that children have been observed to complete using in-hand manipulation skills, and most were on earlier versions of the IMT. Items are repeated twice, as a single measure may not represent the child's typical performance, but more than two repetitions of each item would make the test too long for many children to tolerate.

In this test, children are told the goal of the activity (e.g., to put the lid on the bottle or the key in the lock), but not how to perform the tasks. Therefore, children who are given the test should have basic direction-following skills (e.g., building with blocks). Some children with cognitive delays that affect their ability to engage in these types of play have difficulty understanding the test's activities. Generally children aged 18 months and older are successful in completing the activities, regardless of their level of in-hand manipulation skills.

Standardized Tests and Their Development

The developer of a standardized test must carry out a number of small studies before the test can be used even in a pilot study of the test's reliability or of its construct validity; these studies are typically completed before the test is released in the form of a development edition (Gwyer, 1989). For a test to be considered standardized, specific items and instructions for administering and scoring this set of items must have been developed (Rogers, 1987). Although this aspect of test development is essential for the test to be useful in decision making, it is not sufficient (Rogers, 1987); this process provides no information about how the person performs in relation to a criterion or a norm group. A standardized test also must be considered valid and reliable for use with a particular group of persons for a specific purpose, and it should be practical to use with these persons (Rogers, 1987).

The steps in the process of developing a standardized test, before conducting construct validity, reliability, and norming studies, are:

1. Stating the test's purpose (Benson & Clark, 1982; Bonder, 1989; Crocker & Algina, 1986)
2. Completing a literature review (Benson & Clark, 1982; Bonder, 1989), to help identify aspects of the construct (Crocker & Algina, 1986)
3. Administering open-ended questions to the population for whom the test was developed (Benson & Clark, 1982)
4. Developing test objectives (Benson & Clark, 1982)
5. Preparing a table of specifications (Benson & Clark, 1982; Bonder, 1989; Crocker & Algina, 1986)
6. Developing the initial items (Benson & Clark, 1982; Bonder, 1989; Crocker & Algina, 1986)
7. Reviewing the items (Bonder, 1989; Crocker & Algina, 1986) by conducting a content validity study (Benson & Clark, 1982)
8. Conducting small pilot studies for the purpose of testing the items (Benson & Clark, 1982; Bonder, 1989; Crocker & Algina, 1986) and revising the items (Benson & Clark, 1982)
9. Conducting a formal pilot study and field test (Benson & Clark, 1982; Crocker & Algina, 1986).

This process becomes even more complex when the area being tested is one in which little research has been conducted, such as the area of object manipulation skills. Use of a qualitative rating process complicates the process of determining rater accuracy and reliability as well.

Content validity is addressed early in the instrument development process (Benson & Clark, 1982). Content validity studies address the issues of topics selected for inclusion on the test and how numbers of items are allocated to the various test categories (Cromack, 1989). These studies (as well as construct validity studies) also should address all factors that affect the test, including the test procedures, setting, examiner personal characteristics and techniques that may affect the examinee, and the influence of the examinee's perceptions of the test's...
outcome on his or her test performance (Cronbach, 1971). Test administrators can be asked to provide information orally and in writing about the test items, materials, and process (Gwyer, 1989). Revisions to the test usually are made after each pilot study is completed (Benson & Clark, 1982).

**Study Purpose**

Early stages of instrument development have been completed for the IMT. A statement of the instrument's purpose, objectives, population and test administrator criteria, the definition of terms used in the test, and a table of specifications have been reviewed by 12 occupational therapists who are experts in the area of fine motor development or development of instruments for children or both. On the basis of feedback from these reviewers, the test's table of specifications and other information about the test were revised; this revised test structure and data from previously conducted studies were used to develop the version of the test employed in the present study. However, formal review of the test's activities and items had not yet been conducted. Assessment of the IMT's content validity was an important precursor to further development of the test.

This content validity study was conducted in conjunction with a study of rater accuracy and reliability in scoring the IMT and a study of the IMT's test items. The overall purpose of this group of studies was to obtain information necessary for improving the IMT before conducting the next phase of instrument development. The study reported here was designed to assess the IMT's content, structure, rating system, and general appropriateness for measuring children's in-hand manipulation skills, based on the critiques by pediatric occupational therapists. The studies of rater accuracy and reliability and of the items are not addressed in this paper.

