The Spatial and Temporal Underpinnings of Social Distance

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Abstract. To what extent do people anchor thoughts about social relationships in terms of space and time? Three studies used drawing and estimation tasks to further explore the conceptual structure of "social" distance. In the three studies, participants read short narratives, drew what they imagined happening during the narrative, then estimated both time and distance. In general, results suggest that the conceptual structure of social relationships is linked to thought about space in terms of path drawing and temporal estimation, but not absolute distance estimation. Results are discussed in terms of mental simulation and inter-character interaction.

Keywords: spatial reasoning, distance estimation, temporal judgments, drawing, mental simulation.

1 Introduction

Everyday language is replete with expressions that describe relationships in terms of physical space. This is evident in the domain of friendship. In talking about friends, people readily use statements such as *We have grown close, They stuck together, Bob stood by his side*, or *He leaned on his buddy after he heard the bad news,* to imply familiarity, fondness, confidence, trust, and so on. They also use statements such as *We have drifted apart, They seem distant lately, He turned his back on his friend*, or *Something came between them*, to imply problems in a friendship.

The goal of this research is to explore the connection between physical space and friendship. To what extent do people think about space when they conceptualize friendship? We are especially interested in whether thought about physical space is part of everyday thought about friendship.

It is well known that people describe abstract concepts in terms of their experience with physical space. This reflects an inclination to draw on relatively more basic domains that are grounded in everyday physical or perceptual experience (see [1]; [2]). For example, people think about time in terms of space, which

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is reflected in the ubiquity of linguistic expressions, such as *June comes before July, The first week of school has just passed*, and *We are approaching a holiday weekend*. In these cases, a source domain of physical space maps structure on to a target domain of time (see [3]; [4]; [5]; [6]; [7]; [8]). People also think about numbers and mathematics in terms of space, as is evidenced by the number line and language such as *The number is higher than eight*, or *Six hundred comes after 599*[9]. They also conceptualize the internet in terms of space, as is seen in the use of expressions such as *Go to my website, I was at your website*, and *We came to a website about bobcats*[10].

The idea that people think of relationships in terms of physical space is intuitively appealing, especially given the ubiquity of linguistic expressions that refer to friendship in terms of spatial relations. This has been discussed at length in cognitive linguistics, including details about cross-domain mapping (e.g., [2]; [11]; [1]) and relations to other metaphors (e.g., emotion metaphors, see [12]. But it has also been discussed in social psychology, primarily in the realm of "social distance". A few studies in cognitive science have explored connections between physical space and similarity. Casasanto (2008) gathered similarity ratings of various stimuli (abstract nouns, unfamiliar faces, line drawings) under different conditions and found that when stimuli items were placed close to one another, pairs of stimuli were judged as more similar during conceptual judgments and less similar during perceptual judgments. Distance effects have also been found in variations of the Stroop (1935) task. Bar-Anan, Liberman, Trope, and Algom (2007) found the spatial location of words affects categorization time when the words have temporal, social, and/or hypotheticality interpretations, but not for words that lack such semantic properties. Accessing the spatial location of a psychologically distant word such as "others" is faster when the word is presented in the "background" of an image rather than the "foreground" of the same image. The exact opposite accessibility pattern occurs with words that are psychologically proximate, like "we".

Research on spatial mental models has revealed that in some ways imagined space is analogous to physical space[16] [17]; [18]. For instance, when asked to read a narrative about a person moving through a spatial environment, such as a house, people are quicker to access information about objects that are physically proximate to the protagonist than objects that are physically distant[19]. Spatial mental models are known to structure the comprehension of language about imagined environments, including language about motion events both real [20] and fictive [21].

Although little work has addressed the issue of whether social space is directly conceptualized in terms of physical space, attention has been given to the connection between attitudes about nationalities and how they influence relative position in physical space. Burris and Branscombe (2005) recently found that when presented with a variety of cities, one in Canada and one in Mexico, Americans overestimate distance between the cities when one city is in the United States and the other in a foreign location, when compared to two equidistant U.S. cities. This result replicated with Canadians as well, and only held when the

estimating party was nationally tied to one of the countries used. This suggests that spatial thinking is involved when participating in on-line distance estimation tasks involving nationality.

