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The Role of Presentation Media and Perspective on Direction Giving

Rebeca Costa do Nascimento

Abstract

Research on spatial cognition has tried to understand how perspective (route vs. survey) and media (visual vs. verbal) influence people's spatial cognition on different tasks (e.g., map drawing, navigation, semantic and distance estimation) when materials are presented simultaneously. However, less research has focused on how those spatial features influence people's direction giving when materials are presented sequentially, one piece at a time. In the present study, participants were presented with fragments of sentences and map segments. After learning the materials, they were asked to give directions using their own words or including cardinal terms. As hypothesized, participants provided more accurate directions when presented with visual (map) than verbal (text) media; this finding is consistent with other research studies that show the superiority of visual over verbal media in many spatial cognition tasks. Exploratory analysis showed that participants used significantly more relative terms and streets in their route directions in the map condition compared to the text condition. However, results revealed no differences in route direction accuracy between participants who learned Without layouts and those who learned With layouts. Participants also included more streets and repeated materials fewer times when asked to give directions using their own words than when asked to include cardinal terms. Overall, results indicate that presentation media and spatial perspectives impact the quality and content of route directions.

Keywords: spatial cognition, direction giving, route directions, spatial perspectives

MONTCLAIR STATE UNIVERSITY

The Role of Presentation Media and Perspective on Direction Giving

by

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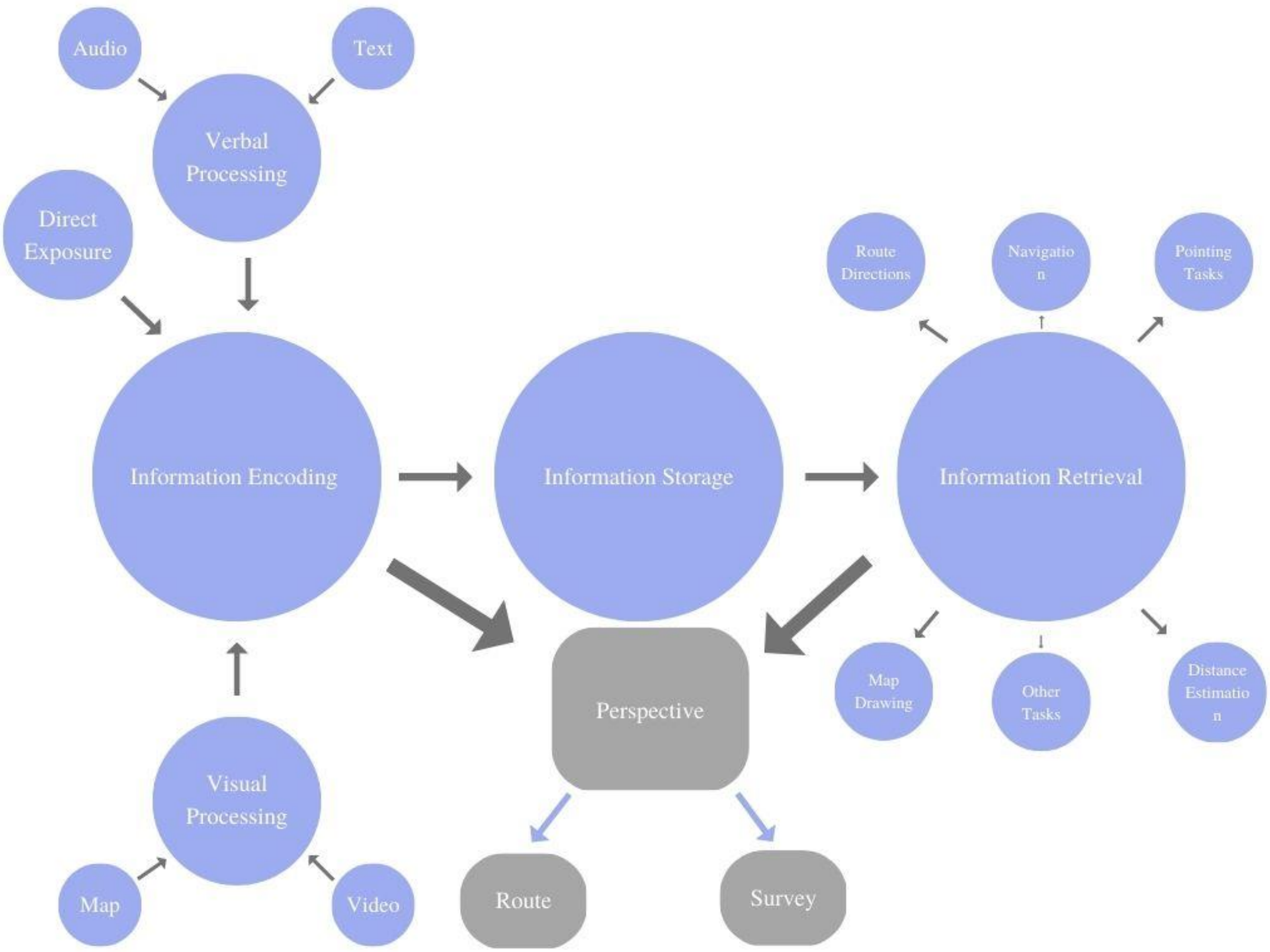
Wayfinding refers to planning, following, and finding a route or destination. Wayfinding can be assisted through *direction giving*. In direction giving, the path indicated takes the recipients from a starting point to a destination (Psathas, 1990). The way route directions are given influences the recipient's success in reaching their destination (Hund & Padgitt, 2010). Moreover, how directions are given is also influenced by many factors. The present thesis considered the impact of environment presentation media (map vs. text), perspective (Without layout vs. With layout), and output perspective (With vs. Without Cardinal terms) on direction giving. One innovation of the study is that the environment was presented sequentially (one at a time), different from previous studies that have exclusively presented environmental information simultaneously (all at once).

A Proposed Model

Before discussing the perspective and presentation media, a model is proposed based on previous studies (Figure 1). The model focuses on spatial processing, and it was developed to represent how spatial information is encoded and later retrieved. The model is not meant to be exhaustive, but it helps to organize and review the literature and establish where the present research study fits within the spatial processing framework.

Figure 1.

Spatial Processing Proposed Model



Note: Picture represents a Spatial Processing Model of spatial processing.

As shown in the model, spatial information encoding might occur from visual and verbal processing or direct exposure to a spatial environment. In this context, maps and videos are two of the most predominant visual media, while audio and text descriptions have been presented as verbal media (Krukar et al., 2020; Taylor & Tversky, 1992). There are also multiple ways to retrieve spatial information in a lab setting. Spatial skills can be measured by map drawing, navigation, semantic and distance estimation (Krukar et al., 2020; Meneghetti, Borella, Grasso, et al., 2012; Meneghetti, Borella, Gyselinck et al., 2012; Meneghetti et al., 2011; Meneghetti &

Pazzaglia, 2021; Taylor & Tversky, 1992); this study focused on verbal direction giving. The present study compared verbal and visual media using texts and maps. Considering texts and maps are the predominant media in various navigation tools, such as GPS and interactive maps, the present research study may help inform ways to develop better wayfinding tools.

Media (Text vs. Map)

The research on the impact of spatial media on wayfinding-related spatial cognition is inconsistent (Table 1). While breaking down the literature on spatial media and creating the summary table, two main studies compared visual (e.g., map and video) vs. verbal (e.g., text and audio) media, and found no differences between visual and verbal media. In the first study, Chabanne et al. (2003) compared text and oral descriptions to a map and videos by measuring participants' time while constructing a mental image of the distance between two landmarks. The researchers hypothesized that participants in the visual media would create a mental image of the environment more quickly than participants in the verbal media. However, they found no differences in time for visual and verbal media. Importantly, Chabanne et al. (2003) did not measure mental image accuracy. Other researchers have also found no difference between visual and verbal media. Meilinger and Knauff (2008) compared maps to text media by measuring participants' time walking, how often they stopped, and how often they got lost. Again, no difference was found between the two media. Notably, methodological limitations such as Meilinger and Knauff's (2008) small sample size (n=35) might have restricted the results.

Table 1.

