Manuscript title: Development and psychometric evaluation of the Chinese version of the Participation and Environment Measure for Children and Youth

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Development and psychometric evaluation of the Chinese version of the Participation and Environment Measure for Children and Youth

Abstract

Purpose: To adapt the Participation and Environment Measure for Children and Youth for use with Chinese children and youths, and to investigate its psychometric properties.

Materials and methods: The Participation and Environment Measure for Children and Youth was translated into Chinese using a cultural adaptation process. Parents of 69 children aged 5–12 years with disabilities and 319 children without disabilities completed the questionnaires. Internal consistency, test-retest reliability, factorial structure and known-group validity were examined using Cronbach's alpha, intraclass correlation coefficient, confirmatory factor analysis and *t*-test, respectively.

Results: We added and/or replaced activities with culturally-relevant activities in the Chinese version. Internal consistency was acceptable for most of the scales (0.55–0.86). Test-retest reliability of the summary scores was moderate to high (0.70−0.84). Data-model fit was confirmed in a one-factor structure for the participation scales and a two-factor structure for the environment scales. There were also significant differences in the summary scores between 65 gender- and age-matched pairs of children with and without disabilities on the school participation scales and all the environment scales.

Conclusion: This study provides psychometric evidence supporting the use of the Participation and Environment Measure for Children and Youth to assess Chinese children's participation and environmental supports/barriers.

Keywords: Participation; Cultural adaptation; Chinese children; Participation and Environment Measure for Children and Youth; Psychometrics.

Introduction

Successful participation in everyday activities is an important rehabilitation outcome for children with disabilities [1,2]. The International Classification of Functioning, Disability, and Health (ICF) [3] defines participation as 'an individual's involvement in life situations', which is conceptualised as being influenced by personal and environmental factors. In recent years, the inextricable relationship between participation and the environment has become evident in qualitative [4,5] and quantitative studies [6,7]. Studies have demonstrated the links between the family income, parents' educational level, and geographical regions and the children's participation [8-11]. Environmental factors, such as the availability of inclusive programmes, specialised equipment, transportation, and positive institutional attitudes are often perceived by the parents as supporting factors or barriers that affect their child's participation [4,12-14]. Therefore, rehabilitation interventions have begun to focus on modifying environmental conditions and the demands of activities in order to promote the participation of children with disabilities [15-17]. This shift in focus is based on the premise that the environment is potentially modifiable, and an increasing amount of evidence has supported the effectiveness of the environment-based interventions for improving the children's participation in leisure or community activities [16-20]. However, prior to the implementation of the environment-based interventions, an essential step is to understand the children's participation and environmental support/barriers through the use of valid and reliable measures.

Many measures have been developed to help professionals to assess the children's participation [21-26] and/or environmental factors that are important for the individual child [22,27], in order to improve the participation and/or development of children with disabilities. The Participation and Environment Measure for Children and Youth (PEM-CY) [28,29] is a recently developed measure that can assess the participation and environmental factors at the same time. The PEM-CY captures the children's participation in home, school, and

community activities. It also includes the assessment of the environmental factors that are perceived by the parents to be supporting/hindering their child's participation in each setting of the home, school, and community. This combination of participation and environment in one assessment allows the direct investigation of the environmental impact on the children's participation within/across settings. The PEM-CY is designed to be completed by parents and it can be used with typically developing children and children with all types of disabilities [29]. It has been demonstrated to have acceptable psychometric properties for use with children living in North America [28,30,31]. To date, the PEM-CY has been translated into more than 10 languages [32] and been applied in many countries [33-36].

There is an imperative need to have a measure that assesses children's participation and environmental factors in order to inform suitable environment-based interventions for the Chinese communities. This need originated from local rehabilitation programme plans [37] that had the vision of empowering children with disabilities to achieve full participation in school, the community, and society, in compliance with the United Nations Convention on the Rights of Persons with Disabilities [38]. However, little is known about the holistic picture of the participation patterns of Chinese children with disabilities and the effectiveness of rehabilitation services for promoting their participation. This is due to the use of participation measures that target only specific settings or environments. For example, Lam et al. [39] and Chan et al. [40] used self-generated questionnaires to assess community participation in children with autism or cerebral palsy. A team led by Pang [41,42] used the Children's Assessment of Participation and Enjoyment to assess participation in out-of-school activities by children with developmental coordination disorder. Leung et al. [43] investigated the school participation of children with developmental delay using the School Function Assessment.

Despite the effects, none of the measures in the abovementioned studies captured Chinese children's participation at home, at school, and in the community at the same time or

assessed the environmental impact on the children's participation. Recently, a few measures have been developed to address the needs to assess the Chinese children's participation and environmental factors. The Functioning Scale of the Disability Evaluation System-Child Version, developed by Hwang et al. [44,45], is one such measure that includes items about both the participation and the environment. The items of this scale were derived from the Chinese version of the Child and Adolescent Scale of Participation [46] and the Child and Adolescent Scale of Environment [47]. The Child and Adolescent Scale of Participation and the PEM-CY have been identified as the only two existing measures that covered all of the ICF Activity and Participation domains [48]. Considering the utility of the PEM-CY [28,29], as mentioned earlier, there is a need to develop its Chinese version and to provide more assessment choices in Chinese-speaking area.