In the current work we designed three studies to examine how thought about friendship interacts with thought about physical space. Drawing on our previous work[23]; [24], we created a novel task to explore this relationship across three modes of transportation (walking, driving, and riding) and three measurement variables (drawing, temporal judgment, and distance estimation). Our earlier work results suggested that greater social distance is associated with greater physical distance.

2 General Method

Overview. Here, three drawing and estimation experiments addressed the hypothesis that spatial thinking is related to thought about social relationships, specifically friendship. In these experiments participants first read narratives that described a person either walking, driving, or riding through a park to deliver a package while passing various figures. They then drew the route they would take to accomplish the goal, estimated how much time had passed during the trip, and how far they had traveled (see Figure 1). If thinking about space and social relationships are related, the social relationship described in the narrative should influence the route taken to complete the package delivery task as well as the physical and temporal judgments made about the journey.

Stimuli. The task appeared on a single page in a booklet that consisted of unrelated materials. Participants read a second-person narrative describing a journey through a city park where the reader passes by different people. Half read a passage describing the other people in the park as strangers: "Imagine you need to deliver a package. Along the way, you (walk/drive/ride) through a park and pass by different people. You *do not know* these people. They are *strangers*." The other half of participants read a passage describing the other people in the park as friends: "Imagine you need to deliver a package. Along the way, you (walk/drive/ride) through a park and pass by different people. You *know* these people well. They are *your friends*." Narratives were phrased such that interaction with the other people was not explicitly mentioned. Below the passage, the following instructions were given to participants: "Please draw the route you take through the park using a continuous line". Below the instructions, a simple map (see Figure 1) was given for participants to sketch a path from two points labeled "Start" and "Finish".

2.1 Figures

Maps contained three horizontal rows of trees and/or fencing with a stick figure or vehicle at the end of each tree/fence row. Maps were constructed so a single path from start to finish served as the only solution to the task, and forced participants to pass by the three figures as mentioned in the narrative (see

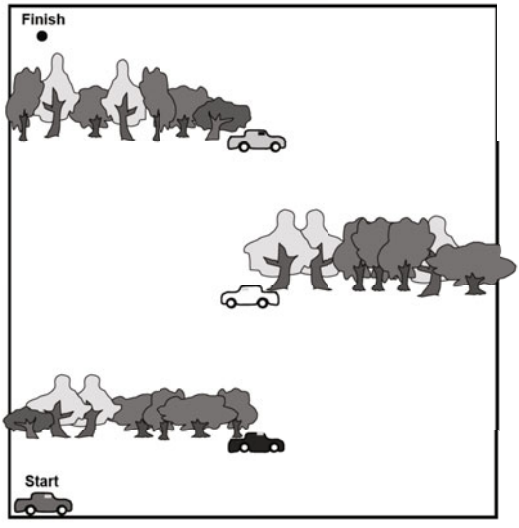

Fig. 1. Example of visual stimuli presented to participants in the *Driving* condition

Figure 1). To complete the task, participants simply drew a continuous line from "Start" to "Finish" depicting their route through the park. After the drawing task, participants provided written estimates of elapsed time: "Using your best guess, how much time (in minutes) did it take you to (walk/drive/ride) through the park?" and distance traveled: "Using your best guess, how far (in feet) do you think you (walked/drove/rode) in the park?" All scenes were similar with only the figures changing across condition (see Figure 2).

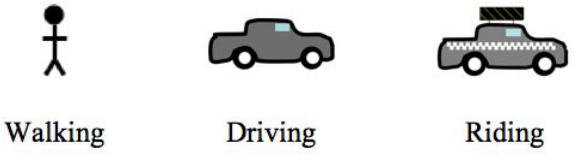

Fig. 2. Figures used in the *Walking, Driving*, and *Riding* conditions

Procedure. Overall, participants were randomly assigned to one of six conditions, differing solely by narrative type: two social relationship conditions (friend or stranger) crossed with three modes of transportation conditions (walking, driving, and riding in a taxi). Participants were instructed to read the narrative then complete the route drawing task and the time and distance estimation tasks.

