

Measuring the Built Environment for Children

Theoretical Perspectives

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INTRODUCTION

Capturing and measuring qualities of the built environment is a fundamental aspect of planning. Planners need to develop a vivid picture of the physical and social environments people inhabit in order to understand what impacts their plans and actions may have. Measures can indicate the built environment's qualities and represent them in a way that is useful for planning to address particular issues and problems. One issue that is currently receiving much attention in planning is the place of children in urban and urbanising environments (Mitchell et al 2007; Handy et al 2008; Lim and Barton 2010; Giles-Corti et al 2011). Noted in this research is that the relationship children share with urban environments is distinct from that of adults in many ways. If planners are to accommodate children in their plans or design plans specifically for children, measures of urban quality and the built environment need to reflect the needs and capacities of children.

This paper is based on the understanding that what planners measure, how it is measured and how measures are used to inform planning plays an integral part to contributing to healthy and safe environments for children. What goes on when we measure and how measures work, needs to be understood in order to be open to possibilities of creating better methods and practices. The purpose of the paper is to explore both the nature of built environment measures and explore their normative aspects, establishing possible avenues for improvement. It will do this by first establishing the role of and looking at a number of issues related to the use of built environment measures in planning. A detailed look at how measures are constructed will follow and ideas from planning theory will be drawn upon to suggest approaches of improving measures. The approach is based upon a review of existing built environment measures in urban planning research; literature on the nature of the human-environment relationship; and methodological discussions on measurement.

CHILDREN AND THE BUILT ENVIRONMENT

The built environment, as referred to here, represents the public spaces and local environments that children inhabit. It incorporates transport systems; the structures and spatial patterns of different land uses; and the form and design of urban areas (Frank and Engelke 2001; Handy et al 2002). Children's local environments have been found to contain places for a range of activities (Tranter and Pawson 2001). Unstructured play outside the home can provide multiple benefits for children such as higher rates of physical activity; developing sense of risk and independence; and can serve a social learning function for children by providing opportunities for interaction with other children. Places have been described as 'restorative' and sources of escape and mental health for children (Kytta 2004; Milligan and Bingley 2007). Regular trips, such as the trip to school, have potential health benefits and engender autonomy and agency amongst children (Ross 2007). Children who engage in active travel by walking or cycling to school are likely to have higher rates of physical activity, and therefore a lower risk of obesity, than those who are driven (Faulkner et al 2009). The ability of children to independently access these activities is an important issue underlying most of these activities and opportunities.

Research has found that rates of children's independent mobility and active travel have been declining (Hillman 1990; O'Brien et al 2000). This decline has implications for children's health through a drop in physical activity levels and associated increase in risk of obesity (Mackett et al 2005). Children may also miss out on opportunities to access social networks, develop a sense of civic responsibility and that their basic rights to access the public realm may be compromised (Chawla 2002). Lower rates of children's mobility have also been said to compromise sustainability objectives. Children's participation in the spatial public realm and the processes that plan and design it is aligned with social aspects of sustainability (Tranter and Pawson 2001). Furthermore, the increase in reliance on motorised transport associated with declining rates of children's independent mobility and active

travel has been said to conflict with the environmental objectives of sustainability (Freeman and Quigg 2009).

The built environment has been found to influence children quality of life in several ways. It has been linked to the extent of children's independent mobility and freedom to access place on their own or with friends (Veitch et al 2006; Kerr et al 2007; Handy et al 2008). Built environment factors that were identified as possible enablers of play in public open space included the presence of challenging and interesting play equipment; a clean and visually appealing park; and facilities that support activities such as basketball and skateboarding (Veitch et al 2007). Street network design has been found to influence both children's independent mobility and outdoor play, for example children living in cul-de-sacs are involved in more outdoor play due to the parent's perception that these places were safer than streets with greater connectivity (Handy et al 2008). Therefore, in order to understand how a particular area's characteristics influences the quality of children's lives and plan for positive changes, the ability to identify and measure in detail the built environment elements is important.

WHAT ARE BUILT ENVIRONMENT MEASURES?

