Development and psychometric evaluation of a new measure for children's participation in hand-use life situations

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Abstract

Objective: To describe the development of the Children's Assessment of Participation with Hands (CAP-Hand), a parent-report questionnaire that assesses children's participation in life situations requiring hand use specifically, and to investigate its construct validity (using Rasch analysis and known-group comparison) and reliability (test-retest reliability and internal consistency).

Design: Cross-sectional, validation and, test-retest studies.

Setting: Eleven special schools, one primary school, and two kindergartens from Australia.

Participants: Parents/caregivers (n=202) reported on their children aged 2 to 12 years with disabilities (n=97) and without disabilities (n=105).

Interventions: Not applicable.

Main Outcome Measure: The CAP-Hand was developed based on a content review of existing children's participation measures and literature, expert review, and pilot testing. The CAP-Hand included 37 items measuring participation diversity, frequency, independence, and desire for change in specific hand-use life situations across four domains of self-care, recreation, education, and domestic life and community.

Results: Evidence for construct validity of the CAP-Hand domains was established through Rasch analysis (after removing two misfitting items from the recreational domain and one item from the domestic life and community domain). Differences in summary scores of each domain between children with and without disabilities were also significant ($P<0.01$). Test-retest reliability of the CAP-Hand was moderate to high (intraclass correlation coefficients=0.69–0.96), except for the desire for change dimension scale of the recreational domain (0.40). Internal consistency was varied across the dimensions/domains.

Conclusion: Results provide preliminary evidence for the construct validity and reliability of the CAP-Hand that could be used in clinical and research settings to gain a specific understanding of the impact of children's hand-use difficulties on their participation in life situations requiring hand use.

Keywords: Children; Social Participation; Outcome Assessment (Health Care)

List of Abbreviations

CAPE	Children's Assessment of Participation and Enjoyment
CAP-Hand	Children's Assessment of Participation with Hands
ICC	Intraclass correlation coefficient
ICF	International Classification and Functioning, Disability and Health
MnSq	Mean square
PCA	Principal component analysis

In the International Classification and Functioning, Disability and Health (ICF),[1] participation is defined as involvement in a life situation. When applying participation into children's contexts, Coster and Khetani additionally defined that life situations are 'sets of organized sequences of activities directed towards a personally or socially meaningful goal'.[2] Participation in life situations provides children with opportunities to develop fundamental skills, form social relationships, and establish adaptive behaviours.[3,4]

The use of the hands and arms is essential for children to perform activities and contributes to their sense of control and active participation. For example, children's engagement in costume play requires the use of their hands to obtain preferred clothes, take off old ones, and put on new ones in order to play imaginary roles with others for fun. Children with disabilities frequently present with hand-use difficulties in performing activities, which may require others' assistance for participation and further compromise the extent of their active participation (particularly in life situations involving hand use largely).[3,5] While studies have devoted to understand children's underlying hand impairments or manual abilities,[6,7] it is also necessary to evaluate the impact of hand-use difficulties on children's participation.

There are an increasing number of children's participation measures, of which the Children's Assessment of Participation and Enjoyment (CAPE)[8] is most documented.[9,10] However, those existing measures do not contain all items representative of children's participation in life situations that require hand use specifically.[9] For example, there are two-thirds of the CAPE's items relating to hand use due to the fact that it is a generic participation measure and not all life situations require hand use during participation. With less hand-use relevance, generic participation measures may have limited ability to reflect children's participation in life situations requiring hand use specifically.[11] Furthermore, there is a call from King's perspectives[12] for more tools measuring children's participation in-depth in specific life situations/domains/settings; for instance, several instruments have been

developed for children's participation specifically in leisure[13] or family activities[14] and communicative participation.[15]

The aims of this study were: (1) to describe the development of the Children's Assessment of Participation with Hands (CAP-Hand) for measuring children's participation in life situations requiring hand use specifically, and (2) to investigate its psychometric evidence including construct validity (using Rasch analysis and known-group comparison) and reliability (test-retest reliability and internal consistency).

METHODS

Development of the CAP-Hand

The CAP-Hand is designed as a region-specific measure that focuses on the entire upper limbs and is applicable across many disorders, following Beaton and Schemitsch's taxonomy of outcome measures.[16] The CAP-Hand, as a parent-report questionnaire, intends to capture the extent to which children participate in life situations requiring hand use specifically. This measure is also purposed for use with children who have a range of disabilities affecting their hand functioning (e.g., developmental or physical disabilities) at the age of 2–12 years and can be used with typically developing children.

