SPATIAL KNOWLEDGE AND DISABILITY

Towards an ecological approach

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ABSTRACT

This paper builds on an ecological approach to disability. It argues for combining descriptive and experimental data in the study of spatial knowledge in people with disabilities and aims to bridge a gap between geographic and psychological approaches.

KEYWORDS

Geography, Psychology, Disability, Ecological Approach, Affordances, Universal Design

INTRODUCTION

Historically, geography has not paid much attention to the concept of disability or to the situations people with disabilities experience as they interact with their environments [6]. However, the past two decades have witnessed a growing interest in the subject [6, 7]. In terms of disability as a concept, there has been a growing consensus, both within academic and professional circles, over the situational and thus sociospatial aspects of disability [4, 11, 12]. Disability can no longer, as virtually all disciplines have done until recently [11], be reduced to its biomedical, individual aspects, but needs to be approached through an ecological framework, by taking into consideration both the individual and their environment through their constant interaction. The case for such a change in perspective has been made both in overall terms of social structure, civic rights and accessibility [11] and in more operational terms of everyday activities of living [4], by conceiving of the environment in terms of obstacles and facilitators to the accomplishment of daily activities. This conception is close to: 1). Von Uexküll's thought [14], who showed that the same environment is perceived differently by different species, human included; 2). Gibson's theory of "affordances" and concept of "niche" [5], focusing on what the environment provides the individual through their constant interaction. This offers an ecological framework for studying the spatial experiences and needs of people with disabilities. In this connection, an increased understanding of spatial knowledge in people with disabilities needs to draw both on descriptive and experimental data. Conflating the two sets into a coherent whole, may also serve as potential for *praxis*, by providing a framework for pursuing what has been termed "universal design" [7], i.e. the development of environments accessible to all, regardless of their physical or mental characteristics.

To this end, this paper presents a descriptive study, analyzing sketch maps drawn by wheelchair users, that provides information on the geographic characteristics of a given environment. Next, an experimental study provides information concerning the accuracy of direction estimation of linear locomotion and turning biases in walking people.

DESCRIPTIVE STUDIES OF URBAN SPATIAL EXPERIENCES

The capacity to move through space may appear to be a very simple behavior consisting in maintaining a body trajectory from a place to another. However, people with disabilities encounter several difficulties when moving about urban environments (for a review, [6]). An obvious example is the difficulties experienced by wheelchair users in reaching a specific location by the most direct path [9]. Spatial information learned by people with disabilities is also quite distinct from that of people with no disabilities. A recent study [1], compared drawings of mental city maps by wheelchair users and people able to walk. The components drawn by the participants were analyzed using Lynch's typology [8]: centers, districts, edges, landmarks and paths (figure 1).

Results suggested that, as wheelchair users must plan their urban traveling very precisely and cannot move about the city as spontaneously as people able to walk, they have to link every place or building with an appropriate access strategy. Thus, we put forward the hypothesis that wheelchair users develop urban mental maps more focused on precise environmental features (landmarks) rather than on an assemblage of large surfaces (districts).

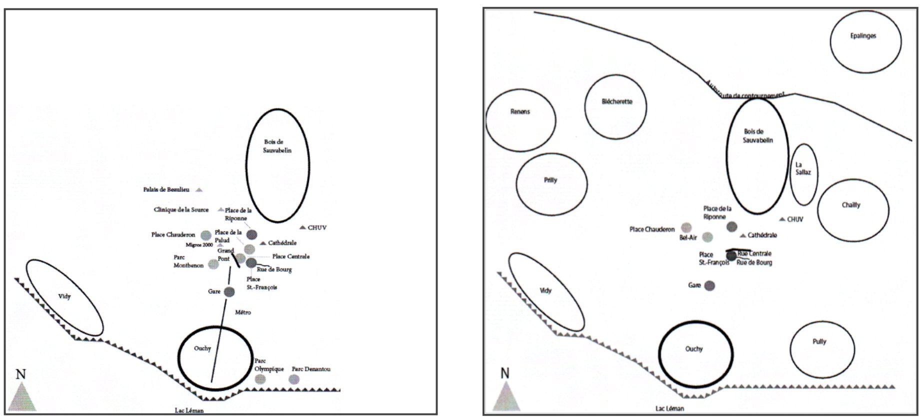

Figure 1: left, the city of Lausanne (Switzerland), seen by wheelchair users (n=9); right, Lausanne seen by people able to walk (n=18). The collective maps of the two groups showed no statistically significant differences, but the p-values relative to districts and landmarks were very close to the significance level (districts: $t(25) = -1.96$; $p = .06$; landmarks: $t(25) = 1.99$; $p = .06$), the former being favored by people able to walk and landmarks being predominant on the collective map of wheelchair users.

This hypothesis cannot be assessed through descriptive studies only. A clear understanding of how the inability to walk affects the elaboration of mental maps, and more generally spatial behavior, also needs to draw on experimental studies of basic information allowing keeping track of spatial location.