Measures here are broadly defined as aspects and qualities of the built environment that are captured and represented in ways that can be of use to planning. Measures can capture the density of urban areas; the connectivity of streets; the distance and accessibility of services to residents; the quality of pedestrian or cycling infrastructure; the aesthetics and comfort of public spaces; and so on. Measures are likely to play a key role in the diagnosis, indication and analysis of urban problems. Southworth (2003) links the ability to quantifiably measure the qualities of the built environment as key to managing and monitoring changes within the built environment. Measures that frame analysis and present information can contribute to the development of impact assessments (environmental, social and health); neighbourhood auditing tools and have recently been developed as publicly available web based measures (Walkscore 2011); indicators; and indices to rank different areas.

Planning for these elements can be understood for a number of spatial scales. Planning at the regional scale can have significant impacts upon the quality of children's lives, for instance the influence of school location policies on residential catchment accessibility (Inouye and Berry 2008); community design (Napier et al 2010); and the location of new housing subdivision in relation to other activity centres (Wilson et al 2010). Measures used to understand human behaviour within the built environment at this scale are based on distance; population and housing densities; land use mix ratio; employment densities; and the amount of retail floor space (Owen et al 2007). Some of these measures are often used as proxies for other built environment qualities, for example the walkability of a neighbourhood being represented in a measure of density (Ker et al 2007).

Measures commonly used at the regional scale may not adequately reflect the finer grain built environment elements that influence the everyday experience of children. Children's independent mobility is achieved primarily by walking and cycling and is experienced at an intimate scale of the neighbourhood. Qualities of place and the perceptions of safety and comfort afforded at this scale may have more influence on children's everyday lives than regional scale measures. Capturing the finer grain built environment elements that are influential on children requires attention paid to the experiential nature of children and their everyday worlds. Children's lives viewed at this scale are constituted by complex social and behavioural relationships. Measures such as those reflecting the distances children are required to travel need to be supplemented with additional measures that indicate the quality of routes and places in respect to their safety and aesthetics and the overall desirability and acceptability to be mobile in certain locations.

Several measures specific to children have been developed in order to better understand the qualities of children's lives in relation to the built environment. Giles Corti et al (2011) captured street connectivity or accessibility of the residential catchment to primary schools in Western Australia and the exposure to traffic along the route. Pont et al (2010) developed a model of children's active travel requiring a consideration of the characteristics of the child and their family; parental perceptions; children's perception; physical and economic environmental factors; and active travel outcomes. Other measures focus on places relevant to children including the size, content, location, quality and signs of use within different playgrounds (Jansson and Persson 2010). These measures have addressed important aspects of the built environment influential to children's everyday lives. However, more can be done.

ISSUES FOR DEVELOPING BUILT ENVIRONMENT MEASURES FOR CHILDREN

Many methods of measuring the built environment approach the human and built environment relationship as something that is fixed and objective. Yet the relationship between humans and their environments is dynamic and 'relational'. Corburn (2009) understands this relational perspective to involve the interdependence of the physical and social characteristics of people's environments and that meanings of the built environment are actively constructed through the social interactions of those living within in it. The relationship has been described as simply as considering people and environments 'together in a common realm' rather than separate physical and mental realms (Chawla and Heft 2002). The interaction between these social and physical contexts confounds efforts to establish objective measures of the built environment because how children relate to the environment is context dependent and ever changing.

Valid measures may require that attention be paid to the meanings that are constructed within particular social and built environment contexts. However, the consideration of context raises some vexed issues for the development and use of built environment measures for children. Geographical difference has been offered as an explanation as to why established built environment concepts do not translate well to a variety of different contexts (Evenson 2009). Contextual problems have been identified in choosing appropriate methods, analysis of data and translating analysis into policy recommendations (Caughy et al 2001). It has been suggested that measures be tailor made to the specific purposes and contexts in which they are needed (Moudon and Lee 2003; Clifton et al 2007; Schaefer-McDaniel et al 2010). There is little guidance, however, on how to go about developing measures. The reliability of evidence for informing policy and planning interventions is challenged by the need to generalise findings and the suggestion that measurements may need to be adapted to research contexts. Processes and protocols have been developed to add consistency to the collection of measurement data and contribute to a robust evidence base by reducing the variability of findings across research (Forsyth et al 2006).

