
Development of an Assessment for Ideational Praxis

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KEY WORDS

- ideational praxis
- pediatric
- praxis
- sensory integration
- sensory processing
- Test of Ideational Praxis (TIP)

OBJECTIVE. This study developed an assessment of ideational praxis, examined its psychometric properties, and analyzed age and gender trends in children who were typically developing.

METHOD. Part 1 developed items and scoring criteria of the Test of Ideational Praxis (TIP) and examined interrater reliability and internal consistency. Part 2 studied performance of 80 typically developing children between ages 5 and 8 years.

RESULTS. The TIP demonstrated acceptable interrater reliability (ICC = .85) and internal consistency (coefficient alpha = .74). Children who were typically developing demonstrated age and gender trends. Girls scored higher than boys, and older children scored higher than younger children.

CONCLUSION. The TIP is the first objective assessment for identification of ideational abilities and is a reliable assessment tool. Further research is needed to validate the construct of ideation and examine the TIP's ability to discriminate between children with and without ideational difficulties.

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Praxis is a theoretical concept that describes a process of action performance and motor skills development. Ayres (1985) conceptualized *praxis* as a process that involves conceptualization or ideation, planning, and execution of a motor act. She emphasized that ideation or conceptualization is a cognitive function dependent in part on the integration of sensory inputs and resultant knowledge of possible body actions. She stated that a child's knowledge of objects and their potential uses developed out of the use of the body in purposeful activity with the objects. Ayres (1985) further noted that some children with dyspraxia were unable to interact effectively with objects or their environment because they did not have the "idea" of what to do or how to do it. Occupational therapists using a sensory integrative frame of reference have confirmed that when presented with a novel object (e.g., a scooter board), some children with dyspraxia do not seem to know how to interact appropriately with it. However, there is little objective information on children's ideational abilities. An operational definition of ideational praxis in children has not been established nor has a means for assessing a child's ideation or self-generated interactions with objects or the environment.

Roy (Roy, Elliot, Dewey, & Square-Storer, 1990; Roy & Square, 1985) proposed a typology of adult apraxia that involved deficits in the production and conceptual processes of praxis and that specified how object use was related to ideation and conceptualization. *Production apraxia* involved a deficit in planning and executing the motor act. *Conceptual apraxia* involved a primary apraxia (a deficit of spatial understanding of actions) and a secondary apraxia (a deficit of sequencing and organization of the components of a gestalt plan). Conceptual praxis required knowledge of object properties that could be acted on and

knowledge of actions that could be used with the various object properties, as well as knowledge of the serial order of actions needed to interact with objects appropriately (e.g., knowing to fold a letter, put it in an envelope, seal the envelope). Roy's work on conceptual apraxia was influenced by Gibson's (1977) theory of object affordances, which proposed that objects in the environment present affordances or object-specific qualities that invite interaction. Thus, in adults, ideational or conceptual difficulties are believed to be related to deficits in the ability to recognize object qualities and the appropriate actions that may be used with those objects.

Gibson's (1977) work also has guided considerable research on object interactions with infants and young children. The ability to act on object affordances through actions such as banging, squeezing, and feeling has characterized young children's exploratory behavior (Gibson, 1982; Rochat, 1989). Leeuwen, Smitsman, and Leeuwen (1994) found that older children demonstrated the ability to perceive and act on the affordances of tools. In addition, Ayres (1985) specified a key role of the environment in her conceptualization of ideation. She stated that "praxis is expressed in a manner which is dependent upon the environmental invitation and demand. Praxis is context dependent and the physical environment elicits and determines the idea and the motor plan" (p. 6). Lastly, Cermak (1985) likened Roy's (Roy et al., 1990; Roy & Square, 1985) conceptual apraxias to ideation and motor planning deficits and production apraxia to execution problems in children with dyspraxia to relate conceptualization—as defined in adult apraxia—to object use, actions, and praxis in children's ideation and object interactions.

Observations of children's actions may therefore be a means to determine their ability to recognize object affordances and to identify their ideational abilities. A model of ideation that specifies that ideation ability (or ideational praxis) requires a knowledge of objects and appropriate actions for objects to recognize and act on object affordances was created by the first author (May-Benson, 2001). This model was then used to develop the Test of Ideational Praxis (TIP), an objective assessment of ideational abilities in children. The purpose of this study is to describe the development of this test of ideational praxis and the performance on the TIP of children who are typically developing.

Specifically, this study addresses the following questions:

- Does the TIP show acceptable interrater reliability?
- Does the TIP have acceptable internal consistency?
- What is the performance of children who are typically developing on the TIP across age and gender?

