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The Role of Recipient Perspective in Giving and Following Wayfinding Directions

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SUMMARY

We examined how recipient perspective and descriptive features affect direction giving and following during wayfinding. In Experiment 1, participants provided directions from starting locations to destinations for fictional recipients driving through a town (route perspective) or looking at a map of the town (survey perspective). As expected, participants included left-right and landmarks more frequently when addressing a person driving in the town and cardinal descriptors more frequently when addressing a person looking at a map. In Experiment 2, participants rated the effectiveness of directions. Effective directions contained significantly more left-right references than did less effective directions. In Experiment 3, participants followed the best- and worst-rated directions. Unexpectedly, they navigated significantly faster when following the worst-rated directions. In Experiment 4, participants gave wayfinding directions for destinations in a familiar town. Again, direction features depended on recipient perspective, highlighting the dynamic nature of wayfinding processes. Copyright © 2007 John Wiley & Sons, Ltd.

The ability to find our way through the environment is vital for daily functioning. Often, people use verbal directions to facilitate wayfinding, particularly when searching for unfamiliar destinations such as tourist sites. What kinds of descriptive language do people include when providing directions for wayfinding? How do those descriptions facilitate efficient wayfinding? Despite the undeniable importance of these questions, very little research has focused on understanding wayfinding processes. The primary goal of this investigation was to examine the processes involved in giving and following wayfinding directions. In particular, we sought to determine how recipient perspective and descriptive features affect wayfinding efficiency.

People provide a variety of details when giving directions for wayfinding, including landmarks, distances, directions, turn descriptions and commands (Golding, Graesser, & Hauselt, 1996; Lloyd, 1991; Mark & Gould, 1995; Ward, Newcombe, & Overton, 1986; Wright, Lickorish, Hull, & Ummelen, 1995). Moreover, there are staggering individual differences in the frequency of each cue and overall length (Denis, Pazzaglia, Cornoldi, & Bertolo, 1999; Klein, 1982; Vanetti & Allen, 1988). For example, some people provide only the most basic instructions, such as, 'left on Main, right on Aggie', whereas others provide many additional details, such as descriptions of landmarks or distances between turns.

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What factors influence the cues included in wayfinding directions? Previous studies have highlighted the importance of sense of direction, environmental familiarity, gender and wayfinding strategies (e.g. Hund & Minarik, 2006; Lawton, 1996; Prestopnik & Roskos-Ewoldsen, 2000; Saucier, Green, Leason, MacFadden, Bell, & Elias, 2002). In particular, two wayfinding strategies or perspectives, have received much recent attention (e.g. Galea & Kimura, 1993; Kato & Takeuchi, 2003; Lawton, 1996; Lawton & Kallai, 2002; Pazzaglia & DeBeni, 2001; Sholl, Acacio, Makar, & Leon, 2000). A route perspective involves adopting a first-person spatial perspective (e.g. assuming the perspective of the traveller) as the frame of reference. Route directions are like mental tours that include references to segments of the route, as a traveller would experience them during locomotion. In particular, they include left and right turns and landmark descriptions that provide a set of procedures for navigating through the environment (e.g. 'Go left on Main, you'll see the park on your right'). In contrast, a survey perspective involves adopting a third-person spatial perspective akin to seeing the entire environment at once (e.g. an aerial view or map). Survey directions provide an overview of the environmental layout, where the frame of reference is global in nature (e.g. the sun, a mountain range). When describing how to get somewhere, the most common survey reference frame involves cardinal directions (i.e. north, south, east and west) and precise distances (i.e. blocks, miles; Lawton, 1996; Shelton & Gabrieli, 2002; Taylor & Tversky, 1996). These differences between survey and route perspectives parallel the theoretical distinction between configural/survey and route knowledge often discussed in the literature (e.g. Golledge, 1999; Hirtle & Hudson, 1991; Pazzaglia & DeBeni, 2001; Shelton & McNamara, 2004; Siegel & White, 1975).

Although both survey and route perspectives can be effective, people using a route perspective may find it difficult to deviate from the designated route and, thus, are more likely to become disoriented or lost. In contrast, people using an integrated, survey perspective can deviate from a given path, finding effective shortcuts or detours (Lawton, 1994, 2001; Saucier et al., 2002; Siegel & White, 1975). Recently, Shelton and Gabrieli (2002) examined the neural mechanisms underlying these perspectives. As expected, they found that the two perspectives were associated with different areas of neural activation (see also Berthoz, Viaud-Delmon, & Lambrey, 2002). Areas in the medial temporal lobe, anterior superior parietal cortex and postcentral gyrus showed greater activation when participants were using a route perspective. In contrast, areas in the inferior temporal lobe and posterior superior parietal cortex exhibited greater activation when participants were using a survey perspective. These neural findings offer additional support for the distinction between survey and route perspectives.

How might perspective affect direction giving in the service of wayfinding? Previous results indicate that people tend to use route descriptors more often than survey descriptors when asked to describe environments for listeners (e.g. Taylor & Tversky, 1996). For example, in one classic study, when asked to describe their apartments, 97% of participants provided a walking tour starting at the front door, whereas only 3% of participants provided a survey-like description of the overall layout of their apartments (Linde & Labov, 1975).

This relation between perspective and wayfinding may be influenced by gender. Numerous studies have shown that men are more likely to report preferences for survey perspectives (e.g. cardinal directions and precise distances) than are women, whereas women are more likely to report preferences for route perspectives (e.g. landmarks) than are men (Galea & Kimura, 1993; Lawton, 1994; Prestopnik & Roskos-Ewoldsen, 2000; Saucier et al., 2002; Sholl et al., 2000; for a recent review, see Montello, Lovelace,

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Golledge, & Self, 1999). To investigate whether these gender differences are evident in people's wayfinding directions, Lawton (2001) asked participants to provide directions to help a friend reach a desired destination. Men included significantly more cardinal directions than did women (e.g. adopting a survey perspective), whereas women included significantly more left and right turns and landmarks than did men (e.g. adopting a route perspective). These findings suggest that similar gender differences emerge both when giving and following wayfinding directions. An important next step is to link together direction giving and following to understand the dynamic nature of wayfinding.