The conceptual frameworks underlying the development of the CAP-Hand are the ICF[1] and its version for children and youth,[17] in combination with additional participation definitions/attributes proposed by Coster and Khetani[2] (mentioned earlier). Each CAP-Hand item asks parents whether the child uses his/her hands to engage in one specific hand-use life situation, in which sets of related activities requiring hand use are provided (see Appendix 1). Those activities may present with a range of demands, challenges, or objects to accommodate diverse hand use of children with different disabilities and ages. Therefore, parents are further instructed to focus on what they have concerns with regard to their child's participation in one or more example(s) when responding to each item. In addition, the CAP-Hand items

specify other information associated with participation such as the locations and/or people surrounding children. Each item also describes a socially/personally meaningful goal in order to conceptualize the purpose/consequence of participating in the life situation (e.g., *helping parents* with shopping or operating a phone to *talk with friends*).

Item generation began with initial identification of potential activities that typically require hand use, based on content review of existing measures and literature.[9,18,19] A total of 757 activities requiring hand use were identified by all authors and were then constituted by the first author into 105 hand-use life situations according to their contexts/relevance. This number was further reduced to 48 hand-use life situations based on group discussion of all authors using the following selection criteria: (1) be common or representative of children's participation, (2) be possible for children between the ages of 2–12 years to engage in, and (3) have minimal seasonal, socioeconomic and gender bias against children's participation. Although the ICF provided an initial framework for development of the CAP-Hand, we decided to organize the 48 hand-use life situations into five common themes/settings for children's participation in accordance with recent findings[20,21] (rather than the ICF chapter structure). The proposed five CAP-Hand domains included self-care, recreation, education, domestic life, and community.

The 48 life situations were further reviewed by 12 occupational therapy experts. In the expert review questionnaire, these experts were asked to rate the life situations in terms of the degree of hand-use involvement, representativeness, and content appropriateness, using 3- or 4-point Likert scales. Furthermore they indicated whether or not the 57 discarded life situations should be retained. The experts were also invited to comment on the wording of the included items, justified the retention of the discarded items, and provided other suitable items. The results of the experts' feedback included 146 comments and a varied degree of ratings across the 48 included life situations. Thirteen life situations were eliminated due to less requirement for hand use (four items), irrelevance to the pre-determined age range (five

items), and inappropriateness or overlap of the item content (four items). One originally eliminated life situation was retained and one new item was added following the experts' suggestions. Changes were also made to combine the domestic life and community domains and to revise the wordings of some items. This expert review resulted in a field-test version comprising 37 life sudations (and a total of 167 activities as illustrative examples) that require hand use specifically across four domains.

To capture multidimensional nature of children's participation, we based literature reviews[9,10] to determine four participation dimensions (diversity, frequency, independence, and parents' satisfaction) as response formats for the CAP-Hand items. Diversity and frequency are the two commonly-used objective dimensions of participation, while the degree of independence and parents' satisfaction are subjective dimensions that allow complementary interpretation of diversity/frequency differences of children's participation.[9,21] For these four participation dimensions, their rating scale formats (described later) were constructed by reference to existing commonly-used participation measures.[8,22,23]

A pilot testing of the CAP-Hand was subsequently completed with two parents of children with disabilities and five parents of typically developing children. The parents completed the CAP-Hand without assistance and then provided cognitive debriefing on the clarity of instructions, item descriptions, and response formats. The 'think-aloud' cognitive method[24] was used by asking the parents whether they had difficulty understanding each item/instruction, how they interpreted each item/instruction, and whether the response choices were clear and consistent with each item. Any misleading wordings or issues (e.g., directing to no hand-use involvement) arising from the parents guided content revision of the 37 items and reduction of response options. The final field-test version of the CAP-Hand was established. For readability, the descriptions of the items are abbreviated throughout this article.

Description of the CAP-Hand

The field-test version of the CAP-Hand contains 37 items across four domains: Self-care (9 items), Recreation (11 items), Education (8 items), and Domestic Life & Community (9 items). In each question, the parent firstly reports a nominal scale of yes or no to indicate whether the child uses his/her hands to participate in the life situation (*diversity*). Some items may not be suitable to all children and hence a "not applicable" option can be chosen. If the child does participate, the parent then records how often (*frequency*) the child participated in the past three months using a 5-point ordinal scale (1=less than once 1 month and 5=everyday). The parent also estimates the degree of assistance that the child currently requires during participation in a 4-point ordinal scale (1=mostly assisted and 4=independent) as an indication of *independence*. Parents' satisfaction is measured by using the response format of *desire for change*, developed by Coster et al.,[25] to determine whether the parent wants to see the child's participation in this type of life situation change (no or yes, with four nominal options for type of change desired).

Therefore, four types of summary scores can be calculated for participation dimensions across four CAP-Hand domains. The form of percentages or average values is adopted in the score calculation because not all of the CAP-Hand items are applicable to every child. Higher summary scores indicate more participation diversity, frequency and independence but more desired changes (i.e., less parents' satisfaction). Specific scoring information is detailed in Table 1, and a guide is available online (www.childrenhandskills.com).