Understanding the interaction between children and the environment is problematic for further reasons. According to Lim and Barton (2010) children use cognitive processes to leverage meaning from their environment, implying that children are active agents in creating a sense of their place in the environment. Furthermore, children have been found to be active negotiators in the "licences to travel" imposed on them (Mitchell et al 2007). Jones (2000) uses the metaphor of the permeability of boundaries, physical and symbolic, to explain that rigid spatial boundaries limit children's freedoms and that permeable boundaries allow children's agency and the formation and reformation of their geographies. Meaningful representations of the relationship between children and the built environment therefore need to be fluid in response to the influence of context and agency.

The elements that the built environment affords children can be significantly different to that of adults and may require new ways of measuring and evaluation. Hart (1979) found that children value and engage in the built environment in a way that is significantly different to adults. Children have been found to subvert the 'adult-centred' intended use of space and objects and instead appropriate built environment elements in alternative ways. Jones (2000) and Kytta (2004) describe the polymorphic spaces that can accommodate a range of alternative uses built environments afford children. Jones (2000) found that children reconfigure adult space by disregarding adult's routes by using short cuts and also may be unaware of sharply adult defined boundaries signifying property ownership.

Creating positive environments for children in the urban environment requires attention be paid to the meanings of their current everyday lives and also the possibilities of that are unknown to them. Moss and Petrie (2002, 9) refer to the children's spaces as "environments of many possibilities" that "presume unknown resources, possibilities and potentials". Focussing on the normative aspect of measuring and attempting to improve the way measures may allow children to access these resources, possibilities and potentials. The normative aspects of measures can be addressed by viewing critically the assumptions built into measures and understanding the way problems are framed and valued.

THE STRUCTURE OF BUILT ENVIRONMENT MEASURES

In order to develop measures of the environment that address issues of context dependent meanings and children's agency and to be open to the possibility of better developing and adapting measures for children a closer look at the structure of measures is helpful. The following section will discuss

three key parts of measures, these being the concept that is being measured; the tools that are used to measure it; and the way the measures are represented.

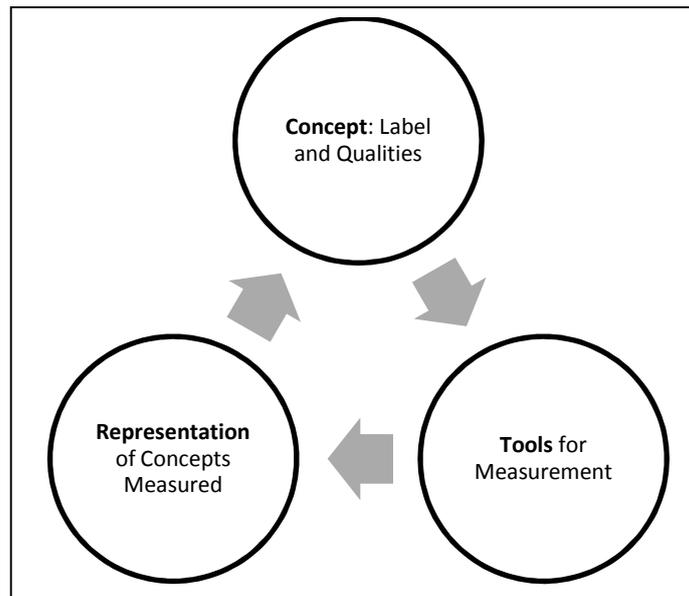


Figure 1: Structure of Built Environment Measures.

Concept

The development of concepts related to the human/built environment relationship is an essential part of measuring. There are two aspects of the concept that require consideration: the label and its qualities or variables. The label is what is being measured. Common concepts of the built environment related to the children quality of everyday lives are labelled as accessibility; proximity to locations; safety; and places to play. Once concepts are identified they need to be operationalised and the elements that are most associated with concepts identified. To operationalise a concept abstract ideas are made measurable through identifying relevant qualities or variables. For example Pikora et al (2003) in a pedestrian and cycling spatial measure (SPACES), operationalise safety by distinguishing between personal and traffic safety. Personal safety is influenced by the presence of street lighting and the passive surveillance of the street. Traffic safety is influenced by the number of crossings, the presence of crossing aids, and the width of verges.

