CONTENT AND CONSTRUCT VALIDITY OF THE EARLY CHILDHOOD *PHYSICAL* ENVIRONMENT RATING SCALE (EC*P*ERS)[1]

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Abstract

The Early Childhood Physical Environment Rating Scale (ECPERS) has been designed to assess the quality of the physical environment of early childhood educational facilities. The purpose of the current research was to examine the content and construct validity of the scale. With regard to content validity, the vast majority of items (93%) in the scale were found to be important to very important by a diverse panel of 12 experts. Construct validity was measured as the degree of agreement between expert's global evaluation of a center and by using the 142-item ECPERS scale. The data from 13 experts assessing 13 different centers across Australia and New Zealand showed a very high correlation between expert's judgements and ECPERS score (r=0.85). The results indicate that ECPERS is a valid instrument for the measurement of the quality of the physical environment of early childhood centers relative to the potential for child development and learning.

Keywords: children/youth, child development, child care centers, educational facilities, architecture, psychometric assessment

Purposes of the Current Research

The purposes of the Early Childhood Physical Environment Rating Scale (ECPERS) are to reliably and validly assess the quality of the designed environment of early childhood education centers relative to child development and learning. The scale can also provide information for center managers, educators, policy makers, architects and parents for improving particular centers, can enable researchers to study more carefully the effects of the physical environment on children's development, and together with other documents can serve as a short-hand design guide for the design of new child care, preschool and other early childhood education centers or the renovation of existing centers. This paper reports on the results of a pair of studies examining the content and construct validity of ECPERS. Other results have been reported elsewhere (e.g., Moore, Hayata & Sivakumaran, 1997, 1999; and Moore, Sugiyama & O'Donnell, 2003).

Some Previous Research on the Designed Environment and Human Development

Research has found a positive effect of preschool and other early childhood centers on children's development. It is generally understood and accepted, based on extensive empirical evidence, that formal child care and preschool contributes to cognitive development for preschool children, and leads to greater intellectual competence and cognitive maturity for a broad range of middle-class Western children (cf. review in Moore, 1987; Weinstein & David, 1987). It is believed the same is true also for non-Western children, but less research has been conducted on this to date.

Past research has found that the planning and design of the physical environment of early childhood centers is also related to children's cognitive, social and emotional development. Research has found that smaller centers offer better quality childcare (e.g., Ruopp et al., 1979) and that density has an influence on aggressiveness, withdrawal and hyperactivity versus more positive development (e.g., Maxwell, 1996). Research also supports the benefits of small, private spaces to which children can retreat from action when they feel tired, overwhelmed or unhappy (e.g., Kirby, 1988; Lowry, 1993). From research from our own labs, we also know that architecturally well-defined activity settings contribute to more cognitive and social activities (Moore, 1986) and that modified open-plan centers further contribute to cognitive and social activities in contrast to either open-plan or closed-plan classroom facilities (Moore, 1987). Regarding outdoor spaces, adventure-type playgrounds have been found to be associated with more cognitive play while neighbourhood play settings have been found to be associated with more social play (Moore, Burger & Katz, 1979). The new EC*P*ERS scale is based on these and other empirical studies and expert opinion from many parts of the world on the effects of the designed environment on child development (cf. Moore, Lane, Hill, Cohen & McGinty, 1994).

Existing Scales: Review and Lessons

A number of scales are in existence for measuring childcare and early childhood education and are widely used around the English-speaking world. Examples include the NAEYC Accreditation Procedures (NAEYC, 1984), Early Childhood Assessment Profiles (Abbott-Shim & Sibley, 1992), HOME Observation for Measurement of the Environment (Caldwell & Bradley, 1984), Purdue Home Stimulation Inventory (Wachs, 1990), and Classroom Environment Scale (Trickett & Moos, 1995). The best known and most widely used family of scales for assessing the quality of curriculum, staffing, and other important aspects of early childhood care are the Infant/Toddler Childhood Environment Rating Scales (ITERS – Harms, Cryer & Clifford, 1990) and the Early Childhood Environment Rating Scales (ECERS – Harms & Clifford, 1980).

Despite the known significance of the physical environment in child development, review of all of these scales has indicated that none is adequately focused on the *physical* designed environment (Moore, 1994). For example, content analysis of ITERS revealed that out of 396 descriptors used in the scale, only 8.8 % pertain to the physical designed environment (Moore, 1994). Our research, therefore, has been focused on developing a new scale specifically focused on the developmentally relevant design qualities of early childhood educational environments.