**Method**

**Design**

Typically, a content validity study of the items is conducted by providing a *copy of the test* to experts for their feedback. However, for the IMT, asking experts to provide feedback after seeing videotapes of the test administered seemed more appropriate. In this way they could have a clear picture of the test materials, the items, and the possible responses of children.

Occupational therapists who participated in this study viewed and rated four children's videotapes twice. After ratings of the videotapes, written and oral feedback from the raters was obtained for the content validity study.

**Subjects**

Children who had a range of fine motor skills were selected for this study. The 16 children (8 boys and 8 girls) were between 2 and 6 years of age. Four children had diagnoses that indicated developmental dyspraxia, developmental delay, or a neuromotor problem. The other 12 children were considered nondelayed on the basis of parent or teacher information, but they had Peabody Fine Motor Scale scores between $-2.33 \text{SD}$ and $+0.39 \text{SD}$. The children in this study were believed to be similar to the children for whom the test is designed.

**Raters**

Twenty-four certified occupational therapists from the Baltimore-Washington area participated in the study. To be included in the study, they had to have pediatric occupational therapy practice experience of at least 1 year, including experience in assessment of children's fine motor skills.

The following procedures were used to recruit and select the raters. The American Occupational Therapy Association was asked for mailing labels of all registered occupational therapists who noted in the last member data survey that they work with young children in their occupational therapy practice. Because therapists from the Baltimore-Washington area were needed due to the costs of transportation and overnight accommodation expenses for those living at a greater distance, zip codes were used in determining the labels to be provided. After receipt, 150 were randomly selected. A letter describing the study was mailed to each of these therapists. The therapists were asked if they met the study criteria, their length of experience in pediatrics, their prior exposure to assessing children for in-hand manipulation skills, and their willingness and ability to participate in the study on the dates set.

After the deadline passed for responding to the letter, the information from all interested participants was reviewed. These therapists were divided into groups based on amount of pediatric experience (i.e., 5 years or less, 6 to 10 years, and 11 or more years). When more than eight in any experience group had indicated a willingness to participate, random sampling was used to select the eight participants for each group. Letters were sent to those selected, and a waiting list was maintained so that an appropriate substitute could be included if a therapist withdrew. This process of recruiting volunteers was considered to be more effective for representing pediatric therapists as a group than using those who would volunteer in response to an announcement of the study.

Demographic data on the raters who participated in the study are shown in Table 1. In the category of highest degree earned, 71% ($n = 17$) had a bachelor's degree; 29% ($n = 7$) had a master's degree. Data on the highest occupational therapy degree earned showed that 83% ($n = 20$) had a bachelor's degree, 17% ($n = 4$) had a master's degree. In their previous experience with assess-
Content validity is typically assessed by recognized experts in the field being tested. However, because another purpose of this study was to determine whether therapists with a wide range of experience in assessing children's motor skills could use the scoring procedures developed for the test, having only therapists who were experts in fine motor assessment of children was deemed inappropriate. To balance both factors, a 1-year minimum of pediatric occupational therapy experience was set.

Instruments

The version of the IMT used in this study was based on earlier versions of the instrument that were used in pilot studies. Its materials and activities were

- picking up coins and placing them in a bank
- picking up chips and placing them in a container
- removing and replacing small bottle lids
- picking up and placing cubes; turning over cubes
- picking up, turning over, and placing pegs
- picking up writing tools
- putting a key into a lock
- turning pages in a magazine
- picking up playing cards

Each of the activities was scored for one or more in-hand manipulation skills, for a total of 101 items. The score assigned for each item represented the rater's judgment about the child's best performance out of the two trials. A 5-point rating scale was used in which 0 indicated that the child used no object manipulation, and 4 indicated that smooth, efficient, and complete in-hand manipulation was used. When no in-hand manipulation was used, the rater recorded the substitution pattern the child used to handle the object.

