Urban Habitat and Health: Understanding Children's Exposure to their Outdoor Physical Environment in Urban Areas

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Introduction

Northern spotted owls require old-growth forest; salmon require freshwater habitat with cool, clean water, woody debris, and appropriate water depth; and an endangered European butterfly requires heterogeneous early successional stages of deciduous woods, but what kind of habitat do children need? Or does the structure of their habitat matter (Noon & McKelvey, 1996; Shared Strategy for Puget Sound, 2005; Freese et al., 2006)? To provide insight into this critical question, I evaluated the use of a novel method, based on global positioning system technology, to better understand children's interactions with their outdoor environments in urban areas.

Background

Through numerous studies and the development and application of new tools and techniques over the past several decades, we have become acutely aware of the direct linkage between non-human organisms' distribution, health, and survival and the quality, quantity, and spatial distribution of their habitat (Bleich, Wehausen, & Holl, 1990; Kiesecker & Skelly, 2001; Kihslinger & Nevitt, 2006). Unfortunately, while there has been increasing emphasis on understanding non-human organisms and their habitat needs, there has been relatively little focus on understanding human habitat needs.

Urban habitat can be thought of as broadly consisting of physical, biological, chemical, and social components, each of which have their own unique characteristics and interact with one another. Each individual is exposed to various habitat components through their experiences, which impact their health and well-being in both positive and negative ways over the short and long-term (Figure 1). Importantly, the types and characteristics of habitat components that individuals experience are influenced by health, land use, and environmental policies; the design of our built environment; and community/parental priorities and practices (Kellert, 2005; Louv, 2005; Frumkin, 2001). The impact of any given exposure can vary for each individual depending on the type of exposure, the dose, the recurrence of the exposure, and the state or susceptibility of the individual. This impact can also change over time as a person develops and ages.

Research to date has primarily focused on the impact of social, chemical, and biological habitat components on health outcomes, such as the impact of schooling on cognitive development and the hazardous health effects of various chemical and biological exposures (Frumkin, 2001; World Health Organization, 2005). There is a large gap in our understanding, however, with regard to the physical structure of urban habitat, which consists of various natural (e.g., trees and grassy areas) and non-natural (e.g., streets and parking lots) elements at varying levels of complexity and its impacts on human health through experience (i.e., exposure). Additional research in this area is critical as is the development and application of new tools and techniques to advance our capabilities and knowledge.

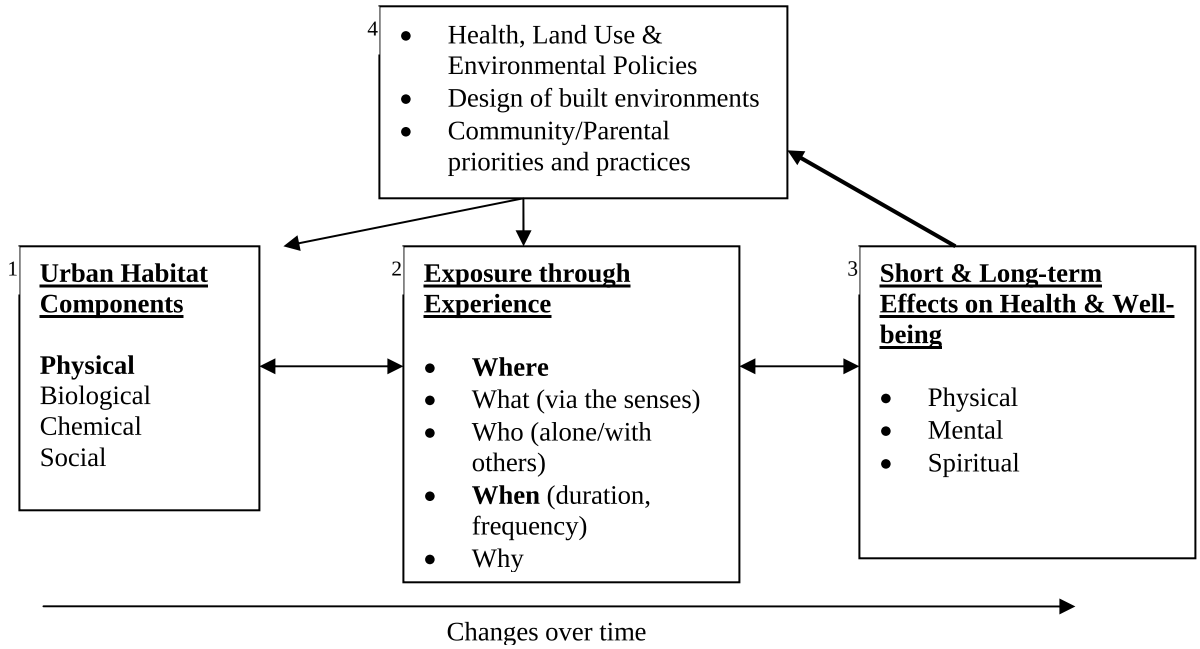

Figure 1. A general diagram, illustrating the relationships between urban habitat and effects on health and well-being through exposure. In this particular project, I focused on evaluating a novel method to better understand specific aspects of box 2 as it relates to our physical environment (box 1), but through this project's impact on future research, including my dissertation research, it will have potentially significant implications for our understanding of health and well-being (box 3), as well as health, land use, design, and community/parental priorities and practices (box 4).