Psychometric Evaluation

Participants

A population-based survey was conducted to recruit children with disabilities who attended special schools within Brisbane Metropolitan regions in Australia. Eleven of 15 special schools provided permission for this study, and a total of 956 questionnaires were

distributed to parents who could read English and had children aged 2–12 years. Ninety-seven parents (10.1% response rate) returned the questionnaires. Twenty-five parents further specified their willingness to participate in the test-retest reliability study, and 23 (92.0%) completed the CAP-Hand twice within an average of 26.7 days (SD=12.8 days).

The demographics of the parents and children with disabilities are presented in Table 2. In the CAP-Hand, the parents reported a total of 473 non-applicable responses to specific items (mean=4.9 and SD=3.9). Additionally, real-life hand skill performance of each child was evaluated by the first author using the Assessment of Children's Hand Skills.[26,27] According to the test manual,[28] hand skill performances of 27 (27.8%) children were categorized as efficient, whereas 64 (66.0%) children as inefficient or poorer. There were six (6.2%) children who were not evaluated and had no information about their hand skill performance.

Another sample of typically developing children was recruited by convenience sampling from two kindergartens and one primary school within the same regions. Four hundred questionnaires were distributed, and 116 (29.0% response rate) were returned. Data for eleven children were disregarded because they had certain impairments/disabilities according to parent-report. Of the remaining 105 apparently typically developing children and 97 aforementioned children with disabilities, 50 pairs were matched for gender and age (Table 2). In this matched sample, the children with disabilities had a total of 265 non-applicable responses (mean=5.3 and SD=3.9), compared to their typically developing peers who had 83 responses (mean=1.6 and SD=1.2).

Ethical approval for the study was granted by Department of Education, Training and Employment and ethical review committee at The University of Queensland. Written consent was obtained from the parents/caregivers.

Data analysis

Construct validity of the CAP-Hand was examined using Rasch analysis and by

192 differentiating groups with known differences. Rasch analysis was performed with Winsteps
193 3.73 software (Winsteps.com, Chicago, IL, USA) based on rating scale or dichotomous
194 models. Rasch analysis provides many features to examine internal construct validity of a test
195 (details can be found elsewhere[29,30]). For the present study, we used Rasch analysis to explore
196 unidimensionality, goodness-of-fit, and targeting of the CAP-Hand items in the sample of
197 children with disabilities. Particularly, we analyzed each participation dimension scale
198 (diversity, frequency, independence, and desire for change) separately in Self-care,
199 Recreational, Educational and Domestic Life & Community domains. However, we expected
200 that the frequency dimension (i.e., an accepted objective dimension of participation[10]) of the
201 four CAP-Hand domains would be likely to be unidimensional. The unidimensional results of
202 the frequency dimensions were accordingly used for item reduction (as used elsewhere[8,13]).
203 For Rasch analysis of this study, *unidimensionality* was examined by principal
204 component analysis (PCA) of residuals. A tentative guideline for PCA is that
205 unidimensionality is supported if the Rasch-identified construct explain >50% of the variance,
206 and the eigenvalue size of the secondary largest component is less than 2.[30] *Goodness-of-fit*
207 analysis was to examine if items exhibited misfit (infit and outfit mean square [MnSq] > 1.4)
208 to the hierarchical difficulty expected by Rasch model.[30,31] *Targeting* was examined by
209 comparing the mean person ability measures to the mean item difficulty measures. As the
210 latter is set by a default of 0 logit, mean person ability measures of >0.5 logits may indicate a
211 meaningful disagreement in terms of item-person targeting.[32]
212 Next, independent *t*-tests were performed to investigate the differences in participation
213 outcome between the matched sample of children with and without known disabilities, and
214 consequently examined the construct validity of the CAP-Hand. To minimize the likelihood
215 of Type 1 error, statistical significance for all analyses was set at the rather conservative level
216 of P<0.01 (one-tailed). Effect size values (eta squared) were calculated and, according to
217 Cohen,[33] 0.01 was considered as a small, 0.06 as a medium, and 0.14 as a large magnitude of

the differences.

Test-retest reliability of the CAP-Hand was examined at individual item and domain score levels. Percent agreement (within one rating category) of >70% was used to examine the test-retest reliability of individual items.[34] We also performed intraclass correlation coefficients (ICC model 2,1) and paired *t*-tests (statistical significance set at $P<0.05$, two-tailed) to examine test-retest agreement of each CAP-Hand domain. ICC values ≥ 0.8 indicate high reliability and values in the range of 0.6–0.8 represent moderate reliability.[35] For internal consistency, Rasch-based person and item reliability coefficients were used. The Rasch-based reliability coefficients are interpreted similarly as Cronbach's alpha, in which a coefficient of >0.70 is deemed acceptable, 0.8 as good and 0.90 is considered as high.[30]

