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Pediatric Arm Function Test:

Reliability and Validity for Assessing More-Affected Arm Motor Capacity in Children with Cerebral Palsy

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Abstract

Objective—Although there are several validated upper-extremity measures in young children with cerebral palsy (CP), none primarily assess capacity to carry out actions and tasks with the more-affected arm. To address this need, we developed the Pediatric Arm Function Test (PAFT), which involves behavioral observation of how children use their more-affected arm during structured play in the laboratory or clinic. This paper evaluates the reliability and validity of the PAFT Functional Ability scale.

Design—In Study 1, 20 children between 2–8 years with a wide range of upper-extremity hemiparesis due to CP completed the PAFT on two occasions separated by three weeks. In Study 2, 41 children between 2–6 years with similar characteristics completed the PAFT and received a grade reflecting severity of more-affected arm motor impairment.

Results—In Study 1, the PAFT test-retest reliability correlation coefficient was 0.74. In Study 2, convergent validity was supported by a strong, inverse correlation ($r = -0.6$, $p < .001$) between PAFT scores and grade of impairment.

Conclusions—The PAFT Functional Ability scale is a reliable and valid measure of more-affected arm motor capacity in children with CP between 2–6 years. It can be employed to measure upper-extremity neurorehabilitation outcome.

Keywords

Upper Extremity; Function; Assessment; Cerebral Palsy

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Approximately one-third of children with hemiparesis due to cerebral palsy (CP) exhibit motor deficits in their more-affected arm.^{1, 2} Although several measures of upper-extremity function in young children with CP are available,³ there are no validated instruments that primarily assess capacity to complete actions and tasks with the more-affected arm. The Pediatric Arm Function Test (PAFT)⁴ was developed to evaluate this aspect of arm function in 2–12 year olds.

The International Classification of Function (ICF)⁵ outlines three domains of function for assessment: anatomy and physiology (i.e., body function and structure); execution of actions and tasks (i.e., activity); and fulfilling social roles (i.e., participation). Furthermore, within the domain of activity, the ICF stresses separately evaluating *capacity*, what a person can do when tested in a standardized environment without assistance from others or devices, and *performance*, what a person actually does in their everyday environment.

In adult neurorehabilitation, a strong emphasis has been placed in the last decade on measuring limitations in activity, as opposed to impairments in body structure and function (e.g., restricted range of motion or spasticity). This has been spurred by considerably more empirical support for therapeutic approaches that emphasize training on tasks, such as Constraint-Induced Movement therapy (CIMT),^{6, 7} than for approaches that emphasize training movements.⁸ Parallel developments in pediatric neurorehabilitation⁹ have led to a similar emphasis on measuring limitations in activity, i.e., deficits in executing actions and tasks.

A recent review of measures of this domain in children with congenital hemiplegia identifies three reliable and valid tests of more-affected arm motor *capacity*.³ However, only a minority of items on these tests assess limitations in capacity in the activity domain: Melbourne Assessment of Unilateral Upper Limb Function (MUUL),¹⁰ 46%;³ Quality of Upper Extremity Skills Test,¹¹ 35%;³ Shriners Hospital Upper Extremity Evaluation (SHUEE) Dynamic Positional Assessment component,¹² 0%. The majority of items assesses impairment in the body structure and function domain. The SHUEE Spontaneous Functional Assessment component,¹² Assisting Hand Assessment,¹³ and ABILHAND-Kids¹⁴ have evidence of reliability and validity *and* a preponderance of items that assess limitations in the activity domain (> 81%).³ These tests, however, assess motor *performance*, i.e., what children actually do in daily life, rather than capacity. Other widely used tests that have upper-extremity components measure performance in the activity domain regardless of which arm is used (e.g., Pediatric Evaluation of Disability Inventory [PEDI] Functional Skills scale)¹⁵ or assess how much assistance is needed from others (e.g., PEDI Caregiver Assistance scale,¹⁵ WeeFIM¹⁶).

Thus, there are no validated instruments that primarily measure the capacity of young children with CP to complete actions and tasks independently with the more-affected arm. Such an instrument would permit researchers to test whether new and accepted interventions for the upper-extremity in children with CP produce changes in this critical domain and to examine the contribution of changes in this domain to changes in everyday performance and participation in social roles. Clinicians who care for children with CP would gain a tool for monitoring progress on building capacity to complete actions and tasks with the more-affected arm and for identifying strengths and weaknesses in this domain for the purpose of treatment planning.