A survey was used to collect written information about the test's proposed domain specifications (see Table 2), its content and structure, the terminology used, the material and activity appropriateness for young children, the ability of the items to elicit the in-hand manipulation skills desired, and the scoring procedures. Most items had a 5-point Likert scale (from strongly disagree to strongly agree), and all had space for comments.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Characteristics of Study Raters (n = 24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of Practice</td>
<td>M</td>
</tr>
<tr>
<td>As occupational therapist</td>
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<tr>
<td>In pediatrics</td>
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</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Proposed Table of Specifications for the IMT (Non-Timed Part)</th>
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<tbody>
<tr>
<td>In-Hand Manipulation Skills</td>
<td>Total Number of Items</td>
</tr>
<tr>
<td>Finger-to-palm translation</td>
<td>10</td>
</tr>
<tr>
<td>Palm to finger translation</td>
<td>11</td>
</tr>
<tr>
<td>Skill</td>
<td>5</td>
</tr>
<tr>
<td>Simple rotation</td>
<td>12</td>
</tr>
<tr>
<td>Complex rotation</td>
<td>12</td>
</tr>
<tr>
<td>Total Test</td>
<td>50</td>
</tr>
</tbody>
</table>

Procedures

Videotape Preparation. The IMT was administered to each child while he or she sat at a table of appropriate height. A videocamera, operated by an occupational therapy graduate student, was placed directly in front of the child about 10 feet away.

I edited the videotapes so that each tape was as short as possible but contained two examples of each tested item. Although some interaction between the children and me was edited out of the tapes, a substantial amount remains. Each edited videotape is 35 to 55 min long.

Rating Workshop. A 2-day session was conducted in which the raters were informed of the study's purpose and design and, through a variety of formats, were presented with information about in-hand manipulation skills. Raters were randomly assigned to the children's videotapes according to the number of years of pediatric occupational therapy experience (0-5 years, 6-10 years, 11 or more years). Four rating sessions were held, with four videotapes shown during each session. During each rating session six raters rated each videotape of the IMT testing. These videotapes were presented as representative of the types of skills and behaviors that actually occur during testing, and included examples of manipulation skills that could not be readily classified. This introduced the issue of ambiguity into the ratings, which is typical of testing children for these skills. After rating four videotapes, each rater viewed and scored the same videotapes again. The raters were given no information about any child's condition.

At the conclusion of the rating session, the raters completed the content validity survey. Survey completion took about 30 to 45 min. The raters were then questioned orally, as a group, about the content of the test and the scoring process.

Results

Descriptive data were computed for each of the quantitative items on the content validity survey. In addition, written and oral comments about each survey area were
compiled. The data show that the raters agreed or strongly agreed with statements about the IMT’s purpose, objectives, population, test administrator criteria, and terminology used on the test. Nine of the raters commented about the population for whom the test is being developed. Some concerns were raised about using the test with children under 2 years of age, and several raters indicated a desire to see the test developed for use with children over the age of 8 years. Although the examples of terms given were noted to be helpful in clarifying the written descriptions, several raters recommended adding pictures or drawings to portray the various skills.

The mean ratings for questions about the table of specifications were between neutral and agree. Some concerns about the structure and content of the test were raised by the raters. Six raters made comments that reflect questions about the use of various in-hand manipulation skills in daily life tasks as compared with the percentages of these skills on the test.

Twelve raters indicated that medium-size objects presented difficulties for many of the children. They stated that these objects were too large for most of the children’s hand sizes to allow for object manipulation. Two raters suggested that several object sizes be used but that the sizes be modified according to the children’s hand sizes. Only one rater indicated that fewer tiny objects should be used on the test.

All items related to scoring had a mean score of agree. Overall, the raters indicated that the scoring system represents an appropriate progression of skills, has all important qualitative elements, has the appropriate number of categories, represents distinctions that can be made by therapists, and includes important substitution patterns for in-hand manipulation skills. However, 17 raters made comments about the rating system, with 8 indicating difficulties making distinctions between two scores on the rating scale or general difficulty determining the most appropriate score to assign for a particular observation. Other raters commented that recording substitution patterns used when the child did not use in-hand manipulation was difficult and may have caused other skills not to be observed. Despite these comments, only one rater indicated that the rating scale had too many categories.