Therefore, the aims of this study were to develop the Chinese version of the PEM-CY and to establish its psychometric properties, including its reliability (internal consistency and test-retest reliability) and construct validity (factorial structure and known-group validity), in children with and without disabilities who live in Hong Kong. Three specific research questions were addressed: (1) do the PEM-CY items need to be adapted culturally for use in the Chinese context? (2) does the PEM-CY Chinese version demonstrate acceptable internal consistency and test-retest reliability for assessing the children's participation and environmental factors? and (3) do the scores of the PEM-CY Chinese version characterise the originally proposed factorial structures and detect the differences between children with and without disabilities in terms of the participation and environmental factors? We hypothesised that the PEM-CY Chinese version would have similar internal consistency and test-retest reliability to the original version [29]. As for the construct validity, it was hypothesised that the PEM-CY Chinese version's participation and environmental constructs would match those that were operationally proposed by the original developers [28,29] and that it would be able to differentiate between children with and without disabilities [28].

Methods

Development of the PEM-CY Chinese version

The PEM-CY Chinese version was developed by adapting the English version and by following the translation guidelines provided by the original authors' team and by other researchers [49-51]. The adaptation process included (1) forward translation, (2) synthesis by an expert committee, (3) cognitive debriefing, (4) backward translation, and (5) a final review by an expert committee.

First, the PEM-CY was translated from English into Chinese by two bilingual translators who were native Chinese speakers. These translators had related health backgrounds in psychology and dental surgery.

Second, the two translated versions were synthesised and discussed within the research team that included three occupational therapy researchers/clinicians and the team coordinator of the original PEM-CY. At this stage, the research team focused on the synthesis of the two translated versions by choosing the words and meanings suitable for the Hong Kong context. The research team also aimed to remove the examples that were irrelevant to the Hong Kong culture or to replace them with suitable descriptions and add culturally relevant examples.

Third, cognitive debriefing was implemented with 15 parents of children without disability aged from 5–17 years (eight boys and seven girls). All of the parents spoke Cantonese (the main language in Hong Kong), and they were divided into five groups according to their child's age: three in the age group of 5–7 years, four in the age group of 8–10 years, three in the age group of 11–13 years, three in the age group of 14–16 years, and two in the age group of 17 years. Most respondents were mothers (86.7%), most had secondary education (53.3%), and most had a full-time job (60.0%). At this stage, the parents completed the PEM-CY Chinese version independently. They were then interviewed about the clarity of the instructions, the cultural appropriateness of the items and example descriptions, and the suitability of the response formats, using the think-aloud cognitive

method [52]. Any misleading wording or issues identified by the parents were used to guide the further modification of the PEM-CY Chinese version.

Fourth, the modified version was translated into English by a native speaker who was also fluent in Chinese and had a related health technology background. The backward translation was conducted to examine any possible conceptual and/or semantic discrepancies between the original and Chinese versions.

Lastly, a final review of the PEM-CY Chinese version was performed by the research team. The pre-final version was generated and sent to the PEM-CY team coordinator for approval.

Psychometric evaluation of the PEM-CY Chinese version

Participants

A convenience sample of parents and their children was recruited from three primary schools and one special school between March and December 2017. The primary schools were selected from three major geographical regions in Hong Kong (one each from Hong Kong Island, Kowloon, and New Territories), and the special school was chosen from the Hong Kong Island region. At each school, parents who had children aged 5–12 years and were able to read Chinese were invited to participate in the study. A total of 1581 printed questionnaires were distributed to eligible parents, and 388 (24.9% response rate) completed the questionnaires. Eighty-nine of those parents of children with and without disabilities were further selected to participate in the test-retest reliability study two weeks apart, and 71 returned the questionnaire in the second evaluation. However, seven parents completed the questionnaires two months late. Additionally, nine retest questionnaires were completed by different parents from those in the first evaluation. Thus, the test-retest reliability analysis included the remaining 55 parents who completed the questionnaire twice within an average interval of 37.2 days (standard deviation [*SD*] = 9.6 days). Ethical approval for the study was

granted by the ethical review committee at *Institution omitted* (*Reference number omitted*). Written consent was obtained from the parents.

Table 1 summarises the descriptive characteristics of the parents and their children in the total sample and retest sample. Most respondents were mothers (75.5–76.4%), who were in their thirties (27.2–42.5%) and forties (47.7–65.4%), and who had completed at least the senior high school diploma (88.2–89.1%). There were slightly more children who were male (56.4–59.0%), and the children's mean age was 8.7 years (*SD* = 1.8) in the total sample and 8.2 years (*SD* = 1.6) in the retest sample. The total and retest samples were similar in all of the demographic characteristics except for the proportion of children with and without disabilities. In the total sample there were 69 (17.8%) children with disabilities, which differed from 28 (50.9%) children with disabilities in the retest sample. The clinical diagnosis/disability was reported by the parents, and 40–50% of them specified more than one diagnosis/disability in their child (see table 2). The majority of these children had Attention Deficit Hyperactivity Disorder (35.7–36.2%), followed by Dyslexia (28.6–31.9%), Autism Spectrum Disorder (21.7–32.1%), and Developmental Delay (18.8–21.4%).

In addition, 65 children with disabilities were age- and gender-matched with 65 children without disabilities from the total sample (48 boys and 17 girls with a mean age of 8.4 years, *SD* = 1.7). Their demographic and clinical information are summarised in tables 1 and 2. The matched sample was used for the known-group comparison of this study.