To address this need, this paper presents two studies examining the measurement characteristics of the PAFT Functionality Ability scale. The PAFT is a behavioral observation system set in the laboratory or clinic that contains both unilateral and bilateral upper-extremity actions and tasks in the context of structured play. The Functional Ability

scale is used by masked raters, who score the PAFT from video, to quantify how effectively a child uses his or her more-affected arm to carry out each item on the test. Study 1 evaluates the test-retest reliability and stability of the PAFT Functional Ability scale after removing items deemed poor by an item analysis. Study 2 evaluates the convergent validity of the streamlined test with an index of the severity of more-affected arm motor impairment in a separate sample. Study 2 also determines the responsiveness of the streamlined test to change in more-affected arm motor capacity.

STUDY 1: METHODS

Participants

Twenty-one children between 2–8 years were enrolled with a wide range of severity of upper-extremity hemiparesis due to CP. Table 1 lists eligibility criteria and recruitment procedures. Table 2 summarizes participants' characteristics. In both this study and Study 2, informed consent was received from the legal guardians of all the participants; study procedures were approved by our Institutional Review Board.

Measures

The PAFT is a behavioral observation system that quantifies more-affected arm function of children with upper-extremity hemiparesis from video of structured play in the treatment setting. It is a substantially modified homologue of the Toddler Arm Use Test (TAUT).¹⁷ The TAUT items were generated by identifying unimanual activities commonly undertaken by 2–8 years olds and selecting 22 so that distal and proximal arm movement and different types of grasp were demanded.¹⁷ Based on experience using the TAUT to evaluate pediatric CIMT,¹⁷ bimanual activities were added when developing the PAFT. In addition, the variety of unilateral activities was increased to demand arm movement in different planes and during different postures, e.g., sitting vs. standing.⁴ Because the item rating scheme for the TAUT proved cumbersome, the Willingness and Amount of Participation scales were dropped, and the How Well scale was replaced with the Functional Ability scale from the Wolf Motor Function Test (WMFT).^{18, 19} This scale, however, was modified so that appropriate use of both arms during bimanual activities, which are absent from the WMFT, would not be penalized.

Table 3 lists the 17 unilateral and 9 bilateral upper-extremity items embedded within a PAFT play session. All 26 items are presented first in a fixed order with no cues given about which arm to employ. On Item 1, for example, the tester positions a ball 6 inches directly above children's heads and says "Touch the ball." The tester then revisits any items that children do not attempt with more-affected arm. The tester now explicitly asks children to use the more-affected arm for the unilateral items and both arms for the bilateral items. If children still do not attempt to use the more-affected arm, the tester asks children to carry out the item again with the same directive to use the more-affected arm. The tester is now allowed to physically restrain the less-affected arm.

After the testing session, trained, masked raters evaluate more-affected arm motor *capacity* item by item from video using the Functional Ability scale (Table 4). The Functional Ability subtotal score for unimanual items is the sum of the first administration scores from Items 1–17 that are only administered once plus the sum of the final administration scores from Items 1–17 that are administered more than once all divided by the number of Items 1–17 actually tested. The subtotal for bilateral items is calculated in the same way for Items 18–26. The Functional Ability total score is the average of the unilateral and bilateral subtotal scores. This quantity was chosen, rather than the average of all the items, to give scores from the unilateral and bilateral sections equal weight.

An index of more-affected arm motor *performance* is also derived from the raters' scores. The Limb Preference total score is the percentage of eight unilateral items (i.e., Items 1–4, 7, 12, 15, and 16) that are attempted with the more-affected arm on the first administration (i.e., Functional Ability score > 0). The other unilateral items are excluded because they have poor item-total correlation or test-retest reliability coefficients (i.e., values < .3) with respect to this index.²⁰ Only tasks from unilateral portion of the test are counted because bilateral activities implicitly constrain children to use the more-affected arm. Only first administration scores are counted because children do not receive prompts about which arm to use. As such, children's spontaneous choices about whether to use their more-affected arm are thought to reflect how much they actually use that arm in daily life. The reliability and validity of the Limb Preference score are reported elsewhere.²¹ Instructions for administering, videotaping, and scoring the PAFT are available online.²⁰

Procedure

The PAFT was administered on two occasions (Test 1, Test 2) separated by approximately 3 weeks. Although no treatment was provided by the study, children were permitted to receive customary care, which ranged from no physical rehabilitation to two hours per week of outpatient physical rehabilitation. The maximum amount of upper-extremity rehabilitation was one hour per week. Such treatment has been shown previously not to affect more-affected arm motor capacity in children with CP.^{4, 17} The PAFT, which typically took 30 minutes, was carried out by pairs of pediatric occupational therapists (OTs). One administered the tasks, while the other controlled the camera and recorded data. Testers had approximately 7 hours of training; they read the manual, shadowed an experienced tester, and conducted 2–3 supervised tests. Testing was done in a private treatment room in an outpatient rehabilitation clinic.