Conceptualization, Organization and Development of EC*P*ERS

Conceptualization EC*P*ERS is based on an interactional-constructivist theory of child development and the environment (Moore, 1987). Following from this theory, the physical environment of early childhood centers may be conceptualised into several distinct parts – the site including outdoor play yards, the building, and inside what we have called the *common core* of shared, functional spaces surrounded by one or several more developmentally oriented *modules* comprised of activity spaces for children. Figure 1 illustrates these different architectural areas. In some centers, it may be difficult to "see" these conceptually distinct areas, whereas in others the clarity is evident, but we would argue based on our earlier research that the better early childhood education centers are implicitly organised along these lines.

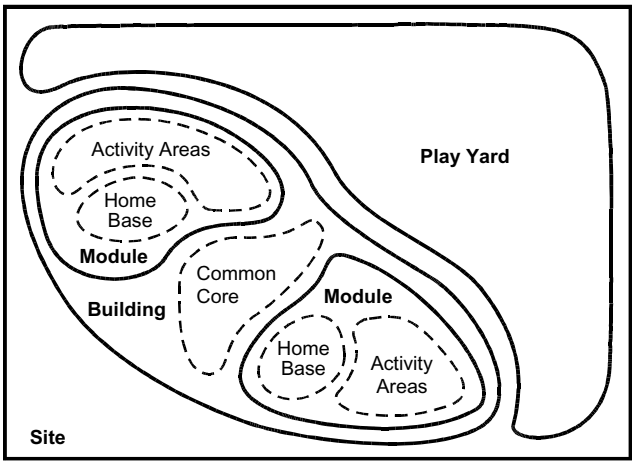

Figure 1. Conceptual diagram of the ideal organization of an early childhood center

The common core includes shared facilities like reception, office, staff room, adults' toilets, kitchen, laundry and often a shared multipurpose gym – the functional "core" to the building. Each module refers to a separate set of spaces for children. Small centres may only have one "module," whereas larger centers will have several modules. The modules may be adjacent, interconnected or entirely freestanding buildings on the same site, and sometimes are called "houses," "wings" or "pods." Each module is often divided into what we have been calling a "home base" and "activity areas." The home base provides for children's basic needs, such as eating, sleeping, toilets, diaper changing and storing personal belongings. The activity areas provide spaces for the children's developmentally related play and learning activities.

Organization. As shown in Table 1, ECPERS is divided into four parts, each of which has one or more subscales. Part A focuses on the overall planning of a center. Part B is concerned with the architectural quality of the building as a whole vis a vis those aspects of architectural design related to childhood development. Part C assesses the module in which children spend most of their time in the center. Part D evaluates the site of the center including the outdoor play/learning areas. At the beginning of this phase of the research, ECPERS consisted of 151 items.[3]

To evaluate a center using ECPERS, a rater indicates how well the center satisfies each item in each subscale. The response format is a series of 5-point Likert-type items assessed from "Not Met" (score of 0) to "Fully Met" (4). Some items ask about the existence of particular spaces in the center, the rater choosing from "No" (0), "Shared" with other functions (2), or" Yes" exists as a distinct area (4). Figures 2 and 3 show examples of items from two of the 11 subscales.

Table 1. Organization of the EC*P*ERS Assessment Scale

Part	Subscale	No of items
A Planning	1 Center Size and Modules	6
B Building as a Whole	2 Image and Scale	7
	3 Circulation	6
	4 Common Core of Shared Facilities	12
	5 Indoor Environmental Quality	9
	6 Safety and Security	12
C Indoor Activity Spaces	7 Modified Open-Plan Space	9
	8 Home Bases	11
	9a Quiet Activity Areas	13
	9b Physical Activity Areas	17
	9c Messy Activity Areas	16
D Outdoors Spaces	10 Play Yards	15
	11 Location and Site	12

Image and Scale		Not Met				Fully Met
2.1	The exterior of the center appears non-institutional and welcoming (e.g., single story, pitched roofs, verandas, use of wood, brick and stone not concrete blocks or large expanses of glass, etc).	0	1	2	3	4
2.2	Children can see some indoor children's activity areas from outside before entering the center (e.g., windows between inside and outside along the entrance path, etc.).	0	1	2	3	4
2.3	The scale of the interior appears small and cosy (e.g., low ceilings, low hanging lights, low windows that children can see through, low openings between adjoining spaces, etc).	0	1	2	3	4
2.4	The interior finishes appear welcoming and natural (e.g., use of carpets, warm colors, soft lighting, curtains, etc).	0	1	2	3	4
2.5	Furniture is child height (e.g., bookcases, display shelves, tables, chairs, etc).	0	1	2	3	4
2.6	Toilets, basins and mirrors used by children are child-height.	0	1	2	3	4

