Comparison Between Wayfinding Direction Descriptors of Local and Tourist Preferences

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Abstract Tourists sometimes would seek the wayfinding information from the local while traveling in unfamiliar countries to decrease the possibility of being lost. However, the wayfinding information provided by the local might end up the tourists with the confusing because people have different way to express their spatial information. The study wants to investigate a tourist's preferences for different types of wayfinding direction descriptors provided by the local for their overseas wayfinding to unfamiliar destination and examine any difference on preference for direction descriptors by culture and gender. According to the study results, the international tourists with different wayfinding strategy preferences, gender and culture background would have different preference towards wayfinding direction information. The international tourists have different preferences towards wayfinding direction information when they are information providers and receivers.

1 Introduction

People are generally aware of their surroundings and know their way around in their daily lives. However, when people travel to new places, they can easily feel lost in the strange surroundings and unfamiliar environments, requiring them to ask for directions to find their way around. This does not only happen to local residents traveling within their own country but also to international travelers who are visiting a country for the first time or on repeated visits. When the tourists travel in unfamiliar countries, they might acquire the help from other local people to decrease the chances of getting lost. However, doing this might make themselves feel more confused. People have different ways and used different descriptors to express their idea, and spatial information such as landmarks, distance, directions, walking minutes, turning right or left and etc. (Denis et al. 1999; Golding et al. 1996;

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Mark and Gould 1995; Vanetti and Allen 1988; Wright et al. 1995). Hund et al. (2012) investigated the preference of wayfinding information descriptors of Americans. The result showed that some people prefer using the third party to express their thoughts by using the information such as east, west, south and north, and others would have favor of using right or left turns to help others. Individual differences in wayfinding details are widespread, with some people providing detailed and specific descriptions (Devlin 2003).

Often people rely on verbal directions to facilitate wayfinding, particularly when searching for unfamiliar destinations such as tourist sites. What sort of descriptive language do people use when giving directions? In what ways might these features vary across cultures? Do they depend on the characteristics of the information receivers? The aim of this study is to investigate what international tourists need when they ask local people for directions to unfamiliar destinations. This study will also investigate whether the tourists' gender, cultural backgrounds and wayfinding strategy preferences affect their preference for direction descriptors.

2 Literature Review

2.1 Wayfinding

Researchers have studied how humans react in geographic space. This research is from a cognitive perspective with an emphasis on how individuals think about and behave in geographic space to process information (Golledge and Stimson 1997; Kitchin and Blades 2002). Wayfinding is a purposeful, directed and motivated means of moving from the point of origin to a given destination (Xia et al. 2008). The ability to find one's orientation while in an open area varies among individuals (Hirtle and Hudson 1991; Kozlowski and Bryant 1977; Montello and Pick 1993). Allen (1999) identified three types of wayfinding tasks: "commute, explore and quest," depending on the purpose for traveling. The third type of wayfinding task is called "quest," which involves traveling from the familiar place of origin to an unfamiliar destination. This destination is known to exist but is one that the traveler has not previously visited. Without stored knowledge, the traveler might need a map, visual references or a verbal description to find their way to their destination.

2.2 Wayfinding Direction

Sometimes, directions are helpful because there are adequate details to effectively guide a person to travel from place to place. At other times, directions that may have originally appeared to be good are actually misleading or have too many details to remember, especially for tourists experiencing language barriers. According to previous studies, everyone has different ways of using spatial information and also

have different preferences for how information is given. They may like to be given landmarks, distances, directions, left or right turns, cues, walking distance, etc. (Golding et al. 1996; Mark and Gould 1995; Wright et al. 1995; Denis et al. 1999; Klein 1982; Vanetti and Allen 1988). In giving directions, some people provide only the most basic instructions, such as "right at the last section", whereas others provide more information, such as distances, landmarks, or clear street names. Directions could be different for different communicators as a function of frames of reference (Levinson et al. 2002).

