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RESEARCH ARTICLE

Proximity bias: Interactive effect of spatial distance and outcome valence on probability judgments

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Abstract

Across a range of decision contexts, we provide evidence of a novel *proximity bias* in probability judgments, whereby spatial distance and outcome valence systematically interact in determining probability judgments. Six hypothetical and incentive-compatible experiments (combined $N = 4007$) show that a positive outcome is estimated as more likely to occur when near than distant, whereas a negative outcome is estimated as less likely to occur when near than distant (studies 1–6). The proximity bias is explained by wishful thinking and thus perceptions of outcome desirability (study 3), and it does not manifest when an outcome is less relevant for the self, such as the case of outcomes with little consequence for the self (studies 4 and 5) or when estimating outcomes for others who are irrelevant to the self (study 6). Overall, the proximity bias we document deepens our understanding of the antecedents of probability judgments.

KEYWORDS

bias, prediction, probability, spatial distance, wishful thinking

INTRODUCTION

Imagine a traveler who is on her way to an airport and has just been notified that her flight is canceled. To rebook the flight, she calls the airline customer service. While she waits to get connected to an agent, she gauges her chance of securing a seat on the next available flight so that she can decide to either cancel or reschedule her trip. Now suppose that our traveler learns that the agent who is helping her with rebooking is on the other side of the country, physically very far from where she is. Would this information—where the rebooking decision takes place—affect her prediction of successfully getting on the next flight? And would this prediction vary depending on whether she thinks about the positive consequences of successfully rebooking versus the negative consequences if the rebooking process fails?

In this research, we shed light on these questions by studying when and why one's probability estimates are biased by two seemingly unrelated factors: (1) the spatial distance between an estimator and where the focal outcome is decided and (2) the valence of the outcome—that is, whether the outcome is positive or negative for the estimator. Prior research suggests that spatial distance alone can impact consumers' probability judgment. People deem potential outcomes taking place in physically nearby locations to be more probable than those taking place in distant locations (Bar-Anan et al., 2006; Wakslak & Trope, 2009; Yan, 2014).

We build on these findings by proposing a novel framework that explains probability estimates based not only on outcome spatial distance, as addressed in prior research but also on the valence and therefore desirability of the outcome for the estimator—whether a focal outcome has a positive valence and therefore desirable consequences, or a negative valence and therefore undesirable consequences. We show that probability estimates are the result of a systematic interaction between spatial distance and outcome valence. If an outcome is positive and thus desirable, the estimator will predict the outcome to be more likely to happen if the location where the outcome is decided is spatially near versus distant, as shown in prior research. Conversely, if an outcome is negative and thus undesirable, the estimator will predict the outcome to be less likely to happen if the location where the outcome is decided is spatially near versus distant. We term this interactive effect the *proximity bias* and test it in six studies across various decision

contexts. Furthermore, we show that the proximity bias is a manifestation of wishful thinking—the extent to which an outcome has desirable or undesirable consequences relevant to the self. We test wishful thinking as an explanation for the proximity bias via both mediation and moderation. Indeed, perceived outcome desirability mediates the proximity bias, and the effect is eliminated for outcomes that are not relevant to the self, either because they are neutral in tone (i.e., they have little consequences for the self), or because they have consequences for irrelevant others but not for the self.

THEORETICAL FRAMEWORK

Wishful thinking and outcome desirability

Our predictions are based on research on wishful thinking—the notion that internal motivations (desires, wishes) prompt people to make optimistic predictions (Krizan & Windschitl, 2007, 2009; Roese & Olson, 2007; Taylor & Brown, 1988). To maintain a positive self-view, people consciously or even unconsciously amplify their virtues (i.e., self-enhancement) and minimize their shortcomings (i.e., self-protection; Alicke & Sedikides, 2009). As a consequence, and across a variety of outcomes and populations, people predict that they will be more likely than an average person to experience desirable outcomes and less likely than an average person to experience undesirable outcomes (Buehler et al., 1995; Perloff & Fetzer, 1986; Weinstein, 1980). For example, most people think they are more likely than others to have a happy marriage or get a good job offer (Neff & Geers, 2013; Shepperd et al., 2013; Weinstein, 1980), but less likely than others to be a crime victim or contract cancer (Chapin & Coleman, 2009; Shepperd et al., 2003; Weinstein & Klein, 1996).