Figure 2. Sample EC*P*ERS Items in the "Image and Scale" Subscale

Music Area		No		Shared		Yes	NA
9b.6	The center (or module being evaluated) has a music area for infants.	0		2		4	☐
9b.7	The center or module has a music area for toddlers.	0		2		4	☐
9b.8	The center or module has a music area for preschoolers.	0		2		4	☐
		Not Met				Fully Met	NA
9b.9	The music area is spatially and acoustically separated from other activity areas (e.g., partitions, partial acoustic panels, partial walls, heavy curtains, etc).	0	1	2	3	4	☐
9b.10	The music area has appropriate furnishings and storage (e.g., open display shelves for instruments, etc).	0	1	2	3	4	☐

Figure 3. Sample ECPERS Items from the "Music Area" Subscale

After all subscales are completed, a subscale score is calculated as a mean of the applicable items in the subscale. If the center has several modules, some subscales are used to assess each module. The total score for the center is total of the subscale scores.

Development. The subscales and items that comprise ECPERS were developed and refined through an iterative research process of analysis and feedback following the model of Alreck and Settle (1995). The process involved item analysis based on theory and the latest research, validity checks with experts, cross-instrument review and several stages of field testing. The development phases were conducted in Milwaukee, USA (Moore, Hayata & Sivakumaran, 1997, 1999) and later in Sydney, Australia (Moore, O'Donnell & Sugiyama, 2002; Moore, Sugiyama & O'Donnell, 2003).

Validity Testing

The validity testing reported here involved field testing of ECPERS in a variety of settings across Australia and New Zealand. Two types of validity were examined: content validity and construct validity. Content validity is the extent to which a test or measure provides an adequate representation of the conceptual domain it is designed to cover, i.e., the degree to which the items are judged valid by experts in the field. Construct validity refers to the extent that the scale as a whole adequately measures the quality of the physical environment of early childhood centers. Following the precedent of validity testing for the ECERS family of scales using convergent evidence (Clifford et al., 1989), the agreement between experts' assessments of centers using different sets of criteria was collected as a measure of convergent construct validity.

Content Validity

Method. To confirm whether the set of items included in ECPERS accurately represented the subject matter, a panel of experts reviewed the scale. Twelve leading experts from diverse parts of Australia, all highly respected for their knowledge of early childhood centers, were identified from a Delphi technique by successive networking among experts in the field. They were invited to assess the 151 items in ECPERS. The panel included four architects experienced in the design of early childhood centers, two early childhood researchers, three center directors and three child care center regulators.

The experts were evaluated each item in ECPERS in terms of its importance in childcare environments. An item was deemed important if it were considered to be relevant to the physical, cognitive and social development of children or to the safety, security and wellbeing of children and staff. The response format was a 5-point Likert-type scale ranging from "Not Important" (0) to "Very Important" (4).

Results. The results from the experts' assessment indicated a very high degree of support for the items in ECPERS. Table 2 shows the frequency of expert ratings. As seen from the third through sixth columns, frequencies for score 3 and 4 ("important" and "very important") accounted for 75.0% of total responses, 78.0% of valid cases that do not include "no responses" and 80.4% of valid cases excluding one outlier. This is comparable to the results Clifford and colleagues reported on their validity test of ITERS (Clifford et al., 1989), shown in the last column. In their study, just five experts rated the importance of 35 items in ITERS on a 5-point scale. Frequencies of rating equivalent to score 3 and 4 totalled 86.2% of their cases. It is interesting to note, however, that the raters of ECPERS rated considerably more of the items of ECPERS as "very important" than did the earlier raters of the ECERS family of scales (57.9-60.9% versus 48.5%, ie, approximately 10 points higher for ECPERS).

Table 2. Frequency of Expert Rating by Score

Score	No of ratings given	Percent	Valid percent	No of ratings without outlier	Valid percent without outlier	ITERS by Clifford et al (1989)
0	90	5.0	5.2	20	1.2	0.6
1	57	3.1	3.3	57	3.6	2.3
2	235	13.0	13.5	235	14.8	10.9
3	310	17.1	17.8	310	19.5	37.7
4	1049	57.9	60.2	969	60.9	48.5
No response	71	3.9	na	70	na	na
Total	1812	100.0	100.0	1661	100.0	100.0

It can be seen that the score 0 ("not important") was given 90 times, 5.2% of the cases in the current study. In Clifford et al. (1989), the frequency of the lowest score was only 0.6% of the total cases. This seems to suggest that the expert panel considered some items in ECPERS not as important as those in ITERS. However, most of the cases of score 0 were given by one particular expert (70 cases). This result suggested that this expert has markedly different values about the significance of the physical environment in early childhood centers from any of the other experts on the panel. Considering that the other experts scored 0 less than twice per expert, it is legitimate to regard this expert as an outlier (Hair et al., 1998). If we disregard the assessments by the outlier, the frequency of score 0 is 1.2%, very comparable to ITERS.