2.3 *Differences in Direction Preferences*

The effectiveness of wayfinding descriptions could be possibly affected by different variables such as environmental features (for example, landmarks, pathway, choice points), delimiters (such as distance, cardinal and left-right directions), verbs of movement (such as turn, go, continue), and also state-of-being verbs (how people use the verbs) (Allen 1997). The issue of gender differences in wayfinding and spatial abilities is still controversial (Voyer et al. 1995). Some research has found that men are more efficient than women at finding locations (Astur et al. 1998; Lawton and Kallai 2002; Malinowski and Gillespie 2001). However, other studies have found no gender differences in wayfinding abilities, especially when landmarks were used as references (Sandstrom et al. 1998). Previous studies have also confirmed that the quality of directions given and received would be affected by the receiver's culture, wayfinding strategy, sense of direction, familiarity with the local environment, gender and age, etc. These factors might influence how efficiently directions are given in the service of wayfinding (Hund and Minarik 2006; Saucier et al. 2002).

Wayfinding strategies are also related to wayfinding efficiency. People use various strategies in their wayfinding behaviors (Lawton 1994; Passini 1984; Rovine and Weisman 1989). Lawton (1994) identified two types of wayfinding strategies, route and orientation, equally functional in most wayfinding situations. Hund and Minarik's study (2006) divided wayfinding strategies into the landmark and cardinal descriptors, also used in earlier research (Jansen-Osmann 2002; Lawton 1994, 1996; Lawton and Kallai 2002; Pazzaglia and DeBeni 2001; Saucier et al. 2002). The route strategy focuses on information about the route to be followed, such as instructions about where to turn, relational directions, landmarks, and specific instructions for getting from place to place. The orientation strategy focuses on the use of global reference points, such as compass directions and the position of the sun (Lawton 1996). When using an orientation strategy, a person thinks of his own position with respect to reference points and integrates information about places and the relations between them.

There are marked individual differences in the frequency with which each cue is given (Denis et al. 1999; Vanetti and Allen 1988). Previous research has found that there are striking cultural differences in frames of reference and associated spatial

terms used to describe geographical locations (Levinson 2003). Ito and Sano (2011) found the differences between Japanese and American subjects in the usefulness of spatial information tools, the use of the tools in wayfinding, and the timing of their wayfinding actions. That study found that Japanese subjects were more certain about their location and their way when they used only the map than when using only the directions. In contrast, American subjects were more certain about their location and their way when they used the directions than when using the map. That study also claimed that the map was a more helpful spatial information tool for Japanese subjects' wayfinding whereas the usage of directions were a more helpful spatial information tool for American subjects. American participants need to match the spatial information with the real world frequently and are too busy to enjoy viewing things along the route when they use the map alone. Ito and Sano (2011) concluded that more real world searches, tool searches and hesitation are observed when Japanese subjects used only the directions than when they had the other sets of tools, though looking at a spatial information tool while walking was an exception (quite confusing, should be paraphrased). They also gazed at nearby features less when using the directions than when using the other sets of tools. With regard to differences within western societies, most psychological research on wayfinding generally proceeds from the assumption that western societies do not differ in spatial perception (Eysenck and Keane 2005). However, differences in preference for spatial perspective and spatial descriptors have been found among western societies. Lawton and Kallai (2002) demonstrated individual differences in wayfinding strategies among participants from different countries. Until now, the subject of cultural differences in describing spatial factors has been ignored (Hund et al. 2008; Pazzaglia et al. 2010). Thus, this study will examine two hypotheses:

Hypothesis 1: Significant differences in preferences for how directions are given (such as orientation, left/right turns, distance, landmark, etc.) exist between tourists and local people.
Hypothesis 2: tourists who have different wayfinding strategies (route/orientation strategy), gender (male/female) and cultural background (Eastern/Western) would have different preferences for how directions (such as orientation, left/right turns, distance, landmarks, etc.) are given.

3 Method

The data was collect in major tourism attractions, Taipei, Taiwan. The 287 study participants included 154 international tourists who never visited Taipei before and 133 local residents who had experiences of helping international tourists find the way to the attraction sites. They participated in the survey voluntarily and must have certain understanding of English. Of the participants, 57.5% were female and 42.5% were male. Further, 53.7% were international tourists and 46.3% were local Taiwanese people. The average age was 32 years. In terms of cultural backgrounds,

52% claimed to have been brought up in an Eastern culture and 48% had a Western background. Being able to speak the same language is essential for interaction to take place between tourists and locals. English is considered to be the most widely used foreign language in Taiwan. The average score for English proficiency is 8.49 out of ten for international tourists; 5.13 for local Taiwanese people. The criteria used to identify participants in this survey was whether local Taiwanese people had had any previous experience of helping foreigners find their way to tourist destinations in English.