Data Analysis. The primary dependent variable, distance of the route drawn to the figures in park, was operationalized by measuring (in millimeters) the absolute distance from the drawn route to the most distal end of the arm of each

stick figure or the outer edge of the front bumper of the depicted vehicle. Three separate measurements were taken from each participant's drawing (distance from drawn route to the bottom figure, distance from drawn route to the middle figure, and distance from drawn route to the top figure). Drawn routes were also coded for route-figure intersection and route-tree/fence intersection. For analysis, all time estimates were converted to minutes and distance estimates were converted to feet.

3 Experiment 1 – Walking

This experiment examined whether social information influences thought about space and time. Participants were instructed to read a short narrative and imagine walking through a park to deliver a package while plotting their route on a provided map. Friend or stranger figures were positioned along the route. If social information influences thought about space and time, then a difference in route-figure distance should be seen across the social relationship conditions; where routes are drawn closer to friends than to strangers.

Participants. A total of 263 UC Merced undergraduate students (159 women; Age M=18.49, SD=1.09) enrolled in either a Cognitive Science or Psychology course participated for partial course credit.

Results - Drawing. On average, more path-figure intersections were found in the friends condition (M=.22, SD=.74) than in the strangers condition (M=.05, SD=.44), $F(1,259)$=5.86, p=.02, η^2=.02. No reliable differences between the friends condition and the strangers condition were found with regard to walking routes intersecting tree/fence barriers, F<1. No other effects were found, all ps>.05.

The three figure-path measurements were not consistent in distance across position, Wilks' λ=.94, $F(2,524)$=7.95, p<.001, η^2=.06. Therefore the three positions were independently analyzed. As predicted, participants who read the friends narrative drew their walking routes reliably closer to the figures in the park than did those who read the strangers narrative (friends and strangers respectively) when drawing at the top (M=14.25, SD=12.35; M=22.59, SD=16.95), middle (M=15.63, SD=16.08; M=24.55, SD=18.19), and bottom (M=13.73, SD=12.93; M=21.14, SD=16.03) positions. Wilks' λ=.92, $F_{top}(1,259)$=19.26, p<.001, η^2=.07 (see Figure 3); $F_{middle}(1,259)$=16.90, p<.001, η^2=.06 (see Figure 4); $F_{bottom}(1,259)$=17.66, p<.001, η^2=.06 (see Figure 5). No other effects (main effect for gender or subsequent higher order interactions) were sanctioned for further examination by the omnibus MANOVA.

Results - Estimation. Data from 10 participants were removed from subsequent analysis for providing time and distance estimates greater than three standard deviations from their respective group means. Participants in the friends condition estimated that it took more time (in minutes) to walk through the park (M=19.43, SD=14.19) than participants in the strangers condition (M=11.56,

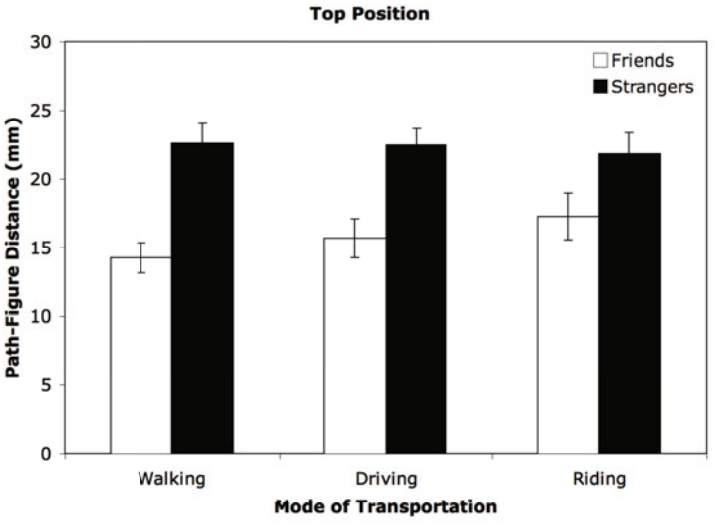

Fig. 3. Top *path-figure distances* (in mm) by *mode of transportation* and *narrative type*

SD=7.01), t(186.68)=5.65, p<.001 (see Figure 6). No reliable differences were found when estimating distance walked between the friends (M=308.35, SD= 459.85) and strangers (M=313.03, SD=534.59) conditions, t(255)=-0.08, p=.94 (see Figure 7).