Wishful thinking is distinct from, albeit similar to motivated reasoning. Both wishful thinking and motivated reasoning stem from people's motives to self-enhance or self-protect (Alicke & Sedikides, 2009). However, whereas motivated reasoning may apply to most judgments of one's current state, wishful thinking typically applies to predictions of future states (Krizan & Windschitl, 2007; Kunda, 1990; Sivanathan et al., 2008). For example, motivated reasoning would explain why an intern believes their performance is superior to those of other interns, whereas wishful thinking would explain why that intern inflates their chance of getting a full-time offer after the internship. Additionally, whereas motivated reasoning involves selectively processing confirming information to draw positive conclusions (Epley & Gilovich, 2016; Kunda, 1990), wishful thinking implicates lower degree of deliberation and awareness whereby people mindlessly expect favorable outcomes to occur (Balcetis & Dunning, 2010; Krizan & Windschitl, 2009). Going back to the prior example, motivated reasoning would imply that the intern would selectively seek out and put more weight on positive feedback to confirm that they are more competent than others. Wishful thinking would instead lead the intern to be optimistic about the prospect of getting the job offer even in the absence of any confirming information—so long as the future outcome (i.e., getting the job offer) seems desirable.

Why then does desirability of an outcome matter in the context of wishful thinking? The tendency to be overly optimistic about a potential outcome increases with its desirability (Budescu & Bruderman, 1995; Cohen & Wallsten, 1992; Krizan & Windschitl, 2007, 2009; Shepperd et al., 2002). To illustrate, Granberg and Brent (1983) examined National Election Study data for all US presidential races between 1950 and 1982 and reported a positive correlation between preference (i.e., how much a voter liked a candidate) and outcome predictions (i.e., how much the voter believed the candidate would win the election). The effect of outcome desirability on optimistic predictions has been also established in several laboratory experiments (e.g., Biner et al., 1998; Budescu & Bruderman, 1995; Lench & Ditto, 2008). For example, in a study conducted by Biner et al. (1998), participants could win a hamburger if they selected a winning card from a card deck. Outcome desirability was manipulated by inducing hunger, and hungry participants indicated a greater desire to win the hamburger. Outcome desirability resulted in optimistic predictions: hungry participants reported greater confidence in drawing the winning card.

Of course, it would be misleading to conclude that these predictions based on wishful thinking are unconstrained by objective evidence and solely determined by how much one desires certain outcomes to happen (Slovic et al., 2000). However, as long as the likelihood of future outcomes is somewhat open to interpretation, and such interpretation is plausible, outcome desirability plays a key role in probability judgments (Ditto et al., 1998; Krizan & Windschitl, 2007, 2009).

Outcome desirability and spatial distance

One potential factor that may influence a focal outcome's perceived desirability, and that is the focus of the present research, is the spatial distance between a person and the location of where that outcome occurs. Prior literature suggests that people are more likely to incorporate affect-relevant information for objects that are psychologically close than those that lie at a greater psychological distance (Williams et al., 2014; Williams & Bargh, 2008), as such information is construed in rich and vivid terms when psychologically proximal (Maglio, 2020). That is, people perceive positive outcomes more positively and negative outcomes more negatively when these outcomes take place somewhere near versus distant. To illustrate, in one of the studies

by Williams et al. (2014), participants were instructed to think about the best or worst possible outcomes from a psychologically proximal or distant perspective, and then rated these outcomes on their pleasantness. When thinking about the best possible outcomes (e.g., winning a lottery and falling in love), participants viewed these outcomes to be more pleasant when they were described from a proximal than a distant perspective. By contrast, the worst possible outcomes (e.g., getting murdered and going bankrupt) were seen as even less pleasant when described from a proximal perspective. This finding is consistent with research that investigated spatial distance and its impact on judgments, which suggests that spatial proximity to a desirable and comforting object (e.g., a shelter) amplifies its comforting characteristics, and spatial proximity to an undesirable and repulsive object (e.g., a disgusting sight) amplifies its threatening aspects (Hemenover & Schimmack, 2007; McGraw et al., 2012; McGraw & Warren, 2010).