RESULTS

Evidence for Construct Validity

Rasch analysis

Initial Rasch-based PCA revealed that more than half of the participation dimension scales in the four CAP-Hand domains did not explain >50% of the total variance or had the secondary largest component of >2.0 eigenvalue (Appendix 2). Goodness-of-fit analyses of frequency dimension scales identified misfit for two items *Play computer games* (infit MnSq=1.8; outfit MnSq=1.6) and *Use electronic devices* (infit MnSq=2.1; outfit MnSq=1.6) in Recreational domain and one item *Communicate by manual gestures* (infit MnSq=2.1; outfit MnSq=1.6) in Domestic Life & Community domain. Based on these results and clinical relevance (mentioned later), the three items were removed and Rasch analyses were re-run.

Table 3 shows Rasch analysis results after item removal. Overall, the frequency dimension scales of all domains (except for Educational domain) were supported for their unidimensionality by PCA results. The independence dimension scales also had unidimensionality evidence for three of the four domains, but the diversity and desire for

change dimension scales did not. Misfit was further identified in only one item *Get around home/community* (infit MnSq=1.7; outfit MnSq=1.5) for participation frequency in Domestic Life & Community domain and additionally six items across other participation dimensions/domains. No further item removal was made due to the acceptability for 5% (or one) of the items exhibiting misfit[36] and/or clinical concerns.

Analysis of item-person targeting showed no disagreement in frequency dimension scales for all domains, diversity for Self-care and Domestic Life & Community domains, and independence for all but not Educational domain (Table 3). For desire for change dimension scales, the mean children's measures were obviously lower (-2.37–-1.71) than the mean difficulties of the items in all domains.

Comparison of known-group differences

As shown in Table 4, significant differences in all participation dimension scales between children with and without known disabilities were found for each CAP-Hand domain. Effect size values were medium (eta squared=0.06) for participation frequency in Recreational domain and large (≥0.12) for all other dimension scales or domains. Table 4 also reveals significant ceiling effects (40–100%) in diversity dimension across all domains and in frequency dimension of Self-care domain for children with or without disabilities. Additional ceiling effects (28–52%) in independence dimension and floor effects (40–58%) in desire for change dimension were found only in typically developing children.

Evidence for Reliability

Test-retest reliability

The test-retest reliability for all individual items was acceptable, except for two items *Engage in unstructured physical activities* (percent agreement=60.9%) and *Help clean up after meal* (68.8%) in participation frequency. The summary scores for all participation dimension scales demonstrated moderate to high test-retest reliability (ICC=0.69–0.96) and

did not differ significantly for all domains (Table 5). The only exception was the parents' desire for change in Recreational domain (ICC=0.40).

Internal consistency

Rasch-based person reliability coefficients were acceptable (0.72–0.78) for most dimension scales and domains, but not for participation diversity (0.34–0.64) across all domains, frequency (0.31) in Self-care domain, and desire for change (0.55) in Domestic Life & Community domain. The item reliability coefficients were acceptable (0.78–0.96) in all dimensions/domains.

DISCUSSION

This study described the development of the CAP-Hand, a new region-specific measure to capture children's life participation in relation to hand use. The CAP-Hand utilizes contemporary participation concepts[2,21,37] to measure children's life participation and, specifically, focuses on life situations that require hand use. Therefore, its assessment provides an indication of children's active participation with their hand-use involvement, which is slightly different from generic participation that includes some life situations in which hand use may be more ambiguous (e.g., listening to music or going for a walk). The hand-use life participation captured by the CAP-Hand is also conceptually different from instruments assessing manual ability,[38,39] real-life hand skill performance,[26,40] or experience of children's hand use.[41] The parent-report questionnaire method is employed, so that the CAP-Hand can be applicable for children who have a range of diagnoses/disabilities affecting their hand functioning but may have insufficient cognitive/communication skills. This measure may have the potential for wide use in clinical practice or population-level research to understand hand-use life participation of children with disabilities.

Before the CAP-Hand is used clinically, its psychometric properties need to be proved. Based on Rasch analysis results of frequency dimension scales, we removed two misfitting

items that involved the use of computers or electronic devices for recreational purposes. This could be justified because computers and electronic tablets are popular in contemporary society and some children may use them excessively, resulting in unexpectedly inconsistent hierarchical patterns within Rasch estimation. In addition, removing the item *Communicate by manual gestures* from Domestic Life & Community domain deemed reasonable as it had less relevance to this domain than other items.

