

Designed Environments for Young Children: Empirical Findings and Implications for Planning and Design¹

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Young children learn through interaction with their physical, social, and cultural environments.... Among the most critical design considerations are the amount and organisation of both indoor and outdoor areas. Research studies confirm that limited space and poorly organised space negatively affect child and staff behaviours. (Australian Early Childhood Association, 1996, p. 1)

This paper focuses on advances in understanding of the nature of developmentally appropriate architecture for preschool children. The Honourable Laila Horne (2001) in her earlier keynote paper highlighted the UN Convention on the Rights of the Child and the importance of quality in pre- and after-school programs including kindergartens. This paper expands on that theme. It will draw upon my own and others' research over some 20+ years in an attempt to highlight principles and patterns for the design of early childhood centres² including child care centres, nurseries, nursery schools, preschools, kindergartens and other forms of centres catering for development needs of preschool children.

Developmental Outcomes of Early Childhood Education

The developmental outcomes of childcare and preschool education are an important issue for educational authorities and society. Although possible negative effects of out-of-home care continue to be a concern in some quarters, the overall research conclusion is that in the vast majority of cases significant gains accrue in cognitive, social and emotional development as a result of quality preschool programs (Cost, Quality & Child Outcomes Study Team, 1995; National Institute of Child Health and Human Development, 1995; Phillips, 1987). Several factors have been found to make a difference in children's development, among them staff training, curriculum, group size and adult-child ratios (Ruopp, Travers, Glantz & Coelen, 1979). These results have now generally been implemented in the best quality preschool, childcare and early childhood centres around at least the developed world.

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² The types of centres we have studied and about which this paper is focused are called by different names in different parts of the world, eg., early childhood centres and kindergartens in New Zealand, childcare centres, preschools and kindergartens in Australia, child care or sometimes even day-care centres in the United States and parts of Canada, etc. I prefer names that focus on the nature of early childhood and development, and will use the terms *early childhood centres*, *early childhood development centres* (ECDCs) and *early childhood environments* somewhat interchangeably in this paper.

A commonly accepted definition of *quality* in preschool education is the ability and characteristics of the overall environment to address the developmental needs of the children attending (Australian Early Childhood Association, 1996; National Association for the Education of Young Children, 1985; Phillips, 1987).

In most of the research and policy literature the quality of child care and preschool programs is referred to in terms of the social and organisational environment, such factors as administrative policies, health and safety, qualifications and training of staff, staff-child ratios, curriculum and programming (eg, Australian Council of Social Welfare Ministers, 1993). There is now no doubt these are critically important aspects of the quality of early childhood education.

Impacts of the Physical Planned and Designed Environment

Previous research – including some we have published – has now indicated that the physical planned and designed environment *also* has an impact on a range of developmental behaviours (Evans, Kliewer & Martin, 1991; Gump, 1975; Johnson, Muirhead & Hierlihy, 1993; NICHD, 1995; Phillips, 1987; Prescott & David, 1976). Our own research has demonstrated that the quality of the physical planned and designed environment of early childhood centres has an impact specifically on cognitive and social developmental behaviours (Moore, 1986, 1987).

While the primary variables in the overall quality of care are the number of children, child-adult ratios, curriculum and the belief system of the teachers (NICHD, 1995), it is now also known that higher quality preschool education particularly in the social and cognitive spheres occurs when the architecture is appropriate (eg, Moore, 1986, 1987). In short, the quality of preschool education is in part related to the quality of the architecturally planned and designed physical environment.

Our research has looked at a number of early childhood centres in the United States and at a wider range of centres and their associated outdoor play areas across the United States and Canada. The research has mostly been quasi-experimental in design (in particular post-test-only control group designs with multiple levels of treatment and proxy pretest measures – cf. Moore, 1986 for details). It has been conducted in a range of early childhood centres designed differently from each other along design dimensions described below. We have looked at a range of observed behaviours including child-initiated vs staff-directed behaviours, exploration, social interaction, cooperation and competition, aggression and affection, type of staff involvement and type of staff-staff interaction. Data have been collected using systematic naturalistic observation and detailed environment-behaviour observation schedules. The data generally have been analysed by analysis of covariance controlling for subject group differences between the different types of design centres remaining after quasi-experimental matching between children, staff and centre philosophies.