The study used a four-page closed-ended survey. The questionnaire collected information about socio-economic and cultural backgrounds, nationality, English and Chinese proficiency. Then items used to measure their wayfinding strategy came from the questions designed in the study of Lawton and Kallai (2002). Four items are related to route strategy and the other three items about survey strategy. The seven items were designed by seven-point Likert scale. Scores on these items were generated by asking participants to rate on a 7-point scale of how likely they would be to engage in various behaviors while trying to find their way around unfamiliar surroundings. The scale ranged from Extremely disagree (1) to Extremely agree (7).

The survey also designed a set of questions to understand their preferred methods for receiving directions when they need the wayfinding direction information from the local people. This set of question is displayed with a hand-made map with two appointed spots: A and B. Then the study participants must read the following sentences before answering the question; that is, "Suppose you were a tourist and experienced trying to find your way from Wonder land to the Dream world. If some local people offered you wayfinding information, which one of the following statements would help you the most from your own perspective. Please read through the following wayfinding direction information. Then rank the statements from 1 to 7 to express your preference (7 refers to the most preferable/helpful; 1 refers to the least preferable/helpful.)". The sever statements were designed according to the literature reviews and then discussed with 30 professional English native speakers in the way they would use in order to help others. Those statements include one or multiple direction descriptors such as landmarks, cardinal points (north/east/south/west); left/right turns, time taken to walk the distance, actual distance, or various methods. All data were analyzed by the SPSS software.

4 Results

4.1 The Wayfinding Direction Descriptors

The main study purpose is to understand what type of wayfinding direction descriptors the international tourists would prefer to receive from the local people and furthermore to examine whether or not there is any difference on wayfinding

Table 1 The cross-tab result for direction descriptors preferred by locals and tourists

Items	Mean	Local	Tourist	t value
After leaving Wonder land, you can walk straight ahead, and then you can see Dream world	3.82	3.70	3.92	−0.625
After leaving Wonder land, walk straight. When you see the fountain, keep walking straight until you see a castle; Dream world is beside that Landmarks	4.92	5.07	4.78	1.448
After leaving Wonder land, walk 900 m south; then you can see Dream world Cardinal + Distance	3.66	3.65	3.68	−0.252
After leaving Wonder land, please head to the south. Walk about 500 m, you will pass a block and the fountain is on the right-hand side. Please keep heading to south 400 m, and you will see Dream world next to the castle Cardinal + Distance	***4.06****	4.43	3.73	**2.362***
After leaving Wonder land, please walk South, and you can see Dream world Cardinal	***3.56****	3.35	3.75	**−2.000***
After leaving Wonder land, please head south, walking about 500 m you can see the fountain is on your right-hand side. Keep heading south, beside the castle is Dream world Cardinal + Distance	4.25	4.34	4.18	0.569
After leaving Wonder land walk straight. After passing two blocks, you can see Dream world Landmarks	4.37	4.26	4.47	−0.921

*$p < 0.05$

direction descriptors existing between the local and the tourists. Table 1 lists the result of mean value on seven statements scored by the local people when they need to provide the wayfinding direction descriptors and also by the tourists when they need to receive the information from the local as well as the result of T value on the comparison between two parties.

The first and second most helpful statements both use the "landmark" descriptor only rather than multiple information for the local and tourists. It is a very simple method. Landmark helps people form a picture of an area. People could link key landmarks in a logical way, improving a person's ability to traverse locations. On the opposite, two items listed as the least help statement use the "cardinal" and "distance" as the descriptors, not the "landmark." The previous studies also found that the orientation and cardinal widely used in the maps, and it takes efforts to create mental images from different perspectives (Roskos-Ewoldsen et al. 1998; Sholl 1988; Thorndyke and Hayes-Roth 1982). Sometimes, it is difficult for children or adults to read maps with cardinal information because they need to understand the relationships among the map, the represented space, and their self(?) (Liben et al. 2002).

According to the T test, the local people and the tourists are significantly different on two statements. The first statement is the usage of "cardinal and

landmark" (t value = 2.362). The local people actually preferred to use the combination of cardinal and landmark to help tourists to find their way to the destination. However, the tourists rated this method as the second least helpful. The local people might think it more helpful with more information. On the contrary, the tourists might not be able to memorize so much information at one time. Lippman (1992) found a negative relationship between age and route wayfinding preferences. Memory always weakens with age, and being old would definitely affect one's ability to use route wayfinding.