It is important to note that there is an unstable relationship between the label that we assign the concept and the variables that operationalise it. Mair (2008) draws upon Gallie's (1956) notion of 'essentially contested concepts' to illustrate that concepts may be agreed upon in the abstract or at the level of labelling but contested when defined by variables and attributes. This means, for example, that the safety of the children's environment may be agreed upon as an influential element in children's lives. However levels of disagreement may occur when establishing the characteristics of what a safe environment is. Does a safe environment mean one that is separated from motor vehicles; or is it one that allows open surveillance of the street; or one that has richer social networks or sense of place so that children feel they can go somewhere when they feel unsafe? Importantly Mair goes on to add that this recognition of the distinction between the label of the concept and the attributes that define the concept does not mean that concepts should be freely defined. Rather the development and assumption that makes up concepts requires openness to challenges to legitimacy and justification for inclusion. In developing built environment measures for children, effort must be paid to the way concepts are defined and who gets to define them.

Measurement methods and tools

Various methods and tools, each with distinct qualities and limitations, are employed to capture qualities of the built environment and transform them into useable knowledge. Brownson et al (2009) categorises the means of measuring the built environment as perceived, self-reported measures elicited through surveys of users; systematic environmental audits; and geographic information

systems (GIS). Each of these measures, all used in research on children in urban environments, has their own strengths and weakness. Surveys incorporate important perceptual and attitudinal knowledge of users, but do not represent measures of the physical environment. Systematic environmental audits are usually carried out by a number of auditors who identify, itemise and/or evaluate areas like streets or parks. These capture the fine grain qualities of physical elements yet are resource intensive. GIS uses detailed data sets to create multi-layered maps that are effective at measuring such concepts as distance and proximity, area and demographics data.

Some researchers go on to separate measures into tools and methods of gathering subjective or objective data about the built environment (Lin and Moudon 2010). However, the boundary of what constitutes objective and subjective measures is not clear. Surveys are distinguished from systematic observational or field audits, as the former elicits perceptual and subjective data while the latter gathers objective counts and identification of physical objects. Field audits can also involve perceptions of field auditors when evaluating aspects of built environment qualities such as the aesthetics of streetscapes. Perceptual biases and messiness of interpretation are addressed through tests of the reliability and consistency of findings across auditors (Pikora et al 2002).

Representation

Finally, measures represent knowledge in certain ways. Concepts such as safety, 'sense of place', and 'proximity' are transformed into representations of knowledge that can be used by planners, researchers, or the public in advocating for change. Representations of measures are important to planning for the built environment because "...plans put representations to use forming intentions that help us tame complex situations (Hoch 2009, 221)." Representations are a key link between the world of research and analysis and the world of planning, policy and action.

Some common representations of built environment measures are quantities, including indices, scales or rankings; indicators; and visual representations and maps. Measures that represent concepts as quantities are useful to understanding and planning for the built environment. Variables represented as quantities are incorporated into statistical analysis, whether for exploratory or descriptive purposes or for interrogating causal chains between variables. Indices play an important part in ranking environments according to various qualities representing complex information in a simple quantity (Gilles Corti et al 2011). GIS offers creative ways in which measures can be represented through inclusion of ethnographic and qualitative material, such as sketches and photographs, into geographic maps (Santo et al 2010).

THEORETICAL POSSIBILITIES: CONTEXTS AND BUILT ENVIRONMENT MEASURES FOR CHILDREN

Considering that built environment measures for children will need to be adapted to a range of planning situations and contexts, a better understanding of how measures work and how they can improve is necessary in order for planners to reflect in practice. The issue of addressing the particulars of context that planning practice occurs in has been explored in the domains of collaborative and pragmatic planning theoretical thought (Hoch 2009; 2002; Healey 2009; Bertolini 2010). According to pragmatic theories of planning understanding problems within the context that they occur is essential to developing plans to address them. Bertolini (2010, 416) suggests planning's engagement with multiple stakeholders and the uncertainty inherent in future conditions and pathways requires "reflection in action" and planning requires "an evolutionary process of *variation* (of moves, frames and names) and *selection* (through reflection)." Hoch (2002, 66) suggests that the quality of plans should be evaluated 'critically and contextually' with practical reasoning and "without the confinement of rational precision, fit, principle and expertise". Adaptation, evolution and learning are inherent in the process of making plans. Plans are made in response to problems rooted in contexts and therefore need to heed both the general and particular nature of the problem. Plan-making involves practical judgement in the appraisal of problems, comparison of alternatives and selection of responses (Hoch, 2009).

