

Social Distance Increases Perceived Physical Distance

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Abstract

Proximity, or spatial closeness, can generate social closeness—the closer people are together, the more they interact, affiliate, and befriend one another. Mediated communication allows people to bridge spatial distance and can increase social closeness between conversational partners, even when they are separated by distance. However, mediated communication may not always make people feel closer together. Here, we test a hypothesis derived from construal theory, about one way in which mediated communication might increase spatial distance, by imposing social distance between two texting partners. In three studies, the social distance generated by a text conversation correlated with estimates of spatial distance. Conversations designed to generate social distance increased estimates of spatial distance. We discuss this relationship in light of the rise in computer-mediated communication.

Keywords

computer-mediated communication, proximity, social distance, social media, mobile devices, distance estimation, social distance can influence perceptions of spatial distance

Humans communicate to survive and to thrive. We use communication to share resources and information and to create alliances. Historically, the most important people to communicate with were nearby: potential allies or mates. Indeed, spatial proximity is a reliable predictor of whether two people will cultivate a social relationship (Newcomb, 1956).

Until recently, people could only communicate in real time with people in close spatial proximity. Telephones, especially mobile phones, have rapidly increased real-time communication over a distance. As of July 2015, 92% of American adults own a cell phone (Pew Research Center, 2015). By bridging physical distance, mediated communication can decrease social distance (Oh, Curley, & Subramani, 2008). In fact, mediated communication can even lead to greater intimacy than face-to-face communication (Walther, 1996). After a phone call, people feel socially closer to their conversational partners than they do to people in their actual physical location (Andrade, 2014).

These findings comport well with research on construal-level theory, which suggest that people conflate different types of distance—spatial, social, and temporal—with each other. People implicitly associate each type of distance with each other (Bar-Anan, Liberman, Trope, & Algom, 2007) and use the same neural systems for thinking about events across all three types of distance (Buckner & Carroll, 2007; Spreng, Mar, & Kim, 2009; Tamir & Mitchell, 2011). As a result, if perceptions of one type of distance change, this can induce parallel changes in the perceptions of another type of distance

(Casasanto & Boroditsky, 2008; Miles, Karpinska, Lumsden, & Macrae, 2010). Importantly, space interacts with social distance in just this way. For example, people feel physically closer to cities that they are emotionally involved in (Ekman & Bratfisch, 1965). If mediated communication serves to bridge physical distance, this might explain how it can also help bridge social distance.

However, there is reason to believe that our ever-growing penchant for mediated communication might actually expand, rather than contract, perceived distance between people. First, the physical distance implied from mediated communication might induce feelings of social distance. Indeed, thinking about a person as spatially distant leads people to think of them as socially distant (Liberman, Trope, & Stephan, 2007). People who talk over large spatial distances treat each other with greater formality, less familiarity, and act less cooperatively than people talking over short distances (Bradner & Mark, 2002; Stephan, Liberman, & Trope, 2010, 2011). Second, existing or induced social divides can further increase

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perceived spatial distance (Henderson, Wakslak, Fujita, & Rohrbach, 2011; Soliman, Gibson, & Glenberg, 2013; Tversky, 2011). For example, Germans with negative feelings about reunification systematically overestimated the distance between formerly West and East German cities, compared to Germans with positive or neutral feelings (Carbon & Leder, 2005).

If people indeed conflate social distance and physical distance, then remote social connections may transform perceptions of the physical world. However, it is unclear whether mediated communication at a distance increases or decreases perceptions of physical distance. On one hand, mediated communication allows people to bridge large spatial distances, which should shrink perceived distances. On the other hand, spatial distance may induce people to treat their conversation partners with more social distance.

Here, we propose that the social distance evoked by mediated communication shapes perceptions of spatial distance. Specifically, we hypothesize that mediated communication will induce people to feel even more spatially distant to their conversation partner, to the extent that they also feel socially distant. That is, people who feel socially distant from their conversational partners during a mediated interaction should report greater spatial distance between themselves and their conversational partners' purported location. We test this possibility in three studies. In Study 1, we first test for a positive correlation between social and spatial distance. In Study 2, we experimentally induce feelings of social distance or social proximity and assess the impact on perceived spatial distance. In Study 3, we replicate the effects of Study 2 using an automated chat bot as the conversational partner.

Study 1

Method and Material

This study was designed to assess whether perceptions of social distance positively correlated with perceptions of spatial distance. In this study, participants interacted with a confederate in real time and then estimated how socially and spatially distant they felt from that person.

Participants

Participants ($N = 47$) were recruited from two North American colleges approximately 30 miles apart. Informed consent was obtained from all participants in a manner approved by the institutional review board (IRB). No sample size was set a priori, and data collection stopped once the semester was over. This sample size is commensurate with previous studies examining social distance (Liviatan, Trope, & Liberman, 2008). This sample size allows for 54.5% power to detect a medium effect size ($r = .30$) and 95.7% power to detect a large effect ($r = .50$). Before analyzing the data, seven participants were removed for incorrect or incomplete survey data, or for stating that they had not paid attention, or that they believed their

conversational partner was a confederate. This left 40 undergraduates (14 male). Importantly, while our primary analyses were done excluding participants who guessed the confederate's identity or failed the manipulation check, it is notable that in this and all subsequent studies, the results are similar when including all 44 participants who provided usable distance data (see Online Appendix G). All participants were compensated in course credit.