Timed items were not included in the test administrations for this study. However, the raters agreed with this being added. A timed section of the test may be useful for older children or those with higher level skills and to identify those who have these skills but are abnormally slow in using them.

In terms of the final structure and length of the IMT, only 2 of the 24 raters indicated that 15 items may be too many items for young children. Using 50 ratings and two trials per item was found to be appropriate by the raters. Although the mean desired test administration time was 30 min, some raters suggested that 20 min would be better. Two indicated that perhaps a test of 15 to 20 min could be given to younger children, while the older children’s version could be 30 min.

The raters agreed that children should receive both a quality score and a time score for the test. A suggestion was to use each score, but also to have a combined score. The possibility of having a time-adjusted score for the children was raised.

Several open-ended questions requested information about the items, materials, and scoring. Ten raters indicated that they thought the test was appealing because the activities can be modified through imaginative play and therapist creativity to make them appropriate for a wide variety of children. Sixteen raters commented on the overall appeal of the activities themselves. Overall, the raters found the test materials and tasks to be gender neutral and age appropriate.

As a general check of face validity, raters were asked to indicate which items did not seem to elicit the desired skills spontaneously. Concerns were raised by six raters about the use of the medium-sized pegs for palm-to-finger translation, particularly with stabilization. Three indicated that movements of the tiny pegs were difficult to view on the videotapes; therefore, they were unsure as to whether or not these elicited the desired skills. The items with the lock and key(s) were reported by five raters as being either difficult to score or ineffective in eliciting the desired skills. One-inch cubes were noted by nine raters to present problems in eliciting finger-to-palm translation skills. Three of the items designed to elicit shift were frequently identified as not eliciting this skill. In the discussion session, suggestions were made for items that may test shift in children more easily.

Several items or materials were identified as being difficult to score. The materials included the lock and key (13 raters), tiny pegs (4 raters), medium-sized pegs (4 raters), blocks (4 raters), and bottle lids (3 raters). Activities that presented scoring problems were turning book pages (6 raters), taking crayons from and putting them in the box (3 raters), and picking up cards (4 raters). Five raters commented on difficulty scoring items in which the child had two or more objects in the hand at one time. The items in which raters were required to score several movements based on one observation of the child’s performance were reported as difficult by 6 raters. Shift, as a general category, was reported to be difficult to score by 5 raters.

In another open-ended question, raters identified items that they found to be relatively easy to score. Specific items identified as fitting in this category were the chips/money (12 raters), picking up the writing tools (8 raters), the blocks (13 raters), the pegs (9 raters), and the bottle lids (6 raters).

When asked about their overall comfort level in rating the videotapes, 11 raters indicated that although they had initial difficulty, by the end of the session they were feeling at least moderately comfortable in their ability to
make rating decisions. Eight noted that they still felt fairly uncomfortable during the last several ratings. Two stated that they felt it would be easier to score in person than it was from videotapes.

Sixteen of the 24 raters indicated that they did not believe they would have difficulty administering this test. Several raters commented that the test would be fun to give, partly because of the imaginative component and the ability to vary item wording to accommodate the child's level and interests.

The raters were asked to make suggestions about training procedures for occupational therapists who would be learning to administer and score the test. Twenty indicated a need for a videotape to accompany a test manual. A suggestion was made for this tape to show in-hand manipulation skills in slow motion. Six stated that a workshop or training course would also be helpful. Hands-on practice sessions were recommended by three raters.

Discussion

Overall, the IMT's content validity is supported by the feedback from the raters. Few raters raised concerns about the fundamental purpose or objectives of the test. The lower (15 months) and upper (8 years 11 months) age limits for the test were questioned by a few raters, but other population characteristics were found to be acceptable.

The proposed final test length of 50 items with two trials per item was considered acceptable, provided that the test takes no longer than 20 to 30 min to administer. The table of specifications was found to be generally acceptable, but some issues related to functional validity of some skills or the proportions of in-hand manipulation skills were raised. Such issues are appropriate concerns, particularly when the area being tested is a newly defined one. In the literature and in clinical practice, manipulation has been addressed as a general skill rather than one that comprises a number of skills. The IMT is designed to discriminate among and test the various component skills that seem to contribute to overall manipulative skill. As with the development of all tests, it is important to consider the proportion of emphasis placed on various skills in functional situations in planning the test's structure. However, to discriminate skill competence effectively, a test may need to give more weight to difficult skills that are used less frequently than easier skills that are used more often. Criterion-related and construct validity studies will be important for determining the final balance of the IMT's items.