4 Experiment 2 – Driving

This experiment investigated whether social information influences thought about space and time, with moderate difficulty of actual character interaction taking place. What will happen if the participants imagine riding in cars past other figures in cars? Delivering the package in a car should make it especially difficult to imagine interacting with others in cars. The procedures used were identical to those in Experiment 1, as were the predictions.

Participants. A total of 324 UC Merced undergraduate students (199 women; Age M=20.33, SD=2.72) enrolled in either a Cognitive Science or Psychology course participated for partial course credit.

Results - Drawing. On average, more path-figure intersections were found in the friends condition (M=.52, SD=1.01) than in the strangers condition (M=.23, SD=.72), F(1,320)=7.17, p=.008, η^2=.02. No reliable differences between the friends condition and the strangers condition were noted with regard to driving routes intersecting tree/fence barriers, F<1. No other effects were noted, all ps>.05.

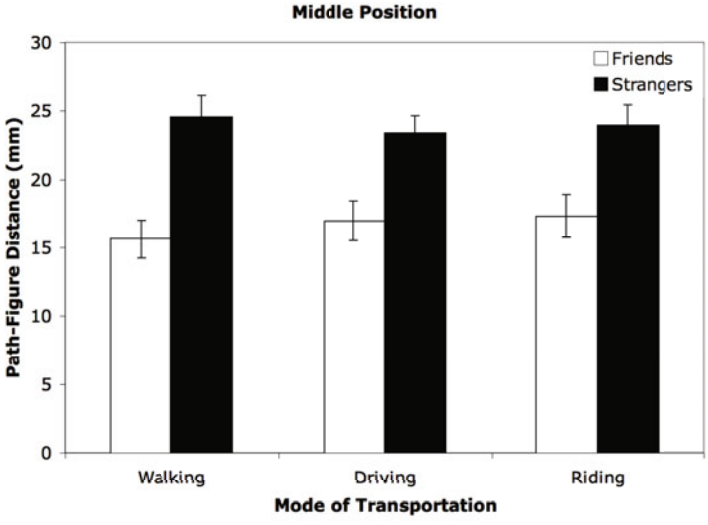

Fig. 4. Middle *path-figure distances* (in mm) by *mode of transportation* and *narrative type*

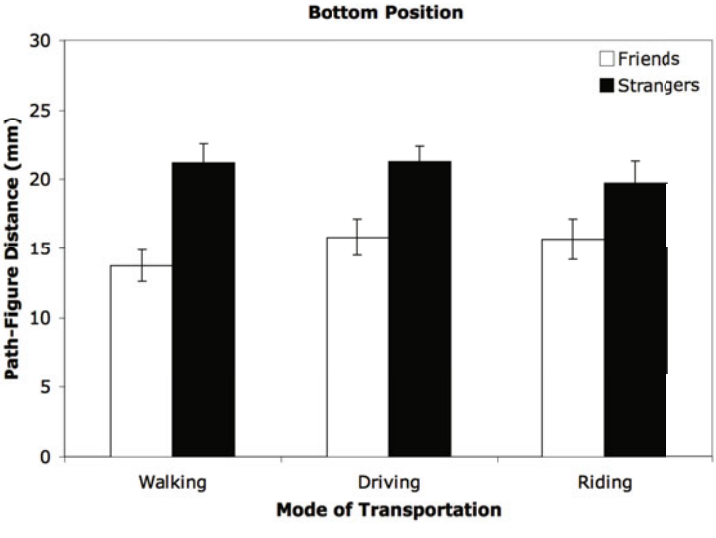

Fig. 5. Bottom *path-figure distances* (in mm) by *mode of transportation* and *narrative type*

The three figure-path measurements were not reliably different from one another with regard to distance across position, Wilks λ=.99, $F(2,322)$=2.48, p=.13, η^2=.01. However methodological consistency was preserved and the three positions were independently analyzed, just as was done in experiment one. As predicted,