The overall goal of this investigation was to specify how factors related to direction givers, direction recipients and the environment interact during wayfinding. The primary goal of Experiment 1 was to specify how the recipient's perspective affects the descriptive features people provide when giving wayfinding directions. A second goal was to examine gender differences in wayfinding. Participants studied a fictitious model town and were asked to provide directions from various starting locations to destinations in the town. For half of the trials, participants were asked to imagine that they were giving directions to a person driving in the town (i.e. using a route perspective). For the remaining trials, they were asked to imagine giving directions to a person looking at a map of the town (i.e. using a survey perspective). We expected that the features provided in directions would differ depending on the recipient perspective. Specifically, we predicted that people would use more left-right turns and landmarks when addressing someone using a route perspective (i.e. driving) than when addressing someone using a survey perspective (i.e. viewing a map). On the other hand, we predicted that people would use more cardinal descriptors (e.g. north, south, east or west) and specific distances (e.g. city blocks) when addressing a person using a survey perspective than when addressing someone using a route perspective. In addition, we expected that women would provide more route-like directions (i.e. landmarks and left-right turns) than would men, and that men would provide more survey-like directions (i.e. north-south-east-west and city blocks) than would women. Experiments 2 and 3 assessed recipients' responses to the wayfinding directions elicited in the first experiment to provide a more complete understanding of wayfinding. Experiment 4 specified direction-giving processes in a familiar town.

EXPERIMENT 1

Method

Participants

Participants were 32 male and 32 female students at a large, public, Midwestern university who received extra credit in their psychology courses. Data from two additional participants were excluded from analyses; one had participated in a similar study, and one provided unusual directions (e.g. driving through buildings).

Apparatus and materials

A 4 ft × 6.5 ft piece of white plywood placed atop a table served as a fictitious model town (see Figure 1). Seventeen landmarks (e.g. park, hospital) were depicted using wooden blocks with unique labelled pictures on top. Twenty-nine streets (e.g. Main St., Ridge Ave.) were depicted using blue tape and printed street names (see also Hund & Minarik, 2006). A red toy car was used to mark the starting locations.

Figure 1. Overhead view of the model town

Design and procedure

During the familiarization phase, the researcher first noted verbally the four cardinal directions and then gave participants 30 seconds to study the town. Participants then completed six trials, three in which they imagined giving directions to a person driving in the town (i.e. using a route perspective; no-map trials) and three in which they imagined giving directions to a person looking at a map of the town (i.e. using a survey perspective; map trials). The order of routes and the assignment of routes to perspectives were counterbalanced.

On each trial, the car was placed at the starting location, and the destination was noted verbally. Participants then were asked to write down the directions they would give to help someone get from the starting location to the destination. The starting locations and destinations were the hospital and mall, post office and library, tavern and lake, courthouse and gym, bank and arena and church and gas station (see Figure 1). Participants were allowed to move around and to take as much time as needed to complete their directions.

Coding and measures

Descriptive features. Researchers coded the frequency with which participants mentioned five descriptive features: cardinal directions (i.e. north-south-east-west), distances (i.e. number of blocks or other units), left or right, landmarks (i.e. 17 named landmarks in the model town) and street names (i.e. 29 named streets in the model town). Then, the total frequency of each descriptive feature was calculated for each perspective. In addition, the total amount of information (i.e. all categories of descriptive features) was calculated for each perspective.

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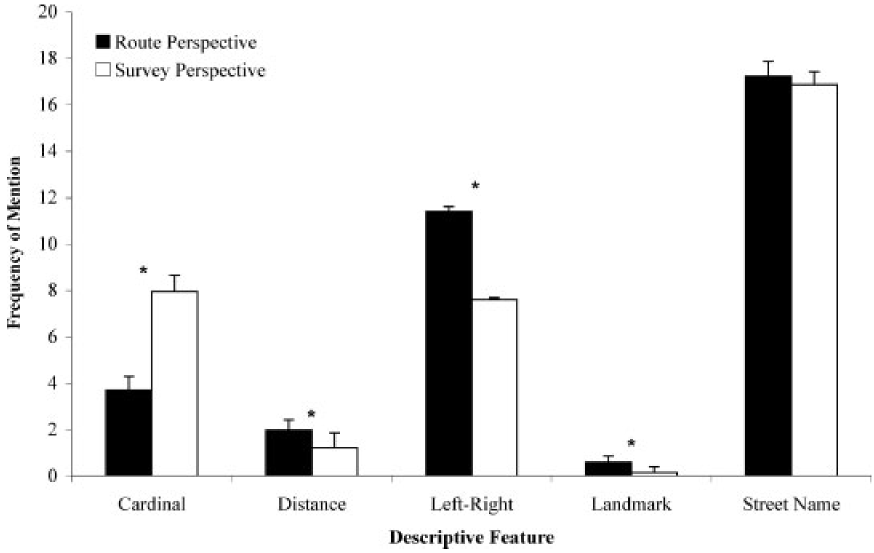

Figure 2. Mean frequency of five descriptive features in wayfinding directions through a model town adopting each of two recipient perspectives (Experiment 1). Asterisks denote significant differences across perspective ($p < .05$). See the text for complete details

Direction accuracy. For each trial, researchers determined whether the directions successfully led from the starting location to the destination.[1]

Inter-rater reliability. Two coders independently assessed the directions provided by 14 randomly selected participants (21% of the sample) to assess overall reliability. They agreed exactly on 333 out of 364 categorical judgments concerning descriptive features and accuracy (91.46% exact agreement). The correlation between judgments was .99, indicating a very high level of inter-rater reliability.

Results

The primary goal was to investigate how the recipient's perspective affected the descriptive features people provide when giving wayfinding directions. A second goal was to investigate the effect of gender on descriptive features. To address these issues, descriptive feature frequencies were analysed using separate Perspective (route, survey) $\times$ Gender (men, women) mixed model Analyses of Variance (ANOVAs). We predicted that when addressing someone looking at a map of the town, people would use more cardinal descriptors (e.g. north, south) and specific distances (e.g. city blocks) than when addressing a person using a route perspective. Conversely, we predicted that when addressing someone driving in the town, people would use more left-right descriptors and landmarks. Frequencies of each feature for the two recipient perspectives can be seen in Figure 2. Moreover, we expected that women would provide more features consistent with a route

[1]Note that this accuracy measure is based on the features provided in the directions. It does not assess how accurately a recipient would find their way if given the directions. For instance, it is possible that accurate directions could be forgotten or misconstrued, particularly if the recipient had difficulty discerning the cardinal descriptors, left-right indicators or other descriptive features employed.