4.2 The Comparison of Direction Descriptors Between Locals and Tourists

Then the seven statements were recorded into three types of wayfinding information descriptors. Three types are the usages of "landmark" (Statement 1, 2, and 7), "cardinal" (Statement 5), and "cardinal and distance" (Statement 3, 4, and 6). Then the most preferable among the three types of wayfinding descriptors would be decided based on the average score of the study participants marking on the items. According to the data transformation, 40% of all study participants preferred the usage of "cardinal and distance"; 36% is the usage of "landmark" and the rest 24% is for "cardinal" information only.

In this study, the hypothesis #1 was examined by using χ^2 analysis. Table 2 showed that the three most widely used types of information are cardinal points (north/east/south/west) and distance (40%), landmarks (36%), and cardinal points (north/east/south/west) only (24%). The results of this study confirm the findings of many previous studies that the most common reference frames involve cardinal point directions and precise distances/names of streets (Lawson 1996; Taylor and Tversky 1996). Landmarks are the second most favorable descriptors that tourists would like to use in wayfinding directions. Landmarks are very useful because they provide environmental features as points of reference and keep people connected to the point of origin and the destination along the route (Allen 2000). They also provide a visual model of the environment (Tom and Denis 2004). According to the results of the cross-tab analysis ($\chi^2 = 12.978$, $p = 0.002$), the local Taiwanese people preferred the direction descriptors together with cardinal points and distances when they require the help from others. The international tourists in Taiwan actually prefer the information to include landmarks when they need the assistance of local people (Table 2). From the perspective of the international tourist,

Table 2 The cross-tab result for direction descriptors preferred by locals and tourists (%)

Direction descriptors	Local people	Tourists	Total
Cardinal + Distance	**51**	31	40
Cardinal only	17	30	24
Landmarks	32	**39**	36
Total	100	100	100

consideration should be given to the fact that directions including information about landmarks would be easier to follow than cardinal points. For example, in Taiwan, most street names have yet given information about cardinal points. It would be very challenging for people to identify cardinal points if they were not familiar with the local road planning system. However, some studies mentioned the possible risk of using landmark information to give directions to destinations. It was claimed that people who performed frequent use of landmarks for wayfinding had a better memory, especially for remembering details given for the end of the routes (what does it mean by the end of the routes?).

4.3 The Difference on Direction Descriptor Preference by Different Variables

Participants rated the seven items to express how they used each of the wayfinding strategies while traveling abroad. The participants' responses to the seven items were combined and subjected to a principle component analysis with two factor solutions specified. The KMO value was 0.895, the Bartlett's Chi-Square value was 2021.729, and the p value was less than 0.05. Two domains were identified for the factor analysis, the route and survey wayfinding strategies. All factors had eigenvalues greater than one, the reliability bigger than 0.7, and explained 55.32% of the total variance. Moreover, the correlation between the two factors was 0.10, showing that they were relatively independent. Then the preference of wayfinding strategy is decided according to their mean score on route and survey strategies. Of all study participants, 77% is considered to have a preference of using route wayfinding strategy and 20% is identified as the user of survey strategy. Another 3% has no preference and then is excluded from the study of the hypothesis #2.

The result of the hypothesis 2 is shown in Table 3. The tourists with different wayfinding-strategy preferences, gender and cultural backgrounds showed a significant preference for wayfinding direction descriptors provided by the local people. The tourists who used a route strategy for wayfinding showed a strong preference for receiving information about landmarks from the local people, but the tourists who used a survey strategy more often liked information that included cardinal points and distances. A route wayfinding-strategy perspective normally

Table 3 The cross table result of direction descriptors by different variables (%)

Direction descriptors	Wayfinding strategy		Gender		Culture	
	Route	Survey	Male	Female	Eastern	Western
Cardinal + Distance	29	**42**	**40**	25	**48**	29
Cardinal only	23	30	21	27	20	33
Landmark	**48**	28	**39**	**48**	32	**38**
χ^2	6.781		6.916		13.500	

involves using a first-person spatial perspective as the frame of reference and includes left and right turns and also landmark descriptions to navigate the environment (Hund et al. 2012). On the other hand, a survey perspective involves adapting a third-person spatial perspective to identify the entire environment. The person using this strategy prefers to know the whole layout of wayfinding environment and likes to know the cardinal points along with precise distances. My study results were consistent with previous studies.