Media (visual vs. verbal) Literature Summary

	Meilinger & Knauff, (2008)	Meneghetti, Borella, Gyselinck et al. (2012)	Meneghetti, Borella, Grasso, et al. (2012)	Meneghetti and Pazzaglia (2021)	Chabanne et al., (2003)	Péruch et al. Exp 1(2006)
IV	IV1: Route length (long vs. short) x IV2: Media (visual vs verbal)	IV1: Media (visual vs. verbal)	IV1: Media (visual vs. verbal vs. verbal + visual)	IV1: Group Media (visual vs. verbal vs. no media presented)	IV1: Media (visual vs. verbal) IV2: Perspective (route vs. survey)	IV1: Media (visual vs. verbal) IV2: Perspective (route vs. survey)
Groups	1. Map short(route) + Directions long(route) vs. 2. Map long(route)+ Directions short(route)	1. Visual (map) vs. 2. Verbal (oral description)	1. Visual (map) vs. 2. Verbal (oral description) vs. 3. Visual + Verbal (oral description + map)	1. Visual (Map before navigation) vs. 2. Verbal (text before navigation vs. 3. Neutral (only navigation)	1.Visual(map) survey vs. 2. Visual (video) route vs. 3. Verbal(text) survey vs. 4. Verbal (oral description) route	1. Visual(map) survey vs. 2. Visual(vide o) route vs. 3. Verbal (oral description) survey vs. 4. Verbal (oral description) route

DV	DV1: Wayfinding performance (A. Time Media: visual = verbal. B. Stops Media: visual = verbal. C. Got lost Media: visual = verbal. D. Needed help Media: visual = verbal.) DV2: Route and Survey Knowledge (A. Pointing task Media: visual = verbal. B. Distance estimation task Media: visual = verbal. C. Marking task Media: visual = verbal. D. Drawing task: Media: visual = verbal. E. Giving directions Media: visual = verbal)	DV1: Verification statement test (Media: visual > verbal. DV2: Map drawing (Media: visual > verbal.)	DV1: Map drawing (Media: visual > verbal; visual + verbal > verbal; visual = visual + verbal) DV2: Pointing task errors (Media: visual > verbal; visual + verbal > verbal; visual = visual + verbal)	DV1: Recall Task (A. Route retracing task Media: visual = verbal; visual = neutral; verbal = neutral. B. Pointing task Media: visual > neutral; verbal = no media; verbal = visual. C. Path Drawing task Media: visual > neutral; visual > verbal; verbal = neutral.)	DV1: Mental Scanning Time (1. Media: visual = verbal. 1.2. Perspective: survey > route)	DV1: Mental distance comparison task (Media: visual > verbal. Perspective: survey > route. DV2: Response time (Media: visual > verbal. Perspective: survey > route.)
Input/Output	Inputs (verbal/visual) = Outputs (verbal/visual)	Inputs (verbal/visual) = Outputs (verbal/visual)	Inputs (verbal/visual) = Outputs (verbal/visual)	Inputs (visual/verbal/neutral) ≠ Outputs (visual)	Input (verbal/visual) ≠ Output (verbal)	Inputs (verbal/visual) ≠ Outputs (verbal)

Note: The only IVs and DVs cited in this table are the ones of interest for the present study. Other IVs and DVs that might have been part of those articles were not discussed. Arrows (>) indicate better overall performance in the tasks.

Nevertheless, the literature review also revealed three studies that found differences between visual and verbal media. In a similar study to Chabanne et al. (2003), Péruch et al. (2006) asked participants to estimate the distance between two pairs of objects after learning the environment. On this occasion, mental image accuracy was measured. Péruch et al. (2006) found that regardless of the environmental perspective (route vs. survey), participants more accurately and quickly estimated the distance between landmarks in the visual media (map and video) than in verbal media (oral description). The researchers suggest that visual media offers the opportunity for more accurate mental representations of the environment, which explains the higher performance in distance estimation tasks. In this case, the accurate representation of the environment provided by visual inputs compared to verbal inputs would also explain participants' high performance in other spatial tasks.

Supporting Péruch et al. 's (2006) findings, Meneghetti, Borella, Grasso, et al. (2012) presented people with a map, a text description, or both a map and a text description. After learning about the environment, participants had to complete a map drawing of the environment and a pointing task. The researchers found that participants had the worst performance in both tasks in the description condition compared to the map and the map + description conditions, while the latter two did not differ from each other. Similarly, Meneghetti, Borella, Gyselinck, et al. (2012) found that when participants were asked to draw and judge inferential sentences about the learned environment, they performed better in the map condition, compared to the text condition.

Meneghetti, Borella, Grasso, et al.'s (2012) and Meneghetti, Borella, Gyselinck, et al.'s (2012) findings are important as they point to the superiority of visual media over verbal media in different spatial and verbal tasks. Meneghetti, Borella, Grasso, et al. (2012) discussed that the similarity between the presentation media-- in this case, the input (map) and the task participants must complete--the output (map drawing) might facilitate the participants' mental representation. Meneghetti, Borella, Gyselinck, et al. (2012) compared input/output media and found that participants in the visual condition (map) demonstrated higher performance than participants in the verbal condition(description), even in verbal tasks. The result shows that the superiority of the visual media over verbal media is not based on the similarities between input and output; the rich features offered by the visual media in their presentation of the environment enhance participants' performance on the tasks. Those features include visual attributions, such as information on the proximity of landmarks and spatial relationships in better overall environment structure (Stock et al., 1995). As a result, this allows for better performance in estimation distance and drawing/direction tasks. However, none of the studies have examined the effects of media on direction giving. Based on the previous research, it was expected that compared to verbal media (description), visual media (map) would also offer better opportunities for higher accurate performance in direction giving tasks.

Perspective (route vs. survey)

As proposed by the model (Figure 1), besides the media, spatial information might also be presented and retrieved from a route or survey perspective (Taylor & Tversky, 1992). In *route perspective*, the information is presented as someone walks through the environment. In this case, *left/right* is usually used to indicate and describe the environment's landmarks. In *survey perspective*, information is presented from a layout perspective, adopting a bird-eye view of the environment. *Cardinal terms* (e.g., north, south, west, east) are better positioned to describe the environment. Similar to presentation media, the research on spatial perspective has compared the two perspectives, focusing on differences between left/right and cardinal terms in their respective perspectives. However, no overall superiority of a perspective has been found, as different perspectives seem to facilitate performance on different spatial tasks. The literature review for this study revealed two studies where route perspective demonstrated more efficiency than the survey preference for direction giving tasks (Hund et al., 2008; Padgitt & Hund, 2012). Other research studies have found a perspective dependence where the performance of various spatial tasks is dependent on the congruence between the perspective people learned (input) and the perspective of the task (output) (Shelton & McNamara, 2004). These studies are discussed in detail below.

Research studies have found that people prefer route perspective over survey perspective in tasks related to direction giving. Padgitt and Hund (2012) showed participants descriptions of an environment and asked them to rate the effectiveness of the description. The researchers found that participants preferred descriptions using route terms to survey descriptions. Padgitt and Hund (2012) also found that when the same descriptions were used to navigate an environment model, participants made fewer errors in the wayfinding when the direction was in route perspective compared to the survey perspective. The researchers argued that the scale of the environment might influence the route perspective's effectiveness on wayfinding tasks. According to Padgitt and Hund (2012), route directions are more beneficial for wayfinding in indoor environments than cardinal terms (survey) because route perspective provides direct information on where to turn in the environment's route.

Padgitt and Hund's (2012) findings are similar to Hund et al. 's (2008) first experiment, where researchers found that participants rated description with route terms more highly than survey terms. In experiment 2, Hund et al. (2008) also manipulated the recipient's perspective. The researchers found that people who believed they were giving directions to someone driving through the town (route) included more left/right in their directions, while people who believed they were giving directions to someone looking at a map (survey) included more cardinal terms. Hence, the question's perspective in direction giving tasks also influences people's output perspective. Nevertheless, Hund et al. (2008) also found in experiment 3 that when navigating a model of the environment, participants were faster in the survey description than in the route description. The researchers discuss many reasons for this discrepancy between wayfinding preference and effectiveness in performance. One possibility is that the participants assumed different perspectives based on different tasks. For instance, when rating the descriptions, it might be the case that participants are adopting a route perspective instead of a survey perspective. However, when navigating, there is a chance that the survey perspective facilitates faster navigation; this would explain the participants' quicker performance with survey descriptions.

Finally, Shelton and McNamara (2004) compared route and survey perspectives in a scene recognition task and found that performance depended on the similarity between input and output. The researchers presented participants with a survey or a route perspective from either verbal (text) or visual (video) media. Participants were asked if they recognized scenes from the route and survey materials after the learning phase. The researchers found that participants presented a perspective dependence. When the participants were presented with a route perspective and asked to recognize a route scene, they could recognize it more quickly in a route than in survey scenes. When participants were presented with a survey perspective and asked to recognize a survey scene, they could recognize it more quickly in the survey than in the route scene. The researchers argue that people establish references for the environment based on their learning perspective. Those findings show that people perform better when tasks are in the same perspective as the learned materials. Shelton and McNamara's (2004) findings might also explain the input/output dependence found in the other studies cited previously, where the similarity of the tasks' perspectives to the learned materials defined the participants' performance. Importantly, although researchers describe survey perspective as offering a "layout" perspective of the environment, not many studies have focused on understanding how this layout of the environment might influence how directions are given when the survey perspective is presented in text media. In the present study, a new perspective on this literature is offered by comparing a With layout perspective of the environment to a Without layout view while keeping the language (cardinal direction) the same in both conditions. Furthermore, the influence of output perspective is further investigated by asking participants to give directions to someone walking through a town either using their words or with cardinal terms, which reflect route and survey perspectives, respectively.