The unidimensionality of most CAP-Hand domains was supported by Rasch analysis for its frequency dimension scale as we expected, but not for diversity and desire for change dimensions. The nature of nominal response scales used in these two dimensions may explain the poor unidimensionality results, compared to the frequency or independence dimensions that are based on ordinal rating scales. In addition, Whiteneck and Dijkers[42] thought that participation items may not be hierarchical along a difficulty continuum in a construct. This is particularly true in some dimensions, because personal preference in participation diversity (e.g., no one can participate in everything and choices must be made) or the individual's subjective satisfaction with participation may confound some Rasch unidimensional results of this study. Therefore, Whiteneck and Dijkers[42] argued that it may be appropriate to consider participation measure that is not unidimensional but combines multiple attributes (measured by one or more items) into a single composite score. In this study, we found that children with disabilities exhibited significantly poorer results on such composite summary scores across all CAP-Hand dimensions/domains than their matched typically developing peers. The ability to capture the difference in hand-use life participation among children provides alternative evidence for construct validity of the CAP-Hand.

The findings of item-person targeting of Rasch analysis suggest that the CAP-Hand items in some participation dimensions/domains may be too difficult or easy for children with disabilities. We argue that it is clinically expected for parents to desire more changes in their children's participation or for children to participate in more quantities of recreational and

educational situations, which are their main occupations during childhood. Such difference in item-person targeting did not provide a detrimental indication (rather than an insight) for the CAP-Hand clinical application.

Results of reliability analyses support test-retest agreement of the CAP-Hand at the item and dimension scale levels. Although two individual items did not reach acceptable test-retest agreement, the reliability of their corresponding dimension scores was not affected. Furthermore there was only one dimension (desire for change) in Recreational domain with poor test-retest reliability. We speculated that parents may be unsure about their children's engagement in certain recreational pursuits; for example attending sports clubs may be unrealistic or irrelevant for children with significant impairments. This lack of certainty may have led to variable responses over time in terms of desire for change. Likewise, internal consistency of most dimension scales across the CAP-Hand domains was marginally supported. However, it is common that more participation in one situation requires/results in less participation in another, and therefore high intercorrelation among participation items would not be expected.[42] This explained largely reduced internal consistency in the diversity dimension across all CAP-Hand domains.

Study Limitations

While the generation of the CAP-Hand items was based on review of existing measures and literature, children with disabilities and/or their parents were not included in the process. This has to be considered as one of the study limitations. Another limitation is the modest sample size of children with disabilities in the psychometric evaluation study due to the low response rate. The parents of this cohort may have been time-poor, given the multiple demands of their children who appeared to have moderate-to-severe disabilities (e.g., multiple diagnoses/disabilities). Those children may also have undergone many investigations, reducing parents' willingness for participation in this study. Compared to one previous study investigating typically developing students' participation patterns in

Australian schools (their response rate was 12.5%),[43] we considered that our response rate was reasonable. However, this low response rate would limit the generalizability of the study's findings to all children with disabilities attending special schools or those with mild disabilities. In addition, the age range of 2–12 years is proposed for the CAP-Hand, but fewer children aged 2–4 years were included in the study sample. Future studies are thus needed to confirm the validity and reliability of the CAP-Hand by involving a larger and more diverse group of children with disabilities (including younger children). Other psychometric evidence (e.g., convergent validity with similar instruments or responsiveness) for the CAP-Hand is also necessary.

CONCLUSION

The CAP-Hand is a parent-report questionnaire that can be used to measure participation in life situations specifically requiring hand use for children with disabilities aged 2–12 years. Its preliminary construct validity was established through Rasch analysis and known-group comparison between children with and without disabilities. Preliminary evidence for its test-retest reliability and internal consistency was also provided. The CAP-Hand may be used to assist service providers and parents in understanding children's hand-use life participation and prioritizing areas warranting intervention. It may be also suitable for use in population-level research studies to examine similarities and differences in children's hand-use life participation among different diagnostic groups. The CAP-Hand is freely available at the website (www.childrenhandskills.com).

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Table 1: Calculation of summary scores for four participation dimensions of the Children's Assessment of Participation with Hands

Participation dimension	Summary score and calculation
Diversity	The percent of the number of items answered with yes divided by total number of applicable items
Frequency	The sum of all reported ratings divided by total number of applicable items including those which children did not participate in
Independence	The average of all reported ratings
Desire for change	The percent of the number of desired change responses divided by total number of items rated