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perspective, whereas men would provide more features consistent with a survey perspective.

The analysis of cardinal direction frequency revealed a significant main effect of perspective, $F(1, 62) = 32.27$, $p < .001$, as well as a significant Perspective × Gender interaction, $F(1, 62) = 4.24$, $p < .05$. Tests of simple effects revealed a significant main effect of perspective for women, $F(1, 31) = 6.00$, $p < .05$, and for men, $F(1, 31) = 33.02$, $p < .001$. Women provided significantly more cardinal descriptors when addressing listeners adopting a survey perspective ($M = 6.63$, SD = 5.37) than when addressing listeners adopting a route perspective ($M = 3.91$, SD = 4.23). Similarly, men provided significantly more cardinal descriptors when addressing listeners adopting a survey perspective ($M = 9.16$, SD = 4.81) than when addressing listeners adopting a route perspective ($M = 3.34$, SD = 4.58). Note that although the overall pattern was similar for both genders, the magnitude of difference across perspectives was greater for men than for women. The main effect of gender did not reach statistical significance, $F(1, 62) = 1.13$, $p > .28$. Contrary to our predictions, participants included distances significantly more frequently when addressing listeners adopting a route perspective ($M = 2.34$, SD = 2.60) than when addressing listeners adopting a survey perspective ($M = 1.41$, SD = 2.23), $F(1, 62) = 9.97$, $p < .005$. No other effects reached statistical significance, all Fs < .60, ps > .44.

As expected, participants included left and right significantly more frequently when addressing listeners adopting a route perspective ($M = 11.67$, SD = 3.01) than when addressing listeners adopting a survey perspective ($M = 6.92$, SD = 5.06), $F(1, 62) = 46.44$, $p < .001$. No other effects reached statistical significance, all Fs < 2.91, ps > .09. Similarly, landmarks were included significantly more frequently by participants addressing listeners adopting a route perspective ($M = 0.59$, SD = 1.49) than by participants addressing listeners adopting a survey perspective ($M = 0.16$, SD = 0.48), $F(1, 62) = 6.09$, $p < .05$, although their overall usage was quite infrequent. No other effects reached statistical significance, all Fs < 2.73, ps > .10. Analysis of street name frequency revealed no significant effects, all Fs < .33, ps > .57. Street names were mentioned very frequently overall ($M = 17.45$, SD = 4.85).

Participants included significantly more information in their directions when addressing listeners adopting a route perspective ($M = 37.99$, SD = 9.38) than when addressing listeners adopting a survey perspective ($M = 35.08$, SD = 8.27), $F(1, 62) = 6.48$, $p < .05$. No other effects reached statistical significance, all Fs < .33, ps > .57. Analysis of direction accuracy revealed no significant effects, all Fs < 2.13, ps > .14. Overall, the directions led to the correct destination on 83% of trials.

Discussion

The primary goal was to examine how recipient perspective affected the descriptive features people provided in wayfinding directions. As predicted, people included significantly more cardinal descriptors when addressing someone looking at a map of the town than when addressing someone driving in the town. Moreover, as expected, left-right and landmarks were mentioned significantly more frequently when addressing someone driving in the town than when addressing someone looking at a map. Contrary to our expectations, distance was mentioned more frequently when addressing someone driving in the town than when addressing someone looking at a map, but the overall frequency was quite low in both cases. It is possible that these differences in feature frequency across recipient perspectives resulted from participants' shifts in perspective (Golledge, 1999;

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Hirtle & Hudson, 1991; Pazzaglia & DeBeni, 2001; Shelton & McNamara, 2004; Siegel & White, 1975; Taylor & Tversky, 1996) and/or pragmatic considerations, particularly communicative conventions for providing directions (Allen, 2000; Golding et al., 1996; Lloyd, 1991; Ward et al., 1986).

In general, participants included significantly more information when addressing listeners adopting a route perspective than when addressing listeners adopting a survey perspective. It is possible that this difference reflects the step-by-step nature with which participants described the vistas experienced by recipients when adopting a first-person route perspective. It is also possible that participants provided less information for recipients who were viewing maps because the maps would contain many details that would not need to be duplicated or explained in the verbal directions. Overall, participants provided directions that were accurate reflections of possible routes from the starting locations to the destinations on 83% of trials. Direction accuracy did not differ as a function of gender or listener perspective. Together, these findings reveal that adults are quite adept at providing directions through a relatively unfamiliar environment, though there is room for improvement. They also indicate that adults can flexibly adapt their directions to the needs of their listeners, an important skill in successful wayfinding.

Contrary to our predictions, we found very few gender differences in the descriptive features provided in wayfinding directions. In fact, the only gender difference was a perspective by gender interaction observed for the frequency of cardinal descriptors. Although both women and men provided more cardinal information when addressing listeners adopting a survey perspective than when addressing listeners adopting a route perspective, the magnitude of difference was greater for men than for women. This interaction is hardly enough evidence to claim substantial gender differences in direction giving. Nonetheless, previous findings have revealed robust gender differences (e.g. Galea & Kimura, 1993; Lawton, 1994; Lawton, Charleston, & Zieles, 1996; MacFadden, Elias, & Saucier, 2003; Miller & Santoni, 1986; Pazzaglia & DeBeni, 2001; Prestopnik & Roskos-Ewoldsen, 2000; Saucier et al., 2002). It is not clear why gender differences emerge only in some tasks. One possibility is that sample characteristics affect the overall pattern of findings. For example, differences in participants' experiences with wayfinding and other spatial tasks may affect the overall results (e.g. Lawton & Kallai, 2002; Stern & Portugali, 1999). Differences in sample size also may affect results, with gender differences emerging when larger samples are tested (Hund & Minarik, 2006). It is also possible that differences in task demands, such as reliance on mental rotation skills (leading to enhanced gender differences favouring men) or increased support for survey cues (leading to fewer differences; see Ward et al., 1986), account for differences reported in the literature (for reviews, see Linn & Petersen, 1985; Montello et al., 1999; Voyer, Voyer, & Bryden, 1995). Future research is needed to clarify these issues.