The Present Study

In the present study, I hoped to understand how the presentation media (map vs. text), text input perspective (Without layout vs. With layout) and output perspective (With vs. Without Cardinal terms) might influence how participants provide route directions. Research studies have shown that compared to verbal media, visual presentation media offers features that facilitate people's performance in map drawing, distance estimation, and pointing tasks, even when input and output are inconsistent (Meneghetti, Borella, Grasso, et al., 2012; Meneghetti, Borella, Gyselinck, et al., 2012; Meneghetti & Pazzaglia, 2021). Here, I examined whether the superiority of visual media is also present in tasks that require direction giving. If direction giving is similar to other types of measures of spatial cognition, then participants in the visual media (map) would show more accurate performance in the direction giving tasks than in verbal media (text).

One difference between text and map is that text may be naturally sequential and related to route perspective, whereas map is naturally simultaneous and related to survey perspective. Here, I used cardinal terms to present the texts of the environment to equate the perspective to that of a map. Therefore, any difference between the two conditions may not be due to how relative/cardinal terms are presented. Furthermore, I created two sub-conditions in the text condition. One may argue that one disadvantage of text is that one has to construct a mental image of the entire environment, whereas one does not need to do in the map condition. Hence, I provided overall layout information in one text sub-condition and did not do so in another text sub-condition. This helps to examine 1) whether perspectives in terms of relative terms/cardinal terms and 2) whether the presence of overall layout might have explained the difference between the superiority of map over text in direction giving.

Furthermore, researchers have also found that people's performance on spatial tasks depends on the consistency of the input/output perspective of the task (Shelton & McNamara, 2004). Previous studies have shown that participants assume a route perspective when giving directions to someone driving through a town (Hund et al., 2008). In the present study, participants are asked to provide directions to someone walking through the town and are expected to assume a route perspective when completing the task. Since establishing a route perspective might help participants give directions to someone walking through a town, I also expected that participants would provide more accurate directions when asked to use their own words, compared to when they have to adapt their vocabulary to include cardinal terms (survey perspective).

The present research study also offered the opportunity to look at the presentation of material from a different viewpoint. All the previously cited research studies have a common point: all the material was presented to the participants simultaneously. In the present study, participants could only access parts of materials at a time; they could only see one route on the map and text at a time. This is important because it helps to examine whether the difference between text and map in previous studies was associated with the simultaneous vs. sequential nature of the presentation. If I still find a difference between text and map, then it would indicate that the advantage of maps over text was beyond its ability to present all the information simultaneously. In my study, the material would then be presented sequentially, allowing participants to revisit the full set of materials as often as they want. Only a few research studies have done so and presented parts of a map one at a time (e.g., Wiegmann et al., 1992). Besides, none of the cited papers above allowed participants to produce their route directions. Here, the accuracy of route directions was the dependent variable (DVs). The independent variables (IVs) were presentation media (map vs. text), text perspective (Without layout vs. With layout), and output perspective (With vs. Without Cardinal terms). In addition, an exploratory analysis was conducted regarding the contents of the route directions (i.e., cardinal terms, relative terms, landmarks, streets, total words) and the number of material repetitions. Based on previous research studies, I predicted that:

Hypothesis 1 (Text Perspective: Without vs. With layout): Participants will be more accurate in direction giving when presented with the With layout perspective compared to the Without layout perspective (Hund et al., 2008).

Hypothesis 2 (Presentation Media: Map vs. Text): Participants will have higher accuracy in direction giving when presented with a map than when presented with a text description of the environment (Meneghetti, Borella, Grasso, et al., 2012; Meneghetti, Borella, Gyselinck, et al., 2012; Meneghetti & Pazzaglia, 2021; Péruch et al., 2006).

Hypothesis 3 (Output Perspective: Without vs. With Cardinal terms): Participants will present higher accuracy on direction giving when they are asked to use their own words, compared to when they are asked to include cardinal terms in their directions (Hund et al., 2008; Hund & Padgitt, 2010).

Exploratory analysis of the interaction between presentation media, text perspective, and output perspective will be conducted, but the interactions' expected direction are unclear.

Methods

Participants

In total, 120 people participated in the online study between 18 and 65 years old (M= 20.44). This number varied in the analysis as some participants did not complete all the study parts, and their data were included for only the conditions they completed. The study was long, with an average time of more than one hour, which explains the high rates of incomplete trials. A hundred women and 18 men participated in the study, while 2 had missing information (Table 2). Sixty identified themselves as White/Caucasian, 19 as Black/African-American, 23 as Latino/Hispanic, seven as Asian, nine as Others, and two were missing ethnic information. Most participants, 104 in total, were native English speakers, while 16 participants had another language as their native language. Most participants were recruited through Montclair State University (SONA), in total 117, and the other were from a snowball sample. Participants from SONA received four credits on the SONA for their participation, while participants from the snowball sample did not receive any compensation. Participants approved informed consent at the start of the experiment, and the study received authorization from the Institute Review Board at Montclair State University.

Table 2.

Subjects' Demographics Characteristics

Baseline Characteristics		**N**
Sex	Female	100
	Male	18
	Missing	2
Ethnicity	White/Caucasian	60
	Black/African American	19
	Latinx/Hispanic	23
	Asian	7
	Others	9
	Missing	2
Language	Native	104
	Non-Native	16

Recruiting	SONA	117
	Snowball	3

Materials

All the media conditions contained 14 slides. Participants were presented with a map for the visual condition (see Appendix A). In the verbal condition the sentences were presented in English and there were two different versions. In the With layout text, the layout of the environment was presented in advance (e.g., "In the city map, there are nine blocks between avenues and streets") (see Appendix B) before specifying relationships between landmarks. In the Without layout text, no layout of the environment was presented in advance (see Appendix C). The visual (map) and the verbal (texts) used in the study represented the same environment: a grid-like city with two main avenues (First Avenue and Tower Avenue), four streets (e.g., Lake Street, York Street), and nine landmarks (e.g., red pepper, lettuce). The verbal (With layout) condition represented the same environment, with one less street (i.e., Lake Street) than the (Without layout) condition.

Software

The present experiment was built in PsychoPy2 (https://www.psychopy.org/index.html) and launched online on the Pavlovia website (https://pavlovia.org/). Pavlovia is a paid website for researchers. Therefore, for every person whose results are saved on the website, I had to pay a Pavlovian credit corresponding to €0.20.

Procedure

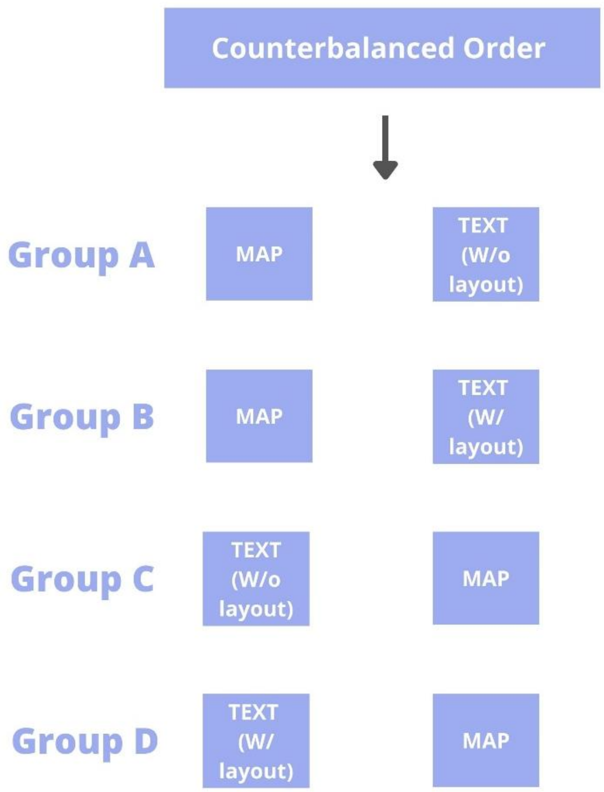
Before starting the experiment, all participants answered a questionnaire in Qualtrics. The questionnaire asked demographic questions such as the participant's age, sex, ethnicity/race, and native language. At the end of the questionnaire, participants typed their names and CWID, if applicable, to receive the credits at SONA. The name and CWID were used only to give credits to the participants in SONA but were not recorded. On the next slide, participants press the “NEXT” bottom to be directed to the Pavlovia website, where the experiment was located online. A Response ID was created in Qualtrics and transferred to the Pavlovia website to counterbalance the experiment.