Insert tables 1 and 2 about here

Measures

The PEM-CY includes 25 items that focus on the children's participation in board types of activities at home (10 items), at school (5 items), and in the community (10 items). It also has 45 items about the environmental impact on participation at home (12 items), at school

(17 items), and in the community (16 items) [28,29]. For each participation item, parents report how frequently their child has participated during the past four months (0 = never to 7 = daily), how involved the child is while participating (1 = minimally involved to 5 = very involved), and the parents' desire for change in their child's participation (yes or no; if yes, the parents can identify what kind of change is desired). For each environmental setting, parents are asked to report whether certain factors support/hinder their child's participation (1 = not an issue/usually helps to 3 = usually makes it harder) and whether supportive resources are perceived to be available (1 = not needed/usually yes to 3 = usually no). Six types of summary scores can be generated (table 3): three from the participation scales (frequency, involvement, and desire for change) and three from the environment scales (supports, resources, and overall environmental supports).

The original PEM-CY was designed as a parent-reported questionnaire that can be completed either on the paper or in a web-based format [28,29]. The paper form of the PEM-CY Chinese version was used and examined for its psychometric properties in this study. The PEM-CY was reported to have moderate to good internal consistency (Cronbach's α coefficients ≥ 0.59) and test-retest reliability (intraclass correlation coefficients ≥ 0.58) [28,30]. It has also been demonstrated that the PEM-CY is able to differentiate between the participation patterns and environmental factors of children with and without disabilities, which is evidence of its the known-group validity [28].

Insert table 3 about here

A demographic questionnaire was designed to obtain information about the children's gender, age, and types of diagnoses/disabilities as well as about the respondents' relationship with the children, age, educational level, and monthly family income.

Data analysis

Cronbach's α coefficients were calculated for the internal consistency of the items of the participation and environment scales. Cronbach's α values of ≥ 0.70 are considered acceptable [53]. Intraclass correlation coefficients were computed to examine the test-retest reliability. Values ≥ 0.80 indicate high reliability and values in the range of 0.50−0.79 represent moderate reliability [54].

The factorial structure validity was examined using confirmatory factor analysis (CFA). Specifically, the CFA of the PEM-CY Chinese version was conducted only for the frequency scale, because the frequency dimension of the participation represents an objective view of the participation, which is defined as 'being there' [55], and it has been investigated in other children's participation measures as evidence of the construct validity [21,56,57]. Thus, we examined three single-factor models of the participation frequency scales of the home, school, and community activities. We also examined three two-factor models (i.e., supports and resources) of the overall environmental supports scales of the home, school, and community. Because all the scales (including the frequency scales and overall environmental supports scales in the three settings) are ordinal instead of continuous scales, we used the diagonally weighted least squares estimator as it can handle categorical variables [58]. To test the data-model fit, four indices were used: the comparative fit index (CFI), Tucker-Lewis index (TLI), weighted root mean square residual (WRMR), and root mean square error of approximation (RMSEA). A CFI and TLI > 0.90, WRMR < 0.90, and RMSEA < 0.08 suggest an acceptable fit [59,60]. Among the fit indices, the CFI and TLI are both comparative fit indices that test the improvement of a proposed model compared to the null model (i.e., the model that assumes that all the variables are independent of each other). The difference between the CFI and TLI lies in the different treatments of the penalty of model complexity. The CFI uses the χ^2 statistic minus the degrees of freedom to adjust for the model complexity, whereas the TLI uses the χ^2 statistic divided by the degrees of freedom for the

adjustment. In addition, the WRMR and RMSEA are both absolute fit indices. The WRMR assesses the difference between the observed correlations and predicted correlations, whereas the RMSEA assesses how the proposed model deviates from the saturated model (i.e., the model that assumes that all the variables are dependent on each other) with an adjustment for the model complexity (using the degrees of freedom) [61,62]. High values of the CFI and TLI together with low values of the WRMR and RMSEA are in favour of the model fit.

For the known-group validity, independent *t*-tests were performed to investigate the differences in the participation patterns and environmental factors between the children with and without disabilities in the matched sample. Effect sizes (Cohen's *d*) were calculated to examine the magnitude of the differences. According to Cohen [63], a *d* value > 0.80 is considered large, 0.50–0.79 is considered medium, 0.20–0.49 is considered small, and 0–0.19 is insignificant.

Statistical Package for the Social Sciences version 20.0 (SPSS Inc., Chicago, USA) was used for all analyses except for the CFA, which was implemented using the lavaan package [64] of the R software. The level of significance was set at $p < 0.05$ for all analyses.

Results

Cultural adaptation of the PEM-CY in Chinese context

Table 4 summarises all the modifications made to the PEM-CY Chinese version after the forward translation, parents' cognitive debriefing interviews, and backward translation. At first, the research team deleted three culturally irrelevant examples and added 15 examples that are relevant to the Hong Kong culture after the two forward-translated versions were integrated. There were also eight examples that were replaced by culturally appropriate ones (e.g., changing the example 'hanging out' to 'killing time' in Item 8 of the community participation [*Getting together with other children in the community*]). These modifications were further discussed and approved by the PEM-CY team coordinator.

Based on the results of the parents' cognitive debriefing interviews, several unclear areas in the instructions and response options were modified. For example, the term 'things' was changed to 'items' in the instructions to make it more easily understood when asking parents to specify which environmental factors helped or made it harder for their child to participate in activities across all settings. In the frequency response options for the school participation, we also added the phrase 'school days' after the option 'daily' to specify only the days that the children are at school, rather than seven days a week. In addition, we removed three uncommon examples and added seven culturally relevant examples according to the parents' suggestions. The other three examples included descriptions that were unclear to the parents and they were replaced by more culturally relevant terms (e.g., changing the term 'service' to 'special service' in Item 13 of the school environment [*Policies and procedures*]).