With reference to gender differences in preferences of wayfinding information, the results indicate that males prefer to be given both cardinal points and exact distances; females show a strong preference for landmark information. Previous studies have found gender differences in wayfinding strategies (e.g., Honda and Nihei 2004; Lawton and Kallai 2002; Saucier et al. 2002). More men than women prefer survey strategies that provide more cardinal descriptions; more women than men prefer route strategies that provide more landmark information (Honda and Nihei 2004; Hund and Minarik 2006; Hund et al. 2008; Lawton and Kallai 2002).

Tourists from an Eastern background prefer cardinal points and distance information; tourists from a Western background like to be given information that includes landmarks. This study found major difference between Eastern and Western tourists in the use of spatial terms. Again, some studies explained this difference by addressing a person's wayfinding perspective (like route or survey), but other studies focused on people's experiences in their daily environment, such as the street layout. For example, people from the USA Midwest/West provided cardinal directions more frequently. This is because, due to the grid system, the property boundaries and road systems are very regular. This could explain the results in this study. Most of the major cities in Asia such as Tokyo, Seoul, Beijing and Taipei use a grid system for their street design. In many parts of Europe and in certain areas of the USA, the property boundaries and roads have less regular patterns (Hund et al. 2012). This explains why tourists with a Western cultural background would be more comfortable with landmark direction descriptors.

5 Conclusion

This study has important implications for the international tourism industry, especially for first-time visitors in unfamiliar cities or countries. The first study purpose is to investigate what kind of information descriptor international tourists need when they ask local people for directions to unfamiliar destinations. According to the study result, three most important ways the tourists might need for the wayfinding to the destination are "cardinal and distance," "cardinal" and "landmark". The international tourists almost have similar preferences towards three ways, but the local people prefer to use "cardinal and distance" and "landmark," rather than "cardinal." Some previous studies found that cardinal and distance are very helpful but others consider cardinal information could make people feel more confused (Allen 2000; Hund and Minarik 2006; Saucier et al. 2002).

Allen (2000) found that it is easier to get lost with the cardinal information compared to the information such as landmark and landmark that could be very useful in the middle and in the end of wayfinding process. Saucier et al. (2002) concluded that cardinal information can help people find their way to their destination in more effective and efficient ways. Each type of wayfinding descriptors has its strength and also weakness and could be useful and beneficial in different conditions. The main key point is whether the user would be able to take advantage of the wayfinding information provided by others.

According to this study result, study participants with different wayfinding strategy preferences, gender and cultural backgrounds would have different preferences towards wayfinding information descriptors. For example, if the individual preferred to use the route strategy to find their way, he or she would prefer to be provided with "landmark" as the wayfinding descriptors from others rather than cardinal information. For people who like to use survey strategy, they would like to have information such as east, west, south and north if they need the help from others. From this study result, inbound tourists to Taiwan would prefer to be told with the descriptors such as landmark. The majority of inbound tourists in this study do not have enough ability to read Chinese or communicate in Chinese. It would be easier for inbound tourists to recognize or memorize the landmarks. Just like other previous studies, this study would also conclude that the effectiveness of wayfinding information descriptors should be examined from the information receiver. Different cultural backgrounds of information receivers would also affect how the information is used and understood (Golledge 1999; Pazzaglia and DeBeni 2001; Shelton and McNamara 2004).

The conclusion of this study is listed with three points. Firstly, due to unfamiliar environments and foreign languages, tourists might have a greater need for assistance from the local people. The information about what descriptors are most effective for wayfinding can be used to develop more effective GPS navigation systems, paper-based travel maps, internet-based map/rout-planning services and also the local signage system. Secondly, some tourists prefer local people to use landmarks as direction descriptors. However, the local people should pay attention to the number of landmarks used when they give directions because tourists may not be able to remember too many landmark descriptors, especially those given for the end of the wayfinding routes (vague). It would be better for the locals to write down the landmark information for the international tourists in order to decrease the need to memorize too many landmarks. Thirdly, the local people should be educated to be more flexible when providing help for others. For example, Hund et al. (2012) found that US participants provided more cardinal descriptors when addressing listeners adopting a survey perspective rather than a route perspective. However, they gave more landmark and left-right descriptors when addressing listeners who adopted a route perspective rather than a survey perspective. Hund et al.'s study revealed remarkable flexibility in people's spatial descriptors.