In Pavlovia, there were four instruction slides. On the first welcome slide of the experiment, an announcement explained to participants that they could move from one slide to the next by pressing the right arrow on the keyboard. Participants were also asked to avoid skipping questions and try to do their best. On the second slide, participants were asked to imagine walking around a town and then provide directions to a tourist from one landmark to another. A note on the slide explained that participants would not see a full map or a full text and could only see parts of the map/text on each slide. Participants were also advised to pay attention to what was being asked (e.g., check if researchers asked them to use cardinal direction in their answer) and to not make notes or draw during the study. Instead, participants were recommended to only make mental representations of the map. On the third slide, participants were notified that they could go back to the materials before providing the directions. Finally, on the fourth slide, a picture of a compass was presented, showing the four cardinal terms (e.g., north, south, west, and east).

Then each condition started, and it was comprised of a learning and a testing phase. I counterbalanced the order of all conditions (Figure 2), so participants would see either the map condition or the text condition first. For the text condition, half of the participants received one version of the text (With layout), and the other half received the other (Without layout). As mentioned earlier, during the learning phase, participants pressed the right arrow to see a series of 14 slides in each condition. Participants could spend as much time as they liked on each slide as they were in control of moving to the next slide.

Figure 2.

Counterbalanced Order of Presentation Media



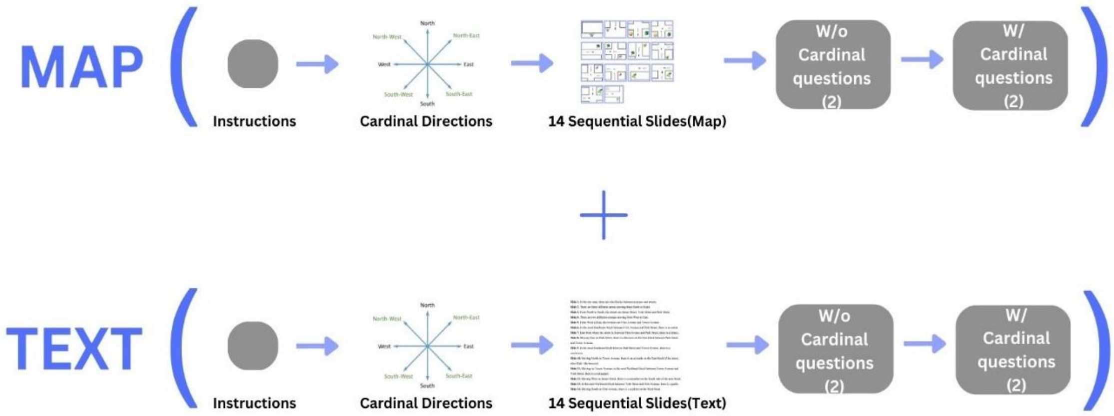
Note: Figure 2 shows all the possible experimental groups. Each participant was assigned to one group.

After the learning phase, participants moved to the testing phase where they were asked to provide directions from one starting point (landmark) to a destination (landmark). For instance, “Please write down the directions below using any words you like. Tourist is interested in moving from ONION to RED PEPPER. Please indicate on your answer the starting point and destination.” Participants were asked to use their own words (Without cardinal terms) in the first two questions of each condition. Then, in the last two questions of each condition, they were asked to include cardinal terms (With cardinal terms). All the questions required participants to use mental transformations of the material learned as it involved landmarks not presented in the same sentence or image and it could be presented backward from the original materials learned. At each question slide, participants could go back to the beginning of the slide presentation and relearn the 14 slides by pressing with their mouse the option "Show me the info/map again."

Once participants had answered the question for the first condition, participants were presented with the study’s instructions again as they started the learning phase for the second condition (either verbal or visual). The same process conducted in the first condition was repeated in the second condition (Figure 3). Once the participants had answered all four questions for the second condition, they moved to the final slide, thanking them for their participation, and their participation was completed.

Figure 3.

Trial Flow Example



Note: Figure 3 shows the visual and the verbal conditions, respectively. Note that each participant had to complete both conditions.

Analysis

Three independent variables (IVs) were manipulated in the experiment. The first IV was the text perspective (Without layout vs. With layout) between-subject factor. Presentation media (map vs. text) within-subjects factor was the second IV. Finally, output perspective (Without vs. With Cardinal terms) was the last IV. Seven dependent variables (DVs) were coded: accuracy, cardinal terms, relative terms, landmarks, streets, total words, and repetitions. All the DVs were coded based on the route directions provided by the participants on how to get from one location to another in the environment. Participants' accuracy was rated based on an accuracy scale developed by the researcher (see Appendix D), ranging from 0 (Participants completely missed the directions) to 10 (Participants gave the correct answer). Inter-rater reliability for accuracy was calculated between two raters for each direction. Discrepancies between raters were resolved with the re-rating of the directions until the reliability between the two raters was > r = 0.80.

LIWC2015 was used to calculate the total number of words in each answer. For cardinal terms (see Appendix E), relative terms (see Appendix E), landmarks (see Appendix E), and streets (see Appendix E) list for each DV was created based on the words recurrent used in the literature for that DV (Bryant & Tversky, 1992; Levinson, 1997; Li, 2012; Sithole & Zlatanova, 2016; Taylor & Tversky, 1996; Winterboer et al., 2012). *BUTTER* (www.butter.tools/) was used to calculate the number of times the words in the list were used in the participants' direction for each DV. Then, for each DV, proportions were calculated by dividing the number of times the words in the list were cited in the participants' direction by the total number of words for each direction using SPSS. Repetitions were coded by measuring how many times participants checked the materials after the learning phase in each condition, cumulative to each question.

For the inferential analysis, seven three-way ANOVAs with Bonferroni corrections were conducted in SPSS for text perspective and for presentation media, separately. Post-Hoc tests were conducted when applicable. Correlation between accuracy and cardinal terms, relative terms, landmarks, streets, total words, and repetitions were conducted in SPSS to evaluate which variables correlate with accuracy. A repeated measures correlation was also conducted to analyze the within-individual relationship between accuracy and cardinal terms, relative terms, landmarks, streets, and repetitions.

Results

Text Perspective: Without layout vs. With layout

All the following descriptive statistics (Table 3) and inferential analyses (Table 4) are based on the text perspective; no maps were involved. Seven three-way ANOVAs with Bonferroni corrections were calculated in SPSS to identify the effect of trial (trial one vs. trial two), text perspective (Without layout vs. With layout), and output perspective (Without vs. With Cardinal terms) on accuracy, cardinal terms, relative terms, landmarks, streets, total words, and repetitions. Post-Hoc tests were conducted when applicable. Significant effects were indicated at the $p < 0.05$ level, with Bonferroni corrections.

Table 3.

Descriptive Statistics by Group (Text Perspective as between subjects)

		Text Perspective	
		Without layout (N = 45)	With layout (N = 55)
Accuracy	M	6.18	5.69
	SD	4.38	4.16
Relative Terms	M	.03	.02
	SD	.03	.04
Cardinal terms	M	.17	.16
	SD	.24	.21
Landmarks	M	.07	.07
	SD	.07	.09
Streets	M	.21	.23

	SD	.13	.18
Total Words	M	30.70	24.05
	SD	25	16.32
Repetitions	M	3.64	2.96
	SD	3.79	2.78

Note: Accuracy ratings ranged from 0 to 10.

Table 4.