The raters were very favorable about the approach used in presenting activities to the children for this test. Imaginative play with materials can be varied according to the particular child's developmental level and interests. During the test administrations, the children were noted to enjoy the activities and only became restless with repetition of tasks in which materials varied in size but not in activity goal. Although the younger 2-year-olds who are nondelayed completed the entire test, alternative tasks may need to be developed for young children who have lower cognitive skills. The children tested for this study were almost always successful in task completion (regardless of the manipulation strategies they used) and seemed to enjoy the activities. It seems feasible to vary the imaginative components of the activities, thereby using the occupational therapy principle of engaging the child in the activity process, while not interfering with assessment of the child's manipulative skills. The child focuses on the outcome of the activity and the play involved, while the therapist assesses the quality of the motor processes used to complete the task.

Many raters indicated concern about the ability of some materials to elicit certain skills. The concerns fell into the categories of object size (some objects seemed too large for the youngest children), tasks in which the rater was to score two or more skills based on one observation, and the materials used for shift items. Despite the difficulties noted with some materials, only three of the test materials were not listed as "easy to score." Therefore, the materials seem to be appropriate, although item size and presentation may need to be modified.

Issues related to the test's rating scale were a major impetus for this study. In general, the raters were positive about the content and structure of the rating scale. However, one third of the raters reported that making distinctions when doing the ratings was difficult. It is interesting to note that the raters generally did not comment about difficulty distinguishing between ratings for "nearly complete or complete but slow manipulation" and "smooth, quick, and complete in-hand manipulation." Their concerns were more often with distinctions between "no manipulation" and "assisted manipulation" (use of a support surface or body part) or between "assisted manipulation" and "beginning or partial in-hand manipulation." Suggestions for combining two of the scores were made; if this were done the rating scale would have 4 points (0-3). The most appropriate combination is "assisted manipulation" with "beginning manipulation."

Concerns about scoring were also reflected in the raters' responses to a question about their comfort level in scoring the tapes. Several raters reported reasonable comfort after the first four ratings were completed, and almost half of them reported reasonable comfort by the end of the eight ratings. Although some of the other raters indicated that comfort varied with the items, about one third indicated generalized discomfort. This discomfort may be seen in other therapists who would use the test, or it could be related to the fact that these raters knew their scores would be checked against other raters' scores.

The raters supported the recommendation that test
administrators should be occupational therapists who have obtained high agreement with scoring three children by videotape and who have administered the test to at least 10 nondelayed children. Most indicated that they did not believe the test would be difficult for them to learn to give.

Conclusion

Further development of the IMT seems warranted. The raters noted the importance of the test for identifying problems in children whom they assess. Some of the items that were identified as having problems will be omitted, and others will be added, particularly in the category of shift. On the basis of the raters' comments, some changes in the materials and methods of presentation for some activities will occur. Reducing the number of points on the rating scale from five to four will retain most of the qualitative aspects of scoring but should enable raters to be more accurate and more confident in making scoring decisions quickly. Finally, training for administering and scoring the test will incorporate the recommendations for written and audiovisual supports and for test administration practice.

The next measurement study with the IMT will be a generalizability study in which therapists administer the tests twice to nondelayed and developmentally delayed children and score during both test administrations. This design will allow for item and internal consistency analyses and assessment of interrater and test-retest reliability. In addition, these data will be used to begin to assess the ability of the IMT to discriminate between children of different ages and those with and without fine motor problems. Feedback from the therapists who participate in the study will be collected, and older children may be surveyed to obtain information about their impressions of the test activities.

In summary, the next step in instrument development follows the sequence outlined by Benson and Clark (1982) in that the present study’s data are used to make revisions in the test, and another study that focuses on basic reliability and validity issues is conducted before normative data collection. Formal construct validity studies will also be needed before distribution of a development edition of the IMT.

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