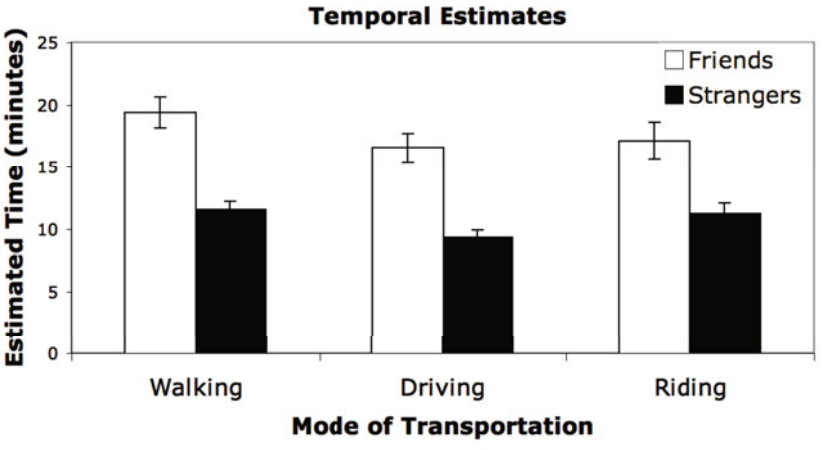

Fig. 6. *Temporal estimations* (in minutes) by *mode of transportation* and *narrative type*

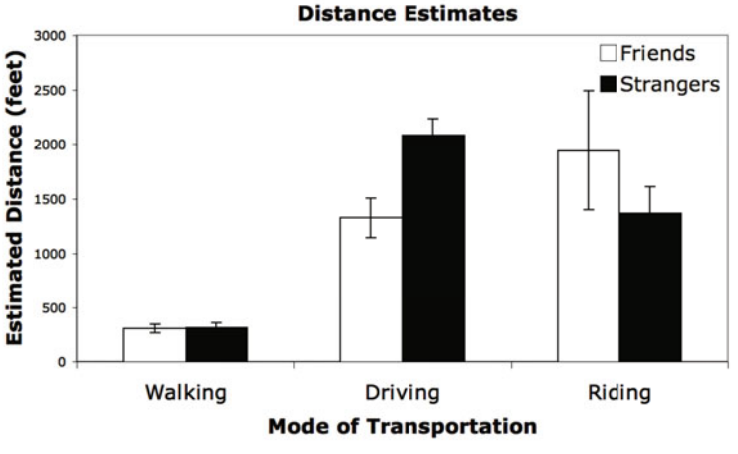

Fig. 7. *Distance estimations* (in feet) by *mode of transportation* and *narrative type*

participants who read the friends narrative drew their driving routes reliably closer to the figures in the park than did those who read the strangers narrative (friends and strangers respectively) when drawing at the top (M=15.69, SD=16.94; M=22.47, SD=16.52), middle (M=16.97, SD=17.33; M=23.39, SD=16.91), and bottom (M=15.82, SD=15.73; M=21.22, SD=15.46) positions, Wilks λ=.94, $F(3,318)$=6.82, p<.001, $F_{top}(1,320)$=18.30, p<.001, η^2= .05 (see Figure 3); $F_{middle}(1,320)$=14.87, p<.001, η^2=.04 (see Figure 4); F_{bottom} (1,320)=12.86, p<.001, η^2=.04 (see Figure 5). Men drew their driving routes reliably closer to the figures in the park than did women (men and women respectively) when

drawing at the top (M=18.64, SD=16.75; M=20.01, SD=17.20), middle (M=18.66, SD=16.57; M=21.74, SD=17.79), and bottom (M=16.34, SD=14.01; M=20.40, SD=16.65) positions, Wilks λ=.97, $F(3,318)$=3.21, p=.02, η^2=.03, $F_{top}(1,320)$= 2.63, p=.11, η^2=.01; $F_{middle}(1,320)$=5.12, p=.02, η^2=.02; F_{bottom} (1,320)=8.22, p=.004, η^2=.03. No higher order interactions were sanctioned for further examination by the omnibus MANOVA.