Inferential Statistics (Text Perspective as between subjects)

	Text Perspective (Without layout vs. With layout)	Output Perspective (Without vs. With Cardinal terms)	Trial (Trial 1 vs. Trial 2)	Interaction
Accuracy	W/o layout = W/ layout $F(1, 98) = .444$, $p = .507$, $\eta_p^2 = .005$.	W/o = With Cardinal terms $F(1, 98) = .670$, $p = .415$, $\eta_p^2 = .007$	Trial 1 = Trial 2 $F(1, 98) = 3.301$, $p = .072$, $\eta_p^2 = .033$.	
Relative Terms	W/o layout = W/ layout $F(1, 98) = 1.318$, $p = .254$, $\eta_p^2 = .013$.	**W/o > With Cardinal terms** $F(1, 98) = 3.975$, $p = .049$, $\eta_p^2 = .039$	Trial 1 = Trial 2 $F(1, 98) = 2.3768$, $p = .126$, $\eta_p^2 = .024$.	
Cardinal terms	W/o layout = W/ layout	**With Cardinal terms > W/o** $F(1, 98) = 5.161$, $p = .025$, $\eta_p^2 = .050$	**Trial 2 > Trial 1**	

	F(1, 98) = .154, p = .696, $\eta_p{}^2$= .002.		F(1, 98) = 5.838, p = .018, $\eta_p{}^2$= .056.	
Landmarks	W/o layout = W/ layout F(1, 98) = .208, p = .605, $\eta_p{}^2$= .002	W/o = With Cardinal terms F(1, 98) = .380, p = .539, $\eta_p{}^2$ = .004	Trial 1 = Trial 2 F(1, 98) = .185, p = .668, $\eta_p{}^2$= .002.	
Streets	W/o layout = W/ layout F(1, 98) = .273, p = .603, $\eta_p{}^2$= .003	**W/o > With Cardinal terms** F(1, 98) = 5.106, p = .026, $\eta_p{}^2$ = .050	Trial 1 = Trial 2 F(1, 98) = 1.322, p = .253, $\eta_p{}^2$= .013.	**Text x Trial** F(1, 98) = 4.804, p = .031, $\eta_p{}^2$ = .047.
Total Words	W/o layout = W/ layout F(1, 98) = 3.755, p = .056, $\eta_p{}^2$= .037.	W/o = With Cardinal terms F(1, 98) = .584, p = .447, $\eta_p{}^2$ = .006	Trial 1 = Trial 2 F(1, 98) = 1.603, p = .209, $\eta_p{}^2$= .016.	**Output x Trial** F(1, 98) = 8.196, p = .005, $\eta_p{}^2$ = .077.
Repetitions	W/o layout = W/ layout F(1, 98) = 1.124, p = .292, $\eta_p{}^2$= .011.	**With Cardinal terms > W/o** F(1, 98) = 54.986, p < .001, $\eta_p{}^2$= .359.	**Trial 2 > Trial 1** F(1, 98) = 46.101, p < .001, $\eta_p{}^2$= .320.	**Output x Trial** F(1, 98) = 6.489, p = .012, $\eta_p{}^2$ = .062.

Note: Except for Streets (Text x Trial), Total Words (Output x Trial) and Repetitions (Output x Trial), none of the interactions were significant. Significant results are in bold.

Hypothesis 1. (accuracy). ***Accuracy should be higher in the With layout than in the Without layout text perspective***. This hypothesis was not confirmed, as indicated by the lack of a significant main effect of text perspective.

Exploratory Analysis 1. (Words used: relative terms, cardinal terms, landmarks, streets, and total words). Results showed that participants used more relative terms (M = .03, SD = .04 vs. M = .02, SD = .03), fewer cardinal terms (M = .15, SD = .20 vs. M = .18, SD = .25), and more streets (M = .23, SD = .15 vs. M = .21, SD = .16) in the Without cardinal than the With cardinal conditions. Text perspective and trial interaction were significant for streets. Post-hoc showed that in the Without layout text, participants used more streets in their second trial (M = .23, SD = .12) compared to their first trial (M = .20, SD = .13), *p* =. 026. However, there was no difference between the use of streets in the first (M = .23, SD = .18) and the second trial (M = .23, SD = .18) for the With layout text. The interaction of output perspective and trial was significant for total words. Post-hoc showed that in the Without cardinal direction output, participants used more words in their second trial (M = 30.85, SD = 20.71) compared to their first trial (M = 25.09, SD = 25.43), *p* = .037. There was no difference in total words in the first (M = 27.68, SD = 17.97) and second trial (M = 25. 88, SD = 18.49) of With cardinal terms outputs.

Exploratory Analysis 1.2. (repetitions). Participants repeated materials more times in the With Cardinal direction (M = 4.17, SD = 4.31) than in the Without cardinal direction (M = 2.44, SD = 2.27) outputs. The interaction between output perspective and trial was significant. Post-hoc showed that in the Without cardinal direction output, participants repeated the material more in the second trial (M = 2.98, SD = 2.92) compared to the first trial (M = 1.90, SD = 1.62), *p* < .001. The same pattern was true for the With cardinal terms questions, where participants repeated the material more during the second trial (M = 4.52, SD = 4.77) than in the first trial (M = 3.81, SD = 3.84), *p* < .001. However, the mean difference between the second and first trial was higher in the Without (1. 079) than in the With (.713) cardinal direction output.

Media: Map vs. Text

All the following descriptive statistics (Table 5) and inferential analyses (Table 6) were based on map vs. text comparisons. Seven three-way ANOVAs with Bonferroni corrections were calculated in SPSS to identify the effect of trial (trial one vs. trial two), media (map vs. text) and output perspective (Without vs. With Cardinal terms) on accuracy, cardinal terms, relative terms, landmarks, streets, total words, and repetitions. Post-Hoc tests were conducted when applicable. Significant effects were indicated at the $p < 0.05$ level, with Bonferroni corrections.

Table 5.

Descriptive Statistics by Group (Map vs. Text Analysis, all data included)

		Without Cardinal terms (N= 88)		With Cardinal terms (N=88)	
		Map	Text	Map	Text
Accuracy	M	7.34	6.33	7.08	6.04
	SD	3.95	4.19	4.07	4.21
Relative Terms	M	.04	.03	.04	.02
	SD	.05	.04	.07	.03
Cardinal terms	M	.12	.14	.14	.18
	SD	.21	.18	.22	.24
Landmarks	M	.05	.07	.06	.07
	SD	.05	.09	.06	.06

Streets	M	.27	.23	.27	.22
	SD	.19	.15	.16	.16
Total Words	M	30.87	27.69	28.24	26.10
	SD	18.32	24.02	18.76	16.84
Repetitions	M	2.01	2.41	3.81	4.12
	SD	1.87	2.25	3.59	4.17

Note: Accuracy ratings ranged from 0 to 10.

Table 6.

Inferential Statistics (Map vs. Text Analysis, all data included)

	Media (Map vs. Text)	Output (Without vs. With Cardinal terms)	Trial (Trial 1 vs. Trial 2)	Interaction Media x Question	Interaction Media x Trial	Interaction Output x Trial	Interaction Media x Output x Trial
Accuracy	**Map > Text** $F(1, 87) = 15.125$, $p < .001$, $\eta_p{}^2 = .148$	W/o = With $F(1, 87) = 2.444$, $p = .122$, $\eta_p{}^2 = .027$	Trial 1 = Trial 2 $F(1, 87) = .964$, $p = .329$, $\eta_p{}^2 = .011$	$F(1, 87) = .003$, p = .957, $\eta_p{}^2 = .00$.	**$F(1, 87) = 5.603$, p = .020, $\eta_p{}^2 = .061$.**	$F(1, 87) = .055$, p = .815, $\eta_p{}^2 = .001$.	$F(1, 87) = .072$, p = .789, $\eta_p{}^2 = .001$.
Relative Terms	**Map > Text** $F(1, 87) = 8.246$, $p =$	**W/o > With Cardinal terms**	**Trial 2 > Trial 1** $F(1, 87) = 4.835$,	$F(1, 87) = .248$, $p = .620$,	$F(1, 87) = .133$, p = .717, $\eta_p{}^2 = .002$.	**$F(1, 87) = 8.738$, p = .004, $\eta_p{}^2 = .091$.**	**$F(1, 87) = 5.541$, p = .021, $\eta_p{}^2 = .060$.**