The current research: Proximity bias

Building on these findings, we propose that when people make a prediction about an outcome that will be decided on somewhere physically close, they will be more likely to rely on its affective characteristics, which are the potential positive or negative consequences for the self of that outcome. As these consequences feel more apparent to people, they will perceive desirable outcomes as even more desirable when they occur nearby, and undesirable outcomes as even more undesirable when they occur nearby. It then follows that people should make more optimistic predictions for desirable outcomes that are decided in a location that is close versus far, resulting in greater probability estimates for positive, desirable outcomes, and lower probability estimates for negative, undesirable outcomes. In other words, positive, near outcomes should be predicted as more likely to happen than positive, distant outcomes, whereas negative, near outcomes should be predicted as less likely to happen than negative, distant outcomes. Accordingly, we hypothesize that the valence of an outcome will moderate the relationship between spatial distance and probability judgment. We refer to this interaction as the proximity bias. Stated formally:

> H1: Outcome valence and spatial distance interactively affect probability estimates.

As discussed previously, we suggest that the proximity bias is a manifestation of wishful thinking and thus driven by the perceived desirability of an outcome. Spatial distance should amplify the desirability or undesirability of an outcome, such that a positive outcome is seen more positively, and a negative outcome is seen more negatively when it occurs someplace close versus distant. This heightened desirability for positive outcomes, or heightened undesirability for negative outcomes, should in turn increase people's tendency to make optimistic predictions for outcomes occurring at proximal locations. In other words, we hypothesize that people's tendency to make optimistic predictions is driven by the (un)desirability of a focal outcome. Stated formally:

> H2: Perceived outcome (un)desirability mediates the proximity bias.

Moderation by outcome relevance to the self: outcome neutrality and outcome target

A theoretical implication of our wishful thinking account is that variables that affect the relevance of the outcome to the self should moderate the proximity bias. Accordingly, we identify two factors related to relevance to the self that should attenuate the proximity bias. One factor is the neutrality of the focal outcome, since outcomes that are neutral have less relevance to the self, and the second factor is who the outcome affects, as outcomes that only have relevance to others should be irrelevant to the self, as we elaborate below.

First, we expect the proximity bias to not manifest for outcomes that have less relevance to the self because they are neutral in terms of the desirability of their consequences for the self (i.e., mildly positive or mildly negative). When outcomes are neutral, the positive or negative consequences for the self—even when amplified by spatial proximity—are too low to trigger wishful thinking and lead people to make optimistic predictions. Stated formally:

> H3: The proximity bias is attenuated for neutral (i.e., mildly positive or mildly negative) outcomes.

Second, we expect the proximity bias to not manifest for outcomes, be they positive or negative, that only affect irrelevant others but do not have any consequences for the self—that is, they are self-irrelevant. Though these irrelevant outcomes may be positive or negative, their implications are not necessarily seen as desirable or undesirable to the self (Eiser et al., 2001). For instance, if an irrelevant other gets a job offer, then even though getting a job offer is in itself desirable, it has no relevance to the self. Thus, the absence of self-relevant implications should not trigger wishful thinking, and thus, the proximity bias should be less likely to emerge. Stated formally:

> H4: The proximity bias is attenuated for outcomes occurring to irrelevant others.