EXPERIMENTAL STUDIES OF SPATIAL ABILITIES

Spatial cognition is assumed to be a hierarchical set of reference frameworks – or maps – containing landmarks, routes, locations, and configurations that integrate their relative information (for a review, [2]). The establishment of such spatial representations relies on the integration of idiothetic and allothetic multimodal sensory information. Stimuli provided by the body, such as vestibular and motor, give idiothetic information about changes in position and orientation. This ability to keep track of spatial location relying on self-motion information is called path integration mechanism. It consists in the continuous integration of translations and rotations over time and allows the derivation of a homing vector leading the individual directly to the departure location [3, 10]. Thus, path integration plays a crucial role in spatial behavior for it allows the subject to directly estimate both the traveling distance and the position of an object relative to their own body. Allothetic information refers to spatial information like visual, haptic, sound or olfactory stimuli. Thus, fixing and maintaining a trajectory is done through a relationship between subject and object. This relationship is categorized in egocentric and allocentric reference frames. The former are centered on the subject, and allow them to directly estimate the position of an object relative to their own head direction. The egocentric bearing is not invariant with respect to the subject's orientation and position. Frameworks centered outside the body are allocentric. They provide the advantage of being invariant with respect to the subject's position and orientation in the environment and therefore represent the relative location of objects independently from the subject's viewpoint. Thus, we need to determine how people who have access to different idiothetic and allothetic stimuli move about and establish spatial representations. In terms of basic spatial competence and behavior, we first conducted experiments in people able to walk in order to estimate standard abilities to point towards a starting point and turning biases (figures 2 and 3).

Results suggested basic spatial competence and behavior are influenced by sex and maturation. Future experimental tasks need to compare such capability and behavior in wheelchair users.

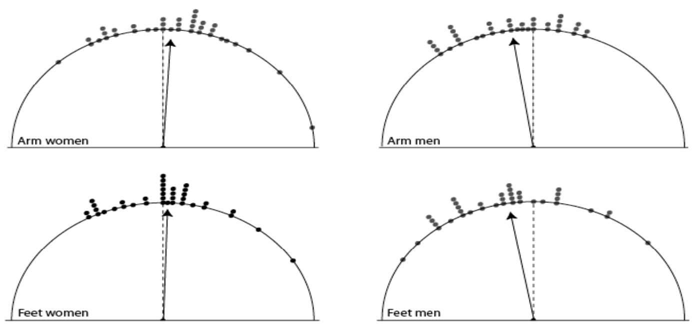

Figure 2: nonvisual direction estimation. Watson-Williams tests on direction estimation showed a significant difference between men (n=37) and women (n=37). Women showed a slight right deviation and men showed a left deviation and were less accurate. Mean arm angle was 4° for women and 350° for men (F[1,74]=6.89, p. < .05). Body deviation as measured at the feet showed a mean angle of 2° for women and 348° for men (F[1,74]=4.98, p. < .05). Angular dispersion was weak, as shown by the length of vectors. Vectors show the mean direction and their length indicates whether the dispersion around the mean angle is high or low. A length of 0 means there is maximum dispersion, a length of 1 means all directions are concentrated on the same point and that therefore there is no dispersion.

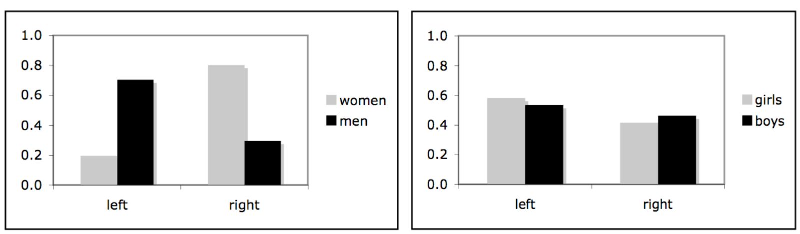

Figure 3: dimorphic turning bias in spontaneous rotational movement. The image to the left shows results for 90 adults (46 women and 44 men). The two groups differed in their spontaneous body turn preference (F[1,88]=27.58; p=.000). Women showed a right turn preference (t[45]=-4.1; p=.000), while men showed a left turn preference (t[43]=-3.35; p=.002). The image to the right shows results for 52 children (24 girls and 28 boys). The two groups did not differ in their spontaneous body preference (F[1,50]=39.19; p=.737), (t[23]=-.811; p=.426), (t[27]=-.372; p=.713).

Reference frames used by people with different capabilities also need to be investigated. The hypothesis put forward for wheelchair users could thus be analyzed in light of basic spatial competence and behavior.

CONCLUSION

Combining descriptive and experimental approaches should offer a fuller picture of the spatial knowledge of people with disabilities. This should help in providing a valid understanding of how remaining sensory capabilities contribute to a person's ability to move through space and may help understand which stimuli play a major role in shaping a person's spatial competence and behavior [13]. It may also help in designing environments more suitable for integrating different basic spatial capabilities and strategies.

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