Procedure

This study took place online. Participants selected a time slot through an online scheduling tool and received instructions for how to participate via e-mail. At their scheduled time, participants logged into an e-mail account provided by the researcher. Through a chat window on this account, a researcher introduced the experiment as measuring how much implicit geographical information could be picked up during a casual conversation. Participants were asked to select five cities they were familiar with to describe to the other study participant.

Participants then interacted with a confederate via another chat window. Each confederate followed a script so that content was as consistent as possible across participants (see Online Appendix A for the script). Confederates greeted the participant, introduced themselves, and described five Midwestern cities in a few sentences each. For each chat, one of the five cities was randomly selected to be described as the confederate's current location. Next, participants took their turn describing the five cities they had selected. The chat then ended, and participants completed an online survey to assess the two primary measures of interest: social and spatial distance.

Measures

Twenty questions assessed how socially distant the participant felt from the confederate. These questions had an α of .93 and were averaged to create a single *social distance* measure. Questions were modified from Bogardus (1933), Kelley (1950), and Lakens and Stel (2011).

Participants next answered questions about each of the five cities their partner described. They estimated the average temperature, the average age of the citizens, and importantly, the distance from the participant's current location. The order in which cities were presented was kept constant. Thus, the position in which participants' conversational partners' randomly assigned home city appeared in the survey varied.

Spatial distance estimates for each city were converted to percentages by dividing each participants' estimate of distance by the actual straight-line distances to each city, in order to allow comparison between the estimates of the cities, whose actual distance varied. A Shapiro–Wilks test indicated that these data were not normally distributed ($W = .94$, $p = .027$). We thus transformed the data using log and square root transformations. To do so, we transformed both the distances that the participants estimated to the relevant cities, and the actual distances to those cities, and then created a new

Table 1. The Correlations (and Confidence Intervals) Between the Measure of Social Distance and the Following Spatial Distance Measures: The Estimated Distance for the Target City in Which the Conversational Partner Was Said to Be Located and the Estimated Distance for Each Individual City When It Was Not the Target City.

Measures	Target (<i>n</i> = 40)	Nontarget Cities (Shown in Order of Presentation)				
		St. Paul (<i>n</i> = 32)	Columbus (<i>n</i> = 29)	Lansing (<i>n</i> = 32)	Madison (<i>n</i> = 33)	Des Moines (<i>n</i> = 34)
Social distance	.38* (.62, .08)	.26 (.56, -.10)	.34 (.63, -.03)	.24 (.54, -.12)	.33 (.61, -.01)	.12 (.44, -.23)

Note. Cities are listed in the order in which they were presented. Italics indicate the confidence intervals for the correlations.
**p* = .015.

percentage for both log and square root transformed distances by dividing the transformed estimated distances by the transformed actual distances. However, in this study and in all subsequent studies, untransformed data and transformed data produced the same results. Thus, for all studies, we present the results using the untransformed data in the main body of this article and the transformed results in full in Online Appendix G.

Results

Analyses measured the degree of correlation between social distance and percentage-transformed spatial distance using Pearson’s *R*. In line with our hypothesis, results showed that as social distance increased, the estimated spatial distance between the participant and the target city also increased. That is, the more socially distant the participant reported feeling from their conversational partner, the further they estimated themselves to be from their partner’s current city (*r* = .38, *p* = .015, 95% confidence interval [CI] [0.08, 0.62]; Table 1). In fact, the greater social distance participants felt from their study partner, the larger their distance estimations to *all five* cities, although none of these secondary correlations were statistically significant.

This study provides initial evidence that perceptions of social proximity relate to perceptions of spatial proximity. After a mediated conversation, participants rated their social affinity for their conversation partner. These ratings of social proximity were significantly correlated with estimates of spatial distance (Figure 1). Study 2 builds on these correlational findings to assess whether social closeness can causally influence perceptions of proximity.

Study 2

Method and Material

In Study 2, participants again interacted with a conversation partner via text. Conversation scripts were designed to engender social closeness or social distance, allowing us to test for the causal effect of social distance on estimates of spatial distance. After these interactions, participants rated how socially and spatially distant they felt from their conversation partner.