Central to these theoretical domains is the issue of the "problem". For example, the "problem" central to this paper could be defined as the concern children's rates of participation and mobility within the built environment are declining, exposing children to a number of risks to their health and well-being and limiting their freedom to participate fully in society. The way problems are defined determines the solutions available to us. For example Sutton (2008, 539) notes that policy discourse associated with

children's play in public spaces has been framed either as a child's right; as a child's resource; or as a problem due to anti-social aspects. Consequently, policy responses towards each different way of framing the problem were characterised as contradictory and conflicting. Understanding the way issues are framed and constructed as problems is an essential part to choosing appropriate measures.

The way that measures are constructed contributes to the framing of problems. The knowledge and assumptions that are incorporated into measures are linked to the qualities of the consequences of plans created. Measures provide a framework for building our understanding of issues and problems. Projects that use built environment measures will most likely use a range of rationales to guide the selection of concepts to be measured and the means in which they are best measured. The Delphi process guides decisions through a series of surveys of an expert panel (Pikora et al 2003; Brennan-Ramirez et al 2006). Feedback on the group's findings is usually provided and panel members are invited to revise their findings. The strength of the method is that it can draw out alternative viewpoints and stimulate debate (Masser and Foley 1987). Delphi processes and expert panels allow more abstract and subjective concepts to be grounded in expert consideration and have been used to operationalise built environment concepts such as transparency, imageability and enclosure (Ewing and Handy 2009). However, these approaches may be exclusive of processes that include children's contextualised knowledge and normative concerns of self-determination and participation in the planning processes that influence them. They rely almost solely on expert knowledge and are not sensitive to meanings about the built environment that may be actively constructed by children within the contexts they live. Children's participation in determining the concepts, tools and representations of built environment measures may better addresses these normative concerns.

DISCUSSION

Adapting or designing measures for particular problems require consideration be paid to both the structure of measures and the specific contexts that they will be used. Recognition of unstable and contestable aspects of measuring, such as determining concepts or the evolving technological capacity of measuring instruments, opens possibilities for developing the normative aspects of measuring. The separation of the label and the qualities that make up the concept is one example. Assigning built environment qualities to the labelling of concepts is an important part of framing a problem. For example measuring and evaluating a park for the design of play equipment, the amount of recreational space and whether there is natural surveillance by surrounding housing will contribute to the way the quality of play areas is framed. The issue of play is reframed when the number of vacant lots for children to play in, informal spaces and the quality of skate parks are instead measured. The unstable relationship between the label and qualities, represented in the notion of the 'contestable concept' discussed above, allows the opportunity for self reflection and revaluing by those who will be most affected by the measure. This enables children's participation and ownership of the process of framing the problems relevant to them.

Flexibility within the way measures are organised may be necessary in order to respond to a range of contexts, though how flexibility can be incorporated into measures has not been investigated. Drawing from theoretical discussions within planning, two possible means are apparent. The first is related to allow participation in developing measures and therefore the way problems and issues are framed in specific contexts. A second means occurs through the weighting of concepts the opening of possibilities for the participation of children in measuring their environments.

Participation in designing the structure of measures can involve children and other relevant agents actively in the processes that construct their worlds. It can also provide additional insight into achieving the research objectives. Contextual particularities may be identified through access to children's local knowledge of an area (Hoehner et al 2006). Kytta (2004) suggests that children's participation in the planning and design of the built environment may influence the number of actualised affordances of children and may improved the relationship between existing affordance and children's own preference of affordances. Participation also allows the opportunity to develop a sense of efficacy, civic competence and provide children with a sense of ownership in the research process that may lead to richer data (Checkoway and Richards-Schuster 2003). Children's participation in the selection and formation of concepts and in the measuring process increases the capacity for measures to be contextually relevant.