Table 2: Demographic characteristics of participants

Characteristics	Children with disabilities		Matched sample	
	Total (%)	Test-retest (%)	Disable (%)	TD (%)
Total number	97	23	50	50
Respondent				
Mother	80 (82.5)	22 (95.7)	43 (86.0)	48 (96.0)
Father	11 (11.3)	1 (4.3)	5 (10.0)	2 (4.0)
Guardian/Carer	6 (6.2)	0	2 (4.0)	0
Respondent age (year)				
39 and younger	42 (43.3)	11 (47.8)	23 (46.0)	21 (42.0)
40–49	43 (44.4)	10 (43.6)	23 (46.0)	25 (50.0)
50 and older	11 (11.3)	1 (4.3)	4 (8.0)	2 (4.0)
Unreported	1 (1.0)	1 (4.3)	0	2 (4.0)
Respondent education				
High school or less	29 (29.9)	9 (39.3)	11 (22.0)	11 (22.0)
College/diploma	33 (34.0)	5 (21.7)	18 (36.0)	18 (36.0)
Undergraduate	18 (18.6)	5 (21.7)	11 (22.0)	8 (16.0)
Postgraduate	17 (17.5)	4 (17.3)	10 (20.0)	13 (26.0)
Child gender				
Male	60 (61.9)	11 (47.8)	26 (52.0)	26 (52.0)
Female	37 (38.1)	12 (52.2)	24 (48.0)	24 (48.0)
Child age (year)				
2–4	6 (6.2)	0	2 (4.0)	2 (4.0)
5–7	33 (34.0)	6 (26.1)	19 (38.0)	19 (38.0)
8–10	39 (40.2)	16 (69.5)	17 (34.0)	17 (34.0)
11 and older	19 (19.6)	1 (4.4)	12 (24.0)	12 (24.0)
Child diagnosis/disability†				
Down syndrome	12 (12.4)	1 (4.3)	5 (10.0)	–
Fragile X	1 (1.0)	0	1 (2.0)	–
Autism	38 (39.2)	8 (34.8)	20 (40.0)	–
Cerebral palsy	7 (7.2)	1 (4.3)	5 (10.0)	–
Muscular dystrophy	1 (1.0)	0	1 (2.0)	–
Physical disability	10 (10.3)	2 (8.7)	4 (8.0)	–
Intellectual disability	43 (44.3)	13 (56.5)	23 (46.0)	–
Language/speech delay	31 (32.0)	6 (26.1)	15 (30.0)	–
Developmental delay	33 (34.0)	7 (30.4)	19 (38.0)	–
Pervasive developmental delay	4 (4.1)	2 (8.7)	2 (4.0)	–
Learning disability	18 (18.6)	4 (17.4)	10 (20.0)	–
Hearing impairment	2 (2.1)	1 (4.3)	1 (2.0)	–
Visual impairment	5 (5.2)	2 (8.7)	2 (4.0)	–

Abbreviation: TD, typically developing.

† Parents can report multiple diagnoses/disabilities which their children have.

Table 3: Final results of Rasch analysis for each dimension scale of four Children's Assessment of Participation with Hands domains

Participation dimension‡	Self-care domain (9 items)	Recreational domain* (9 items)	Educational domain (8 items)	Domestic Life & Community domain* (8 items)
Frequency				
% variance explained	52.1	50.2	42.4	56.5
Eigenvalue for second component	1.9	1.7	2.0	2.0
Misfit items	0	0	0	Item 7
Mean person measures (SD)	0.49 (0.54)	-0.01 (0.59)	0.14 (0.50)	0.02 (0.74)
Diversity				
% variance explained	43.1	36.6	44.6	49.4
Eigenvalue for second component	2.0	1.8	2.1	1.9
Misfit items	Item 3, Item 9	0	Item 4	Item 5, Item 8
Mean person measures (SD)	0.41 (1.66)	0.97 (1.24)	1.35 (1.45)	0.32 (1.69)
Independence				
% variance explained	51.2	52.5	52.2	54.9
Eigenvalue for second component	2.1	1.9	1.6	1.7
Misfit items	Item 9	Item 8	0	0
Mean person measures (SD)	-0.29 (1.16)	0.01 (1.20)	-0.53 (1.33)	-0.28 (1.44)
Desire for change				
% variance explained	55.6	51.1	55.0	48.2
Eigenvalue for second component	1.8	2.4	2.2	2.0
Misfit items	Item 9	0	0	Item 8
Mean person measures (SD)	-2.37 (2.09)	-1.71 (1.64)	-1.73 (2.03)	-1.86 (1.57)

* Three items were removed from the CAP-Hand, including two from Recreational domain, and one from Domestic Life & Community domain.
‡ Frequency was analyzed in Rasch analysis by coding 'did not participate' for diversity as 0 in combination with its 5-point frequency rating scale; Diversity was analyzed using dichotomous categories (yes and no); Independence was analyzed using its 4-pint independence rating scale; Desire for change was analyzed by treating 'no desire for change' as 0 in combination with the number of desired changes.
Note: In Self-care domain, Item 3 is *Eat meal* and Item 9 is *Put on/remove assistance device*. In Recreational domain, Item 8 is *Engage in organized sport*. In Educational domain, Item 4 is *Operate computer in classroom learning activities*. In Domestic Life & Community domain, Item 5 is *Eat outside the home*, Item 7 is *Get around home/community*, and Item 8 is *Hold/operate a phone/mobile to talk*.

