Towards a Theory of Spatial Assistance from a Phenomenological Perspective:

Technical and Social Factors for Blind Navigation

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Abstract.
There is a long history of providing assistive technology to blind persons. In the spatial domain, most of this effort has focused, however, on low-level mobility cues (e.g., avoiding obstacles) and has been developed from the third-person engineering perspective. We argue that improving independence and navigation abilities without vision requires a broader context that encompasses spatial awareness as well as awareness of how the person and the environment in which they are acting are dynamically coupled. We maintain that study of first-person experiences (based on phenomenological methods) can and should be developed to identify maximally useful information and to guide designers of new technical devices promoting environmental access and spatial behavior. This argument is rooted in the phenomenological recognition that spatial experience is not akin to an independent object positioned in a container-like space, but rather arises through a person's way of being-in-the-world.

Introduction.
The ability to navigate is such a fundamental component of daily life that most sighted people give little thought as to how they do it, what information they use to support their behavior, or the consequences of what would happen if this ability was taken away. Typically, navigation is not something to which most people actively attend (Leder, 1990; Merleau-Ponty, 1962). For people with visual impairments, however, interaction with the environment is frequently an active process that often involves challenges in terms of one's independence and efficiency. A major difference in navigating without vision is the added demand of learning to interpret nonvisual sensory signals (Giudice & Legge, 2008). Blind navigators need to learn how to safely traverse their environment, and to do so they must learn how to detect obstructions in their path of travel, find curbs and stairs, interpret traffic signals, and myriad other navigational tasks. By contrast, sighted people solve these problems visually in a more automatic, less cognitively demanding way. In short, whereas vision-based navigation proceeds as a more immediate perceptual process, blind navigation typically demands an effortful endeavor requiring the use of multiple and mediated cognitive and attentional resources. In addition, being effective in navigating one's surroundings requires a <u>fluid</u> "connection" with the environment that most sighted people have never considered. For instance, to "know" one's surroundings, it is not enough simply to know that a coffee table is blocking the path, one must also be aware of this current obstacle as something to which one may later return insofar as it affords a place to set a plate or play cards. Thus, developing one's navigational abilities involves not only coming to be at home in the spatial relations among the surround's elements, but also developing a grasp on what these elements do and do not afford for a variety of actions. To be able to navigate a spatial situation involves, in other words, the ability, more or less, to "make oneself at home" in that situated event.

The connection between bodily possibilities and spatial possibilities

Phenomenological theorists argue that space, as far as humans perceive it, cannot be adequately viewed as independent from a spatial agent (Merleau-Ponty, 1962; Bachelard, 1964; Heidegger, 1996). For instance, in his ecological approach to visual perception, James J. Gibson rejects the notion that we exist as perceiving subjects who receive data from a self-contained and value-free surrounding (Gibson, 1979; see also van den Berg, 1972). To the contrary, Gibson argues that objects, and our spatial surroundings in general, are defined by the subject's activities and locomotive and perceptual abilities. These bodily possibilities inform our spatial possibilities, and, thus, give shape to our way of being-in-the-world. Limitations to a person's ability to freely navigate the world (whether in the form of blindness or low-vision, or other limiting factors such as decrease in lung capacity, the loss of a limb, etc.) typically lead to a corresponding contraction in one's world (Hull, 1997; Dyck, 1995; Toombs, 1995). Phenomenological studies demonstrate that shifts in or additions to the body's abilities (e.g., in the form of a walking cane) not only allow for a more articulate experience of one's surroundings, but also augment the shape and size of one's way of being-in-the-world (Merleau-Ponty, 1962; Carel, 2008).

Throughout the years, many technological solutions have been developed to address the challenges of nonvisual navigation. Most fail, however, because they either strive to solve problems that have already been successfully addressed (e.g., that of mobility aids), or they do not appreciate the importance of addressing or fostering first-person interactions with the environment (Karlsson, 1996). The dominant focus of current technological development is often purely an engineering effort and largely devoid of end-user input to guide the process.