Following the backward translation results, we identified two semantic discrepancies between the original and backward-translated versions. For example, as the term 'play' was not included in the PEM-CY Chinese version for Item 2 of the home participation (*Indoor play and game*) it was put back. The missing word 'building' was also inserted in the examples of Item 1 of the school environment (*Physical layout*). For Item 9 of the community environment (*Safety*), the concept of the example 'traffic' was backward-translated misleadingly to 'transportation'. Therefore, we elaborated in this example by using the phrase 'traffic situation' in Chinese to avoid this misconception.

Insert table 4 about here

Reliability

Internal consistency coefficients (i.e., Cronbach's α) were 0.63, 0.55, and 0.63 for the home, school, and community settings for the participation frequency scales; 0.72, 0.70, and 0.68 for the participation involvement scales; and 0.80, 0.82, and 0.85 for the desire for

change scales. Internal consistency coefficients were acceptable, ranging between 0.72 and 0.86, for all the environment scales.

Test-retest reliability estimates (i.e., intraclass correlation coefficients) were moderate to high for the participation frequency scales in the home, school, and community settings (0.73, 0.77, and 0.84, respectively) and for the desire for change scales (0.70, 0.72, and 0.81). High test-retest reliability estimates were found for the participation involvement scales (0.80, 0.83, and 0.80 for the home, school, and community settings). All the environment scales also had high test-retest reliability estimates across all settings: environmental supports (0.80–0.85), environmental resources (0.80–0.85), and overall environmental supports (0.85–0.89).

Construct validity

Before the CFA was conducted, the missing values in the datasets were inspected. We found that 15–34 (3.8–8.8%) of the 388 parents of children with and without disabilities did not provide 38–96 (0.82–2.45%) responses to specific items in one of the participation or environment scales across the home, school, and community settings. Considering the impact of the missing data on the CFA results, these responses with missing values were removed from each of the corresponding scales.

The CFA results showed that all the participation and environment scales had an excellent data-model fit (table 5), except for the participation frequency scale in the home setting (CFI = 0.72, TLI = 0.64, RMSEA = 0.07, and WRMR = 1.35). Therefore, we used the modification indices to improve the fit of the home participation frequency scale. Three pairs of item uniqueness were found to have overlapping concepts after the inspection, and their error terms were connected in the CFA re-run. These pairs of items were: Item 1 (*Computer and video games*) and Item 4 (*Watching TV, videos, and DVDs*), Item 1 and Item 6 (*Socialising using technology*), and Item 6 and Item 2 (*Indoor play and games*). The revised model for the home participation frequency scale showed improved fit indices, which were

acceptable (CFI = 0.95, TLI = 0.93, RMSEA = 0.03, and WRMR = 0.89). Figure 1 illustrates the final factorial structures (with factor loadings) of the home participation and environment scales as an example.

Insert table 5 and figure 1 about here

Significant differences were found between the children with and without disabilities for the participation frequency scale in the school setting and for the participation involvement scales in the home and school settings (see table 6). For example, the children with disabilities participated in school activities less frequently (mean = 3.6, *SD* = 1.3) than the typically developing children did (mean = 4.3, *SD* = 1.2). The participation involvement in school activities (mean = 3.7, *SD* = 0.9) and home activities (mean = 3.7, *SD* = 0.6) was also lower for the children with disabilities compared to the typically developing children (mean = 4.2 and 4.0 and *SD* = 0.8 and 0.6, respectively). No significant differences were identified for the participation frequency/involvement scales in the other settings and the desire for change scales in all settings. However, a significant effect of disability was observed across all the environment scales except for the environmental resources scale in the community setting. The parents of the children with disabilities reported lower environmental supports, environmental resources and overall environmental supports than the parents of the typically developing children (table 6). The effect sizes were small to medium (d = 0.20–0.68) for all the participation and environmental variables across all settings.

Insert table 6 about here

Discussion

By combining the participation and environmental factors in the same assessment, the PEM-CY enables rehabilitation professionals to identify and intervene directly in the environmental support/barriers in order to promote children's participation in daily life. In order to use the PEM-CY in the Chinese communities, this study developed the Chinese version and examined its psychometric properties in children with and without disabilities. We found that a few modifications were needed in the PEM-CY that involved adding or replacing activities that are relevant to the Chinese culture. The PEM-CY Chinese version was found to have acceptable internal consistency (except for the participation frequency scales) and moderate to high test-retest reliability. The CFA results demonstrated an acceptable data-to-model fit in all the participation and environment scales, after appropriate modifications were made in the home participation frequency scale. Significant differences between the matched pairs of children with and without disabilities were also found in the school participation scales and almost all the environment scales. These results provide evidence of the reliability and construct validity of the PEM-CY Chinese version, supporting its use for assessing the children's participation and environmental support/barriers.

The results of the reliability analyses showed that the PEM-CY Chinese version had lower internal consistency estimates in the participation frequency scales compared to the other participation and environment scales. This accords with previous findings for the original PEM-CY [28] and the other language versions [33]. Coster et al. [28] stated that high internal consistency was not expected for the participation frequency scales due to many influencing factors (e.g., preference, family values, or priorities) [55,65]. For example, if a child prefers to participate more often in one specific activity at home, he or she will spend less time on the remaining home activities. This situation could possibly result in the low intercorrelations between the participation frequency items which, in turn, affect the internal consistency [66]. On the other hand, the PEM-CY Chinese version showed moderate to high

test-retest reliability, which is similar to the original version [28]. This supports the temporal stability of using the PEM-CY Chinese version to capture children's participation and environmental factors over time.