After testing, the children's more-affected arm Functional Ability was scored from video by one of three pediatric OTs, all of whom were masked to testing occasion. Each rater had approximately 25 hours of training; they read the test manual, scored 3 PAFT sessions *jointly* under the supervision of an experienced tester, and scored 8 sessions *independently* followed by joint review of each session under the supervision of the experienced tester. Before scoring study data, raters demonstrated high inter-rater reliability on an additional set of 10 tests (intra-class correlation [ICC]²² = .96).

To describe everyday manual ability, an OT assigned each child a Manual Ability Classification System (MACS)²³ level based on a retrospective review of the children's records. Although the MACS is done ideally by professional and family caregivers together, adequate agreement between professional and family MACS ratings (ICC, range = .73–.85) has been reported even when up to 60% of professionals' ratings were based solely on chart reviews.²⁴

Data Analysis

Item and content analyses of the PAFT were conducted. Subsequently, several statistics were calculated to evaluate the reliability and validity of the Functional Ability test score. To index internal consistency, Cronbach's α was calculated using Test 1 data. Test-retest reliability was evaluated by the ICC Type 2,1²² between Test 1 and 2 scores. Power to detect adequate levels of internal consistency and test-retest reliability, i.e., coefficients .7,²⁵ was very good (> .93).^{26, 27} Stability was evaluated by paired *t*-tests of Test 1 and 2 scores. Data from one participant who did not return for follow-up testing without giving a reason was excluded from all analyses.

STUDY 1: RESULTS

Item and Content Analysis

The item analysis (Table 3) suggested that Items 9 (Wave bye-bye), 23 (Come to sit), and 26 (Come to stand using bench) be dropped. Functional Ability scores for these items correlated weakly with the summary score for the rest of the test, indicating that these items do not assess the same parameter as the others. In addition, Item 10, which tests whether children use their more-affected arm “reflexively” to help maintain their balance when it is perturbed, was dropped because arm movement is elicited rather than being voluntary, as on all the other tasks. Item 10 was also more difficult to administer than the others.

For the remaining items, the content analysis (Table 3) indicated that all were developmentally appropriate and that all, except for Items 1–3 (Reach above head, at waist level, and across midline) were in the ICF activity domain. Finger movement was necessary for 59% of items. The breakdown for plane of arm movement in which reaching took place during each item was: straight ahead (59%), to the floor (18%), overhead (14%), midline (9%) and side (9%). The percentages add to > 100 because Item 22, putting on boots, can be done either reaching straight ahead or to the floor. Sixty-four percent of items were done in sitting, 27% in standing, and 9% in quadrupedal posture. Only Item 19 (Carry large ball) required transition from one posture to another, i.e., squat to stand.

Reliability, Stability, and Precision

After dropping Items 9, 10, 23, and 26, the internal consistency of the PAFT Functional Ability total score was high (Cronbach’s $\alpha = .96$). Test-retest reliability was adequate (ICC = .74). Furthermore, total scores did not change from one administration to another (mean change $\pm SD = 0.1 \pm 0.5$, $CI = -0.2-0.3$, $p = .51$).

For the unilateral and bilateral sections of the PAFT, Cronbach’s α values were .96 and .87, respectively, while test-retest reliability coefficients were .7 and .68, respectively. As for the total score, subtotals for these sections did not change from one administration to the other (unilateral subtotal mean change = 0.0 ± 0.5 , $CI = -0.2-0.3$, $p = .76$; bilateral subtotal mean change = 0.2 ± 0.6 , $CI = -0.1-0.5$, $p = .29$).