The Table 3 item analysis indicates the distribution of average rating scores of items across 12 experts. Average

score of the items ranged from 1.5 to 4.0. This table shows that slightly more than 40% of the total was considered "very important" by most of the experts, receiving the highest possible ratings between 3.5 and 4. Another half of the items were regarded as "important," an average score between 2.5 and 3.5. Thus a total of 90.7% of the raw items and 93.4% of the items (excluding the outlier) were considered "important" or "very important." However, the experts considered 14 items in the scale relatively less important with an average rating between 1.5 and 2.5. No items were judged by any of the experts to be totally unimportant (i.e., no scores between 0 and 1.5).

Table 3. Distribution of Average Rating of Items

Range of average score	No of items	Percent	No without outlier	Percent without outlier
0.0 – 0.5	0	0.0	0	0.0
0.5 – 1.0	0	0.0	0	0.0
1.0 – 1.5	0	0.0	0	0.0
1.5 – 2.0	4	2.6	2	1.3
2.0 – 2.5	10	6.6	8	5.3
2.5 – 3.0	34	22.5	21	13.9
3.0 – 3.5	40	26.5	55	36.4
3.5 – 4.0	63	41.7	65	43.1
Total	151	100.0	151	100.0

We refined the scale based on these results. Of the 14 items that have average score between 1.5 and 2.5, six items were discarded from the scale. The other eight items in this level were kept in the scale because we had continuing reasons to believe they are relevant to the development of children, but they were modified in the light of the experts' feedback. Because of this modification, the total number of items was reduced to 145.

Construct Validity Testing

Method. To assess construct validity, we contacted thirteen different experts highly knowledgeable about early childhood centers in Australia and New Zealand. They included six researchers in early childhood education, six professional educators involved in the education and management of early childhood centers and one internationally highly experienced architect in the design of child care and educational facilities. .

The experts were asked to assess a variety of centers in three ways. In Part I, each expert was asked to do a site visit of a designated center and make an overall evaluation of the physical environment of the center based solely on his or her knowledge and experience, ie, they were not lead in any way. The response format was a 9-point linear numeric scale ranging from "*Very poor design for children*" (0) to "*Excellent design for children*" (4) (using whole numbers and half-way points in between). In Part II, each expert judged the same center using thirteen single-item criteria, corresponding to the thirteen subscales of EC*P*ERS. In this case, the response format was a 5-point numeric scale. Finally, in Part III, each expert was asked to use the full 145-item EC*P*ERS to assess the same center. In order to insure independence of the three assessments, they were instructed not to advance to the next part, each sealed in a separate envelope, until they had completed the earlier part and sealed it away.

As mentioned above, EC*P*ERS was modified in an iterative process of development, field-testing and further refinement. After the content validity testing, we conducted three phases of inter-rater reliability testing (to be reported separately), during which some additional items were deleted or merged. At the time of the construct validity testing, EC*P*ERS consisted of 142 items.

Results. The results showed substantial agreement between experts on the three separate assessments. Figure 4 is a scatter diagram showing the relationship between Part I scores (experts' overall assessment) and Part II scores (average of the thirteen items). Figure 5 is a diagram showing the relationship of Part I and III scores (EC*P*ERS). The Pearson correlation coefficient between Part I and II was 0.89 ($p < .01$), and between Part I and III was 0.85 ($p < .01$).

The overall construct EC*P*ERS aims to measure, i.e., the quality of the physical environment of early childhood centers relative to child development and learning, is quite complex and comprised of many different aspects. The strong and highly significant correlation between Part I and II indicates that the 13 criteria included in EC*P*ERS represent this comprehensive construct quite well. The strong and highly significant correlation between Part I and III means that the items in EC*P*ERS as a whole measure the quality of the physical environment very well relative to a range of experts' assessments.