This study is the first to examine the factorial construct validity of the PEM-CY using CFA. The results confirm the participation and environmental constructs as proposed by the original developers of the PEM-CY [28,29] across all settings, and provide new evidence for its construct validity. It is noteworthy that, in the analysis of the home participation scale, the acceptable data-model fit was achieved only after correlating the error terms among four items; that is, Item 1 (*Computer and video games*), Item 4 (*Watching TV, videos, and DVDs*), Item 6 (*Socialising using technology*), and Item 2 (*Indoor play and games*). These correlated error terms may suggest a lack of independence between these pairs of home activities. For example, there are three items regarding the use of electronic devices, such as a computer, television, and mobile phone for entertainment or socialising purposes. Engaging in indoor play/games may also involve socialisation using the technology given that mobile electronic devices are common nowadays. The connections between the electronic devices, play, and socialising may explain the interdependency of the children's participation in these home activities.

While the PEM-CY has been investigated for known-group validity [28,34,67], previous studies did not match children with and without disabilities in terms of gender and age, which may influence the children's participation [68-70]. The present study addressed this limitation by controlling for these two confounding variables. The results showed that, compared to gender- and age-matched typically developing peers, children with disabilities participated less frequently in the school activities and were involved less in the school and home activities. Particularly, children with disabilities were reported to have less environmental support and resources across all settings, strengthening the need for environment-based interventions to promote the children's participation [15-17,71]. The findings are consistent

with the original PEM-CY and provide evidence that supports the construct validity of the Chinese version. Unlike the original study [28], however, our study did not identify group differences in the children's community participation (frequency and involvement) or their parents' desire for change across all settings. Cultural influences could be one explanation for this discrepancy. In the Chinese culture, parents usually hope that their children will succeed and outperform others in their academic competence and personal growth [72]. Therefore, Chinese parents tend to put all of their efforts into their child, such as arranging many academic-related lessons and leadership activities in the community during out-of-school hours. Furthermore, Chinese parents tend to push their child a lot and set very high standards for learning [73]. This may explain why Chinese parents want to see a change that improves their child's participation in all types of activities, regardless of having disabilities or not.

Study limitations

This study has several limitations. First, the participating schools in this study were not selected randomly; therefore, the samples of children may not be representative of the Hong Kong population. Second, while the PEM-CY Chinese version was developed for children aged 5–17 years in the cultural adaptation phase, we validated it using children aged 5–12 years due to the limited access to secondary schools. Future studies are needed that examine whether the Chinese version can be used as a valid and reliable measure in children aged 13–17 years. Third, the current study did not compare the differences in the children's participation and environmental support/barriers in relation to other important child or family variables (e.g., the severity of the disability or type of family income). The participation involvement scales were also not examined for the factorial structures using the CFA in this study. As such, further evidence of the factorial structure and known-group validity of the PEM-CY Chinese version will be needed in future studies. Fourth, the PEM-CY Chinese version was culturally adapted only in the Hong Kong context. Further cross-cultural

adaptations in other Chinese contexts (e.g., mainland China, Macau, and Taiwan) should be conducted before this measure is used [74]. Lastly, the PEM-CY is a parent-reported questionnaire. As parents may interpret their child's participation differently from the child's self-perceived participation, the development of child-reported participation measures for direct use with Chinese children is warranted in future studies.

Conclusion

The PEM-CY Chinese version was developed through a cultural adaptation process. Its construct validity was established through a CFA and known-group comparison. Evidence for its test-retest reliability and internal consistency was also provided. Therefore, it is suggested that this measure can be used to assist rehabilitation professionals in assessing Chinese children's participation patterns across the home, school, and community settings as well as identifying environmental barriers that warrant intervention.

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Declaration of Interest Statement

The authors report no declaration of interest.

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Table 1. Demographic characteristics of participants

Characteristics	Total sample n (%)	Retest sample n (%)	Matched sample	
			Non-disability n (%)	Disability n (%)
Total number	388	55	65	65
Respondent				
Mother	293 (75.5)	42 (76.4)	45 (69.2)	50 (76.9)
Father	89 (22.9)	13 (23.6)	20 (30.8)	13 (20.0)
Guardian/Carer	6 (1.5)	0 (0)	0 (0)	2 (3.1)
Respondent age (year)				
39 and younger	165 (42.5)	15 (27.2)	30 (46.2)	27 (41.5)
40−49	185 (47.7)	36 (65.4)	28 (43.1)	33 (50.8)
50 and older	28 (7.2)	2 (3.6)	6 (9.2)	3 (4.6)
Missing	10 (2.6)	1 (1.8)	1 (1.5)	2 (3.1)
Respondent education				
Primary school or lower	4 (1.0)	1 (1.8)	0 (0)	1 (1.5)
Junior high school	42 (10.8)	5 (9.1)	9 (13.8)	9 (13.8)
Senior high school	178 (45.9)	24 (43.6)	26 (40.0)	32 (49.2)
Diploma/associate degree	44 (11.3)	8 (14.5)	9 (13.8)	8 (12.3)
Undergraduate	82 (21.1)	14 (25.5)	17 (26.2)	10 (15.4)
Postgraduate	24 (6.2)	2 (3.6)	4 (6.2)	2 (3.1)
Missing	14 (3.6)	1 (1.8)	0 (0)	3 (4.6)
Monthly family income				
< HKD $10,000	15 (3.9)	1 (1.8)	2 (3.1)	4 (6.2)
HKD $10,000–19,999	84 (21.6)	17 (30.9)	11 (16.9)	17 (26.2)
HKD $20,000–29,999	76 (19.6)	9 (16.4)	12 (18.5)	16 (24.6)
HKD $30,000–49,999	100 (25.8)	17 (30.9)	17 (26.2)	15 (23.1)
≥ $50,000	112 (28.9)	11 (20.0)	23 (35.4)	13 (20.0)
Missing	1 (0.3)	0 (0)	0 (0)	0 (0)
Child gender				
Male	229 (59.0)	31 (56.4)	48 (73.8)	48 (73.8)
Female	159 (41.0)	24 (43.6)	17 (26.2)	17 (26.2)
Child age (year)				
5.5–7.5	141 (36.3)	26 (47.3)	28 (43.1)	28 (43.1)
7.6–9.5	122 (31.5)	17 (30.9)	21 (32.3)	21 (32.3)
9.6–12.5	125 (32.2)	12 (21.8)	16 (24.6)	16 (24.6)
Child's disability				
Non-disability	319 (82.2)	27 (49.1)	65 (100.0)	–
Disability	69 (17.8)	28 (50.9)	–	65 (100.0)