Improving information on the physical structure of urban habitat and impacts on health is especially critical for children because they are a vulnerable population who are developing physically, mentally, and spiritually. It is also critical to improve understanding in this area because our landscape is changing: each year millions of acres of land are developed in the United States and a greater percentage of the U.S. population lives in urban areas (Natural Resource Conservation Service, 2006; U.S. Census Bureau, 1990). Cities represent a huge shift in our way of living. Even though the majority of the U.S. population lives in urban areas and developing countries are becoming increasingly urbanized, we know very little about the structure of the physical environment in these areas and how this structure impacts our health. *What impact, if any, does the structure of a child's physical environment have on his or her experiences and health?* While a few studies offer critical insights (Cobb, 1977; Derr, 2002; Wells, 2000; Wells & Evans, 2003; Faber Taylor & Kuo, 2006), our lack of more complete knowledge in this area limits our ability to live in a sustainable manner and address critical environmental issues. It also limits our ability to meet the needs of diverse populations and achieve a better quality of life as individuals and as a society.

To better understand how the structure of the urban physical environment impacts children, we must understand where children spend their time and how much time they spend in specific places. For decades, it has been nearly impossible to directly collect this type of information and researchers have primarily relied on indirect techniques, such as time diaries or self report mechanisms, which provide an incomplete and often inaccurate picture, but with advancements in Global Positioning System (GPS) technology this type of information can now be collected in an objective, time-conserving, and non-intrusive manner. Despite its widespread application and use in studies of other organisms, however, only one pilot study has used GPS to better understand children's exposure to their outdoor physical environment (Legett, 2006; Linke et al., 2005; Weimerskirch et al., 2002; Bleich, Wehausen, & Holl, 1990; Elgethun et al., 2003).

Objectives

The objectives of this project were to: 1) review the GPS literature and develop a list of specific features that would be needed in a GPS device to understand children's interactions with their urban physical environment and 2) conduct field tests with several of the most appropriate off-the-shelf GPS units to assess their ability to meet the specifications outlined.

Results

After reading the literature and speaking with a number of experts in the field, I generated a list of specific features that I needed to have in a GPS device in order to successfully understand children's interactions with their physical environment: where children spend their time and how much time they spend in specific places. These features included specifications regarding the instrument's weight, size, accuracy, sensitivity, memory, battery life, data storage and access, durability, processing speed, interface, and ease of use. With these specific criteria delineated, I spoke with numerous vendors and purchased several off-the-shelf GPS units that were most appropriate given my specifications. I then developed and conducted several field tests in different environments to assess the reception, accuracy, and precision of the GPS units in both stationary and dynamic (i.e., moving) situations. In evaluating these units, I followed a strict testing and evaluation protocol. Results from a few of my stationary tests are presented below (see Table 1 and Figure 2).

	Unit 1	**Unit 2**	**Unit 3**
1.Open Environment			
Reception	0.05pps	0.167pps	0.05pps
Precision	0.7998448m	1.382006m	2.303934m
Accuracy	4.032158m	3.388798m	4.837843m
2.Partially Wooded Environment			
Reception	0.05pps	0.167pps	0.05pps
Precision	1.339774m	0.9287913m	2.235061m

Accuracy	2.631466m	4.63919m	1.964473m
3.Wooded Environment			
Reception	0.05pps	0.167pps	0.05pps
Precision	1.889253m	1.424460m	4.458247m
Accuracy	1.581474m	2.214677m	2.802916m

Table 1. Results from several stationary tests with three different GPS units. Reception is reported in points per second. Accuracy and Precision are reported in meters. Values highlighted in light grey are significantly different from one another at the 0.05 level as calculated by ANOVA. Values not highlighted are not significantly different from one another.

While each unit examined and/or tested varied in its ability to meet my delineated requirements, common areas where commercially available units fell short included size, weight, battery life, antenna placement, durability, and access to raw data.

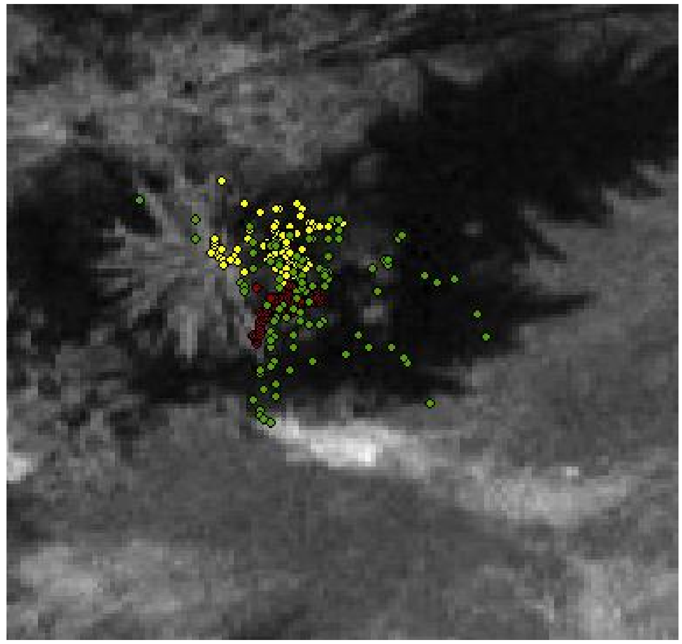

Figure 2. Image from ArcMap of GPS position points from a stationary field test. The recorded positions for each of the three units is represented by a different color. The stationary reference position was in the middle of a number of trees and the units collected data continuously for a 30 minute period.

Conclusion

As a result of this project, I discovered that using GPS technology is feasible and ultimately useful towards my interest in better understanding children's interactions with their outdoor physical environment in urban areas, but that to meet my specific research needs different equipment is required than is currently available via commercial vendors. I determined that purchasing an off-the-shelf unit or making slight modifications to an off-the-shelf unit is not feasible given my research needs and the current structure of the GPS industry. To proceed with my larger dissertation research agenda, I will investigate the practicability of developing a custom GPS unit that will meet my specific requirements.

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