Method

Part 1: Development and Psychometric Properties of the TIP

The TIP was developed through a sequence of recommended steps (Ebel & Frisbie, 1990). Test development involved (a) identification of the need for an assessment of the ideational aspect of praxis, (b) definition and operationalization of the construct of ideation, and (c) initial construction and pilot testing of a formal test of ideation.

Test item development. The initial test conceptualization and possible test items were based on the ideation model developed by the first author (May-Benson, 2001). Initial test-item development and exploration of possible language for item directions occurred in three rounds of testing and feedback with small groups of children who were typically developing and children with dyspraxia. Review and discussion of items, language, and directions with expert occupational therapists and a research support group resulted in refinement of the assessment and completion of a final pilot version of the TIP.

Instrumentation of the TIP. The TIP assesses a child's ideational skills based on his or her ability to demonstrate recognition of object affordances. The child is presented with a series of 6 objects and asked to show the examiner all the things he or she can think of to do with the object within a 5-min time limit for each item. Four items (a hoop, a string, a tube, and a box) are presented individually, and two items (a string and tube; a box and rope) are presented in combination (see Table 1). The child's responses are videotaped and scored later.

Scoring criteria development. Scoring criteria for the TIP were based on an analysis of the object–action affordances provided by each test object or combination of objects. An

Table 1. Test Items on the Test of Ideational Praxis

Item	Description
Hoop	One rigid plastic hoop, 16 inches in diameter.
String	One round, heavyweight shoelace, 24 inches long.
Tube	One cardboard tube 9 inches in length, with 2 small notches cut opposite each other at each end of the tube and 2 holes approximately $\frac{1}{4}$ inch in diameter cut opposite each other in the middle of the tube, with 4 small holes cut around one edge.
String/Tube	The string and tube described above presented together.
Box	One tri-wall box 24 inches square, an 18-inch-diameter circle cut in one side, an 18-inch arch cut in 2 opposite sides, and 6 circles (each 3 inches in diameter) in 2 rows of 3 cut into the center of the 4th side. A small hook is placed above the 2 rows of small circles. The 4th side of the box is left open.
Box/Rope	The box above presented with 1 clothesline-weight rope, 3 feet long, with a 2-inch loop at one end.

initial list of affordances for each object or item on the test, operationalized definitions of scoring criteria, and the scoring form were refined and modified based on two rounds of expert clinician review and preliminary pilot testing. In the final protocol, the child's interactions with each object or set of objects were scored on his or her ability to indicate perception of the object's various affordances through actions. (See Table 2 for sample scoring criteria. The complete protocol is available from the first author.)

Children were instructed to "show me everything you can do with this object" for single items and to "show me everything you can do with these two things together" for multiple items. The child received credit when he or she demonstrated an affordance with the object, either through the intent to perform an action (e.g., the child attempts to put the tip of the string into the hole of the tube but does not get it through) or the actual performance of an action (e.g., the child puts the string through the hole in the tube). Neither quality of motor planning nor execution influenced scoring. Actions that were deliberate but not necessarily completely conscious were given credit (e.g., the child who is "thinking" of things to do with the hoop and begins to swing it back and forth in his hands).

No credit was given for accidental actions (e.g., a child swings a hoop on his arm and it flies off due to lack of control). Because the TIP assesses the ability to generate ideas for object interaction and not verbal creativity, no credit

was given if the child talked about an action and did not make some attempt to initiate the desired action (e.g., a child says that she could tie the string on her leg but just stands there). In this case the child was encouraged to "show me what you can do."

Variations in actions specific to a particular object affordance were also recorded (e.g., the child receives individual credit for twirling the hoop with the left hand, right hand, foot, and neck). Several scoring methods were examined initially that considered the child's ability to produce variations on actions or a variety of different affordances. However, the total number of actions (sum of scores from each of the six items) the child performed that demonstrated recognition of object affordances was found to have the greatest discriminative ability and thus was identified as the preferred scoring method (May-Benson, 2000). This method emphasized the total number of ways in which the child interacted with the objects.

Interrater Reliability

Procedures. Before initiating the reliability study, the first author and two other occupational therapists were trained to refine the scoring criteria and reach consensus on the final criteria. One of the two trained raters and the first author then independently scored 10 children (5 boys, 5 girls), ages 4–8 years, who were typically developing.

Results. Interrater reliability was examined for the total scores and individual item scores using the intraclass correlation coefficient (ICC), (2,1) (Shrout & Fleiss, 1979). Adequate interrater reliability was found for the total test score (ICC = .85) and 5 of 6 test items (i.e., Hoop, .80; String, .87; Tube, .83; String and Tube, .96; and Box, .89). The Box and Rope item (ICC = .43) had low reliability, possibly due to little variance in the data.

Internal Consistency

Procedure. Thirteen children who were typically developing (including the 10 interrater children) and 1 child with suspected ideational difficulties were videotaped and rated by the primary researcher.