Abbreviation: HKD, Hong Kong dollars.

Table 2. Parent-reported diagnosis/disability of children in the samples

Diagnosis/disability*	Total sample n (%)	Retest sample n (%)	Matched sample n (%)
Number of children with disabilities	69	28	65
Developmental delay	13 (18.8)	6 (21.4)	12 (18.5)
Autism spectrum disorder	15 (21.7)	9 (32.1)	15 (23.1)
Dyslexia	22 (31.9)	8 (28.6)	21 (32.3)
ADHD	25 (36.2)	10 (35.7)	22 (33.8)
Traumatic brain injury	1 (1.4)	0 (0)	1 (1.5)
Affective disorder	6 (8.7)	4 (14.3)	5 (7.7)
Intellectual disability	3 (4.3)	3 (10.7)	3 (4.6)
Learning disability	6 (8.7)	2 (7.1)	6 (9.2)
Hearing impairment	1 (1.4)	0 (0)	1 (1.5)
Vision impairment	1 (1.4)	0 (0)	1 (1.5)
Speech/language impairment	3 (4.3)	0 (0)	3 (4.6)
Health condition	5 (7.2)	2 (7.1)	5 (7.7)

* Parents can report multiple diagnoses/disabilities which their child has.

Abbreviation: ADHD, Attention Deficit Hyperactivity Disorder.

Table 3. List of summary scores of the Participation and Environment Measure for Children and Youth and the corresponding calculation methods

Section	Summary scores	Scales	Scoring	Score range
Participation	Frequency	8-point scale (0 = never to 7 = daily)	Mean of all ratings	0–7
	Involvement	5-point scale (1 = minimally to 5 = very involved)	Mean of all ratings	1–5
	Desire for change	No = 0 or Yes = 1 with five options for type of change desired	% maximum possible of activities in which any change(s) is(are) desired	0–100%
Environment	Supports	3-point scale (1 = 'usually makes harder' to 3 = 'usually helps' or 'not an issue')	% maximum possible of environmental supports to participation	0–100%
	Resources	3-point scale (1 = 'usually no' to 3 = 'usually yes' or 'not needed')	% maximum possible of environmental resources available for participation	0–100%
	Overall environmental supports	3-point scale (1 = 'usually makes harder or usually no' to 3= 'usually helps, usually yes, not an issue or not needed')	% maximum possible of all environmental supports and resources available for participation	0–100%

Note: % maximum possible indicates the percent of maximum possible that is calculated in four steps: (1) add all the ratings (or number of activities targeted); (2) calculate the maximum possible rating (or total number of activities rated); (3) divide the result of the first step by the result of the second step; and (4) multiply by 100.

Table 4. Details of the modifications of the instructions, response options, items, and item examples in the Chinese version of the Participation and Environment Measure for Children and Youth

Sections	Original version	Chinese version	Reasons for modification
Instruction of question C for all settings	Would you like your child's participation to change in this type of activity? IF YES, CHECK *ALL THAT APPLY*	Would you like your child's participation to change in this type of activity? IF YES, CHECK *MULTIPLE ANSWERS*	#To remind that respondents could select more than one option for desired change
Response options of question A for school setting	*Daily* Few times a week Once a week Few times a month Once a month Few times in last four months Once in last four months Never (skip to Question C)	*Daily (school days)* Few times a week Once a week Few times a month Once a month Few times in last four months Once in last four months Never (skip to Question C)	#To specify that the term "daily" refers to the days children are in school
Instruction for home environmental supports	Do the following *things* help or make it harder for your child to participate in activities at home?	Do the following *items* help or make it harder for your child to participate in activities at home?	#To make it easy to be understood
Instruction for school environmental supports	Do the following *things* help or make it harder for your child to participate in activities at school?	Do the following *items* help or make it harder for your child to participate in activities at school?	#To make it easy to be understood
Instruction for community environmental supports	Do the following *things* help or make it harder for your child to participate in activities in the community?	Do the following *items* help or make it harder for your child to participate in activities in the community?	#To make it easy to be understood