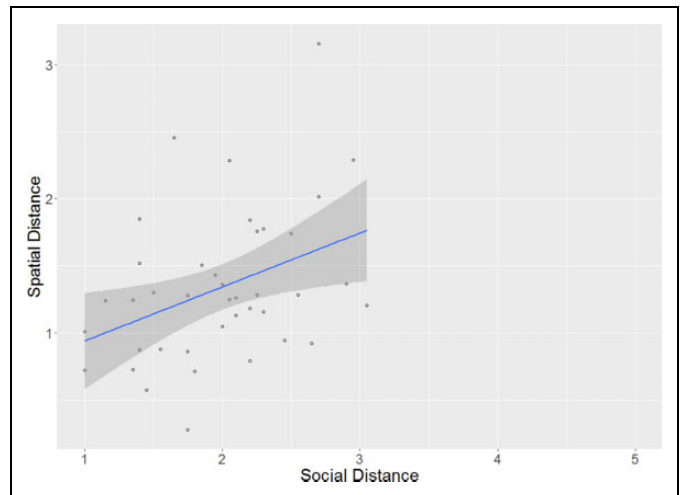


Figure 1. This scatterplot shows the positive correlation between social distance and spatial distance in Study 1. The spatial distance measure was created by dividing the participant’s estimate of the distance to the target city by the actual distance to the target city. The X-axis reflects the scale of the survey questions from 1 to 5 so that this figure may be compared to the same measures in Study 2 (Figure 3a and b) and Study 3 (Figure 5a and b). We note that because the confederate always followed a friendly script in Study 1, social distance remained low overall.

Participants

Participants (*N* = 79) were recruited from the same two colleges as in Study 1. A power analysis based on the correlation (*r* = .38) found in Study 1 indicates a target sample size of 20.9 participants per condition for power of 0.8. Given the high attrition rate in Study 1, the target sample size was 25 participants per condition. Informed consent was obtained from all participants in a manner approved by the IRB, and all participants were compensated in course credit. Seven participants were removed for not completing all questions or misunderstanding the questions, nine for failing to remember their conversational partner’s current city, and nine for guessing the purpose of the study or indicating that they believed their conversational partner was a confederate. This left 54 participants (11 male).

Procedure. The design of Study 2 was similar to that of Study 1. Participants completed the task either on a computer in the lab or from an off-site computer of their choice. As before, participants interacted with the confederate via online chat. Conversation partners followed two distinct scripts, designed to elicit

feelings of either social closeness or social distance, respectively. Scripted material for all conditions can be found in Online Appendices C, D, and E. In the *warm conversation* condition ($n = 19$, 6 males), confederates used smiling emoticons and attempted to respond to participants' comments promptly and pleasantly. In the *cold conversation* condition ($n = 17$, 2 males), confederates were curt, did not respond promptly to the participants' comments, and used periods at the end of comments but no emoticons. In both conditions, participants and their partners each described only two cities to each other. One city was that person's current place of residence, and the other city was assigned to them. This time, in order to vary the location of the target cities, the cities that the confederates described as their current locations were randomly assigned to be Dallas, TX, Cleveland, OH, or Atlanta, GA, while the "assigned" city was Denver, CO.

While our primary goal was to replicate the correlation found in Study 1 and examine the effects of manipulating social presence on distance, we also wanted to assess whether interaction was necessary or whether warm content itself was sufficient. Thus, we created a second comparison. We compared the *warm conversation* condition to a *warm transcript* condition in which participants ($n = 18$, 3 males) read an anonymized chat between a participant and a confederate who was following the warm conversation script. The transcript was pasted into the chat window by the researcher. In this case, participants did not type any material of their own.

After participants completed the conversation or finished reading the transcript, they completed an online survey designed to measure perceived social and spatial distance. In order to increase the salience of the social interaction (Miles, Christian, Masilamani, Volpi, & Macrae, 2014), participants in the warm transcript condition were directed to answer survey questions from the perspective of the second participant, which was the role of actual participants in the warm conversation and cold conversation conditions.

Measures

Social distance was assessed via the same 20-item questionnaire as in Study 1. These questions had an α of .93. Participants then provided estimates of physical distance from their own location to the two cities their partner discussed. *Target city distance* represented the distance to the target city where participants thought the confederate was located, and *control city distance* represented the distance to the nontarget city, Denver, CO. Both estimates were converted to percentages by dividing by the actual straight-line distance to each city. As before, all statistically significant results were consistent whether or not the distances were transformed, regardless of which transformation (log or square root) was used.

Results

To assess whether the conditions successfully manipulated social distance, we compared the effect of all three conditions

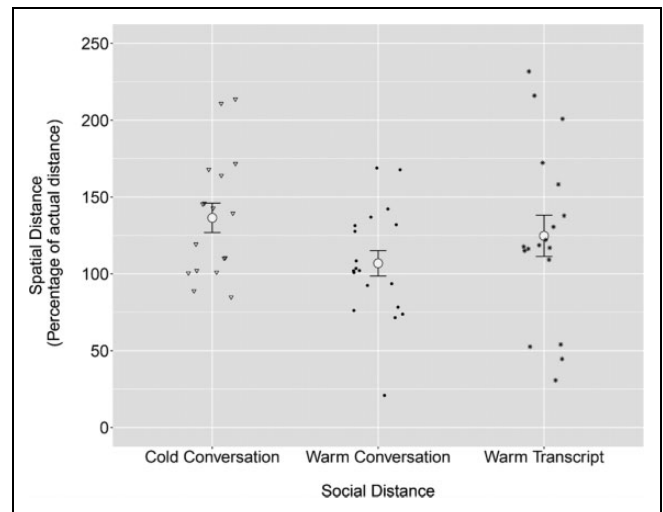


Figure 2. Scatterplot showing distance estimation across conditions in Study 2, along with means and standard errors by conditions. Participants overestimate spatial distance most during cold conversations and least during warm conversations.