One possible limitation of the present results stems from our decision to elicit wayfinding directions in writing rather than orally. Despite well-documented differences between written narrative and oral conversations in general (e.g. Chafe & Danielewicz, 1987; Ellis & Beattie, 1986), previous research has found very few differences between written and oral formats when communication maintains the same discourse focus, such as giving directions to facilitate wayfinding (Hildyard & Hidi, 1985; Wright et al., 1995). Thus, we are confident that the written directions provided here were reasonably similar to the directions they would have provided in other settings, including offering oral directions. Nonetheless, discourse format is one of many contextual factors deserving further empirical study.

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The goal of Experiments 2 and 3 was to add to our understanding of wayfinding processes by assessing recipients' responses to the wayfinding directions provided in the first experiment. In Experiment 2, a new group of participants read sets of descriptions (provided by participants in Experiment 1) of particular routes through the town. They were asked to rate each route description based on its effectiveness for aiding wayfinding using a 7-point scale. Given previous demonstrations of people's overall preference for wayfinding directions using a route perspective (Denis et al., 1999), we expected that participants would rate descriptions that utilized left-right turns and landmark references as highly effective. In contrast, we predicted that they would rate as less effective descriptions that included cardinal directions.

EXPERIMENT 2

Method

Participants

Participants were 38 male and 42 female college students. Data from one additional participant who did not complete the rating task were excluded from analyses. Participants were recruited and compensated in the same manner as in Experiment 1.

Apparatus, materials, design and procedure

The same model town and car were used as in Experiment 1. A packet containing 48 descriptions of routes (8 different descriptions of 6 routes) was used to elicit effectiveness ratings. Participants were randomly assigned to one of eight groups. Each group rated a subset of the directions provided in Experiment 1 (i.e. eight different descriptions for each of the six starting location-destination pairs).

Familiarization was identical to that used in Experiment 1. For each set of rating trials, the researcher placed the car at the starting location and noted the intended destination. Participants read eight different descriptions and rated how effective each description was for navigating to the final destination using a 7-point Likert-type scale from 'highly ineffective' to 'highly effective' (Denis et al., 1999). Participants' preferences for particular descriptive features in wayfinding directions were assessed using an open-ended question, 'What factors influenced your effectiveness ratings of the descriptions?' The frequency of positive and negative mentions of cardinal directions, distances, left-right and landmarks were coded.

Results

The goal was to specify the descriptive features contained in effective and ineffective route descriptions. Towards that end, we compared the frequency with which each feature was included in routes that received above-median ratings (i.e. the effective descriptions) and below-median ratings (i.e. the ineffective descriptions) using independent samples *t*-tests. Left-right information was significantly more frequent in the best-rated route descriptions than in the worst-rated route descriptions, $t(63) = -3.77$, $p < .01$ (see Table 1). Although cardinal directions were somewhat more frequent in the worst-rated route descriptions than in the best-rated route descriptions, this difference did not reach traditional levels of statistical significance, $t(63) = .67$, $p > .49$ (see Table 1). Analyses focusing on the

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Table 1. Mean frequency of descriptive features in the best- and worst-rated route descriptions in Experiment 2

Descriptive feature	Best-rated descriptions	Worst-rated descriptions	*t*-value
Cardinal	1.88 (.60)	2.02 (1.00)	.67
Distance	.31 (.30)	.31 (.37)	.02
Left-right	3.46 (.68)	2.78 (.80)	-3.77^{**}
Landmark	.13 (.17)	.12 (.15)	$-.22$

Note: Standard deviations are listed in parentheses. Asterisks denote significant results ($p < .01$) from independent samples *t*-tests (df = 63).

frequency of landmarks and distance information revealed that there were no significant differences between the best- and worst-rated route descriptions, all $|t|\text{s} < .23$, $p\text{s} > .82$ (see Table 1).

In participants' open-ended responses concerning wayfinding preferences, positive mentions of left-right information and landmarks were very frequent (see Table 2). In fact, positive mentions of left-right, landmarks, cardinal descriptors and distance information differed significantly from a uniform distribution, χ^2 (4, $N = 80) = 148.63$, $p < .01$. Negative mentions of cardinal descriptors also were very frequent (see Table 2). As expected, negative mentions of cardinal descriptors, left-right, landmarks and distance information differed from a uniform distribution, χ^2 (4, $N = 80) = 141.94$, $p < .01$. These reports generally correspond to the numerical ratings of route descriptions. That is, left-right cues were frequent in directions that received high effectiveness ratings and received many positive mentions from direction recipients. In contrast, cardinal cues were somewhat frequent in directions that received low effectiveness ratings and received many negative mentions. Interestingly, the frequency of landmark cues did not differ across directions receiving high and low effectiveness ratings; however, recipients noted them as positive wayfinding cues. Together, these findings provide strong support for people's preferences for left-right descriptors over cardinal descriptors. Preferences for landmark cues deserve further study (see Experiment 4).

Discussion

Wayfinding descriptions receiving high effectiveness ratings contained more left-right descriptors than did those receiving lower ratings. These preferences were further supported by numerous positive mentions of left-right descriptors, as well as landmarks, in open-ended responses. In contrast, numerous negative mentions of cardinal descriptors were included. Together, these results are consistent with findings from Experiment 1 and from the broader literature suggesting that wayfinding descriptions providing a mental tour of the environment (i.e. a route perspective) often are preferable to descriptions providing a

Table 2. Frequency of positive and negative mentions of descriptive features in Experiment 2

Descriptive feature	Positive mentions	Negative mentions
Cardinal	14	53
Distance	19	3
Left-right	54	0
Landmark	45	1

survey perspective (e.g. Linde & Labov, 1975; Levelt, 1982; Shanon, 1984; Taylor & Tversky, 1996; see also Montello et al., 1999).

In addition to documenting features included in effective and ineffective wayfinding directions, the present findings were necessary to determine which route descriptions should be included in our experimental examination of wayfinding efficiency in Experiment 3. In particular, we selected the single best- and worst-rated route descriptions for each starting location and destination. These descriptions were used to guide a new set of participants who attempted to navigate in our model town (see Denis et al., 1999 for a similar methodological approach). We expected that participants would navigate more efficiently (e.g. faster and with fewer errors) when following the best-rated directions than when following the worst-rated directions. We also sought to investigate the relations among gender, wayfinding strategies and wayfinding performance. We expected that men would navigate more efficiently than would women (see also Galea & Kimura, 1993). We also predicted that men would prefer orientation/survey strategies and women would prefer route strategies.