Results. The TIP showed acceptable internal consistency, with a Cronbach's alpha of .74. Results indicated that all items contributed approximately the same to the total score because the overall alpha level did not change significantly with removal of any one item. The individual-item-to-total correlations (Hoop, $r = .65$, $\alpha = .66$; String, $r = .43$, $\alpha = .72$; Tube, $r = .62$, $\alpha = .67$; String and Tube, $r = .44$, $\alpha = .72$; Box, $r = .36$, $\alpha = .74$; Box and Rope, $r = .41$, $\alpha = .73$) were generally lower than desired, most likely due to the small sample size and high variability among items.

Table 2. Sample Scoring Criteria for the TIP Box Item

Affordance	Operational Definition
Bang/Kick-able	Child bangs or drums on any portion of box or kicks box in any manner.
Carry-able	Child carries box 3 or more steps, not just picks up and stumbles with weight.
Climb-on-able	Child climbs on box so all 4 limbs are in contact with box's upper surface (i.e., on all fours).
Go in-able	Child crawls in or out of box through circular hole (only credit once), or child goes in or out of box through arches in box (give separate credit if child goes straight through box from one arch to another or in/out arch and circle).
Hide/Sit/Stand-in-able	Child sits or stands in box with box in any position. Walking through upside-down box may be a variation.
Jump-off-able	Child jumps off solid top of box. No credit for just getting off box.
Push/Pull-able	Child pushes, pulls, or slides box with box in any position; credit pushing box over to a new position as Turn-able.
Put body part in holes-able	Child puts any body part through any hole; for example, child puts hands through small holes or sticks head out of large hole without going through it.
Put on head-able	Child places box over head while in any position, usually standing.
Sit/Stand-on-able	Child stands or sits on solid top of box. Feet may touch the ground.

Note. TIP = Test of Ideational Praxis.

Part 2: Performance of Typically Developing Children on the TIP

Participants. Eighty-four children who were typically developing (42 boys, 42 girls), between ages 5 and 8 years, were recruited. Fifty-nine children were obtained through a sample of convenience and 25 from a local school system. The group consisted of 63 Caucasian, 7 Asian, 4 African-American, and 5 Middle Eastern children, and 1 Eastern European child, with ethnicity distribution approximately equal between genders. All children were in a regular education classroom, had not received or been evaluated for motor or educational problems, were on no medications for attention or behavioral problems, had no current or past major medical problems, had no identified or suspected sensorimotor problems, and received no support services.

Procedure. Informed consent was obtained, and parents of all participants completed a screening form of medical, diagnostic, and service information to assure the child's eligibility. All children were tested with the TIP at the child's school or home or at a private occupational therapy clinic. Total testing time was approximately 35 min. The child's performance was videotaped and scored at a later time by a trained research assistant.

Results. Means and standard deviations were computed for each Age by Gender (Age \times Gender) group. Exploratory stem-and-leaf and box plots were generated, resulting in identification of four outliers (e.g., more than 3 standard deviations from the mean for their age group) across the various age and gender groups. Outliers were eliminated from further analyses, leaving a final study group of 80 children with 10 in each Age by Gender group. Means and standard deviations were then recalculated for each Age by Gender group (see Table 3). Homogeneity of the groups was confirmed with Levene's Test of Equality of Error Variance, $F(7, 72) = 1.432, p = .206$.

Two-way analysis of variance (ANOVA) found a significant main effect of Gender— $F(1, 72) = 6.399, p = .014$ —with girls scoring higher than boys, and a significant main effect of Age— $F(3, 72) = 6.024, p = .001$ —with older children scoring higher than younger children. There was no significant Age by Gender interaction, $F(3, 72) = .765, p =$

.517. Post hoc *t* tests using a Bonferroni correction found significant differences between the 5-year-old and 7-year-old groups ($p = .012$), and between the 5-year-old and 8-year-old groups ($p = .004$). No other differences were found. A linear age trend was suggested by the mean scores and confirmed with contrast analysis for both boys, $F(1, 36) = 9.15, p = .004$, and girls, $F(1, 36) = 7.60, p = .008$.

Because no significant differences existed between the 7-year-olds and 8-year-olds, these two age groups were combined, keeping boys and girls separate. The standard scores and rank order of individual children were not affected by combining the two ages in either of these groups. Scores for 5- and 6-year-olds also showed no significant differences between these two age groups for either gender. However, when these two ages were combined for each gender, the standard scores assigned to individuals varied by as much as half a standard deviation for the boys. This variation resulted in nearly half of the combined group being assigned a different standard score or rank order than they were when the groups were not combined. The scores of the younger girls were not affected by combining the ages. Based on these results, we decided to keep the 5-year-old and 6-year-old age groups separate and standard scores were determined for each of these age groups. Means and standard deviations were recalculated for the new age groupings (see Table 3). The homogeneity of these Age by Gender groups was confirmed with Levene's Test of Equality of Error Variance, $F(5, 74) = 1.737, p = .137$.