	.005, η_p^2 = .087.	F(1, 87) = 6.947, p = .010, η_p^2= .074	p = .031, η_p^2= .053.	η_p^2= .003.			
Cardinal terms	Map = Text F(1, 87) = 1.908, p = .171, η_p^2= .021.	**With Cardinal terms > W/o** F(1, 87) = 12.482, p <.001 η_p^2 = .125	**Trial 2 > Trial 1** F(1, 87) = 5.908, p = .017, η_p^2= .064.	F(1, 87) = 1.607, p = .208, η_p^2= .018.	F(1, 87) = .442, p = .508, η_p^2 = .005.	F(1, 87) = 1.821, p = .181, η_p^2 = .021.	F(1, 87) = .000, p = .997, η_p^2 = .000.
Landmarks	**Text > Map** F(1, 87) = 6.481, p = .013, η_p^2 = .069	W/o = With Cardinal terms F(1, 87) = .627, p = .431, η_p^2 = .007	Trial 1 = Trial 2 F(1, 87) = 2.234, p = .139, η_p^2 = .025.	F(1, 87) = .068, p = .795, η_p^2= .001.	F(1, 87) = .756, p = .387, η_p^2 = .009.	F(1, 87) = .308, p = .580, η_p^2 = .004.	F(1, 87) = .504, p = .480, η_p^2 = .006.
Streets	**Map > Text** F(1, 87) = 9.012, p = .004, η_p^2 = .094	W/o = With Cardinal terms F(1, 87) = 1.121, p = .293, η_p^2 = .013	Trial 1 = Trial 2 F(1, 87) = .474, p = .493, η_p^2 = .005.	F(1, 87) = .279, p = .599, η_p^2= .003.	F(1, 87) = .536, p = .466, η_p^2 = .006.	F(1, 87) = .000, p = .992, η_p^2 = .000.	F(1, 87) = .065, p = .799, η_p^2 = .001.
Total Words	Map = Text F(1, 87) = 3.133, p = .080, η_p^2= .035.	**W/o > With Cardinal terms** F(1, 87) = 4.658, p = .034, η_p^2= .051.	Trial 1 = Trial 2 F(1, 87) = .645, p = .424, η_p^2 = .007.	F(1, 87) = .232, p = .631, η_p^2= .003.	**F(1, 87) = 7.834, p = .006, η_p^2 = .083.**	**F(1, 87) = 7.977, p = .006, η_p^2 = .084.**	F(1, 87) = 1.952, p = .166, η_p^2 = .022.

Repetitions	Map = Text $F(1, 87) = 1.044$, $p = .310$, $\eta_p^2 = .012$.	**With Cardinal terms > W/o** $F(1, 87) = 84.189$, $p < .001$, $\eta_p^2 = .492$	**Trial 2 > Trial 1** $F(1, 87) = 73.574$, $p < .001$, $\eta_p^2 = .458$.	$F(1, 87) = .130$, $p = .719$, $\eta_p^2 = .001$.	$F(1, 87) = .000$, p = 1.00, $\eta_p^2 = .000$.	**$F(1, 87) = 10.967$, p = .001, $\eta_p^2 = .112$.**	$F(1, 87) = .013$, p = .998, $\eta_p^2 = .000$.

Note: Significant results are in bold.

Hypothesis 2 (accuracy). ***Accuracy should be higher when participants are presented with a map than with a text description of the environment***. Results showed a main effect of media, such that participants' accuracy was higher in the map media (M = 7.21, SD = 4.01) than in the text media (M = 6.19, SD = 4.20). Interaction between presentation media and trial was significant for accuracy. Post-hoc showed that in the text condition, participants' accuracy was higher in their second trial (M = 6.45, SD = 4.20) compared to their first trial (M = 5.92, SD = 4.21), *p* = .049. However, there was no difference between the first (M = 7.29, SD = 3.95) and the second (M = 7.12, SD = 4.08) trial for the map condition. Hence, hypothesis 2 was confirmed.

Exploratory Analysis 2. (Words used: relative terms, cardinal terms, landmarks, streets and total words). Results showed that participants used more relative terms (M = .04, SD = 0.06 vs. = .03, SD = .04), fewer landmarks (M = .05, SD = .05 vs. = .07, SD = 0.08), more streets (M = .27, SD = 0.17 vs. M = .22, SD = .15) in the map than the text condition. Participants also used more relative terms (M = .04, SD = .05 vs. M = .04, SD = .05), fewer cardinal terms (M = .13, SD = .20 vs. M = .16, SD = .23), and more total words (M = 29.28, SD = 21.17 vs. M = 27.17, SD = 17.80) in the Without cardinal direction than the With Cardinal direction output perspective.

The interaction between presentation media, output perspective and trial was significant for relative terms. Post-hoc analysis showed that participants used more relative terms in their second Without cardinal terms output perspective trial (M = .05, SD =.07) compared to their first trial (M = .03, SD = .04) when information was presented in a map, p = .005. No difference between the first (M = .04, SD =.07) and second trial (M = .03, SD =.06) of With cardinal terms questions was found when information was presented on a map. There was also no difference in the use of relative terms in text media as the number of trials increased for either Without cardinal terms or With cardinal terms questions.

The interaction between presentation media and trial was significant for total words. Post-hoc showed that in the map condition, participants used more words in the first trial (M = 31.24, SD = 19.82) compared to their second trial (M = 27.87, SD = 17.26), p <. 001. However, there was no difference between the first (M = 25.97, SD = 22.37) and the second (M = 27.82, SD = 18.48) trial for text condition. Finally, the interaction between output perspective and trial was significant for total words. Post-hoc showed that in the With cardinal direction output, participants used more words in their first trial (M = 28.77, SD = 18.60) compared to their second trial (M = 25.57, SD = 17.00), p <. 001. However, there was no difference in total words in the first (M = 28.44, SD = 23.60) and second trial (M = 30.12, SD = 18.75) of Without cardinal terms output.

Exploratory Analysis 2.2. (repetitions). The main effect of output perspective was significant for repetitions; participants repeated the materials more times in the With Cardinal direction (M = 3.96, SD = 3.88) than in the Without cardinal direction (M = 2.21, SD = 2.06) output perspective. The interaction between output perspective and trial was also significant for repetitions. Post-hoc showed that in the Without cardinal direction output, participants repeated material more in the second trial (M = 2.72, SD = 2.57) compared to their first trial (M = 1.70, SD = 1.55), *p* <. 001. In the With cardinal terms output, participants repeated material more in the second trial (M = 4.32, SD = 4.25) compared to their first trial (M = 3.61, SD = 3.51), p <. 001. However, the mean difference between the second and first trial was higher in the Without (1. 017) than in the With (.710) cardinal direction output.

Accuracy Correlation Analysis

To establish what features of the directions better correlated with the accuracy of directions, simple correlations were performed with map and text together and separately. For the conjugated correlation, the average of map and text was calculated together for each one of the dependent variables for each participant. For instance, I averaged the accuracy for 1) the first trial in the route questions of the map condition, 2) the second trial in route questions of the map conditions, 3) the first trial in the survey questions of the map condition, 4) the second trial in survey questions of the map condition, 5) the first trial in the route questions of the text condition, 6) the second trial in route questions of the text conditions, 7) the first trial in the survey questions of the text condition, and 8) the second trial in survey questions of the text condition. After that, a simple correlation was conducted between the accuracy average and the relative terms, cardinal terms, landmarks, streets, total words, and repetitions averages. Simple correlation revealed that the relationship between accuracy and relative terms: *r*(86) = .186, 95% CI [-.025, .380], *p* = .082, streets: *r*(86) = .002, 95% CI [-.207, .212], *p* = .983, and repetitions: *r*(86) = -.075, 95% CI [-.280, .137], *p* = .485 were not significant. The only significant correlations were between accuracy and cardinal terms: *r* (86) = -.634, 95% CI [-.743, -.486], *p* < .001, landmarks: *r* (86) = .217, 95% CI [.007, .407], *p* = 0.042 and total words: *r* (86) = .739, 95% CI [.623, .820], $p < .001$. Higher accuracy was associated with lower cardinal terms, higher use of landmarks, and higher total words.

A separate analysis of simple correlations between map and text accuracy was conducted (Table 7). For this second simple correlation, the average for map and text was calculated separately. Then, a simple correlation between the accuracy average and the relative terms, cardinal terms, landmarks, streets, total words, and repetitions averages was conducted. In the text condition, higher accuracy was associated with lower cardinal terms, higher relative terms, streets, and total words. In the map condition, higher accuracy was associated with lower cardinal terms, high use of landmarks and total words.

Table 7.

Separated Correlation Analyses

Variables	1. Map	1. Text
1. Accuracy	-	-
2. Relative Terms	- .125 [-.312, .073]	**.286** **[.093, .455]**
3. Cardinal terms	**- .445** **[-.587, -.271]**	**-.581** **[-.696, -.432]**
4. Landmarks	**. 347** **[.161, .507]**	.030 [-.167, .225]
5. Streets	-.186 [-.368, .010]	**.239** **[.044, .415]**

6. Total Words	**.725** **[.615, .805]**	**.636** **[.500, .738]**
7. Repetitions	-.082 [-.273, .115]	-.044 [-.238, .154]

Note: Values in the square brackets indicate a 95% confidence interval for each correlation. Bolded results indicate p < .05.