EXPERIMENT 3

Method

Participants

Participants were 34 male and 34 female college students. Data from one additional participant who did not complete the strategy questionnaire were excluded from analyses. Participants were recruited and compensated in the same manner as in the previous experiments.

Apparatus and materials

The same fictitious model town and car were used as in the previous two experiments. Bound sets of note cards contained the single best- and worst-rated descriptions for each of the six routes, based on ratings obtained in Experiment 2. Each note card contained one route segment. The wayfinding strategy questionnaire (Lawton & Kallai, 2002) was used to assess participants' preference for particular wayfinding strategies (see below for details).

Design and procedure

Participants followed 12 sets of directions to navigate specific routes in the model town. Six of the routes were the best-rated directions (one for each starting location and destination), and the remaining six were the worst-rated directions (one for each starting location and destination) from Experiment 2.[2] The order of the routes was counterbalanced.

The familiarization phase was identical to that used in the previous experiments. Following familiarization, the toy car was placed at the first starting location. When the researcher said, 'Go!' participants read the note cards one at a time and followed the

[2]Only route descriptions that could be used to reach the correct destinations were included. We did not systematically control the descriptive features included, the general manner of communication or the overall length of route descriptions across best and worst trials because our goal was to assess the utility of directions in a global manner, preserving external validity. Nonetheless, a *post hoc* comparison of the number of words in the best and worst directions revealed no significant difference, $t(10) = .87$, n.s. On average, the best-rated directions contained 37 words (SD = 11 words), and the worst-rated directions contained 30 words (SD = 19 words). Further empirical work is needed to test the influence of overall description length (as well as other features) on the efficiency of wayfinding.

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directions by moving the car from the starting location to the destination. When participants reached the destination they said, 'Stop!' Participants repeated the procedure for each of the 12 trials (see also Hund & Minarik, 2006). They also completed the wayfinding strategy questionnaire.

Coding and measures

Wayfinding time. The researcher recorded the time it took for participants to navigate each route (i.e. from when the researcher said, 'Go!' to when the participant said, 'Stop!'). Wayfinding times were averaged across the six best-rated and six worst-rated routes.

Wayfinding errors. Errors also were recorded for each trial. They included backing up, turning the wrong way, taking an incorrect street, ending at a wrong destination, stopping more than one car length short of the correct destination and giving up on the route all together. Wayfinding errors were summed across the six best-rated and six worst-rated routes.

Wayfinding strategy scale. Orientation and route wayfinding strategies were assessed using the 17-item Wayfinding strategy scale (Lawton & Kallai, 2002). Participants rated the degree to which each item applied to them using a 5-point Likert-type scale ranging from 'not at all' to 'very much'. Orientation strategies (survey strategies) involve keeping track of the relation between one's own position and global reference points, such as cardinal directions (e.g. 'I keep track of the direction [north, south, east or west] in which I am going'). Responses for the 11 items pertaining to orientation strategies were summed to obtain one orientation strategy score. Route strategies involve keeping track of the relation between one's position using step-by-step routes involving landmarks (e.g. 'I ask for directions telling me how many streets to pass before making each turn'). Responses for the six questions pertaining to route strategies were summed to obtain one route strategy score. Higher strategy scores reflected greater strategy preference.

Results

One goal was to determine whether wayfinding time and errors differed across rating level and gender. Mean wayfinding time and total wayfinding errors were entered into separate Rating Level (best-rated, worst-rated) $\times$ Gender (men, women) mixed model ANOVAs. Analyses of wayfinding time yielded a significant main effect of rating level, $F(1, 66) = 6.20, p < .05$. Contrary to our expectations, participants navigated significantly faster when utilizing the worst-rated directions ($M = 34.26$ seconds, $\text{SD} = 7.24$) than when utilizing the best-rated directions ($M = 36.11$ seconds, $\text{SD} = 9.38$). No other effects reached statistical significance, all $F\text{s} < .92$, $p\text{s} > .33$. The analysis of wayfinding errors yielded no significant effects, all $F\text{s} < .22$, $p\text{s} > .64$. Overall, errors did not differ for the best- ($M = 2.07$, $\text{SD} = 1.85$) and worst-rated routes ($M = 2.13$, $\text{SD} = 1.69$).

A second goal was to specify the relations among wayfinding strategies, gender and performance using Pearson correlations. A significant negative correlation was found between reported use of route strategies and overall wayfinding errors, $r(66) = -.25$, $p < .05$. As preference for route strategies increased, the overall number of wayfinding errors decreased. Similarly, as preference for route strategies increased, the number of wayfinding errors during trials involving ineffective directions also decreased, $r(66) = -.26, p < .05$. No other correlations reached traditional levels of statistical significance, all

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$|r|$s $< .21$, $ps > .09$. As expected, women reported greater preferences for route strategies ($M = 24.65$, SD $= 2.77$) than did men ($M = 21.85$, SD $= 4.07$), $t(66) = 3.31$, $p < .01$. In contrast, men reported greater preferences for orientation strategies ($M = 33.32$, SD $= 8.57$) than did women ($M = 26.15$, SD $= 6.87$), $t(66) = -3.81$, $p < .01$.

Discussion

Participants navigated significantly faster when following the worst-rated directions than when following the best-rated directions. This finding was inconsistent with our predictions and with findings from a similar study investigating the link between direction giving and following in the city of Venice (Denis et al., 1999). Why might this be the case? It is possible that overall features of the directions and routes, such as the clarity and length of explanation, led to differences in wayfinding efficiency across rating level. Close inspection of the route descriptions revealed that the worst-rated set included descriptions that were very concise and somewhat vague, particularly because they failed to provide details regarding the final portion of the route (i.e. reaching the destination). Nonetheless, it is possible that these route descriptions allowed efficient wayfinding because they were easy to read and relatively easy to follow in our model town. The fact that details about the destination were not included may have been ameliorated by our inclusion of a general statement about reaching the specified destination at the end of each route. It is also possible that the observed pattern of results stemmed from the predominance of descriptive features included in the route descriptions. In particular, the worst-rated directions contained a high proportion of cardinal descriptors, whereas the best-rated directions contained a mixture of left-right descriptions, distances, landmarks and cardinal descriptors (see Table 3). In a recent study using the same model town, we found that people were faster when following directions that contained cardinal descriptors (e.g. Turn east on Main Street) than when following directions containing landmark descriptors (e.g. Turn towards the grocery store on Main Street; Hund & Minarik, 2006). Perhaps participants in the present study were faster when the directions contained cardinal descriptors than mixed descriptors.