Results - Estimation. Data from 11 participants were removed from subsequent analysis for providing time and distance estimates greater than three standard deviations from their respective group means. Participants in the friends condition estimated that it took more time (in minutes) to drive through the park (M=16.57, SD=13.70) than participants in the strangers condition (M=9.34, SD=7.32), $t(202.02)$=5.67, p<.001 (see Figure 6). Participants in the friends condition (M=1323.91, SD=2143.22) estimated their traveled distance to be shorter than those in the strangers condition (M=2081.29, SD=4287.92), $t(270.56)$=-2.05, p=.04 (see Figure 7).

5 Experiment 3 – Riding

This experiment attempted to address whether social information influences thought about space and time, with extreme difficulty of actual character interaction taking place. Here participants imagined delivering a package by riding in a taxi through a park. Again, the procedures used were identical to those in Experiments 1 and 2, as were the predictions.

Participants. A total of 190 UC Merced undergraduate students (115 women; Age M=19.11, SD=1.67) enrolled in either a Cognitive Science or Psychology course participated for partial course credit.

Results - Drawing. On average, more path-figure intersections were found in the friends condition (M=.56, SD=1.12) than in the strangers condition (M=.16, SD=.62), $F(1,186)$=5.79, p=.02, η^2=.03. On average, more barrier-path intersections were observed in the friends condition (M=.03, SD=.18) than in the strangers condition (M=.00, SD=.00), $F(1,186)$=4.83, p=.03, η^2=.03. No other effects (main effect for gender or subsequent higher order interactions) were observed for neither path-figure intersections nor barrier-path intersections, all ps>.05. The three figure-path measurements were not consistent in distance across position, Wilks λ=.95, $F(2,188)$=5.87, p=.007, p=.003, η^2=.03, therefore the three positions were independently analyzed. Participants who read the friends narrative tended to draw their riding routes closer to the figures in the park than did those who read the strangers narrative (friends and strangers respectively) when drawing at the top (M=17.29, SD=16.67; M=21.83, SD=15.00), middle (M=17.32, SD=15.68; M=23.93, SD=14.83), and bottom (M=15.67, SD=14.40; M=19.69, SD=15.35) positions. Wilks' λ=.96, p=.048, $F_{top}(1,186)$= 2.71, p=.10, η^2=.01 (see Figure 3); $F_{middle}(1,186)$=7.78, p=.006, η^2=.04 (see Figure 4); $F_{bottom}(1,186)$=3.05, p=.08, η^2=.02 (see Figure 5). No other effects (main effect for gender or subsequent higher order interactions) were sanctioned for further examination by the omnibus MANOVA.

Results - Estimation. Data from 10 participants were removed from subsequent analysis for providing time and distance estimates greater than three standard deviations from their respective group means. Participants in the friends condition estimated that it took more time (in minutes) to ride through the park (M=17.13, SD=14.35) than participants in the strangers condition (M=11.21, SD=8.11), $t(147.60)$=3.471, p=.001 (see Figure 6). No reliable differences were found when estimating distance rode between the friends (M=1944.21, SD= 5246.91) and strangers (M=1361.65, SD=2361.44) conditions, $t(126.41)$=0.97, p=.33 (see Figure 7).

6 Discussion

Three studies investigated whether an underlying spatial framework influences thinking about social groups. Questions addressed whether or not people think about and express social relationships (social distance) in terms of actual space (physical distance). In all experiments, social relationship primes influenced the way people conceptualized the passage of time and how people drew paths through physical space to complete a task.

In all three experiments, participants drew lines on maps to show where they would travel when delivering a package and estimated how long it would take. In Experiment 1, when participants imagined walking, they drew their lines closer to figures in the park map and estimated that the trip took longer when they believed the figures were friends (versus strangers). Experiment 2 showed the same results. In that case, participants depicted driving routes, specifically, routes past cars that contained friends or strangers. The same effect was also obtained in Experiment 3, in which participants imagined riding in a taxi through the park. Thus, whether the person walked, drove, or rode, social information appeared to influence how people implicitly conceptualized space relative to another person. Friendship consistently resulted in closer distance and longer time.