We argue that this first-hand experience is of critical importance to the design and production of future technological aids for blind and low-vision persons, and, thus, that development of such aids should be derived in conversation with the input of blind/low-vision users in a systematic manner. Our current work considers the scientific question of how first-hand experience reports could be generated and applied to technology development promoting environmental awareness, independent spatial behavior, and social engagement. Our proposed solution uses phenomenological methods of considering the experience a person has when involved in a specific activity and how this experience is altered—to good or bad effect—by changes in the surrounding situation or the tools or means by which the person can engage that situation.

Specifically, we aim to gather first-hand accounts from blind and low-vision persons of their live-time experiences of moving through familiar and unfamiliar territories. We will focus on subjects' "tools" for navigation in these terrains, and also on their emotional and intellectual experiences when encountering regular and unexpected challenges during their navigation. To uncover often "hidden" perceptual habits at work in daily practices of navigation, we anticipate recording a second round of reports that include an accompanying interviewer, who will ask questions of the subjects at crucial "task" points (such as crossing a street, etc.) that will help to elicit reflection about how a task is performed and what sort of challenges (emotional or intellectual) it raises. These interviews will offer a productive means of assessing the usefulness of new assistive technologies for blind and low-vision persons. Moreover, this work will allow us to make an important step towards composing a general theory of environmental awareness and engagement (and the effects of introducing new tool usage into the experience) that could also be relevant to contexts other than blindness.

First-person considerations in blind navigation

Frustrating experiences with many spatial activities outside a known space can often result in blind persons not leaving their zone of spatial comfort (Clark-Carter, 1986). This compensatory strategy has led to negative educational and vocational consequences, as well as increased social isolation for this demographic (Giudice and Legge, 2008). Traditional "medical model" solutions for the preceding challenges call for development of better technologies and coping methods for people to overcome their fears, but they generally completely ignore first-person accounts of what underlies these fears. The goal of the current project is to integrate the concerns and interests of blind and low-vision persons more readily into any technology that may augment their ability to forge connections with the surroundings, and we proceed by recognizing the importance of existential bodily experience in informing decisions pertaining to the development of these technologies (Schenck, 1986).

We posit that the fundamental challenge of blind navigation stems from insufficient access to environmental information. The problem with much of the extant research addressing blind spatial performance is that the results are used to inform an understanding of vision (or visual experience), instead of addressing the use of information from non-visual sensing. In order to truly understand blind or low-vision spatial abilities, and to develop useful learning strategies to remediate travel-related problems, the focus of research on the presence or absence of visual information must be redirected to consider spatial information from all sensory modalities and, more importantly, to learn how to foster better interactions with the environment. To this end, at least three important factors should be considered when studying the design and implementation of technology for blind navigation:

- Any mapping between the input and output modality, especially if it is cross-modal (e.g., visual input and auditory output), must be well specified.
- To be effective, the product must focus on conveying task-specific environmental information, and should attend carefully to a person's ability to select desired information.
- Any developed adaptive technology should be capable of being incorporated into a person's habits and life in an intuitive manner, without excessive difficulty.

This project ultimately aims to examine the ability for devices providing environmental awareness to enrich blind or low-vision persons' engagement with their surroundings. The long-term focus of this project is to support the development of devices that 1) can be successfully incorporated, like an extension, into one's habits and habit body—i.e., that do not further sever or unnecessarily complicate one's connection with the surrounding world and that do not take over functions that the user is capable of completing without the device's assistance; 2) may be capable of helping a person to develop new capacities for engaging with one's surroundings without developing a long-term reliance on the device itself; 3) do not throw users into situations beyond their capacities to adapt or learn effectively; and, 4) do not dictate the user's lifestyle or choices, but instead can be adaptive to the demands, interests, and capacities of the particular user.

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