Table 3. Frequency of descriptive features in the best- and worst-rated route descriptions in Experiment 3

	Descriptive features				
Route	Cardinal	Distance	Left-right	Landmark	Street
Best-rated descriptions					
Bank to arena	0	0	4	1	9
Hospital to mall	3	3	3	0	6
Tavern to lake	0	0	6	1	6
Church to gas station	0	0	3	1	6
Post office to library	0	0	5	1	5
Courthouse to gym	4	0	4	1	6
Worst-rated descriptions					
Bank to arena	4	0	0	0	4
Hospital to mall	0	1	3	0	1
Tavern to lake	5	0	1	1	5
Church to gas station	6	0	5	0	6
Post office to library	0	5	6	0	6
Courthouse to gym	3	0	0	0	3

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A third possibility is that the differences in ratings (Experiment 2) and wayfinding efficiency (Experiment 3) stem from differences in the perspectives assumed by the participants across tasks. Perhaps participants in the second experiment relied on a route perspective, given their instructions to rate the effectiveness of wayfinding directions. Thus, it is not surprising that route features such as landmarks and left-right descriptors received high ratings. In contrast, it is possible that participants in the third experiment relied on a survey perspective while looking at the model (from an overhead view) and navigating through it. As a result, it is not surprising that they responded with efficiency to directions containing survey cues. Future research is needed to clarify the role these factors might play in facilitating skilful wayfinding.

As expected, the present findings revealed significant relations between wayfinding strategies and performance. In particular, increasing reliance on route strategies was related to decreasing wayfinding errors overall and when using ineffective directions, suggesting that route strategies were well suited to our route-following task. These findings confirm that wayfinding strategies are related to wayfinding performance (Hund & Minarik, 2006; Lawton, 1994, 1996; Pazzaglia & DeBeni, 2001; Saucier et al., 2002). Our findings also revealed robust gender differences in wayfinding strategies. As in previous studies, women reported higher preferences for route strategies than did men, whereas men reported higher preferences for orientation/survey strategies than did women (e.g. Lawton & Kallai, 2002; MacFadden et al., 2003; Saucier et al., 2002; Ward et al., 1986). Note, however, that wayfinding efficiency did not differ across genders as has been found in previous studies (e.g. Galea & Kimura, 1993).

EXPERIMENT 4

The goal of Experiment 4 was to further specify the types of cues people provide when giving wayfinding directions. Experiment 1 probed these issues, but the generalizability of its results might be questionable given its reliance on a small-scale environment that was not very familiar but was visible throughout the direction-giving task. Using a small model town changed the nature with which participants learned about the environment (given their reliance on a model viewable from a survey perspective, rather than direct exposure via wayfinding). The model town also might have reduced people's overall familiarity with the environment relative to everyday environments that are very familiar. In contrast, however, the model town was visible throughout the task, thereby reducing memory demands often evident in everyday direction-giving situations. The present experiment's method was identical to Experiment 1, except that participants provided wayfinding directions through a familiar, large-scale environment (i.e. the community in which our university is located) for (fictitious) recipients driving through the town or looking at a map of a town. We hypothesized that the general pattern of results would be similar to that of Experiment 1, indicating that people adjust the cues provided in wayfinding directions based on recipient perspective.

Method

Participants

Participants were 21 male and 51 female college students. Participants were recruited and compensated in the same manner as in the previous experiments.

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Materials, design and procedure

To assess direction-giving processes using a familiar, large-scale environment, participants gave wayfinding directions involving locations in the community (e.g. two contiguous towns surrounding our university). As in Experiment 1, participants completed six trials, three in which they imagined that they were giving directions to a person driving in the towns (i.e. using a route perspective) and three in which they imagined that they were giving directions to a person looking at a map of the towns (i.e. using a survey perspective). The starting locations and destinations were a bookstore and a big box store, a children's museum and a hospital, a big box store and a theatre, a public library and an arena, a student centre and a coffee shop and a football stadium and a mall. The order of routes and the assignment of routes to perspectives were counterbalanced.

Coding and measures

As in Experiment 1, researchers coded the frequency with which participants mentioned cardinal directions, distances, left or right, landmarks (i.e. towers, buildings or other unique environmental features) and street names. In addition, researchers determined the total amount of information and whether the directions led from the starting location to the destination.

Two coders independently assessed the directions provided by 16 randomly selected participants (22% of the sample) to assess reliability. They agreed exactly on 1020 out of 1056 categorical judgments concerning descriptive features and accuracy (96.59% exact agreement). The correlation between judgments was .99, indicating a very high level of inter-rater reliability.

Results

The primary goal was to investigate how recipient perspective affected the descriptive features people provide when giving directions to help others find their way through a familiar environment (i.e. the community in which our university is located). A second goal was to investigate the effect of gender on the descriptive features provided. To address these issues, dependent measures were analysed using separate Perspective (route, survey) × Gender (men, women) mixed model ANOVAs. We predicted that when addressing someone driving in the town, people would use more left-right descriptors and landmarks. Conversely, we predicted that when addressing someone looking at a map of the town, people would use more cardinal descriptors (north-south-east-west) and specific distances (e.g. city blocks). Frequencies of each feature in the two recipient perspectives can be seen in Figure 3. Moreover, we expected that women would provide more features consistent with a route perspective, whereas men would provide more features consistent with a survey perspective.

As expected, participants provided significantly more cardinal descriptors when addressing listeners adopting a survey perspective ($M = 1.47$, $SD = 2.64$) than when addressing listeners adopting a route perspective ($M = 0.47$, $SD = 0.99$), $F(1, 70) = 11.77$, $p < .005$. No other effects reached statistical significance, all $F\text{s} < .70$, $p\text{s} > .40$. Contrary to our expectations, the analysis of distance frequency revealed no significant effects, all $F\text{s} < .13$, $p\text{s} > .73$. Distance was mentioned fairly infrequently overall ($M = 0.98$, $SD = 1.18$).