Table 4: Comparisons of participation outcome between children with and without disabilities

Domain with dimension	Children with disabilities		TD children				
	Mean (SD)	Floor (ceiling) effect, %	Mean (SD)	Floor (ceiling) effect, %	t	*p* value	Eta squared
Self-care domain							
Diversity	89.2 (20.3)	0 (66.0)	100 (0)	0 (100)	3.737	<0.001	0.12
Frequency	4.3 (1.0)	0 (40.0)	5.0 (0.1)	0 (92.0)	4.435	<0.001	0.17
Independence	2.2 (0.8)	2.0 (4.0)	3.7 (0.4)	0 (52.0)	11.399	<0.001	0.57
Desire for change	87.9 (58.8)	4.0 (0)	12.0 (19.6)	56.0 (0)	-8.497	<0.001	0.42
Recreational domain							
Diversity	83.2 (20.8)	0 (44.0)	93.8 (9.3)	0 (64.0)	3.299	<0.001	0.10
Frequency	2.9 (1.0)	0 (2.0)	3.3 (0.6)	0 (0)	2.608	0.006	0.06
Independence	2.3 (0.7)	4.0 (2.0)	3.6 (0.5)	0 (46.0)	10.096	<0.001	0.51
Desire for change	90.9 (50.7)	2.0 (0)	27.0 (39.8)	50.0 (0)	-6.786	<0.001	0.32
Educational domain							
Diversity	87.5 (18.5)	0 (56.0)	98.5 (4.1)	0 (88.0)	4.091	<0.001	0.15
Frequency	3.7 (0.9)	0 (2.0)	4.4 (0.4)	0 (8.0)	5.389	<0.001	0.23
Independence	2.1 (0.7)	4.0 (0)	3.7 (0.4)	0 (42.0)	13.382	<0.001	0.65
Desire for change	94.6 (55.2)	0 (0)	18.6 (33.6)	58.0 (0)	-8.115	<0.001	0.40
Domestic Life & Community domain							
Diversity	79.9 (27.5)	0 (48.0)	96.6 (7.6)	0 (92.0)	4.126	<0.001	0.15
Frequency	2.8 (1.2)	0 (2.0)	3.6 (0.6)	0 (0)	4.205	<0.001	0.15
Independence	2.4 (0.6)	4.0 (0)	3.5 (0.5)	0 (28.0)	9.166	<0.001	0.46
Desire for change	76.3 (51.4)	10.0 (0)	25.0 (31.8)	40.0 (12.0)	-5.651	<0.001	0.25

Abbreviation: TD, typically developing.

Table 5: Test-retest reliability of the Children's Assessment of Participation with Hands domains

Domain with dimension	First evaluation Mean (SD)	Second evaluation Mean (SD)	Difference Mean (SD)	*t*	*p* value	ICC
Self-care domain						
Diversity	77.1 (35.4)	75.0 (37.0)	2.1 (10.2)	0.992	0.33	0.96
Frequency	3.7 (1.8)	3.6 (1.9)	0.1 (0.5)	0.945	0.36	0.96
Independence	2.7 (0.9)	2.9 (0.8)	-0.2 (0.4)	-1.691	0.11	0.87
Desire for change	58.4 (47.8)	49.9 (48.6)	8.5 (25.7)	1.320	0.21	0.86
Recreational domain						
Diversity	79.9 (23.0)	74.4 (24.8)	5.5 (17.9)	1.480	0.15	0.72
Frequency	2.6 (0.9)	2.4 (0.9)	0.2 (0.7)	1.153	0.26	0.69
Independence	2.7 (0.8)	2.8 (0.9)	-0.2 (0.6)	-1.219	0.24	0.77
Desire for change	78.0 (44.3)	57.9 (46.9)	20.1 (49.8)	1.752	0.10	0.40
Educational domain						
Diversity	88.3 (22.8)	86.8 (17.7)	1.5 (13.9)	0.476	0.64	0.77
Frequency	3.9 (1.1)	3.7 (1.0)	0.2 (0.8)	1.147	0.27	0.72
Independence	2.5 (0.8)	2.5 (1.0)	0 (0.3)	0.086	0.93	0.93
Desire for change	65.0 (44.5)	67.3 (54.1)	-2.3 (36.2)	-0.250	0.81	0.73
Domestic Life & Community domain						
Diversity	71.8 (34.6)	77.8 (29.8)	-6.0 (13.1)	-1.993	0.06	0.92
Frequency	2.7 (1.3)	2.6 (1.2)	-0.1 (0.6)	-0.498	0.62	0.87
Independence	2.9 (0.7)	2.8 (0.8)	0.2 (0.5)	-1.112	0.29	0.81
Desire for change	38.3 (35.9)	49.0 (59.4)	-10.7 (32.9)	-1.127	0.28	0.78

Abbreviation: ICC, intraclass correlation coefficient.

