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How good are these directions? Determining direction quality and wayfinding efficiency

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ABSTRACT

Our goal was to specify the effectiveness of wayfinding directions in a complex indoor environment. We measured direction quality using effectiveness ratings and behavioral indices. In Study 1, participants provided effectiveness ratings for seven combinations of wayfinding descriptions. In general, ratings were higher for route details than for survey details, and ratings increased as the number of features increased. Moreover, people with a good self-reported sense of direction gave higher ratings to survey descriptions (cardinal directions and distances) relative to those with a poor self-reported sense of direction. In Study 2, participants provided effectiveness ratings for route and survey directions before and after wayfinding using these directions. Route directions resulted in fewer wayfinding errors and higher effectiveness ratings than did survey directions. People with a poor self-reported sense of direction made more wayfinding errors and provided lower effectiveness ratings than did people with a good self-reported sense of direction. We also demonstrated important relations between wayfinding errors and ratings after wayfinding, as well as links with sense of direction, wayfinding strategies, and mental rotation.

Imagine that you are finding your way through a complex building for the first time. Someone tells you how to get to the room you need, and the directions sound like they contain the right information to get you there. However, as you are following the description, you get confused regarding what was meant by, "go left at the T." You forget the last turn because you focused too much on remembering several details at the beginning of the route, and you get lost. You must reorient yourself and try to find your way again while not getting anxious about being lost. Upon finally finding the room, you realize that perhaps the directions you received were not as efficient as you originally thought. This example illustrates several challenges people face while trying to find the way from place to place. Sometimes, directions that seem helpful have an adequate number of details to effectively lead someone from place to place. At other times, directions that originally appeared to be high in quality end up being misleading or overwhelming to remember. The primary goal of the present study was to specify the quality of wayfinding directions using effectiveness ratings and behavioral indices. Another goal was to examine how individual differences such as sense of direction and gender relate to wayfinding.

How does one determine the quality of wayfinding directions? According to Lovelace, Hegarty, and Montello (1999), the quality of directions can be measured in three ways. First, quality can be determined by calculating the number of elements included in the directions, such as landmarks, turns, or other descriptive information. Second, quality can be measured subjectively by having people rate the effectiveness of route directions. Finally, quality can be determined by measuring how well the directions facilitate wayfinding.

Analyzing the specific details in route descriptions can be accomplished in a variety of ways. One way is to count the number of words used in a description or count how many times different elements are used (Lovelace et al., 1999). However, the number of words and descriptive features is not nearly as important as the specific descriptors included, because not all descriptors aide wayfinding in the same way. For instance, previous research has highlighted the important benefits of including landmarks—environmental features that function as points of reference (Lynch, 1960)—that serve as sub-goals to keep people connected to the point of origin and the destination along the wayfinding path (Allen, 2000) and that help people construct a visual model of the environment (Tom & Denis, 2004). Landmarks can be at points of a route where a choice needs to be made about

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which direction to proceed (i.e., at choice points) or along a stretch of a route where no decision needs to be made (i.e., at non-choice points). Allen (2000) found that wayfinding errors were less frequent when following routes containing landmarks at choice points than when following routes containing landmarks at non-choice points, especially at the end of the routes when memory demands were greatest. It is possible that the performance advantage for routes with choice point landmarks results from better memory (Janzen, 2006) based on the usefulness of choice point landmarks during wayfinding (Stankiewicz & Kalia, 2007).

In addition to landmarks, previous research has highlighted the importance of cardinal directions and distance information, though the benefits and limits of cardinal directions are not consistent across studies (Allen, 2000; Hund & Minarik, 2006; Saucier et al., 2002). Allen (2000) found that wayfinding errors were more frequent when following descriptions with cardinal directions and distances than when following descriptions with landmark information, especially in the middle and final portions of the route, indicating that cardinal directions are not beneficial. In contrast, Hund and Minarik (2006) found that participants navigated through a model town faster and with fewer errors when following cardinal directions than when following landmark directions (see also Saucier et al., 2002).

What mechanisms might explain these differences in effectiveness for different types of descriptors? It is possible that spatial perspectives provide one such mechanism. Spatial perspectives, or reference frames, help describe the spatial relations involved in wayfinding (Tversky, 2003). Previous research has identified two perspectives: route and survey (e.g., Hund, Haney, & Seanor, 2008; Pazzaglia & DeBeni, 2001; Shelton & Gabrieli, 2002; Taylor & Tversky, 1996). A route perspective entails adopting the frame of reference involved in moving through an environment and includes references to segments of particular routes. The viewpoint is intrinsic and changes as a result of moving through the environment. Landmarks and left-right turns are frequently used as descriptors. In contrast, a survey perspective provides an overview of spatial layout and adopts an extrinsic frame of reference. This perspective is most commonly acquired by looking at a map or examining an environment from above. The viewpoint for survey perspectives remains fixed from a vertical outlook. Cardinal descriptions and distances often are used to describe a space from a survey perspective. Although studies have shown benefits of learning via a survey perspective (e.g., Fields & Shelton, 2006; Hund & Minarik, 2006), there still exists a general disliking of cardinal directions (Hund et al., 2008; Hund & Padgitt, 2010). For instance, several people commented that cardinal directions were not helpful, especially if one does not know which way is north (Devlin, 2003).