The first two correlations examined inter-individual correlation by obtaining the average for each individual and then conducting correlation among different individuals. In the third correlation, I examined the intra-individual correlations, the repeated measures correlation by using the rmcorr package in RStudio (see Appendix I). This analysis does not violate the assumption of independence. It estimates the common within-individual association for repeated measures for multiple individuals. Hence, it allows for the analysis of correlations within each individual level of paired repeated measures (Bakdash & Marusich, 2017). The results of the intra-individual level correlation analysis showed that the correlation between accuracy and relative terms r_{rm} (752) = .07, 95% CI [−.002, .140], p = 0.07; cardinal terms r_{rm} (752) = -.05, 95% CI [-.123, .019], p = 0.15; streets r_{rm} (752) = .04, 95% CI [−.033, .109], p = 0.29; and repetitions r_{rm} (752) = -.00, 95% CI [−.079, .064], p = 0.84 were not significant. The only significant within-individual correlation was between accuracy and words r_{rm} (752) = .21, 95% CI [.141, .278], p <.001; and landmarks r_{rm} (752) = -.09, 95% CI [-.158, -.016], p = 0.02. Higher accuracy was associated with lower use of landmarks.

Discussion

The present study aimed to understand how presentation media (map vs. text) and perspective (Without layout vs. With layout), and output perspective (With vs. Without Cardinal terms) influence participants' direction giving. I presented participants with two presentation medias (map vs. text) of an environment. In the text condition, perspective (Without layout vs. With layout) was manipulated, and participants were presented with one of the text versions. Participants provided directions from one landmark to another. They were asked to use their own words (Without cardinal terms) or include cardinal terms (With Cardinal terms) in each direction they gave. The results showed that, as hypothesized, participants provided more accurate directions when presented with a map than text media of the environment. However, different from what was hypothesized, there was no difference in the directions' accuracy when participants were presented with a survey with a layout text compared to a route without layout text. Furthermore, there was no difference in direction giving accuracy when participants included cardinal terms (With Cardinal terms) to when they did not include cardinal terms (Without Cardinal terms). Importantly, materials were presented sequentially, similar to how information is sometimes presented in GPS and other wayfinding tools. Past research on direction giving has presented material simultaneously to participants (Blades & Medlicott, 1992; Deborah M. Saucier et al., 2003). The present study contributes to a better understanding of how the presenting routes of the materials at a time might influence the accuracy of directions.

Visual vs. Verbal Media

The most significant finding was that visual media, compared to verbal media, better supports participants' direction accuracy, even after the confound of sequential vs. simultaneous processing is controlled and removed. In this context, the robustness of visual media over verbal media indicates a structural difference between the two media, unrelated to their sequential or simultaneous presentation. In a study with children and adults, Uttal et al. (2006) found similar results, with participants doing better in construction tasks when presented with a visual media (map) compared to a verbal media (description), regardless of their age. In Uttal et al. (2006), researchers also attempted to control for sequential vs. simultaneous confounding in maps and descriptions by revealing an outline of the environment before the descriptions. However, the descriptions were still presented all at once. This attempt to control for simultaneous confounding was further developed in the present study, and participants were presented with a sentence at a time in the verbal condition.

In addition, the results contributed to the existing literature on the overall supremacy of visual (map) media over verbal (text) media in map drawing, mental distance comparison, statement verification, and pointing tasks (Meneghetti, Borella, Grasso, et al., 2012; Meneghetti, Borella, Gyselinck, et al., 2012; Meneghetti et al., 2011; Péruch et al., 2006), by also studying direction giving. The finding is consistent with Meneghetti, Borella, Gyselinck, and De Beni's (2012) study that compared the input and output media and found that participants in the visual media demonstrated better performance than verbal media in verbal tasks. Similarly, in the present study, participants gave directions more accurately in the visual condition, even if the direction giving tasks required a verbal output. Altogether, those results point to structural differences in visual and verbal media, highlighting important visual media components that allow for better performance in numerous spatial cognitive tasks, including wayfinding and direction giving.

Researchers have argued that the reason for visual media's superiority over verbal media is associated with maps' layout view of the environment. They defend that seeing a map allows people to construct a complete mental representation of the environment with more integrated knowledge of the input learned. As a result, this knowledge allows them to perform tasks that sometimes need further processing of the material presented (Meneghetti & Pazzaglia, 2021). In the present study, maps are better than texts even when the former did not provide an overall layout all at once, yet the latter included layout information. Therefore, the advantage of maps over texts may go beyond simply providing more information about the overall layout. Future research should continue to explore other factors that explain the map over text advantage. Nevertheless, these results support the preeminence of visual media over verbal media in spatial tasks.

Text Perspectives

Contrary to the hypothesis, results revealed no difference in participants' direction accuracy between With layout and Without layout perspectives. In past research, researchers asked participants to provide directions to someone walking "through the town" or "looking at a map of the town" to differentiate the recipients' route and survey perspective, respectively (Hund et al., 2008). In Hund et al. (2008), participants used more left-right when providing directions to someone driving through the town and used cardinal terms when addressing someone looking at a map. Thus, the researchers argued that they assume the recipients' perspective when giving directions. In the present study, participants were asked to provide directions to a tourist walking "through the town." Thus, I expected participants would assume a route perspective when providing directions. Furthermore, the additional layout information was expected to facilitate participants' direction giving. However, this hypothesis was not supported.

How the two perspectives were defined in the present study might have influenced the lack of significant difference between the With and Without layout perspectives. Most researchers rely on left/right and cardinal terms (e.g., north, south, west, and east) to represent differences between perspectives, such as route and survey (Taylor & Tversky, 1992). However, in the present study, the differentiation between perspectives was based on the layout description of the environment. In the Without layout perspective, the town was described with cardinal terms from an inside view of the environment. Therefore, there was no advantage to the layout of the environment. In the With layout perspective, cardinal terms were also used, but a layout of the environment was presented first. Hence, participants knew how the environment layout would look before understanding the proximity and relationship between the town's landmarks. The lack of difference in the W and Without condition may be due to an overall difficulty in using texts to construct a visual-spatial mental representation of the environment. In other words, the cognitive demand of converting texts to visual-spatial information may have reduced the efficacy of using overall layout information, whether it is present or not. Alternatively, participants may have already inferred the layout of the environment even when the layout was absent (as in the Without layout condition). Future research may continue to explore why layout information in texts did not improve accuracy in route directions.

Words Used

Exploratory analysis showed that participants used significantly more relative terms and streets, and fewer landmarks in the map condition compared to the text condition. Interestingly, relative terms (left/right) were not mentioned in the map or the text material at any moment. Still, participants relied on relative terms when providing directions. These findings complement other research studies that found that participants' rated descriptions in route perspective using left/right as more efficient than survey perspective (using cardinal direction) (Padgitt & Hund, 2012). More importantly, in Padgitt & Hund (2012), participants relying on relative terms in the route perspective also made fewer errors in the wayfinding task than in the survey perspective with cardinal terms. Altogether, those results indicate that relative terms may reflect participants' default or spontaneous reference frames when participants are asked to give directions.

Participants included more total words and used more streets when asked to give directions using their own words than when asked to include cardinal terms. Moreover, the interaction between text perspective and trial was significant for streets. In the second trial of the Without layout perspective, participants used more streets in their answers compared to the first trial. Research looking at cultural differences between American and Dutch participants has found that when asked to provide directions, American participants used more streets in their directions than Dutch participants (Hund et al., 2012). According to them, this happens because in the US, the layout of cities is more regular than in European countries, and people tend to focus more on streets and numbers instead of unique landmarks in the environment. In the present study, all the participants lived in the United States. Hence, the high use of streets in directions aligns with previous research, showing participants’ reliance on streets when providing directions.

Finally, participants repeated the materials more when asked to use cardinal terms. Interaction between question perspective and trial for repetitions also showed that participants repeated the materials more in the second questions of both Without cardinal terms or With cardinal terms questions. Importantly, this repetitive need to check materials when asked to use cardinal terms might be related to the findings that relative terms might be participants' default features when providing directions. In this case, these exploratory results could demonstrate that participants needed to return to the materials to adapt their directions to include cardinal terms.

A simple correlation looking at the map and text together and separately revealed that as the number of cardinal terms increased, participants’ accuracy decreased across participants. Considering the findings that relative terms (left/right) are the participants’ default when giving directions, this result demonstrates that participants have trouble adapting their default to include cardinal terms. Moreover, the correlation between accuracy and landmarks was also significant for the conjugated simple correlation analyses; accuracy increased as the use of landmarks increased. In the separated analysis, for map only, higher accuracy was associated with high use of landmarks. Importantly, although significant, this relationship was weak in the two analyses. On the other hand, the intra-individual correlation also revealed a significant but negative correlation between accuracy and landmarks. Hence, the effects of landmarks on accuracy varied depending on whether the analysis is inter-individual or intra-individual, suggesting the importance of analyses at different levels. It is possible that at a group level, including more landmarks is associated with better interpretation and representation of the environment hence better route directions. However, at an individual level, including more landmarks may have implied a reduced ability to infer other environmental information, such as streets and turns, and hence worse accuracy. Future research should continue to examine why this might be the case.