In one study we looked at the effects of different degrees of *spatial definition* of behaviour settings on these social and cognitive developmental outcome variables – that is, we studied the impact on these social and cognitive developmental variables of spatially well defined or poorly behaviour settings or different activity centres, holding constant as best we could all other variables constant (Moore, 1986). In another study we looked at the effects of open-plan, closed-plan or what we have been calling *modified open plan* facilities on the same range of cognitive and social developmental variables (Moore, 1987). For this pair of studies,

centres were selected that differed in terms of their basic plan type (closed, open and modified open plan facilities) and a different set that differed in terms of the spatial definition of activity settings (well-defined, poorly defined and in-between). Within each set, centres were selected that were the same or similar in terms of size, socioeconomic background of the children, educational philosophy of the centre, and teacher styles of interaction with children, all of which were subsequently measured to permit statistical verification of equivalence or nonequivalence. Where minor differences remained, as they always will in quasi-experimental research designs, the remaining differences were covaried out of the way through the statistical analyses done, i.e., remaining subject-group differences were statistically controlled.

Other studies, done by other researchers, have looked at the effects of child-care centres vs family day-care homes, at centre size and group size, at density of children to the amount of space available and at the effects of a range of what I might call technical design features like acoustics, indoor climate control, lighting, floor surfaces, wall surfaces and colour (summarised in Moore, 1987).

From these studies, taken together, we now know much about the impact of the planning and designed physical environment of early childhood centres on cognitive and social outcome behaviours. In particular we have found the following:

- Exploratory behaviour is more frequent in family day-care homes, whereas numerical and art activities are more frequent in formal child-care centres (Prescott, 1973; Prescott & David, 1976).
- Overall centre size is a good predictor of program quality – smaller is better (Prescott, Jones & Kritchevsky, 1967/1972). In centres of more than about 60 or 75 children, emphasis tends to be placed on rules and routine guidance, play areas tend to be low on organisation, variety and amount of things to do per child, and children are less interested or enthusiastically involved in comparison to smaller centres (corroborated in Cohen, Moore & McGinty, 1978).
- In larger centres, again those over 60 or a maximum of about 75 children, children around 2 years of age appear to be and are reported by caregivers to be overwhelmed by the numbers of staff and even just the size of the space (Cohen *et al.*, 1978).
- The overall judgment of a number of well-respected researchers is that centres of 60 to 75 children are best, both for the children and for the staff (Prescott *et al.*, 1967/1972; Travers & Ruopp, 1978; summarised in Cohen *et al.*, 1978, pp. 410-412). This obviously has implications for overall centre size, and is represented in legislation, licensing requirements and accreditation standards in many places around the world.
- Small groups also work best, that is the size of the group in which children spend most of their time while in childcare has important developmental impacts on the children. In smaller group sizes, eg, those under 14 children per group, children show more verbal initiative, more reflective behaviour and more task-focused behaviour (Travers & Ruopp, 1978). Children in the smaller groups also make more developmental gains as measured on standard developmental tests (Travers & Ruopp, 1978). These findings are well known, and also have obvious implications for the size of rooms, activity

centres or pockets and many other aspects of the spatial layout of early childhood centres.