Highlights

- We develop an assessment for children's participation in hand-use life situations.
- The CAP-Hand is a parent-report questionnaire.
- We provide construct validity and reliability evidence for the CAP-Hand.
- The CAP-Hand holds promise for use in children with disabilities aged 2–12 years.

1 Appendix 1: Sample items and response formats in the Children's Assessment of Participation with
2 Hands questionnaire

3

Does your child use his/her hands to:	Diversity of Participation (In the past 3 months)	Frequency of Participation (In the past 3 months)	Level of Independence	Desire for Change (Select ALL that apply)
Self-care domain **Put on clothes at home after a shower/bath or when getting dressed** For example, your child may put on pyjamas, T-shirt, shirt, dress, jumper, jacket, underwear, pants, trousers or skirt, including fastening the buttons or zippers (if relevant). **[Circle example(s) you have concerns about]**	❒ Yes ❒ No	❒ Less than once 1 month ❒ 1–2 times 1 month ❒ Once 1 week ❒ 2–3 times 1 week ❒ Everyday	❒ Mostly assisted ❒ Help sometimes ❒ Need very little help or supervision only ❒ Independent	❒ No change desired ❒ Yes, do more often ❒ Yes, do less often ❒ Yes, need less help ❒ Yes, enjoy more
Recreational domain **Play with construction toys with family/ friends at home or at other venues (outside school)** For example, your child may play with some kinds of blocks (e.g., wooden blocks, Lego blocks or unifix cubes) or build models. **[Circle example(s) you have concerns about]**	❒ Yes ❒ No	❒ Less than once 1 month ❒ 1–2 times 1 month ❒ Once 1 week ❒ 2–3 times 1 week ❒ Everyday	❒ Mostly assisted ❒ Help sometimes ❒ Need very little help or supervision only ❒ Independent	❒ No change desired ❒ Yes, do more often ❒ Yes, do less often ❒ Yes, need less help ❒ Yes, enjoy more
Educational domain **Engage in classroom learning activities or lessons at kindergarten, preschool or school** For example, your child may get school items (e.g., pencils or books), copy from the board, write notes, or write examination answers. **[Circle example(s) you have concerns about]**	❒ Yes ❒ No ❒ NA (not applicable)	❒ Less than once 1 month ❒ 1–2 times 1 month ❒ Once 1 week ❒ 2–3 times 1 week ❒ Everyday	❒ Mostly assisted ❒ Help sometimes ❒ Need very little help or supervision only ❒ Independent	❒ No change desired ❒ Yes, do more often ❒ Yes, do less often ❒ Yes, need less help ❒ Yes, enjoy more
Domestic Life & Community domain **Help parents with shopping at grocery stores or shopping centres** For example, your child may help to pick up goods, push a trolley, or carry shopping bags. **[Circle example(s) you have concerns about]**	❒ Yes ❒ No ❒ NA (not applicable)	❒ Less than once 1 month ❒ 1–2 times 1 month ❒ Once 1 week ❒ 2–3 times 1 week ❒ Everyday	❒ Mostly assisted ❒ Help sometimes ❒ Need very little help or supervision only ❒ Independent	❒ No change desired ❒ Yes, do more often ❒ Yes, do less often ❒ Yes, need less help ❒ Yes, enjoy more

4

1 Appendix 2: Initial results of Rasch analysis for each dimension scales of four Children's Assessment of Participation with Hands domains

Participation dimension‡	Self-care domain (9 items)	Recreational domain (11 items)	Educational domain (8 items)	Domestic Life & Community domain (9 items)
Frequency				
% variance explained	52.1	48.0	42.4	53.1
Eigenvalue for second component	1.9	1.9	2.0	2.0
Misfit items	0	2 items	0	1 item
Mean person measures (SD)	0.49 (0.54)	0.14 (0.50)	0.14 (0.50)	0.14 (0.60)
Diversity				
% variance explained	43.1	35.0	44.6	46.0
Eigenvalue for second component	2.0	1.9	2.1	2.1
Misfit items	2 items	0	1 item	0
Mean person measures (SD)	0.41 (1.66)	1.20 (1.25)	1.35 (1.45)	0.59 (1.48)
Independence				
% variance explained	51.2	48.2	52.2	53.8
Eigenvalue for second component	2.1	2.0	1.6	1.8
Misfit items	1 item	1 item	0	1 item
Mean person measures (SD)	-0.29 (1.16)	0.10 (1.12)	-0.53 (1.33)	-0.20 (1.36)
Desire for change				
% variance explained	55.6	49.3	55.0	46.7
Eigenvalue for second component	1.8	2.3	2.2	2.2
Misfit items	1 item	0	0	0
Mean person measures (SD)	-2.37 (2.09)	-1.84 (1.60)	-1.73 (2.03)	-1.79 (1.52)

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3