on social distance. For these and all following comparisons between conditions, we used Welch's t tests, which do not assume equal variance, resulting in fractional degrees of freedom. Because warm conversation appears in both comparisons, they are nonindependent and so $\alpha = .025$. As expected, participants reported greater social distance to conversational partners in the cold conversation condition ($M = 3.65$, standard deviation [SD] = 0.51) compared to the warm conversation condition ($M = 2.49$, $SD = 0.32$): $t(26.2) = 7.99$, 95% CI [1.78, 3.58], $d = 2.74$, $p < .001$. There was not a statistically significant difference in social distance between the warm transcript ($M = 2.74$, $SD = 0.58$) and warm conversation conditions, $t(26.2) = 1.60$, 95% CI [-0.13, 1.18], $d = 0.53$, $p = .121$.

Thus, social distance increased when confederates followed the less friendly script, but a friendly script affected participants similarly whether they actually interacted with a friendly confederate or only took the perspective of a participant who did so. Next, we tested our main hypothesis that inducing feelings of social distance would cause estimates of spatial distance to increase. Again, because warm conversation appears in both comparisons, they are nonindependent and so $\alpha = .025$. Results of a t test comparing cold and warm conversation conditions were marginally statistically significant in support of this hypothesis, $t(32.6) = 2.32$, 95% CI [0.08, 1.44], $d = 0.78$, $p = .027$, such that participants in the cold conversation condition ($M = 1.36$, $SD = 0.40$), who had socially distant conversational partners, estimated their partners' city to be significantly further away than did participants in the warm conversation condition ($M = 1.07$, $SD = 0.36$). There were no significant differences between spatial distance estimates to the target city in the warm conversation and warm transcript ($M = 1.25$, $SD = 0.57$) conditions, $t(28.5) = 1.13$, 95% CI [-0.28, 1.02], $d = 0.38$, $p = .267$). See Figure 2 for these data.

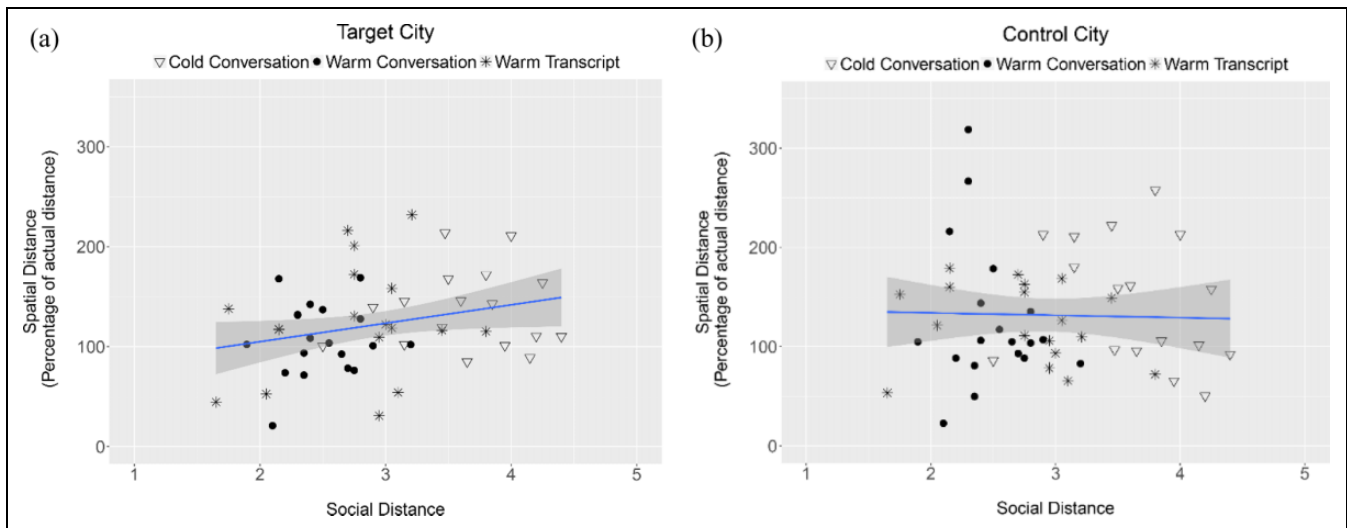


Figure 3. (a) Correlation between social distance and spatial distance to the target city in which the conversation partner was located. Estimated spatial distances to the target city increased as social distance increased. (b) Correlation between social distance and spatial distance to the control city which was described as assigned to the conversation partner. Social distance did not correlate with estimated spatial distances to the control city.

Replicating the correlations in Study 1, social distance correlated with target city spatial distance across all conditions ($r = .27, p = .046, 95\% \text{ CI } [0.01, 0.50]$; Figure 3a).