STUDY 2: METHODS

Participants

Participants were 41 children between 2–6 years with a wide range of severity of upper extremity hemiparesis due to CP. Their data were assembled from two clinical trials: (1) a randomized controlled trial (RCT) testing the efficacy of pediatric CIMT and (2) a dose-response trial testing the effect of reducing the duration of pediatric CIMT on the magnitude of treatment gains. The eligibility criteria and recruitment procedures for these two trials were the same; they are described in Table 1. Table 2 summarizes participants’ characteristics.

Measures, Procedure, and Data Analysis

In the RCT,⁴ 10 children received 97.5 hours of CIMT over 3 weeks: 90 hours were for more-affected arm training and 7.5 hours were for a package of behavioral techniques^{4, 7} designed to transfer training gains to daily life. The children also wore a cast on their less-affected arm to limit its use. Twelve children received customary care. In the dose-response trial, nine children received 52.5 hours of CIMT over 3 weeks, while ten received 35 hours of CIMT over 2 weeks. Two reviews conclude that the efficacy of pediatric CIMT is supported.^{28, 29}

Participants completed the PAFT before and after CIMT or customary care. Testers gave participants a “Grade” before treatment that reflected severity of more-affected arm motor impairment.⁴ Table 5 describes this grading scheme, which is based on active range of motion present at the upper-extremity joints. In addition, an OT assigned each child a MACS level, as in Study 1. PAFT administration and scoring was conducted in the same manner as Study 1. Raters, however, were masked to group assignment and Grade and MACS level in addition to testing occasion.

Convergent validity was evaluated by the Spearman correlation between PAFT Functional Ability scores and more-affected arm Grade before treatment. A strong, inverse correlation ($r = -.5$)²⁷ was predicted based on previous studies showing that severity of upper-extremity motor impairment is inversely related to capacity to carry out tasks.^{30–32} Power to test this prediction was very good ($> .93$).²⁷ Responsiveness to change was indexed by the standardized response mean (*SRM*).^{27, 33} the mean change in Functional Ability scores from pre- to post-treatment for CIMT children in the RCT divided by the *SD* of the corresponding change scores in the control children. For d' , which is a statistic similar to the *SRM*, values 0.57 are considered large.²⁷ Two controls who withdrew because of medical complications after pre-treatment testing were excluded from this analysis.

STUDY 2: RESULTS

The correlation between PAFT Functional Ability total scores and Grade was -0.6 ($p < .001$). The *SRM* for the Functional Ability total score was 0.73. For both the Functional Ability unilateral and bilateral subtotal scores, the correlation with Grade was the same as for the total score. *SRM* values for the unilateral and bilateral subtotals were 0.55 and 0.53, respectively.

OVERALL DISCUSSION

As noted in the Introduction, none of the existing measures with evidence of validity for assessing more-affected arm function in young children with CP primarily assess capacity to execute actions and tasks. This ICF domain, activity, is important because of the considerable empirical support for therapeutic approaches that emphasize training on tasks^{8, 9} and the limits that deficits in capacity to execute actions and tasks place on participation in social roles.³⁴ The content analysis in Study 1 indicates that the PAFT Functional Ability scale, excluding four items that the item analysis deems poor, has a preponderance of items that address this domain.

In addition, Study 1 indicates that the PAFT Functional Ability total score is a reliable and stable measure of more-affected arm capacity. Participants, who received little or no upper-extremity rehabilitation between testing occasions, had total scores at the second occasion that were similar in rank and absolute value to those at the first.

Study 2 indicates that the Functional Ability total score validly measures more-affected arm capacity. Total scores and severity of upper-extremity motor impairment were strongly inversely correlated. Study 2 also shows that the total score is responsive to change. The mean gain in children who received 35 hours or more of CIMT was large relative to the variability in total scores in children who received usual care, i.e., little or no upper-extremity rehabilitation.

In both Study 1 and 2, the reliability and validity of the Functional Ability subtotal scores for the unilateral and bilateral sections of the test are largely similar to those for the total score. The high Cronbach's α value for Functional Ability scores from the entire test suggest that the items, regardless of whether they are from the unilateral or bilateral section,

all assess a single underlying construct, which supports reporting the total score. Reporting the total score only is also supported by high correlations between baseline unilateral and bilateral subtotals in both Study 1 and 2 (r 's $\geq .8$, p 's $< .001$). The unilateral and bilateral section subtotal scores might be of interest in special cases, such as evaluating the effects on bilateral function of an intervention that only trains more-affected arm function.