Home participation			
Item 2	Indoor *play and* games (e.g., playing with toys, puzzles, or board games, playing kitchen or dress-up)	Indoor *play and* games (e.g., playing with toys, puzzles, or board games, playing kitchen or dress-up)	†Added back the term "play" because it was omitted in the forward translation
Item 3	Arts, crafts, music, and hobbies (e.g., doing arts and crafts, listening to music, playing an instrument, collecting, *reading for leisure*, cooking for fun)	Arts, crafts, music, and hobbies (e.g., doing arts and crafts, listening to music, playing an instrument, collecting, *extracurricular reading*, cooking for fun, *gardening*)	#Replaced the example "reading for leisure" by "extracurricular reading" because the latter term is more commonly used in Hong Kong #Added the example "gardening" to fit the cultural relevance
Item 4	Watching TV, videos, and DVDs	Watching TV, videos, and DVDs *(e.g., using the TV, computer, cellphone, tablet)*	*Added these examples to fit the cultural relevance
Item 6	Socializing using technology (e.g., telephone, computer)	Socializing using technology (e.g., *cellphone*, telephone, computer, *social networking software*)	*Added the two examples "cellphone" and "social networking software" to fit the cultural relevance
Item 7	Household chores (e.g., *unloading/loading the dishwasher*, cleaning room or other areas of the house, cooking, taking out the garbage, setting the table, caring for household pet)	*Doing* household chores (e.g., *washing the dishes*, cleaning room or other areas of the house, cooking, taking out the garbage, setting the table, caring for household pet)	*Added the term "doing" to make it easy to be understood in Chinese *Added the example "washing the dishes" to fit the cultural relevance #Removed the example "unloading/ loading the dishwasher" because dishwashers are not commonly used in Hong Kong
Home environment			
Item 7	The attitudes and actions of babysitters, therapists, and other professionals who care for your	The attitudes and actions of babysitters *(or domestic helper)*, therapists, and other professionals	#Added the example "domestic helper" to fit the cultural relevance

	child at home	who care for your child at home	
School participation			
Item 2	Field trips and school events (e.g., going to a museum, the school fair, *spring concert* or play, dances, fundraisers)	Field trips and school events (e.g., going to a museum, the school fair, *concert* or play, dances, fundraisers)	*Removed the term "spring" before the example "concert" because there is no spring concert in Hong Kong culture
Item 4	Getting together with *peers* outside of class (e.g., *hanging out* during lunch, at recess, or other breaks during the school day)	Getting together with *classmates* outside of class (e.g., during lunch, at recess, or other breaks during the school day)	#Replaced the term "peers" by "classmates" because the latter term is commonly used in Hong Kong *Removed the term "handing out" in the example because it is redundant in Chinese expression
Item 5	Special roles at school (e.g., *lunch room supervisor*, student mentor)	Special roles at school (e.g., *class leader*, *discipline leader*, student mentor)	*Removed the example "lunch room supervisor" because it is not common in Hong Kong *Added two examples "class leader" and "discipline leader" to fit the cultural relevance
School Environment			
Item 1	The physical layout or amount of space in the classroom, on the playground, or on other parts of school premises (e.g., presence of sidewalks, availability of ramps or elevators in school *building*)	The physical layout or amount of space in the classroom, on the playground, or on other parts of school premises (e.g., presence of sidewalks, availability of ramps or elevators in school *building*)	†Added back the word "building" because it was omitted in the forward translation
Item 11	Access to public transportation to get to school (e.g., school bus, train, subway)	Access to public transportation to get to school (e.g., school bus, train, subway, *bus*)	*Added the example "bus" to fit the cultural relevance

Item 12	Programs and services (e.g., after school, recreational, special resources, *educational assistant/aide*)	Programs and services (e.g., after school, recreational, special resources, *teaching assistant/aide*)	*Replaced the example "educational assistant/aide" by "teaching assistant/aide" to fit the cultural relevance
Item 13	School-related policies and procedures (e.g., eligibility criteria for *services*, rules for behaviour)	School-related policies and procedures (e.g., eligibility criteria for *special services*, rules for behaviour)	#Replaced the term "service" by "special service" to make it easy to be understood and directed to certain kind of special services
Community participation			
Item 1	Neighborhood outings (e.g., shopping at the store/mall, going to a movie, eating out at a restaurant, visiting the local library/bookstore)	Neighborhood outings (e.g., shopping at the store/mall/*supermarket*, going to a movie, eating out at a restaurant, visiting the local library/bookstore)	#Added the example "supermarket" to fit the cultural relevance
Item 3	Organized physical activities (e.g., sports teams or classes such as baseball, hockey, martial arts, dance, horseback riding, swimming, gymnastics)	Organized physical activities (e.g., sports teams or classes such as baseball, *softball*, *basketball*, hockey, martial arts, dance, horseback riding, swimming, gymnastics)	*Added the two examples "softball" and "basketball" to fit the cultural relevance
Item 4	*Unstructured* physical activities (e.g., nature trail walks, bicycle riding, rollerblading, skateboarding, playing hide-and-seek or chase, playing *pick-up games* like basketball)	*Non-organized* physical activities (e.g., nature trail walks, *hiking*, bicycle riding, *ice skating*, rollerblading, *yoga*, skateboarding, playing hide-and-seek or chase, playing *passing games* like basketball)	*Replaced the term "unstructured" by "non-organized" for the ease of understanding in Chinese *Replaced the example "pick-up games" by "passing games" to fit the cultural relevance *Added the example "ice skating" to fit the cultural relevance #Added the two examples "hiking"