In summary, the present findings reveal that tourists with different cultural backgrounds, wayfinding perspectives and gender have different preferences for descriptive features of the wayfinding route. Again, giving and receiving directions are dynamic processes that are dependent on complex interactions between the local people and tourists.

References

Allen, G. L. (1997, October). From knowledge to words to wayfinding: Issues in the production and comprehension of route directions. In *International Conference on Spatial Information Theory* (pp. 363–372). Berlin: Springer.

Allen, G. L. (1999). Spatial abilities, cognitive maps, and wayfinding. *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes*, 46–80.

Allen, G. L. (2000). Principles and practices for communicating route knowledge. *Applied Cognitive Psychology, 14*(4), 333–359.

Astur, R. S., Ortiz, M. L., & Sutherland, R. J. (1998). A characterization of performance by men and women in a virtual Morris water task: A large and reliable sex difference. *Behavioural Brain Research, 93*(1), 185–190.

Denis, M., Pazzaglia, F., Cornoldi, C., & Bertolo, L. (1999). Spatial discourse and navigation: An analysis of route directions in the city of Venice. *Applied Cognitive Psychology, 13*(2), 145–174.

Devlin, J. (2003). Brand architecture in services: The example of retail financial services. *Journal of Marketing Management, 19*(9–10), 1043–1065.

Eysenck, W. M., & Keane, T. M. (2005). Cognitive Psychology. Hove (UK): Psychology Press.

Golding, J. M., Graesser, A. C., & Hauselt, J. (1996). The process of answering direction-giving questions when someone is lost on a university campus: The role of pragmatics. *Applied Cognitive Psychology, 10*(1), 23–39.

Golledge, R. G. (1999). Human wayfinding and cognitive maps. *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes*, 5–45.

Golledge, R. G., & Stimson, R. J. (1997) *Spatial behaviour: A geographic perspective*. New York.

Hirtle, S. C., & Hudson, J. (1991). Acquisition of spatial knowledge for routes. *Journal of Environmental Psychology, 11*(4), 335–345.

Honda, A., & Nihei, Y. (2004). Sex differences in wayfinding behavior using well-or poorly-written route descriptions. *Tohoku Psychologica Folia, 63*, 15–24.

Hund, A. M., Haney, K. H., & Seanor, B. D. (2008). The role of recipient perspective in giving and following wayfinding directions. *Applied Cognitive Psychology, 22*(7), 896–916.

Hund, A. M., & Minarik, J. L. (2006). Getting from here to there: Spatial anxiety, wayfinding strategies, direction type, and wayfinding efficiency. *Spatial Cognition and Computation, 6*(3), 179–201.

Hund, A. M., Schmettow, M., & Noordzij, M. L. (2012). The impact of culture and recipient perspective on direction giving in the service of wayfinding. *Journal of Environmental Psychology, 32*(4), 327–336.

Ito, S., & Sano, M. (2011). Effects of error on fluctuations under feedback control. *Physical Review E, 84*(2), 021123.

Jansen-Osmann, P. (2002). Using desktop virtual environments to investigate the role of landmarks. *Computers in Human Behavior, 18*(4), 427–436.

Kitchin, R., & Blades, M. (2002). *The cognition of geographic space* (Vol. 4). Ib Tauris.

Klein, W. (1982). Local Deixis in Route Directions1.

Kozlowski, L. T., & Bryant, K. J. (1977). Sense of direction, spatial orientation, and cognitive maps. *Journal of Experimental Psychology: Human Perception and Performance, 3*(4), 590.

Lawson, L. D. (1996). The composition and chemistry of garlic cloves and processed garlic. *Garlic: The science and therapeutic application of Allium sativum L., Williams and Wilkins, Baltimore* (pp. 37–108).

Lawton, J. H. (1994). What do species do in ecosystems? *Oikos, 71*, 367–374.

Lawton, C. A. (1996). Strategies for indoor wayfinding: The role of orientation. *Journal of Environmental Psychology, 16*(2), 137–145.