Study Limitations

Limitations are study samples too small to permit sub-analyses by age or gender, exclusion of participants > 6 years in Study 2, and demonstration of convergent validity with the classification system used rather than an established measure. With regard to age, the PAFT is thought to be appropriate up to twelve years. For older children, whose activities are not that different from adults, the WMFT^{18, 19} would be appropriate. With regard to the convergent measure, the MACS was not selected because it assesses how well a child handles objects *regardless* of which arm is used. Thus, MACS ratings can reflect how well the child uses the more-affected arm, less-affected arm, or both in coordination.²³ Given this indirect relationship with more-affected arm function, it was not surprising that the association of the PAFT with the MACS was significant ($r = -.44$, $p = .001$) but less strong than with the classification system used as the convergent measure, i.e., grade of more-affected arm impairment. Future studies might correlate the PAFT with an established measure such as the MUUL.¹⁰

OVERALL CONCLUSIONS

Studies 1 and 2 support the reliability and validity of the PAFT Functional Ability scale for measuring the capacity of children between 2–6 years with upper-extremity hemiparesis due to CP to complete actions and tasks with their more-affected arm. Researchers might use the Functional Ability scale to quantify more-affected arm motor status in children with CP or other conditions with similar upper-extremity sequelae in the above age range. Collection of such data would permit examination of the relationship between capacity to complete actions and tasks with the more-affected arm and actual use of that capacity in everyday life, for example. Researchers might also use the PAFT to document changes in motor status after upper-extremity pediatric neurorehabilitation. Collection of this type of data would permit evaluation of the effect of new and accepted interventions for children with asymmetric upper-extremity motor impairment on capacity to perform actions and tasks with the more-affected arm. In addition to documenting changes after treatment, clinicians might use the PAFT to assist with treatment planning. Activities on which children show limited capacity before treatment might be targeted for training.

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TABLE 1**Inclusion and exclusion criteria and recruitment procedures for Study 1 and 2**

STUDY 1
<i>Inclusion Criteria:</i> between 2 and 8 years; clinical diagnosis of CP; upper-extremity hemiparesis
<i>Exclusion Criteria:</i> serious or recurring medical complications that would interfere with study participation (e.g., uncontrolled seizures)
<i>Recruitment Procedures:</i> Participants were recruited from a pediatric outpatient physical rehabilitation facility at an urban medical center in the southeastern United States. They were paid \$50 for their participation. Consecutive children who met the eligibility criteria were enrolled.
STUDY 2
<i>Inclusion Criteria:</i> between 2 and 6 years; stroke in the prenatal, perinatal, or very early antenatal period confirmed by magnetic resonance imaging; upper-extremity hemiparesis; substantial nonuse of the more-affected upper-extremity in daily life (i.e., PMAL Arm Use score < 2.5)
<i>Exclusion Criteria:</i> serious or recurring medical complications that would interfere with study participation (e.g., uncontrolled seizures); spasticity medication within the last 3 months; previous pediatric CIMT; fixed contractures in the more-affected upper-extremity (Ashworth score > 4)
<i>Recruitment Procedures:</i> Families of the children either contacted our laboratory because of their interest in CIMT or were referred by local rehabilitation professionals. Consecutive children who met the eligibility criteria were enrolled.

Abbreviations: PMAL, Pediatric Motor Activity Log;²¹ Ashworth, Modified Ashworth Scale.³⁵

TABLE 2

Demographic and more-affected arm characteristics of participants

Characteristics	Study 1 (N = 21)	Study 2 (N = 41)
Age		
Mean years $\pm$ SD	4.9 $\pm$ 1.8	3.7 $\pm$ 1.5
Range, years	2–8	2–6
Female, <i>n</i> (%)	13 (62)	25 (61)
Race, <i>n</i> (%)		
European American	15 (71)	35 (85)
African American	4 (19)	4 (10)
Other	2 (10)	2 (5)
Paresis of right side, <i>n</i> (%)	16 (76)	27 (66)
Severity of more-affected arm motor impairment, * <i>n</i> (%)		
Grade 2	NA [†]	13 (32)
Grade 3	NA	13 (32)
Grade 4	NA	11 (27)
Grade 5	NA	4 (9)
Everyday ability to handle objects regardless of arm used: MACS Level, <i>n</i> (%)		
Level I (with ease and success)	5 (24)	7 (17)
Level II (with reduced quality and/or speed but mostly successful)	10 (48)	16 (39)
Level III (with difficulty and limited success; needs help with set up)	6 (28)	18 (44)
More-affected arm capacity for completing tasks: PAFT Functional Ability scale, mean points $\pm$ SD (95% CI)		
Total score	2.7 $\pm$ 0.7 (2.4–3.0)	2.2 $\pm$ 0.7 (2.0–2.4)
Unilateral subtotal score	2.7 $\pm$ 0.7 (2.4–3.0)	2.3 $\pm$ 0.8 (2.0–2.6)
Bilateral subtotal score	2.7 $\pm$ 0.8 (2.3–3.1)	2.2 $\pm$ 0.7 (2.0–2.4)