Weighting of the concepts being measured is a further way that the value of measures can respond to contexts. Weighting allows for reflection on the values associated with what is measured and

discriminates between measures that may be valued more highly than others. Beyazit (2011) notes that concerns about social justice use the issue of weighting criteria as a way of improving a distributive evaluation of transport projects and planning. Children have the capacity as competent social actors to reflect on values and make choices accordingly (Holloway and Valentine 2000). Lim and Barton (2010) categorise three levels of children's environmental understanding. Contextualised understanding refers to the richer layers of social and cultural meaning that children perceive that the built environment affords them. Comprehensive understanding means that children perceive the environment in their own terms and meaning is informed by their own experience. Finally, critical understanding involves children seeing positive and negative aspects of the built environment and being able to conceptualise how it could be constructively changed. Despite this weighting of measures has commonly been done through a process of expert panels or at the researcher's discretion. A process in which children can reflect, possibly deliberate and assign more importance to certain elements allows planners and researchers to incorporate the values directly into planning.

A further issue for developing measures is that existing measures may reflect traditional practices and assumptions that do not match emerging trends and new knowledge. Level of service measures originally used to indicate the road capacity for motorised vehicles were originally applied to measure the qualities of pedestrian environments (Moudon and Lee 2003). However, it was found that this way of measuring was not suitable for non-motorised transport as pedestrian travel is usually under-utilised and capacity constraints were unlikely to be relevant. Jansson and Persson (2010) found that long established standards for playgrounds in Sweden, led to large numbers of monotonously designed places that risked an overall decline in use through lack of interest. The designs that were influenced by standard measures of suitable location, size of play areas and the content were not seen to be relevant or interesting to the needs and desires of modern children.

Consideration of planning context in which measures are used also needs to be responsive to emerging technologies or changes to capacity to measure. Theories within GIS about the nature of reality and representation are particularly useful as they focus attention on how spatial and built elements are measured and what happens when they are measured in order to change them or plan for them (Pavlovskaya 2006). GIS practices are being radically altered by the incorporation of web-based methods that create the potential for public participation in the creation of data for GIS. Technology can play a role in democratising the planning process by opening up avenues for participation in framing problems and the design of plans (Sieber 2006). Children have been the focus of these emerging practices (Dennis Jr 2006; Santo et al 2010). New emerging web applications facilitate the inclusion of greater volumes of user generated data into measurement tools (Rantanen and Kahila 2009; Rinner et al 2008). Technological advances are not necessarily positive though and new opportunities provided by technological change will be laden with new power dynamics that must be critically examined. Increased participation into the plan-making process elicited by fast evolving technologies must therefore be open to the emerging positive and negative issues of power.

CONCLUSION

Measures of the built environment are required when researching, planning and designing spatial changes to the built environment to better accommodate children. They can inform indicators of urban quality; identify areas that need improvement; rationalise and direct budgets; focus attention of research; provide leverage for community groups to advocate for change; and inform monitoring of the implementation of interventions. This paper has approached improving measures of the built environment for children by considering two key aspects. Firstly, the key elements of measuring were identified as the concept, consisting of a label and variables or qualities assigned to the label; the tools that are used to measure; and the way measures are represented. Within these three aspects there are 'contestable' and unstable characteristics, for example the assignment of variables to the concept and the developing nature of technologies and methods of measuring. Paying attention to each of these parts allows planners to be reflexive, improving and adapting measures to particular situations and contexts. The second aspect addresses the normative aspects of measures for children. It considers how measures can incorporate values that improve children's capacity to engage meaningfully in their everyday realm (Chawla and Heft's 2002). Allowing children's participation and developing their capacity to engage in defining problems, selecting measures and weighting of concepts within the contexts that measures are used creates possibilities for developing a shared understanding and decision-making for urban areas. Developing an understanding of these two aspects of measuring of built environment quality may assist in measures that better reflect and contribute to positive developments in children's everyday lives.

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