- Child-caregiver ratios are also known to have marked impacts on young children – again, not at all surprisingly, as less often is more. Child-caregiver ratios impact most markedly on infants (Travers & Ruopp, 1978; Belsky, Steinberg & Walker, 1982) and somewhat less for older preschoolers (O’Conner, 1975). This also has implications for the amount of space needed and the size of activity centres, i.e., just the right size for one teacher and a small number of children to be engaged in a developmental activity.
- Decisions about group size, child-caregiver ratios and density have implications for the spatial organization and design of childcare facilities (Moore, Lane *et al.*, 1979).
- Density – the number of children to a space – has massive effects on social behaviour (higher density leads to more aggression and destructive behaviour; Rohe & Patterson, 1974) but has little effect on social and intellectual performance and achievement (Weinstein, 1979).
- A number of technical design features have been found to be related (correlated) to positive child outcomes, eg., good acoustics, good indoor climate control, good lighting, non-slippery floor surfaces and soft wall surfaces and warm colours (reviewed in Prescott & David, 1976).
- A high level of interior noise from which a child cannot escape is negatively related to cognitive development (Wachs, 1976; Wachs, Uzgiris & Hunt, 1971).
- The greater the impact of exterior noise on children, eg., from nearby roadways, freeways or airports, the poorer is their auditory discrimination and reading test scores (Cohen, Glass & Singer, 1973). Furthermore, exterior noise leads to lower academic performance, lower reading scores, and “learned helplessness” on cognitive tasks (Cohen, Evans, Krantz & Stokols, 1980).
- The availability of a room or a space to which a child can escape from too intense stimulation – what Wachs (1976) called a “stimulus shelter” and we have called a space for retreat and refuge (Moore *et al.*, 1979/1996) – is a strong predictor of later cognitive development.
- Significantly more engaged behaviour or task-focused behaviour (in contrast to random, withdrawn or transitional behaviours) occurs in spatially well defined behaviour settings and activity centres than in spatially poorly defined settings (Moore, 1986).
- Well-defined behaviour settings combined with an open style of education reinforce each other in jointly leading to more engaged behaviour (Moore, 1986).
- Significantly more exploratory behaviour is directly related to the degree of spatial definition of activity centres, that is, better spatially defined activity centres lead to greater degrees of exploratory behaviour (Moore, 1986).

- When activity pockets in an early childhood centre are well defined and resource rich, children engage in activities more on their own without the need for staff involvement; more staff involvement is needed in poorly defined spaces and those with less resources (Moore, 1986).
- The highest degree of social interaction and significantly more positive social interactions (cooperation and affection vs competition and aggression) also occurs in spatially well defined behaviour settings and activity centres than in spatially poorly defined settings (Moore, 1986). Again interaction effects have been found, such that we now also know that cooperative behaviour is more pronounced in well-defined setting staffed by teachers with strongly open styles of education (Moore, 1986).
- Teachers are also more involved with children in active ways (co-action and encouragement, in contrast to passive observation or controlling behaviour) in centres having spatially well defined activity pockets (Moore, 1986).
- Children in modified open plan early childhood facilities (that is, buildings where space is organised into a variety of large and small activity spaces open enough to allow children to see the play possibilities available to them while providing enough enclosure for the children to be protected from noise and visual distractions) – children in modified open plan facilities use significantly more activity settings than in either open- or closed-plan facilities, that is, they move around more, engaging in different activities through the day more than in the other two plan types (Moore, 1987).
- Children are in smaller group sizes in modified open plan facilities (Moore, 1987).
- Engagement in cognitively oriented behaviours is more pronounced and children are more deeply immersed in cognitively oriented behaviours in modified open-plan centres, while random behaviour (no sustained activity) is most prevalent in open-plan centres and transitional behaviour (moving between activities) is more prevalent in closed-plan centres (Moore, 1987).
- Children initiate behaviours themselves significantly more often in modified open plan centres (Moore, 1987).
- Exploratory behaviour is significantly more pronounced in modified open plan centres than in either of the two other major plan types (Moore, 1987).
- Centre size is also related to exploratory behaviour, with children exploring more in smaller than larger centres (Moore, 1987).

Taken together, these findings from a number of studies point out that the quality of the planned and designed physical environment does have marked and significant impacts on a range of cognitive and social developmental outcomes.

The findings from these studies, and certainly from our own studies, support a Piagetian-type group x setting interactional theory of child development. That is, the findings support that a number of strictly social factors lead to developmental gains (group size, staff-child ratios, curriculum, the belief system of the teachers and staff training, among other factors) *and* that a number of physical environmental factors also lead to important developmental gains

(centre size, density, noise levels, stimulus shelters, definition of activity setting, modified open plan type, etc) *but also* that there are important and positive interactions between the socioeconomic level of the child, the philosophy of the centre, the educational style of the teacher *and* the physical designed environment in affecting social and cognitive development.