Abbreviation: NA, not applicable.

* Testers assigned participants a “Grade” based on active range of motion available at the upper-extremity joints. Table 5 describes the scheme used.

[†] These data were not collected for Study 1.

TABLE 3

Characteristics of the PAFT items ($n = 20$)

Dimensions Classified in Content Analysis					
Item	Item-total correlation [†]	ICF Domain (code)	Finger movement required	Plane of arm Movement	Posture in which activity is done
Unilateral items					
1 Reach above head	.42	Body Function (7101)	No	Overhead	Sitting
2 Reach at waist level	.70	Body Function (7101)	No	Straight ahead	Sitting
3 Reach across midline	.67	Body Function (7101)	No	Across midline	Sitting
4 Grasp ball	.53	Activity (4452, 4450)	Yes	Straight ahead	Sitting
5 Carry ball	.84	Activity (4401, 4301)	No	Straight ahead	Standing
6 Release ball into cup	.82	Activity (4403)	Yes	Straight ahead	Standing
7 Pour ball out of cup	.80	Activity (4452, 4453)	No	To the side	Standing
8 Throw ball onto target	.74	Activity (4454)	Yes	Overhead	Standing
9 Wave bye-bye [*]	.24	Activity (3350)	No [‡]	To the side or Overhead	Standing
10 Protective extension in sitting [*]	.51	Body Function (755)	No	To the floor	Sitting
11 Isolated finger use	.65	Activity (4452, 4402)	Yes	Straight ahead	Sitting
12 Remove big-knob puzzle piece	.83	Activity (4452, 4400)	Yes	Straight ahead	Sitting
13 Crayon grasp	.76	Activity (4452, 4400)	Yes	Straight ahead	Sitting
14 Crayon use	.82	Activity (4401, 4402)	No	Across midline	Sitting
15 Grasp cracker-sized food (e.g. animal or graham cracker, saltine)	.89	Activity (4452, 4400)	Yes	Straight ahead	Sitting
16 Grasp small food item (e.g. cheerio or raisin)	.83	Activity (4452, 4453, 4450)	Yes	Straight ahead	Sitting
17 Eat with a spoon	.83	Activity (4452, 4453, 4450)	Yes	Straight ahead	Sitting
Bilateral items					
18 Separate pull-apart toy	.84	Activity (4452, 4450)	Yes	To the side	Sitting
19 Carry large ball (e.g. basketball)	.69	Activity (410, 4452, 4300, 4301)	No [‡]	To the floor	Standing
20 Throw ball into hoop	.75	Activity (415, 4454)	Yes	Straight ahead	Standing
21 Place hat on head	.72	Activity (4452, 4300, 4450)	Yes	Overhead	Sitting
22 Put on boots (using hands)	.39	Activity (4452, 4300, 4450)	Yes	Straight ahead or To the floor [‡]	Sitting
23 Come to sit [*]	.10	Activity (410)	No	To the floor	NA

Item	Dimensions Classified in Content Analysis				
	Item-total correlation [†]	ICF Domain (code)	Finger movement required	Plane of arm Movement	Posture in which activity is done
24	.47	Activity (415)	No [‡]	To the floor	Quadruped
25	.64	Activity (455)	No [‡]	To the floor	Quadruped
26	.30	Activity (410)	No	Straight ahead	NA

NOTE. For the content analysis, two pairs of pediatric OT's independently classified each item along five dimensions.

1. Following the method described by Cieza et al.,³⁶ the pairs broke up the item into the component actions being tested and assigned an ICF code to each component. The ICF Domain column reports whether the item was placed in the body functions and structure (Body Function) or activities and participation (Activity) domain and reports the codes assigned to each component action. The key³⁷ to these codes is given in the list of abbreviations for this table.
2. The pairs judged whether the item required use of the fingers to be done successfully.³⁸
3. The pairs coded the plane of movement in which reaching was required.
4. The pairs coded the posture in which the item was done.
5. The pairs judged whether the item was age appropriate. Since all items were deemed so, these ratings are not reported in the table.