Based on the data collected, social distance does appear to involve thought about real distance. However, simply mapping thought about physical space onto thought about social space does not represent the entire picture. Both path drawing and temporal judgments are influenced by social relationship primes, at least in the studies presented here. Classic social distance theory posits that social distance and feelings of favorability are inversely related; as the social distance between two groups increases, feelings of mutual favorability between the groups decrease ([25]; [26]; [27]). This relationship was elicited in the three experiments reported here. In general, while drawing an imagined route through an open space populated with figures or vehicles, participants under the impression that the figures or vehicles were their friends tended to draw paths closer to those pictured figures, so close in fact that many routes drawn in the friend condition physically intersected the figures/vehicles in space. Route-figure intersections were 2 to 3 times more prevalent in the friend conditions than in the stranger conditions, even when narratives used in the task never explicitly

mentioned figure interaction (see Figures 8 and 9). Are readers simulating interaction with their friends even when interaction is not mentioned? Data from Experiment 1 would support such a conclusion, evidenced by time and distance estimates made by participants after completing the task. When asked to estimate how long it took them to walk through the park, and how far they walked during their travel, estimates regarding distance did not reliably differ by narrative condition, however estimates of time did vary across narrative condition. Participants under the impression they were passing their friends judged the time taken to walk though the park as longer than those in the stranger condition. However, unlike Experiment 1, where the physical qualities of the environment are conducive to character interaction, Experiments 2 and 3 were designed to make potential interaction increasingly more difficult to imagine, yet participants still drew their paths closer to friends figures/vehicles and further from strangers figures/vehicles.

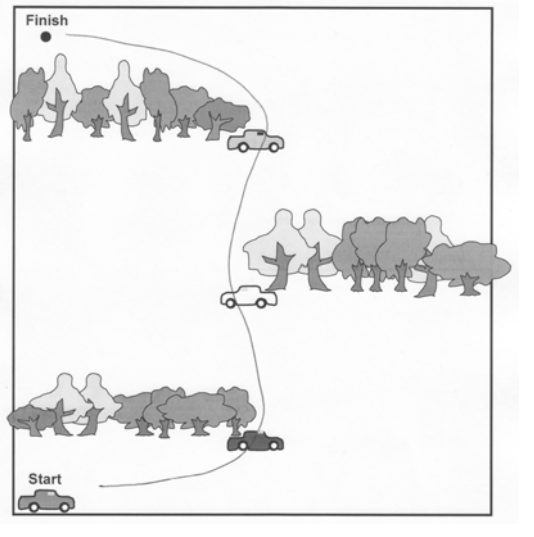

Fig. 8. Participant drawing from the *friend/driving* condition

Future research will address how reasoning about space in the understanding of relationships unfolds over time, including collecting information regarding speed of travel. When people pass by friends, will they slow down, and if so, how much and at what point? Here we only examined situations where participants imagined moving. It will also be informative to explore situations in which others move past the participant (where the stationary figure is the participant). Future explorations in the realm of social distance will also include a variety of manipulations based on social categories ubiquitously found in everyday language, like race, sexual orientation, gender, and ethnicity.

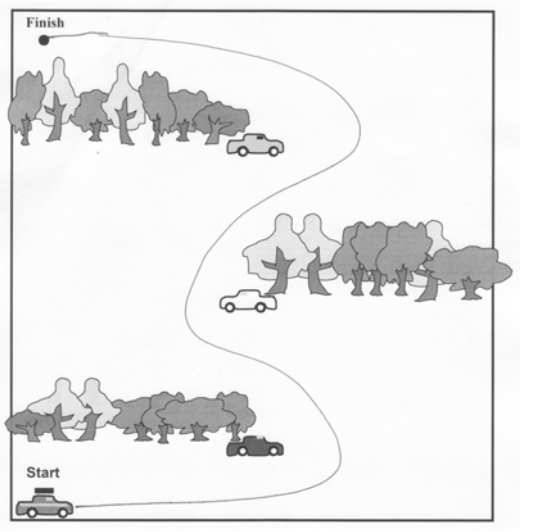

Fig. 9. Participant drawing from the *stranger/driving* condition

In sum, this research examined the interplay between social distance and physical distance, two concepts that have been studied largely by independent groups of researchers, social psychologists and cognitive scientists. The assumption that "distance" in social distance is analogical or metaphoric should be updated to include spatial thinking as a factor that influences the perception of social groups.

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