There were no significant differences between spatial distance estimates to the control city in the cold conversation ($M = 1.45, SD = 0.63$) and warm conversation ($M = 1.27, SD = 0.73$) conditions, $t(34.0) = 0.82, 95\% \text{ CI } [-0.39, 0.92], d = 0.27, p = .418$. Distance estimates to the control city were also not correlated with social distance ($r = -.03, p = .846, 95\% \text{ CI } [-0.29, 0.24]$; Figure 3b).

Study 3

In Study 3, we replicated Study 2 while improving the study design in the following ways. First, we automated the conversation such that participants conversed with a bot online rather than with a researcher. Second, we recruited participants from two colleges on opposite coasts of the United States, to reduce the chance that the effects found in Study 2 were specific to one geographic location. We chose one city in the middle of the United States, Lawrence, KS, as the target city because it was approximately equidistant from the two colleges. Third, we preregistered the study design, our outcome measures, the exclusion criteria for data cleaning and our proposed statistical analysis through the Open Science Framework, which can be found at <https://osf.io/xar84/> (Won, Shriram, & Tamir, 2017). (A complete copy of the preregistration can be found in Online Appendix F.) Our preregistered hypotheses were identical to those in Study 2, as follows: First, using a “warm” or “cold” script will manipulate social distance between participants in a computer-mediated chat such that the cold script will result in greater social distance. Second, as social distance increases, perceived physical distance from the conversational partner’s purported location will also increase. Finally, manipulating

social distance using a warm or cold script will manipulate perceived physical distance such that greater social distance will result in greater perceived spatial distance from the conversational partner’s purported location.

Method and Material

Conversation scripts were designed to engender social closeness or social distance, allowing us to test for the causal effect of social distance on estimates of spatial distance. After these interactions, participants again rated how socially and spatially distant they felt from their conversation partner.

Participants

Participants ($N = 86, 38$ male) were recruited from one college on the west coast and one college on the east coast. The study began as soon as preregistration was approved and ran through the end of the semester. Informed consent was obtained from all participants in a manner approved by the IRBs, and all participants were compensated in course credit. Our target sample size was 88 participants in each condition or the total number of students run during the spring quarter, whichever was reached first.

Data exclusion occurred according to the following preregistered criteria. Four participants who did not fully complete the survey, or entered values of zero for distance, were removed from the sample. The participants ($n = 17$) who did not correctly complete the manipulation check by stating which city their conversational partner was from were also removed. Twenty-nine participants were eliminated because they did not believe that they were really speaking to another student. In addition, three participants were eliminated for stating that they did not understand the units or geography involved. These

stringent elimination criteria left only 16 participants in the warm and 17 in the cold condition. However, it is important to note that the effect of condition on spatial distance remains statistically significant even when all of the 82 participants who provided a usable distance estimate for the cities were retained.

Procedure

The design of Study 3 was similar to that of Study 2, except that while participants were again told that researchers would be available online during the scheduled time, the researchers did not serve as confederates. Therefore, there was no contact between researchers and participants during the experiment unless a participant had a question (which happened only 4 of the 86 times).

The conversations in each condition were automated to follow very similar scripts to those in Study 2. The gender selected by each participant determined the name assigned to the bot (again, Kelley or Bryan) who was always described as located in Lawrence, KS, a location approximately equidistant from both colleges. In the warm conversation condition ($n = 16$, 6 males), confederates used smiling emoticons and attempted to respond to participants' comments promptly and pleasantly. In the cold conversation condition ($n = 17$, 10 males), confederates were curt, did not respond promptly to the participants' comments, used periods at the end of comments but no emoticons, and complained that the participants typed slowly. In both conditions, participants and their partners described two cities to each other. One city was that person's current place of residence, and the other city was assigned to them. The control city was always Des Moines, IA, for the participant and Denver, CO, for the confederate.

After participants completed the conversation, they completed the same online survey as in Study 2.

Measures

Social distance was assessed via the same 20-item questionnaire as in Study 1. These questions had an α of .96. Participants then provided estimates of physical distance from their own location to the two cities their partner discussed. Target city distance represented the distance to the target city, Lawrence, KS, where participants thought the confederate was located, and control city distance represented the distance to the nontarget city, Denver, CO. Again, both estimates were converted to percentages by dividing by the actual straight-line distance from each participant to each city and participants provided these estimates in a counterbalanced order.

Results

To assess whether the conditions successfully manipulated social distance, we first compared the effect of both conditions on social distance using t tests. As before, participants reported greater social distance to conversational partners in the cold conversation condition ($M = 3.69$, $SD = 0.60$) compared to the

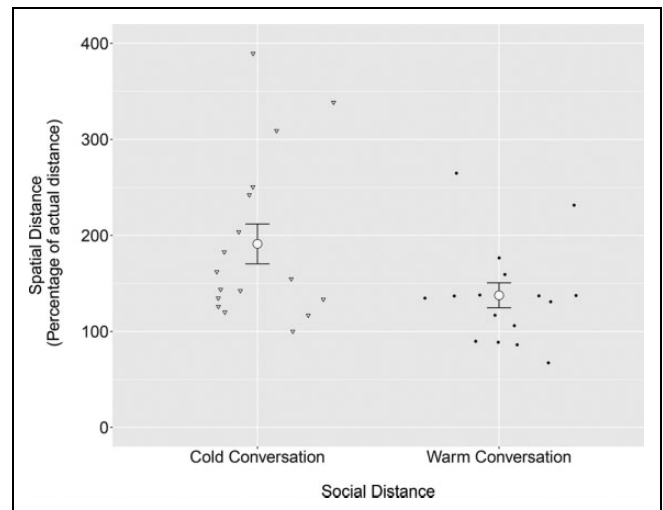


Figure 4. Scatterplot (with jitter to increase readability) spatial distance estimations across conditions in Study 3, along with means and standard errors by condition. Participants overestimate spatial distance most during cold conversations and least during warm conversations.