Excluding Items 9, 10, 23, and 26, which were dropped on the basis of the item-analysis, agreement between the pairs of raters for classification of items along Dimension 1, i.e., Body Function vs. Activity, was 100%. For Dimensions 2, 3, 4, and 5 agreement was 86%, 95%, 100%, and 100%, respectively.

Abbreviations: NA, Not applicable; 3350, Producing body language; 410, Changing basic body position; 415, Maintaining a body position; 4300, Lifting; 4301, Carrying in the hands; 4400, Picking up; 4401, Grasping; 4402, Manipulating; 4403, Releasing; 4450, Pulling; 4452, Reaching; 4453, Turning or twisting the hands or arms; 4454, Throwing; 455, Moving around; 7101, Mobility of a single joint; 755, Involuntary movement reaction functions.

^{*}The *a priori* criterion for dropping an item was an item-total correlation < .3.²⁵ Item 10, which tests whether children use their more-affected arm "reflexively" to help maintain their balance when it is perturbed, was dropped on a *post-hoc* basis because arm movement is elicited rather than being voluntary, as on all the other tasks. Item 10 is also more difficult to administer than the others.

[†]For the item analysis, the Pearson correlation between each item and sum of the other items is reported.

[‡]Classification of items for which there was disagreement between the pairs of raters was adjudicated by authors G. U., E. T., & A. G.

TABLE 4

PAFT Functional Ability Scale

Rating	Anchor
0	<u>Not Used</u> – Does not attempt with upper extremity being tested.
1	<u>Very Poor</u> – Affected upper extremity does not participate functionally; however, an attempt is made, or the less-affected upper extremity is used to move the upper extremity being tested. <i>In bilateral tasks, the more-affected upper extremity serves as a helper but through only part of the task.</i>
2	<u>Poor</u> – Requires assistance of the less-affected upper extremity, another body part, or therapist for minor readjustments or change of position, or requires more than two attempts to complete, or accomplishes very slowly. Movement is governed by synergy. <i>In bilateral tasks, the more-affected upper extremity serves only as a helper.</i>
3	<u>Fair</u> – A moderate amount of synergy is seen, (i.e., synergistic pattern observed with some involuntary posture or movement, and or lack of control of movement, compensatory strategies with trunk/shoulder/elbows observed) or task performed somewhat slowly or with effort. <i>In unilateral tasks, does not require assistance from other upper extremity.</i>
4	<u>Good</u> – Movement is slightly slower; may lack precision, fine coordination, or fluidity, some synergy may be present, but isolation of movement is predominant.
5	<u>Normal</u> – Movement appears to be normal.

TABLE 5
Grading system for severity of more-affected arm motor impairment in children with cerebral palsy

Grade of Deficit	Shoulder	Elbow	Joint			Thumb
			Wrist	Fingers		
2 (Mild/Moderate)	WNL/mild limitation [*] in flexion or abduction	WNL/mild limitation in extension	WNL/mild limitation in extension	WNL/mild limitation in extension		WNL/mild limitation in lateral abduction
3 (Moderate)	moderate limitation [†] in flexion or abduction	moderate limitation in extension	moderate limitation in extension	moderate limitation in extension		moderate limitation in lateral abduction
4 (Moderately severe)	severe limitation [‡] in flexion or abduction, but > 30°	severe limitation in extension	severe limitation in extension	severe limitation in extension		severe limitation in lateral abduction
5A (Severe)	30° flexion or abduction	initiation of flexion or extension	initiation of flexion or extension	initiation of wrist, fingers or thumb movement		
5B (Very severe)	30° flexion or abduction	initiation of flexion or extension	no initiation of wrist, fingers and thumb movement			

NOTE. Movements described are minimum motor criteria, i.e., if a child does not meet the AROM criteria listed for the grade at even one joint he or she would be placed in the grade corresponding to the movement present at the worst joint.

Abbreviations: WNL, within normal limits; AROM, active range of motion.

^{*} AROM is > 2/3 to just below normal range.

[†] AROM is between 1/2 and 2/3 of normal range.

[‡] AROM is < 1/2 of normal range but can initiate movement.