Implications for Planning and Design – Principles for the Planning and Design of Quality Early Childhood Centres

I hope it is now obvious that these findings have massive implications for how we should be planning and designing the environments of early childhood education – how we can aid through good planning and good architectural design the quality of early childhood care, education and overall development.

In addition to these hard empirical findings, there is a wealth of expert opinion that we and others have tapped over the years about other more-than-likely impacts of the physical designed environment on early childhood development (see, for example, Moore *et al.*, 1979/1996). While in strict scientific terms these must be considered as working hypotheses, many of which are as yet not formally tested, they are still the collected wisdom of many experts and keen observers in the field from various places around the world.

Taking together the hard empirical data and findings with the best of expert opinion, over the years we have developed a series of planning and design guidelines for the building of early childhood developmentally oriented centres (eg., Moore *et al.*, 1979, 1996; Moore, Friendly & Rubin, 1995; cf. also the series of articles in *Child Care Information Exchange* between July 1996 and March 1998 – see Sources of Additional Information at the end of this paper). Over 250 different recommendations, first presented in a pair of fairly widely disseminated reports (each the size of a telephone book), have been organised into a smaller set of some 16 or so principles for the planning and design of quality early childhood centres.

The rest of and paper will focus on just 10 of these principles for the architecture of early childhood development. Discussion will focus around three major categories of principles, with examples shown of buildings that exemplify the principles:³

- ***Neighbourhood Planning – The Neighbourhood Hub Model***
 - ***Network of early childhood development facilities*** – A comprehensive child care program can be composed of family child care, group care centres for larger numbers of children (perhaps as large as 60-75 children), and other child and family resources at the hub of a neighbourhood hub model.

Insert Figure 1 about here⁴

³ On the evening before this keynote paper was presented, I was invited to give a talk at the Dunedin College of Education to early childhood educators from the city and region. My thanks to Dr Judith Duncan for organising that seminar. The following day I visited three early childhood centres and kindergartens in Dunedin. On entering one, I was delighted to be told by the director that she had attended the earlier evening's presentation, had met with her senior staff that morning to discuss the implications and had already identified three design things they were going to do to improve their centre. I hope this paper will influence others to consider how they might renovate or expand their facilities and influence the planning and architectural design of new facilities.

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- ***Favourable location for early childhood centres*** – The best location for early childhood centres is in the home neighborhood or at the workplace. Appropriate proximities must be considered – accessibility, away from busy roads, away from noxious or dangerous elements, close to natural features, close to community resources, and a large enough site to accommodate the building and a variety of play yards. An ideal location can be on the seams between neighbourhoods.

Insert Figure 2 about here

- ***Building size*** – How large should the centre itself be? Evidence summarised above from the U.S. National Day Care Study found that the size of group in which children spend most of their time in childcare is a very good predictor of quality--smaller is better. We recommend that early childhood centres should accommodate no more than 60 to 75 children (25 to 40 would be much better developmentally). The space needed is 9-10 m²/child [100 gross square feet GSF/c] for the building, and another 9-10 m²/c [100 GSF/c] for outdoor play yards, drives, drop-offs and set-backs.

Insert Figure 3 about here

- ***Building Organisation***

- ***Village- or campus-plan concept: Identifiable houses around a common core*** – For centres serving over 60-75 children, and even for ones in the 60-75 range, the building can be decomposed into "houses" (pavilions/modules) of, preferably, 25-40 children each. Each house best serves mixed-age groupings (from infants through the oldest preschoolers) where the staff moves with the children. Each house is large enough to have all the activity pockets necessary for developmentally oriented care of these children, its own separate entrance, immediately adjacent play yards, and its own identity. Houses may be clustered around a common core of shared facilities – some indoors, some outdoors or a combination of the two.