Another way to analyze the quality of route descriptions is to have people subjectively rate how effective they think the descriptions would be in leading them from a starting location to a destination. In Hund et al. (2008), participants rated the effectiveness of descriptions for six different routes in a model town. Higher rated descriptions contained more left-right descriptors than did lower rated descriptions. Furthermore, when participants responded to an open-ended question about their preferences regarding wayfinding directions, positive mentions of left-right and landmark information and negative mentions of cardinal directions were common. Lovelace et al. (1999) analyzed the quality of descriptions for familiar and unfamiliar routes using coder ratings. Mention of landmarks correlated positively with route direction quality. Furthermore, longer descriptions received higher ratings because they were more complete, suggesting that people prefer detailed information when wayfinding.

One question posed by Lovelace et al. (1999) was whether highly rated directions actually facilitate wayfinding efficiency. Research evaluating wayfinding efficiency when following high- and low-rated directions has yielded mixed results. Denis, Pazzaglia, Cornoldi, and Bertolo (1999) asked participants to follow the highest and lowest rated descriptions of routes in Venice (based on participant ratings in a previous experiment). As expected, participants navigated with fewer errors when following highly rated directions in comparison to poorly rated directions. Other studies have replicated these findings in similar settings, such as routes through college campuses (Daniel, Tom, Manghi, & Denis, 2003; Honda & Nihei, 2004). However, still other studies have found that the worst rated descriptions led to more efficient wayfinding in a model town (Hund et al., 2008) and in a complex university building (Hund & Padgitt, 2010) relative to the best-rated descriptions.

Why might this be the case? One reason could be the specificity of the directions. It is possible that people navigated more quickly when following the worst rated descriptions because these descriptions were concise and to the point, which facilitated wayfinding relative to the overly specific best-rated descriptions that may have exceeded working memory capacity. When participants provide ratings, they may be evaluating the descriptions abstractly rather than focusing on practical details necessary for successful wayfinding in that particular space. Another reason could be differences in processing related to different environmental scales. In the model town used in Hund et al. (2008), the environment was experienced via a survey perspective, perhaps rendering cardinal descriptions efficient for wayfinding. Furthermore, the entire environment was visible throughout the task, which reduced memory demands relative to everyday wayfinding in large-scale environments that involve ground-level views in which only part of the route is visible at any given moment. Although this seems like a viable account for the model town, it does not explain why the indoor wayfinding task involving routes through a university building yielded similar results (Hund & Padgitt, 2010). A third explanation could be related to differences in the wayfinding tasks. For instance, Denis et al. (1999) gave participants a written version of the entire route to be followed and asked them to study it for 2 min. Participants then followed the route from memory. This is in contrast to Hund et al. (2008) and Hund and Padgitt (2010), where participants read each segment on note cards while navigating the routes. Different cognitive demands may emerge from these wayfinding tasks, which may result in differences in efficiency when following the descriptions. Although descriptive features, environmental space, and cognitive demands may all account for these discrepancies in wayfinding, individual differences in spatial skills also may play a role (Hegarty, Richardson, Montello, Lovelace, & Subbiah, 2002; Hund & Nazarczuk, 2009; Kato & Takeuchi, 2003).

One important individual difference is sense of direction, or "awareness of orientation or location" (Kozlowski & Bryant, 1977, p. 178). Sense of direction is related to wayfinding such that people with a good sense of direction actively explore and attend to details in new environments, and they remember new routes better than do people with a poor sense of direction. In contrast, people with a poor sense of direction are more likely to lose their way and worry more about becoming lost (Sholl, Acacio, Makar, & Leon, 2000). Kozlowski and Bryant (1977) asked participants to rate their sense of direction and indicate the direction of five unseen buildings, two nearby cities, and northward heading, finding that sense of direction ratings and indications of spatial features were tightly coupled. Similarly, Hund and Nazarczuk (2009) found that larger errors when indicating the direction of buildings and locations were indicative of more frequent wayfinding errors and slower navigation through a campus building relative to smaller sense of direction errors. These results show that sense of direction relates to wayfinding, but more research is needed to further specify this