As expected, participants included left and right marginally more frequently when addressing listeners adopting a route perspective ($M = 6.57$, $SD = 4.15$) than when

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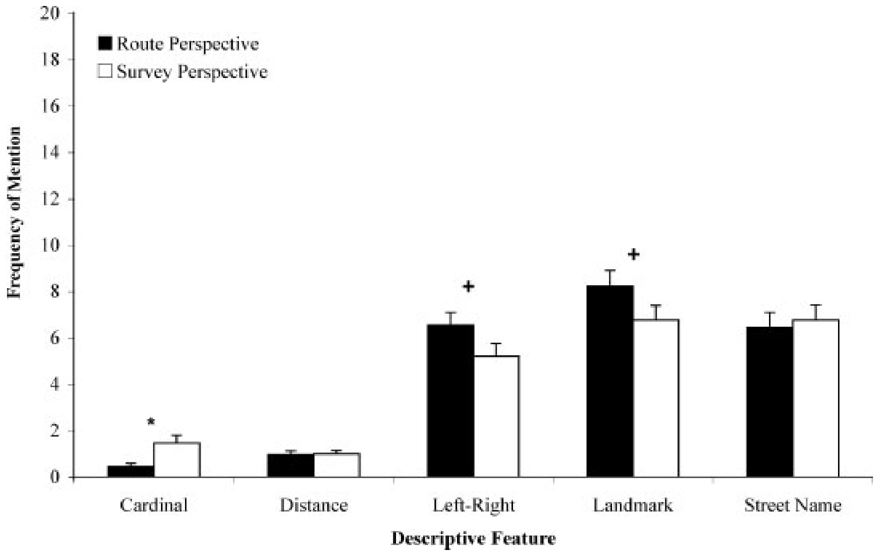

Figure 3. Mean frequency of five descriptive features in wayfinding directions through a familiar community adopting each of two recipient perspectives (Experiment 2). Asterisks denote significant differences across perspective ($p < .05$). Plus signs denote marginally significant differences across perspective ($p < .06$). See the text for complete details

addressing listeners adopting a survey perspective ($M = 5.21$, SD = 4.23), $F(1, 70) = 3.82$, $p = .055$. No other effects reached statistical significance, all Fs < .49, ps > .48. Similarly, landmarks were included marginally more frequently when addressing listeners adopting a route perspective ($M = 8.24$, SD = 5.26) than when addressing listeners adopting a survey perspective ($M = 6.79$, SD = 4.78), $F(1, 70) = 3.70$, $p = .059$. No other effects reached statistical significance, all Fs < .23, ps > .63. Analysis of street name frequency revealed no significant effects, all Fs < 2.19, ps > .13. Street names were mentioned fairly frequently overall ($M = 6.63$, SD = 4.91).

Analysis of total information revealed no significant effects, all Fs < .49, ps > .48. Overall, participants provided detailed instructions containing multiple descriptive features ($M = 23.77$, SD = 13.29). Similarly, analysis of direction accuracy revealed no significant effects, all Fs < 1.07, ps > .30. Overall, the directions led to the correct destination on 20% of trials. The directions were nearly accurate (i.e. one piece of information was missing or incorrect) on another 14% of trials. Participants responded that they did not know enough to provide directions on 31% of trials, and the remaining 36% of trials contained incorrect wayfinding details. When focusing only on trials in which participants attempted to provide wayfinding directions, 30% of trials were correct, an additional 20% were nearly correct and 50% were incorrect.

Discussion

Our main goal was to assess how the features of wayfinding directions differ depending on recipient perspective when using a familiar, large-scale environment. We assume that people learned this environment mainly via direct navigation. Moreover, participants

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needed to rely on their memory of the environment when giving directions. These circumstances more closely parallel direction-giving situations in everyday settings (e.g. stopping to ask a clerk or pedestrian for directions to find a location). As predicted, the general pattern of results was similar to that found in Experiment 1. In particular, participants provided cardinal descriptors with greater frequency when addressing a listener adopting a survey perspective than when addressing a listener adopting a route perspective. In contrast, they provided more left-right and landmark details when addressing a listener adopting a route perspective than when addressing a listener adopting a survey perspective. Interestingly, distance mentions did not differ across recipient perspectives, failing to replicate the unexpected results in Experiment 1 (but replicating the overall low inclusion of distance). These findings suggest that people use recipient perspective to formulate wayfinding directions, providing important converging evidence that strengthens the external validity of our results.

Interestingly, the directions provided were not highly accurate. Why might this be the case? It is possible that accuracy varies as a function of familiarity with the environment. In general, our participants had lived in the community for less than 2 years ($M = 1.53$, $SD = 1.05$). They rated their familiarity with the community as fairly familiar ($M = 2.47$, $SD = .94$, on a 5-point Likert-scale). Importantly, as familiarity increased, the number of trials on which participants provided accurate directions increased, $r(71) = .49$, $p < .001$, and the total amount of information provided increased, $r(71) = .59$, $p < .001$. In contrast, as familiarity increased, the number of trials on which participants responded 'I do not know', when asked to provide wayfinding directions decreased, $r(71) = -.62$, $p < .001$. Moreover, the accurate directions included significantly more cardinal descriptors, distances, left-right descriptors, landmarks and street names than did the inaccurate directions, all $|t|\text{s} > 2.65$, $p\text{s} < .01$. Although these findings support the common sense notion that wayfinding directions improve as a function of familiarity, future research is needed to probe changes in wayfinding directions over learning experience.

GENERAL DISCUSSION

Our results confirm that people provide wayfinding directions appropriate for their recipients. Specifically, Experiments 1 and 4 revealed that when addressing a listener adopting a route perspective, people included more route descriptors (e.g. left, right) than survey descriptors (e.g. north, south). In contrast, when addressing a listener adopting a survey perspective, people included more survey descriptors (e.g. cardinal directions) than route descriptors. It is possible that these changes in responding result from a combination of shifts in perspective (i.e. differences in cognitive processing; for related ideas, see Golledge, 1987, 1999; Hirtle & Hudson, 1991; Pazzaglia & DeBeni, 2001; Shelton & McNamara, 2004; Siegel & White, 1975; Taylor & Tversky, 1992, 1996) and pragmatic considerations, particularly communicative conventions for providing directions in diverse contexts (Allen, 2000; Golding et al., 1996; Lloyd, 1991; Ward et al., 1986). These findings suggest not only fine-tuning to listener perspective, but adaptive flexibility in providing wayfinding directions.

Experiments 2 and 3 examined recipients' responses to the wayfinding directions. Descriptions receiving higher ratings contained high frequencies of left-right descriptors, whereas descriptions receiving lower ratings contained high frequencies of cardinal directions.