			and "yoga" to fit the cultural relevance
Item 6	Organizations, groups, clubs, and volunteer or leadership activities (e.g., *Boy Scouts*, *Brownies/Girl Guides*, youth groups, public speaking)	Organizations, groups, clubs, and volunteer or leadership activities (e.g., *scouts*, *girl scouts*, youth groups, public speaking)	*Replaced the example "boy scouts" by "scouts" to fit the cultural relevance *Replaced the example "brownies/girl guides" by "girl scouts" to fit the cultural relevance
Item 7	Religious or *spiritual* gatherings and activities (e.g., attending places of worship, religion classes, groups)	Religious or *belief* gatherings and activities (e.g., attending places of worship, religion classes, groups)	*Replaced the term "spiritual" by "belief" to fit the cultural relevance
Item 8	Getting together with other children in the community (e.g., *hanging out*, informal gatherings outside of the home or school)	Getting together with other children in the community (e.g., *killing time*, informal gatherings outside of the home or school, or *playing in the park*)	*Replaced the example "hanging out" by "killing time" to fit the cultural relevance #Added the example "playing in the park" to fit the cultural relevance
Item 9	Working for pay (e.g., *babysitting*, paper route, working in a store, doing chores or running errands for pay)	Working for pay (e.g., paper route, *private tutoring*, working in a store, doing chores or running errands for pay)	#Removed the example "babysitting" because it is not common in Hong Kong #Added the example "private tutoring" to fit the cultural relevance
Item 10	Overnight visits or trips (e.g., sleepovers, vacations, camp)	Overnight visits or trips (e.g., sleepovers, vacations, camp, *bivouac*)	*Added the example "bivouac" to fit the cultural relevance
Community environment			
Item 7	The attitudes and actions of other members of the community	The attitudes and actions of other members of the community	*Replaced the example "shopkeeper" by "shop workers" to

	towards your child (e.g., *shopkeepers*, instructors, coaches, other families)	towards your child (e.g., *shop workers*, instructors, coaches, other families)	fit the cultural relevance
Item 9	The safety of the community (e.g., *traffic*, crime, violence)	The safety of the community (e.g., *traffic situations*, crime, violence)	†Elaborated the example "traffic" by "traffic situations" to avoid the confusion with the term "transportation"
Item 14	Equipment or supplies (e.g., sports equipment, craft *supplies*, reading materials, assistive devices or technology)	Equipment or supplies (e.g., sports equipment, craft *materials*, reading materials, assistive devices or technology)	#Replaced the term "supplies" by "materials" to fit the cultural relevance

* indicates the modifications made after the forward translation

# indicates the modifications made after the parents' cognitive debriefing interviews

† indicates the modifications made after the backward translation

Table 5. Fit indices of confirmatory factor analysis in participation and environment scales

Setting (sample size*)	χ^2 (degree of freedom)	CFI	TLI	RMSEA (95% confidence interval)	WRMR
Home					
Participation frequency† (n = 373)	43.85 (32)	0.95	0.93	0.03 (0.00, 0.05)	0.89
Overall environmental supports (n = 361)	46.94 (53)	1.00	1.01	0.00 (0.00, 0.03)	0.78
School					
Participation frequency (n = 368)	42.54 (35)	0.98	0.98	0.02 (0.00, 0.05)	0.88
Overall environmental supports (n = 359)	118.93 (103)	0.99	0.99	0.02 (0.00, 0.04)	0.94
Community					
Participation frequency (n = 366)	8.37 (5)	0.98	0.96	0.04 (0.00, 0.09)	0.75
Overall environmental supports (n = 354)	117.14 (118)	1.00	1.00	0.00 (0.00, 0.03)	0.88

* The sample sizes were varied across the scales because of the removal of missing data.

† With three pairs of error terms correlated (Items 1 and 4; Items 1 and 6; and Items 2 and 6).

Abbreviations: CFI, comparative fit index; TLI, Tucker-Lewis index; RMSEA, root mean square error of approximation; and WRMR, weighted root mean square residual.

Table 6. Comparisons of participation and environment outcome between the matched pairs of children with and without disabilities

Settings with participation and environmental variables	Children with disabilities Mean (standard deviation)	Children without disabilities Mean (standard deviation)	*t*	*p*	*d*
Home					
Participation frequency	5.3 (0.9)	5.5 (0.7)	1.89	0.06	0.33
Participation involvement	3.7 (0.6)	4.0 (0.6)	3.27	<0.01	0.58
Desire for change	75.4 (24.3)	69.0 (26.9)	1.41	0.16	0.25
Environmental supports	87.7 (12.8)	94.0 (10.4)	3.07	<0.01	0.54
Environmental resources	78.7 (17.4)	85.7 (16.1)	2.40	0.02	0.42
Overall environmental supports	84.0 (12.8)	90.6 (10.8)	3.17	<0.01	0.56
School					
Participation frequency	3.6 (1.3)	4.3 (1.2)	3.18	<0.01	0.56
Participation involvement	3.7 (0.9)	4.2 (0.8)	3.74	<0.01	0.68
Desire for change	79.9 (24.7)	70.2 (34.2)	1.82	0.07	0.33
Environmental supports	93.3 (8.5)	96.4 (6.9)	2.26	0.03	0.40
Environmental resources	84.1 (11.3)	89.7 (10.2)	2.96	<0.01	0.52
Overall environmental supports	89.0 (8.0)	93.3 (6.9)	3.29	<0.01	0.58
Community					
Participation frequency	2.4 (0.9)	2.6 (0.8)	1.45	0.15	0.26
Participation involvement	3.9 (0.8)	4.2 (0.7)	1.82	0.07	0.33
Desire for change	65.4 (26.8)	55.4 (31.8)	1.89	0.06	0.34
Environmental supports	90.4 (11.8)	94.6 (10.0)	2.18	0.03	0.38
Environmental resources	81.8 (13.5)	84.6 (14.4)	1.14	0.26	0.20
Overall environmental supports	86.6 (9.8)	90.3 (9.1)	2.21	0.03	0.39

Figure Captions

Figure 1. Factorial structures of the participation frequency scale and the overall environmental supports scale in the home setting

Note: Three pairs of error terms were correlated between Items 1 and 4, Items 1 and 6, and Items 2 and 6 in the participation frequency scale.