Lawton, C. A., & Kallai, J. (2002). Gender differences in wayfinding strategies and anxiety about wayfinding: A cross-cultural comparison. *Sex Roles, 47*(9–10), 389–401.

Levinson, S. C. (2003). *Space in language and cognition: Explorations in cognitive diversity* (Vol. 5). Cambridge: Cambridge University Press.

Levinson, S. C., Kita, S., Haun, D. B., & Rasch, B. H. (2002). Returning the tables: Language affects spatial reasoning. *Cognition, 84*(2), 155–188.

Liben, L. S., Kastens, K. A., & Stevenson, L. M. (2002). Real-world knowledge through real-world maps: A developmental guide for navigating the educational terrain. *Developmental Review, 22*(2), 267–322.

Lippman, A. (1992). Led (astray) by genetic maps: The cartography of the human genome and health care. *Social Science and Medicine, 35*(12), 1469–1476.

Malinowski, J. C., & Gillespie, W. T. (2001). Individual differences in performance on a large-scale, real-world wayfinding task. *Journal of Environmental Psychology, 21*(1), 73–82.

Mark, D. M., & Gould, M. D. (1995). Wayfinding directions as discourse: Verbal directions in English and Spanish. *Deixis in Narrative: A Cognitive Science Perspective*, 387–405.

Montello, D. R., & Pick, H. L. (1993). Integrating knowledge of vertically aligned large-scale spaces. *Environment and Behavior, 25*(3), 457–484.

Passini, R. (1984). Spatial representations, a wayfinding perspective. *Journal of Environmental Psychology, 4*(2), 153–164.

Pazzaglia, F., & DeBeni, R. (2001). Strategies of processing spatial information in survey and landmark-centered individuals. *Europeaan Journal of Psychology, 13,* 493–508.

Pazzaglia, F., Meneghetti, C., De Beni, R., & Gyselinck, V. (2010). Working memory components in survey and route spatial text processing. *Cognitive Processing, 11*(4), 359–369.

Roskos-Ewoldsen, B., McNamara, T. P., Shelton, A. L., & Carr, W. (1998). Mental representations of large and small spatial layouts are orientation dependent. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 24*(1), 215.

Rovine, M. J., & Weisman, G. D. (1989). Sketch-map variables as predictors of way-finding performance. *Journal of Environmental Psychology, 9*(3), 217–232.

Sandstrom, N. J., Kaufman, J., & Huettel, S. A. (1998). Males and females use different distal cues in a virtual environment navigation task. *Cognitive Brain Research, 6*(4), 351–360.

Saucier, D. M., Green, S. M., Leason, J., MacFadden, A., Bell, S., & Elias, L. J. (2002). Are sex differences in navigation caused by sexually dimorphic strategies or by differences in the ability to use the strategies? *Behavioral Neuroscience, 116*(3), 403.

Shelton, A. L., & McNamara, T. P. (2004). Orientation and perspective dependence in route and survey learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*(1), 158.

Sholl, M. J. (1988). The relation between sense of direction and mental geographic updating. *Intelligence, 12*(3), 299–314.

Taylor, H. A., & Tversky, B. (1996). Perspective in spatial descriptions. *Journal of Memory and Language, 35*(3), 371–391.

Thorndyke, P. W., & Hayes-Roth, B. (1982). Differences in spatial knowledge acquired from maps and navigation. *Cognitive Psychology, 14*(4), 560–589.

Tom, A., & Denis, M. (2004). Language and spatial cognition: Comparing the roles of landmarks and street names in route instructions. *Applied Cognitive Psychology, 18*, 1213–1230.

Vanetti, E. J., & Allen, G. L. (1988). Communicating environmental knowledge, the impact of verbal and spatial abilities on the production and comprehension of route directions. *Environment and Behavior, 20*(6), 667–682.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: a meta-analysis and consideration of critical variables. *Psychological Bulletin, 117*(2), 250.

Wright, P., Lickorish, A., Hull, A., & Ummelen, N. (1995). Graphics in written directions: Appreciated by readers but not writers. *Applied Cognitive Psychology, 9*(1), 41–59.

Xia, J. C., Arrowsmith, C., Jackson, M., & Cartwright, W. (2008). The wayfinding process relationships between decision-making and landmark utility. *Tourism Management, 29*(3), 445–457.