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Participants' open-ended responses confirmed these positive evaluations of left-right references (as well as landmarks) and their negative evaluations of cardinal descriptors. These findings support the notion that wayfinding descriptions providing a mental tour of the environment (i.e. a route perspective) often are preferable to descriptions that provide an overhead, survey perspective (Levelt, 1982; Linde & Labov, 1975; Noordzij, Zuidhoek, & Postma, 2006; Shanon, 1984; Taylor & Naylor, 2002; Taylor & Tversky, 1996; but see Noordzij & Postma, 2005). Perhaps this effect is tied to the task at hand—finding one's way from place to place. That is, descriptions adopting a route perspective are well suited to route-following tasks. In Experiment 3, participants navigated significantly faster when using the worst-rated routes than the best-rated routes. This unexpected finding may have resulted from the high frequency of cardinal descriptors in the worst-rated descriptions (Hund & Minarik, 2006) or from differences in overall route complexity and description details. It might also have resulted from participants' reliance on a survey perspective during wayfinding, given their overhead view of the small model town.

Wayfinding is a complex, dynamic process that depends on features of the direction giver, the direction recipient and the environment and task at hand. For example, our findings indicate that direction givers appreciate the perspective of the recipients of wayfinding directions—the descriptive features they provide depend on the recipient's perspective (see also Galea & Kimura, 1993; Hund & Minarik, 2006; Lawton & Kallai, 2002; Saucier et al., 2002). Moreover, individual differences in wayfinding strategies also affect performance. In particular, increasing reliance on route strategies was related to decreasing wayfinding errors. Although these correlational findings preclude clear analysis of causal relations, our contention is that wayfinding experience shapes strategies and performance. For example, Ward et al. (1986) suggested that driving experience, geography courses and activities involving cardinality might account for gender differences in wayfinding tasks (see also Allen, 1999; Kozlowski & Bryant, 1977; Lawton & Kallai, 2002; Ondracek & Allen, 2000). Future experimental investigations are needed to specify how experience shapes wayfinding strategies and performance.

The structure of the physical environment also shapes wayfinding processes. For instance, people are more likely to provide route descriptions when the available landmarks are similar in size and an obvious path is available (Taylor & Tversky, 1996). Moreover, the nature of the wayfinding task faced by direction givers and receivers affects their interactions. For instance, Plumert, Carswell, DeVet, & Ihrig (1995) demonstrated that participants organize their descriptions differently when describing a space than when giving directions to a traveller (see also Golding et al., 1996; Plumert, Spalding, & Nichols-Whitehead, 2001; Taylor, Naylor, & Chechile, 1999). When describing the location of a coffee cup, for instance, people note that it is on the desk, in the office, on the fourth floor of the psychology building. In contrast, when giving directions for locating the same cup, they note that it is in the psychology building, on the fourth floor, in the office, on the desk.

Similarly, wayfinding differs when participants learn via direct travel through a space versus via a map of a space (Moeser, 1988; Pazzaglia & DeBeni, 2001) and when their goals involve learning a route versus learning the overall layout (Magliano, Cohen, Allen, & Rodrigue, 1995; Taylor & Naylor, 2002). For example, recent theoretical and empirical work has focused on the extent to which spatial knowledge gained from maps is orientation-specific, whereas knowledge gained from direct travel is orientation-independent (e.g. Diwadkar & McNamara, 1997; Montello, Hegarty, Richardson, & Waller, 2004; Presson, DeLange, & Hazelrigg, 1987, 1989; Presson & Hazelrigg, 1984;

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Richardson, Montello, & Hegarty, 1999; Sholl & Nolin, 1997; but see Roskos-Ewoldsen, McNamara, Shelton, & Carr, 1998 for contradictory findings). To avoid confusion, direction givers and receivers must coordinate their efforts by selecting an appropriate perspective or frame of reference, assessing the familiarity of the environment, and understanding their individual skills and preferences, as well as cultural conventions for communication (Allen, 2000; Allen, Kirasic, & Beard, 1989; Carlson-Radvansky & Radvansky,1996; Levinson, 1996; Plumert, Pick, Marks, Kintsch, & Wegesin, 1994; Plumert & Strahan, 1997; Taylor & Tversky, 1992; Wright et al., 1995). For instance, Golding et al. (1996) found that when approached by a student requesting wayfinding directions, participants asked clarifying questions to be sure that they were describing the correct destination and to assess the requester's knowledge of the campus. This example demonstrates two ways direction givers and receivers coordinate their efforts to facilitate successful wayfinding.

Our results revealed few significant gender differences in wayfinding performance. Although Experiment 1 revealed that the frequency of mention for cardinal descriptors differed as a function of gender and recipient perspective, closer examination revealed a similar pattern for both genders: men and women provided more cardinal descriptors when addressing a listener adopting a survey perspective than when addressing a listener adopting a route perspective, though the magnitude of difference was larger for men. Experiment 4 also failed to reveal gender differences in wayfinding cues. In contrast, our findings revealed robust gender differences in wayfinding strategies (Devlin & Bernstein, 1995, 1997; Galea & Kimura, 1993; Lawton, 2001; Miller & Santoni, 1986; Pazzaglia & DeBeni, 2001; Prestopnik & Roskos-Ewoldsen, 2000; Saucier et al., 2002; Ward et al., 1986; for reviews, see Linn & Petersen, 1985; Montello et al., 1999; Voyer et al., 1995). The divergent pattern of results reported here (and elsewhere in the literature) makes it difficult to determine whether men indeed rely on survey knowledge and women rely on route knowledge. Questions remain regarding the locus of such differences, including the possibility that gender roles and expectations shape responses (e.g. Lawton & Kallai, 2002; Steele, 1997). Clearly, additional research is needed to specify the mechanisms underlying gender effects.

In summary, the present findings show that adults are skilful in adapting the descriptive features they provide to match the needs of their listeners attempting to find their way through an environment. Moreover, they understand how the features provided by others affect the effectiveness of wayfinding directions. These findings confirm that direction giving and following are dynamic processes that depend on interactions between those providing directions, the recipients of such directions and the environments through which they navigate (Hirtle & Heidorn, 1993; Montello et al., 2004; Newcombe & Huttenlocher, 2000; Plumert et al., 1995; Schober, 1993, 1995; Shelton & McNamara, 2004). Thus, they add to our growing understanding the dynamic processes involved in skilful wayfinding.

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