warm conversation condition ($M = 2.57$, $SD = 0.55$), $t(31.0) = 5.62$, 95% CI [1.08, 2.73], $d = 1.95$, $p < .001$. Thus, social distance increased when the conversation was cold, supporting Hypothesis 1.

Next, we tested Hypothesis 2 that inducing feelings of social distance would cause estimates of spatial distance to increase. Results of a t test comparing cold and warm conversation conditions supported Hypothesis 2, $t(26.6) = 2.18$, 95% CI [0.03, 1.44], $d = 0.75$, $p = .038$, such that participants in the cold conversation condition ($M = 1.91$, $SD = 0.86$), who had socially distant conversational partners, estimated their partners' city to be significantly further away than did participants in the warm conversation condition ($M = 1.38$, $SD = 0.52$; Figure 4). We note that this effect size found in Study 3 ($d = 0.75$) is similar to that found in Study 2 ($d = 0.78$).

Finally, supporting Hypothesis 3 and replicating the correlations in Studies 1 ($r = .38$) and 2 ($r = .27$), social distance correlated with target city spatial distance across both conditions ($r = .48$, $p = .004$, 95% CI [0.17, 0.71]; Figure 5a). We note that, unlike in Study 2, social distance was also significantly correlated with spatial distance for the control city ($r = .38$, $p = .030$, 95% CI [0.04, 0.64]; Figure 5b). Condition was not statistically significantly predictive of spatial distance for the control city, $t(28.6) = 0.78$, 95% CI [-0.43, 0.95], $d = 0.27$, $p = .440$, warm conversation condition ($M = 1.49$, $SD = 0.52$) and cold conversation condition ($M = 1.66$, $SD = 0.75$).

General Discussion

Phone calls and texts connect physically remote individuals. But while mediated communication bridges spatial distance, it does not guarantee that people will feel closer to one another. In three experiments, we find evidence that perceived spatial

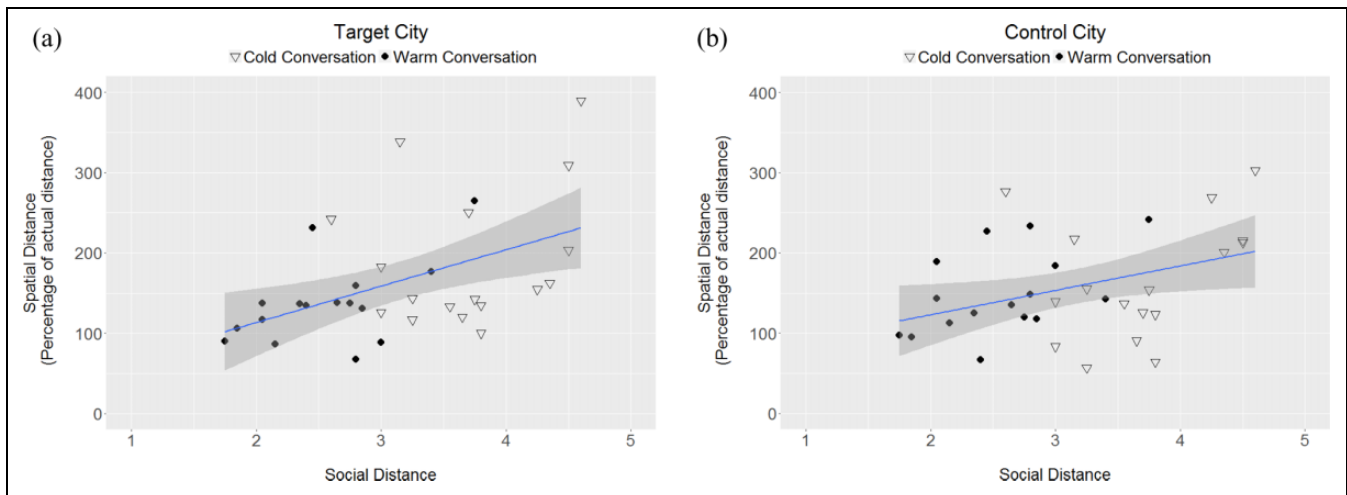


Figure 5. (a) Correlations from Study 3 between social distance and spatial distance to the target city in which the conversation partner was located. Estimated spatial distances to the target city increased as social distance increased. (b) Correlations from Study 3 between social distance and spatial distance to the control city, which was described as assigned to the conversation partner. In this study, social distance also correlated with estimated spatial distances to the control city.

distance correlates with social distance during a mediated interaction. Further, we find evidence that perceived spatial distance may depend on social distance such that when social distance increases or decreases, estimated spatial distance follows suit. Even during these brief text exchanges with a stranger, participants overestimated spatial distance after conversing with someone from whom they felt socially distant. These results suggest that the extent to which mediated interactions bridge physical distance will depend on the social warmth those interactions engender.