Insert Figure 4 about here

- ***Modified open plan space*** – Each house can be spatially organized in terms "modified open space." Not to be confused with the totally open plan of the 1960s, with all its problems, nor with the double-loaded corridor of many primary schools, a modified open plan is a creative compromise that combines the best of both while minimising the limitations of each. It is composed of semi-enclosed/semi-open age-appropriate

⁴ The actual figures are in the published version; please see M. Gallop & J. McCormack (Eds.), *Children and Young People's Environments*. Dunedin, New Zealand: University of Otago, Children's Issues Centre, 2002. Pp. 53-63.

activity pockets, utilizing half walls, open archways, glazed or unglazed windows, etc. between different pockets. Modified open space is ideal for mixed-age groupings and for mixed-age houses where age groupings are kept somewhat separate--our research has shown that it maximizes child-child interaction, sharing, participation, cooperation, and supportive staff-child interactions ... centred around ...

Insert Figure 5 about here

- **Home bases for 12-16 children** – At the heart of each house is a home base where children come at the beginning of the day, end of the day, for lunch, potty breaks, and whenever they need a hug or some down time. Each home base serves the mixed-age family groupings of the entire house. It includes the cubbies, a small kitchenette, an eating cluster, intimate diapering areas/learning bathrooms, separate napping areas as needed, and perhaps a quiet reading-listening area ... each surrounded by ...

Insert Figure 6 about here

- **Resource-rich activity pockets** – Surrounding each home base is a cluster of resource-rich activity pockets (primary activity spaces), one for each of the developmentally oriented activities for each age group in that house. Three to four activity pockets can be clustered together, each sized for 2-5 children plus a caregiver. Each activity pocket has a sense of closure, but has cross visibility and is easily visible by an adult. Each pocket has all the teaching materials, displays, and work/play surfaces necessary for that activity. Examples of the great variety necessary: block area, art studio, music corner, science corner, reading/listening area, sand/water play, etc. Depending on predilection, and applicable child care licensing regulations, these resource-rich activity pockets may be grouped by age (some for infants, toddlers, and older preschoolers), or may be age mixed ... and all in an appropriate ...

Insert Figure 7 about here

- **Residential scale: Home as a template for early childhood centres** – Early childhood development centres are not just scaled down schools. For a variety of good reasons, the elementary school is not an appropriate image, template, or precedent for child care centres. Child care centres can be patterned after the prevailing residential imagery and scale of nearby houses – with residentially scaled roofs, materials and design details that are compatible with the best residential quality in the community, vegetation and landscaping, a covered friendly-face entry, enclosed yards, back-yard-sized play areas, etc. – in general, the building as a friend.

Insert Figure 8 about here

- ***Outdoor Activity Spaces***

- ***Indoor-outdoor connections*** – Progressive childcare programs are run outdoors as much as indoors (weather permitting). No longer the elementary school model of learning indoors and "recess" outdoors, the developmentally appropriate activities of the best child care programs are held equally outdoors as indoors. Thus the need for wonderful visual and movement connections between in and out--low windows, wide doorways from each house, etc.

Insert Figure 9 about here

- ***Developmentally appropriate play yards*** – Child care centre play areas can be modeled after back yards, with resource-rich activity pockets zoned appropriately and linked by clear circulation. The scale is that of typical back yards. The diversity of activities is the same as inside (e.g., not only gross motor playing areas, but also intimate reading/listening areas, a garden and perhaps a greenhouse, several quiet areas for nurturing fantasy play, and so on). The same design principles apply as apply inside--immediate indoor-outdoor connections, separate entries to each play area, organized per modified open space, with resource-rich activity pockets for different activities, appropriate zoning, and clear circulation which overlooks.

Insert Figure 10 about here

Conclusion and Current Research

Many of these design principles are supported by the empirical research summarised earlier in this paper on the relation between child development and the built environment. Others are based on studies conducted of child care centres overseas and on our experience advising and working with child care centres, their directors and staff over the past 15 years in Canada, the US, Australia and northern Europe. This combination of empirical research and reflective professional practice leaves us quite convinced that these – and other – design principles are absolutely critical for the success of any centre-based child care centre.

Based on the research presented in this paper, we currently are developing and validating a set of systematic scales for measuring the quality of the architecture of early childhood environments (called the Children's *Physical Environment Rating Scales* – CPERS) based on these principles (see Moore, 1997; Moore, Hayata & Sivakumaran, 1997, 1999; and Moore, O'Donnell, Hayata, Lee & Sugiyama, 2002).

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