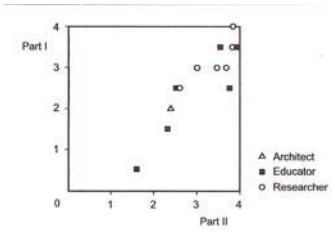

Figure 4. Scatter Diagram of Experts' Overall Evaluation (Part I) and the Average Score of Thirteen Items (Part II)

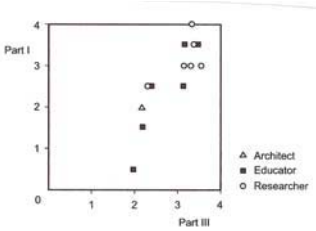

Figure 5. Scatter Diagram of Experts' Overall Evaluation (Part I) and the Total Score of EC*P*ERS (Part III)

It might be asked how the respondent types (the experts) and their backgrounds affected the results statistically. Using experts from different professional backgrounds certainly affected the results, but for the scale to be valid, it needs to be considered valid by different types of experts. Table 4 indicates how the responses varied based on background differences of the experts, especially the correlations between Parts I, II and III between different professions. This table shows that correlation coefficients were lower for researchers (especially between Part I and III). This may suggest that the implicit criteria the researchers

employed in making their global overall assessing of a center were slightly different from those included in EC*P*ERS. However, the low correlation may also be ascribed to characteristics of particular centers the researchers visited. As Figure 4 and 5 illustrated, the range of researchers' scores was narrower than that of the educators. As found later from their responses, the researchers visited mostly high score centers, and the lack of variance among these centers may have contributed to somewhat lower correlations. Although it is difficult to determine for sure what caused the difference between these two groups, the choice of the centers may have some relevance in this regard.

Table 4. Correlation Coefficients between the Three Assessments

Combination	Total (n = 13)	Researcher (n = 6)	Educator (n = 6)
Part I and Part II	0.89**	0.81	0.90*
Part I and Part III	0.85**	0.61	0. 90*

*: $p < .05$ ** : $p < .01$

Figure 5 shows that the range of total scores using ECPERS (ie, Part III) is smaller than that of the score on Part I. The ECPERS scores ranged from 1.97 to 3.54, while the experts' overall evaluations ranged from 0.5 to 4.0. This might imply that ECPERS tends to be less sensitive to the changes in the quality of the physical environment. The reason for this phenomenon may be that a number of items in ECPERS changed very little across centers. Of 142 items of ECPERS, eleven items (8%) were assessed identically or varied only 1 point on a 5-point scale across 13 centers. These items deal with very basic features of childcare environment such as safety and security, child-size furniture, and flexibility of activity areas. Because of the importance of these factors, all the centers evaluated were in a very good condition on these items. These constant items may have contributed to a smaller variance of the total score of ECPERS. In general, a scale needs to be comprehensive and cover all relevant items. However, a dilemma is that including all such items, some of which could be the same across centers, may lead to a scale that is less responsive to the difference between centers.

Nevertheless, using the three-way assessment method developed for this research, construct validity testing found significantly high agreements between different assessment procedures by a range of international experts. The results suggest that the scale, the subscales, and items in the subscales accurately represent salient physical characteristics of early childhood educational environments.

Conclusion

The current phase of research found that ECPERS has very high content and construct validity. The results indicate a high degree of cross-expert support for the vast majority of items in the scale. A total of 93.4% of the items were judged as important to very important by an international panel of experts, with only 6.6% of the items deemed as relatively unimportant and none as totally unimportant. The construct validity testing also identified a high correlation coefficient (0.85, $p < .01$) between experts' overall judgement of centers and scores using the full and much more detailed 142-item ECPERS scale. Together with other results to be reported about inter-rater and test-retest reliability, these results were used to further refine the Early Childhood Physical Environment Rating Scale before formal release.

While the main purpose of the current research is refining of the ECPERS scale and the assessment of its content and construct validity, it was suggested in the introduction that the scale may serve, together with other documents, as a type of short-hand design guide for the design of new centers or the modification of existing centers. The 142 items of the scale each describes in detail one research-based, specific, and easily interpreted design criterion to achieve in any developmentally oriented child care, preschool, kindergarten or other early childhood education center. Not only do the 142 items suggest good criteria around with a program or brief can be based, but the assessment scale can be used by center directors, principals, parent groups and others to do a quick assessment of preliminary designs presented for such centers, demanding changes as appropriate to the designs before final documentation and construction. The scale can also be used as a powerful tool in any post-occupancy evaluation of early childhood education centers, which could lead to briefs for renovation or more minor design interventions.

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(Footnotes)

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3 The final size is shorter due to changes in the instrument based on the results of the current research.

Figure 5. Scatter Diagram of Experts' Overall Evaluation (Part I) and the Total Score of ECPERS (Part III)

Figure 4. Scatter Diagram of Experts' Overall Evaluation (Part I) and the Average Score of Thirteen Items (Part II)