In addition, separated and conjugated simple correlations also revealed that as total words increased, accuracy also increased. As participants added more words and, consequently, more details to their directions, the more accurate the directions were. More importantly, although ANOVA analyses showed that participants relied on streets when giving directions, simple correlation revealed that higher accuracy was associated with higher use of streets for text only. Still, intra-individual correlation showed no significant relationship between streets with accuracy. Hence, using streets does not contribute to their accuracy when providing directions. Similarly, ANOVA analyses showed that participants repeated materials more times when asked to use cardinal terms in their directions. Nevertheless, this repetitive behavior did not contribute to the accuracy of the directions, given that intra-individual correlation showed no significant relationship between repetitions and accuracy. Altogether, those results indicate that the overall conjunction of different features in people's directions, not individual features, supports participants' direction accuracy.

Limitations and Future Research

The present study has some limitations. One limitation is that data were collected online without the supervision of the researchers during the COVID-19 pandemic. Online data collection limited the data quality since many participants did not complete all the study parts, and consequently, data was lost. Second, the study relied heavily on the subject pool of Montclair State University, and most of the participants were women. Previous research has found that men and women have different ways of providing directions. Deborah M. Saucier et al. (2003) found that men rely more on using cardinal terms when providing direction. On the other hand, women used more left/right in their direction giving. Thus, the high number of women in the present study might have influenced the results in a direction. Future research should focus on understanding and controlling for gender differences in direction giving.

Conclusion

In the present study, participants provided more accurate directions when presented with a map than a text. This finding aligns with other research findings demonstrating visual media superiority over verbal media (text) across different spatial tasks. More importantly, the prominence of visual media over verbal media is consistent even when information is presented sequentially, suggesting that visual media deeply supports people's ability to provide accurate directions. Furthermore, results revealed no differences between learning a Without layout or With layout perspective on how people provide direction accuracy, implying an overall difficulty in using texts. More importantly, when categorizing the words participants used in the directions and correlating them with direction accuracy, no single feature of direction (e.g., landmarks, streets) is solely responsible for supporting people's direction accuracy. Instead, the overall convergence of features and detailed use of words better enhance people's direction giving accuracy.

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Appendix A

Visual Map

Appendix B

With layout text

Slide 1. In the city map, there are nine blocks between avenues and streets.

Slide 2. There are three different streets moving from North to South.

Slide 3. From North to South, the streets are James Street, York Street and Park Street.

Slide 4. There are two different avenues moving from West to East.

Slide 5. From West to East, the avenues are First Avenue and Tower Avenue.

Slide 6. In the most Southwest block between First Avenue and Park Street, there is an onion.

Slide 7. East from where the onion is, between First Avenue and Park Street, there is a lettuce.

Slide 8. Moving East on Park Street, there is a broccoli on the East block between Park Street and Tower Avenue.

Slide 9. In the most Southeast block between Park Street and Tower Avenue, there is a mushroom.

Slide 10. Moving North on Tower Avenue, there is an avocado on the East block of the street, after the broccoli.

Slide 11. Moving on Tower Avenue, in the most Northeast block between Tower Avenue and York Street, there is a red pepper.

Slide 12. Moving West on James Street, there is a cucumber on the South side of the next block.

Slide 13. In the most Northwest block between York Street and First Avenue, there is a garlic.

Slide 14. Moving South on First Avenue, there is a scallion on the West block.

Appendix C

Without layout text

Slide 1. Starting at the Southwest corner, begin moving towards the East side of Lake Street.

Slide 2. Continuing on Lake Street, there is an intersection with 1st Ave, go up North onto 1st Ave.

Slide 3. Moving North on 1st Ave, there will be an onion on the Westside and the lettuce on the Eastside.

Slide 4. Pass the onion and the lettuce; there is an intersection of 1st Ave and Park St. Head East onto Park Street.

Slide 5. A little farther along Park Street, there is broccoli on the North corner.

Slide 6. After broccoli, there is an intersection of Park Street and Tower Avenue. There is a mushroom located on the Southeast side of Park Street after the intersection.

Slide 7. Next, head North onto Tower Ave in the intersection of Park Street and Tower Ave. There is an avocado placed on the Eastside.

Slide 8. Moving North on Tower Ave, there is an intersection of Tower Ave and York Street. Pass the intersection, head North.

Slide 9. After the intersection of Tower Ave and York St., there is a red pepper on the Northeast side.

Slide 10. After the red pepper, there is an intersection of James Street and Tower Ave. Head West to James Street.

Slide 11. Moving West on James Street, there is a cucumber in the South corner of James Street.

Slide 12. After cucumber on James St., there is the 1st Ave on South. Head South onto 1st Ave.

Slide 13. Moving South on 1st Ave, York Street is crossing 1st Ave, head West on York Street.

Slide 14. A little farther along York Street, there is a scallion to the South and garlic to the North.

Appendix D

Accuracy Rating Scale

If a participant gave the right answer, a coder gave the score '10'.

If a participant gave the right destination, pointed the streets and avenues correctly but used cardinal terms or relative terms incorrectly when describing direction, a coder gave the score “8’.

If a participant got to the wrong destination, but it's still on the same side of the right path, a coder gave the score ‘6'.

If a participant got to the wrong destination, but it's on the wrong side of the right path, a coder gave the score '4'.

If a participant got to the wrong destination, and it’s more than two blocks away in any direction without regard to the right path, a coder gave the score ‘2'.

If a participant completely missed, a coder gave the score ‘0'.

Appendix E

List of Cardinal terms, Relative Terms, Landmarks and Streets

Cardinal terms	Relative Terms	Landmarks	Streets
North	left	garlic	Street
north	right	Garlic	street
South	Left	scallion	Avenue
south	Right	scallions	avenue
West	front	Scallions	ave
west	back	Scallion	Ave
East	Front	onions	Av
east	Back	onion	av
northeast	straight	Onions	av.
Northeast	Straight	Onions	Av.
southeast	backward	cucumbers	block
Southeast	Backward	cucumber	blocks
southwest	forward	Cucumber	Block
Southwest	Forward	Cucumbers	Blocks
northwest	head	lettuce	intersection
Northwest	Head	Letucce	intersection
	Feet	pepper	road
	feet	Pepper	Road
		Peppers	lane
		peppers	Lane
		avocados	track

	avocado	Track
	Avocados	roadway
	Avocado	Roadway
	Broccoli	boulevard
	broccoli	Boulevard
	mushrooms	st.
	mushroom	St.
	Mushrooms	st
	mushrooms	St
	food	corner
	Foods	Corner
	Vegetables	building
	Foods	building
	foods	edge
	veggies	Edge
	vegetables	Junction
		junction
		Park
		park
		james
		James
		first
		First
		1st
		tower

	Tower
	Lake
	lake
	york
	York

Appendix I

R Script

```
getwd()
# View data set 1
View(FinalCoding_Long)
CorrelationData <- read.csv(file="FinalCoding_Long.csv", header = TRUE, sep = ",")
print(CorrelationData)
CorrelationData$Session_ID <- as.factor(CorrelationData$id)
# Clean Missing Data
CorrelationData[CorrelationData == 999] <- NA
View(CorrelationData)
# Open rmcorr
library(rmcorr)
#Correlation Accuracy and relative terms
Accuracy_relativeterms <- rmcorr(participant = Session_ID, measure1 = Accuracy, measure2 =
RelativeTerms, dataset = CorrelationData)
print(Accuracy_relativeterms)
#Correlation Accuracy and cardinal terms
Accuracy_cardinalterms <- rmcorr(participant = Session_ID, measure1 = Accuracy, measure2 =
CardinalTerms, dataset = CorrelationData)
print(Accuracy_cardinalterms)
#Correlation Accuracy and landmarks
Accuracy_landmarks <- rmcorr(participant = Session_ID, measure1 = Accuracy, measure2 =
Landmarks, dataset = CorrelationData)
print(Accuracy_landmarks)
#Correlation Accuracy and streets
Accuracy_streets <- rmcorr(participant = Session_ID, measure1 = Accuracy, measure2 = Streets,
dataset = CorrelationData)
print(Accuracy_streets)
#Correlation Accuracy and total words
Accuracy_totalwords <- rmcorr(participant = Session_ID, measure1 = Accuracy, measure2 =
TotalWords, dataset = CorrelationData)
print(Accuracy_totalwords)
#Correlation Accuracy and repetitions
Accuracy_repetitions <- rmcorr(participant = Session_ID, measure1 = Accuracy, measure2 =
Repetitions, dataset = CorrelationData)
print(Accuracy_repetitions)
```