Two-way ANOVA confirmed that the significant main effects of the differences between Gender, $F(1, 74) = 5.715, p = .019$, and Age, $F(2, 74) = 9.215, p = .000$, remained after combining groups and that there was still no significant Age by Gender interaction, $F(2, 74) = 1.177, p = .314$. Post hoc *t* tests with a Bonferroni correction on the revised age groupings showed no significant difference between the 5-year-olds and 6-year-olds ($p = 1.00$). Significant differences were found between the combined 7-year-old and 8-year-old group when compared with the 5-year-old group ($p = .001$) and when the combined 7-year-old and 8-year-old group was compared with the 6-year-old group ($p = .014$). After these analyses, raw scores for each final Age by Gender group were converted to standard *z* scores. The standard *z* scores for each group were then converted to scaled scores with a mean of 10 and a standard deviation of 3. These scores were then available for use in further applications to examine the validity of the TIP.

Discussion

Investigation of ideational abilities related to motor performance in children has been hampered by the absence of a

Table 3. Means and Standard Deviations on the TIP by Age and Gender for Children Who Were Typically Developing

Age, Years	Boys		Girls	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
5	79.1	10.9	92.6	11.2
6	89.2	19.8	90.0	13.7
7	95.3	10.7	103.4	9.6
8	96.9	12.1	104.6	15.4
7 & 8	96.1	11.1	104.0	12.5

Note. $n = 10$ per age \times gender group, except combined groups 7 & 8 ($n = 20$); TIP = Test of Ideational Praxis.

reliable measure that can capture individual differences in abilities. The TIP was developed to address this limitation. The results of this study provide evidence that the TIP is a reliable objective assessment of a child's ability to demonstrate awareness of object affordances. Further study would be beneficial to determine the optimal number of items needed to identify individual differences and to achieve maximum interrater reliability and internal consistency. Results demonstrated that the TIP can detect developmental differences among age groups and gender. Lack of significant differences between the adjacent younger age groups is likely due to the greater variability in performance of the younger children, especially the boys. Lack of significant differences between the adjacent older age groups may be due to smaller incremental changes between older ages or may reflect a ceiling effect. Further examination of older age groups to examine these issues would be beneficial. Preliminary standard scores for the assessment are now available, but examination of a larger sample is needed to develop clinically usable normative scores.

The TIP is the first objective means to examine ideational abilities in children and presents a frame of reference for conceptualizing and assessing these skills. Further research is needed to validate the conceptualization of ideation used in the development of this assessment. Results of this study indicate that children who are typically developing demonstrate a range of ideational abilities. The relation between ideational problems and the larger construct of dyspraxia may be investigated by development of an operational definition of ideational problems and examination of these problems in relation to difficulties in other areas of motor performance. Examination of the TIP's ability to discriminate children with dyspraxia and ideational difficulties from other children with dyspraxia and peers who are typically developing, and examination of differences in motor performance among those groups, would be logical next steps in the investigation of ideational abilities in children. Additionally, further validation of the conceptualization of ideation used in this study may be accomplished by examining in more depth the relation between ideational difficulties as identified on the TIP and other cognitive, behavioral, language, and motor abilities believed to be related to ideational abilities.

For occupational therapists, this study presents an approach to conceptualizing and assessing ideational abilities in children. The TIP provides an objective means to assess ideational abilities; however, further work is needed to make it a clinically useful tool. A larger sample is needed to provide clinically useful norms, and refinement of the scoring criteria so that videotaping is not needed for scoring also would be important.

Ideational abilities are thought to be highly relevant to children's engagement in daily life activities and occupations because ideation underlies planning, sequencing, and organization of actions. Ideational abilities may influence how children engage in activities and occupations in novel environments or unstructured situations. Children's behavioral responses, attention, play skills, and independence in activities are all functional aspects that may be influenced by difficulties with ideational abilities. Examination of the relationship between ideational abilities and aspects of children's daily life functioning is necessary to increase the occupational therapist's knowledge about how ideational praxis develops and how problems in that development contribute to the important aspect of children's occupational engagement: that of knowing how one comes up with ideas for activities. This study contributes to this knowledge through the clinical assessment of ideational praxis and thus contributes to occupation-based practice through increased information on children's ideation. This information will facilitate the occupational therapist's ability to identify and understand ideational deficits in children with dyspraxia and provide a foundation for development of appropriate and effective intervention methods for this problem. ▲

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