Previous work has found that perceived spatial proximity can determine how people will interact with a conversation partner. Here, we build on those findings to demonstrate that the reverse can also be true when people interact through media. In such interactions, people not only change the impression of their conversational partners, but they also use those impressions to inform their perceptions of the physical environment. These findings comport well with research on construal theory, which suggests that changes in estimates of distance in one dimension (e.g., social) should result in parallel changes in estimates of distance in any other dimension (e.g., spatial).

However, construal alone could not predict whether mediated communication will increase or decrease perceived distances between communicators, only that spatial and social distance will increase or decrease in parallel. Instead, we suggest that people will align their distance estimates with their social goals. Indeed, research on motivated cognition finds that such social factors can affect perception of distance (Gross & Profitt, 2013; Oishi, Schiller, & Gross, 2013). For example, people who have been rejected will underestimate the distance to social targets (Knowles, Green, & Weidel, 2013; Pitts, Wilson, & Hugenberg, 2014), suggesting that a desire to reduce social distance will translate into perceived physical closeness. In the current studies, we used cold conversation to similarly invoked feelings of social distance. However, here our

participants had no concomitant motivation to connect, and as such, our cold, distant conversation increased both social and spatial distance. This motivated cognition account of our findings raises the possibility that any negatively valenced conversation that concurrently evokes an approach orientation, for example, one defined by anger rather than rejection, might reduce rather than increase perceptions of distance (Balci et al., 2016; Xiao & Van Bavel, 2012).

In the studies described above, we find that social distance impacts estimates of spatial distance to the *specific* locations of conversational partners more than to the other control cities mentioned in the conversation. However, these studies have insufficient power to test whether these effects are indeed specific to the target’s location or whether they might impact spatial estimates more generally. In fact, in Study 3, social distance correlated with spatial distance to both the target city and the control city. While we note that the scripts in Studies 1 and 3 may have artificially inflated the association between the target and control cities, future research should directly examine the effects that social distance may have on spatial distances more broadly and avoid the anchoring effects of estimating distances sequentially.

The circumstances under which social distance is created also bear further investigation. We note that the positive relationship between social distance and spatial distance persisted even when the conversational partner was not “live,” for example, as in the warm transcript condition in Study 2. Our post hoc analysis of the more inclusive data set in Study 3 also shows the effect of condition persisting even when participants suspected that their conversational partner might not be a real person. These findings suggest an interesting potential for artificial social interactions to mimic the effects of actual social interactions. Future investigation should examine the role such artificial social relationships might play in spatial distance estimations and more. If even simple text-based interactions

can expand or shrink our perceptions of the world, more immersive media that can create very plausible artificial social actors—for example, virtual reality—may prove even more influential.

If our sense of social distance, as evoked through mediated communication, alters our mental model of our physical environment, this could help to explain why remote communication has proven so distracting. Lay critics of media may be right to point out that social communication through media makes us less “present” in the real world. If presence is a fixed resource, then feeling close to a distant location—because a person feels socially present with a distant partner—might also make that person feel far from her current location. This is particularly relevant since texting is a less formal medium. We are more likely to text with close associates and so may see the effects of decreased social distance on spatial distance on a daily basis. This expands the potential for prosocial interventions (Guillory, Hancock, Woodruff, & Keilman, 2015; Katz & Byrne, 2013). Future research should further investigate how feeling present with a remote other, or in a remote location, impacts our local presence.

Mediated communication is increasingly ubiquitous, allowing us to connect socially with people who are spatially remote. These mediated interactions do not just affect the social connections we are able to forge; they also affect our perceptions of the physical world, in ways that may counter our hopes for connection through media.

Authors' Note

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Declaration of Conflicting Interests

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Supplementary Material

The supplemental material is available in the online version of the article.

References

- Andrade, A. D. (2014). From physical co-location to perceived co-presence: “I feel close to you when I use my mobile.” *Pacific Asia Journal of the Association for Information Systems*, 6, 2.
- Balcetis, E. (2016). Approach and avoidance as organizing structures for motivated distance perception. *Emotion Review*, 8, 115–128.
- Bar-Anan, Y., Liberman, N., Trope, Y., & Algom, D. (2007). Automatic processing of psychological distance: Evidence from a Stroop task. *Journal of Experimental Psychology: General*, 136, 610–622.
- Bogardus, E. S. (1933). A social distance scale. *Sociology & Social Research*, 17, 265–271.
- Bradner, E., & Mark, G. (2002, November). Why distance matters: Effects on cooperation, persuasion and deception. In *Proceedings of the 2002 ACM conference on computer supported cooperative work* (pp. 226–235). New Orleans, LA: Association for Computing Machinery.
- Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences*, 11, 49–57.
- Carbon, C. C., & Leder, H. (2005). The wall inside the brain: Overestimation of distances crossing the former Iron Curtain. *Psychonomic Bulletin & Review*, 12, 746–750.
- Casasanto, D., & Boroditsky, L. (2008). Time in the mind: Using space to think about time. *Cognition*, 106, 579–593.
- Ekman, G., & Bratfish, O. (1965). Subjective distance and emotional involvement. A psychological mechanism. *Acta Psychologica*, 24, 430–437.
- Gross, E. B., & Proffitt, D. (2013). The economy of social resources and its influence on spatial perceptions. *Frontiers of Human Neuroscience*, 7. doi:10.3389/fnhum.2013.00772
- Guillory, J. E., Hancock, J. T., Woodruff, C., & Keilman, J. (2015). Text messaging reduces analgesic requirements during surgery. *Pain Medicine*, 16, 667–672.
- Henderson, M. D., Wakslak, C. J., Fujita, K., & Rohrbach, J. (2011). Construal level theory and spatial distance. *Social Psychology*, 42, 166–173.
- Katz, S. J., & Byrne, S. (2013). Construal level theory of mobile persuasion. *Media Psychology*, 16, 245–271.
- Kelley, H. H. (1950). The warm-cold variable in first impressions of persons. *Journal of Personality*, 18, 431–439.
- Knowles, M. L., Green, A., & Weidel, A. (2013). Social rejection biases estimates of interpersonal distance. *Social Psychological and Personality Science*. doi:10.1177/1948550613491972
- Lakens, D., & Stel, M. (2011). If they move in sync, they must feel in sync: Movement synchrony leads to attributions of rapport and entitativity. *Social Cognition*, 29, 1–14.
- Liberman, N., Trope, Y., & Stephan, E. (2007). Psychological distance. *Social Psychology: Handbook of Basic Principles*, 2, 353–383.
- Liviatan, I., Trope, Y., & Liberman, N. (2008). Interpersonal similarity as a social distance dimension: Implications for perception of others. *Journal of Experimental Social Psychology*, 44, 1256–1269.
- Miles, L. K., Christian, B. M., Masilamani, N., Volpi, L., & Macrae, C. N. (2014). Not so close encounters of the third kind: Visual perspective and imagined social interaction. *Social Psychological and Personality Science*, 5, 558–565.
- Miles, L. K., Karpinska, K., Lumsden, J., & Macrae, C. N. (2010). The meandering mind: Vection and mental time travel. *PLoS One*, 5, e10825.
- Newcomb, T. M. (1956). The prediction of interpersonal attraction. *American Psychologist*, 11, 575.
- Oh, H., Curley, S. P., & Subramani, M. R. (2008). The death of distance? The influence of computer mediated communication on

- perceptions of distance. In *ICIS 2008 proceedings—Twenty-ninth international conference on information systems, Paris, France* (p. 149).
- Oishi, S., Schiller, J., & Gross, E. B. (2013). Felt understanding and misunderstanding affect the perception of pain, slant, and distance. *Social Psychological and Personality Science, 4*, 259–266.
- Pitts, S., Wilson, J. P., & Hugenberg, K. (2014). When one is ostracized, others loom social rejection makes other people appear closer. *Social Psychological and Personality Science, 5*, 550–557.
- Pew Research Center. (2015). *Technology device ownership*. Retrieved from <http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015/>
- Soliman, T., Gibson, A., & Glenberg, A. M. (2013). Sensory motor mechanisms unify psychology: The embodiment of culture. *Frontiers in Psychology, 4*, 885.
- Spreng, R. N., Mar, R. A., & Kim, A. S. (2009). The common neural basis of autobiographical memory, prospection, navigation, theory of mind, and the default mode: A quantitative meta-analysis. *Journal of Cognitive Neuroscience, 21*, 489–510.
- Stephan, E., Liberman, N., & Trope, Y. (2010). Politeness and psychological distance: A construal level perspective. *Journal of Personality and Social Psychology, 98*, 268–280.
- Stephan, E., Liberman, N., & Trope, Y. (2011). The effects of time perspective and level of construal on social distance. *Journal of Experimental Social Psychology, 47*, 397–402.
- Tamir, D. I., & Mitchell, J. P. (2011). The default network distinguishes construals of proximal versus distal events. *Journal of Cognitive Neuroscience, 23*, 2945–2955.
- Tversky, B. (2011). Spatial thought, social thought. In T. W. Schubert & A. Maass (Eds.), *Spatial dimensions of social thought* (pp. 17–36). Berlin/Boston: Walter de Gruyter.
- Walther, J. B. (1996). Computer-mediated communication impersonal, interpersonal, and hyperpersonal interaction. *Communication Research, 23*, 3–43.
- Won, A. S., Shriram, K., & Tamir, D. (2017, February 25). *Distance*. Retrieved from osf.io/ye3wt
- Xiao, Y. J., & Van Bavel, J. J. (2012). See your friends close and your enemies closer social identity and identity threat shape the representation of physical distance. *Personality and Social Psychology Bulletin, 38*, 959–972.

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