One final consideration warrants mention. These hypotheses differ from prior findings showing the role of egocentrism on predictions—that psychological distance matters only when an individual estimates these distances from their own perspective but not from that of others (Yan, 2014). Our predictions do not necessarily imply egocentrism for the proximity bias to emerge. In fact, we expect the proximity bias to occur even when a person estimates the likelihood of an outcome happening to other people *as long as* the outcome is self-relevant in that it has positive/desirable or negative/undesirable consequences for the self. For example, a job offer to somebody other than the self can still be relevant to an individual if that offer is given to a competing candidate. In such a case, a competitor getting a job offer may seem *undesirable* to that individual, especially when the job is highly sought-after. However, if someone else gets an offer for a job that one did not apply for, then that outcome—a random individual getting a job offer—would seem neither desirable nor undesirable to them as the outcome does not yield positive or negative consequences for the self.

OVERVIEW OF THE STUDIES

We tested the predicted proximity bias—the interactive effect of spatial distance and outcome valence on probability estimates—in a set of six studies. In all studies, we described a positive or negative outcome that had not yet occurred and manipulated spatial distance by varying the distance between the person who was making the probability estimate (a participant) and the location where the outcome was to be decided.

Studies 1 and 2 tested H1 and provided evidence of the proximity bias across various decision contexts. Study 3 tested H2 and the proposed underlying account based on wishful thinking in an incentive-compatible setting using mediation analysis. Studies 4–6 provided evidence of an explanation based on wishful thinking via moderation. Specifically, these studies tested H3 and H4 and showed that the proximity bias does not manifest for outcomes that are irrelevant for the self: when an outcome is neutral (study 4–5) or happening to an irrelevant other (study 6). Table 1 summarizes our six studies and their main findings.

For all the studies, we determined the sample size to be at least 100 participants per cell, following a rule of thumb employed in recent research (Cadario et al., 2021). We relaxed this criterion only when participant availability was limited (an undergraduate subject pool in study 1). We report all conditions, manipulations, data exclusions and critical measures related to our hypothesis testing. We report the experimental stimuli for all studies in the Methodological Detail Appendix (MDA).

STUDIES 1–2: EVIDENCE FOR THE PROXIMITY BIAS

The goal of studies 1 and 2 was to provide evidence for the proximity bias in different decision contexts.

Study 1: Rebooking a flight ticket

Method

Three hundred and forty undergraduate students (M_{age} = 19.67, SD_{age} = 1.11; 51.2% female) from a US university completed this study in exchange for course credit. The study employed a 2 (spatial distance: near vs. distant) × 2 (outcome valence: positive vs. negative) between-subjects design.

Participants imagined they were traveling to Iceland and were at the nearest airport (i.e., at Boston's Logan International Airport) when they were told that their flight was canceled, and they would have to see an airline attendant at the counter to book an alternative flight. Participants in the positive condition then read that, as they waited for their turn to meet the attendant, they thought about the desirable aspects of making it to Iceland in a timely manner. These aspects included staying at a five-star hotel and taking a private tour to the Blue Lagoon. In the negative condition, participants thought about the undesirable aspects of not making it to Iceland in a timely manner, including the cancelation fees they would have to pay for the hotel and missing the private tour. We provided different sets of information to participants in the two valence conditions to ensure that they would perceive the implications of the imagined outcomes—making it or not making it to Iceland on time—to be either only positive or only negative.

All participants further read that when their turn arrived, the attendant had to contact another agent to check whether they could be on the next available flight. We manipulated spatial distance by telling participants that the agent in charge of rebooking the flight was based in Boston, close to where they also were, or in Los Angeles, far away from where they were.

To measure our key dependent variable, we had participants estimate the likelihood of getting a seat (positive condition) or failing to get a seat (negative condition) on the next flight on a seven-point scale (1 = *not at all likely*, 7 = *very likely*). Note that the wording of the dependent variable was different across the outcome valence conditions. We did this for two reasons. First, we wanted to keep the information consistent with what participants in each valence condition had read. Second and relatedly, the different wording served to reinforce the valence manipulation and ensure that participants focused only on the desirable or undesirable aspects of the stated outcomes. The use of different wordings could

TABLE 1 Summary of all studies and main findings

Studies 1–3: Evidence of a proximity bias across consumer contexts

Study 1: Flight ticket ($N = 340$; laboratory)

	Near/Positive (rebooking the flight)	Distant/Positive (rebooking the flight)	Near/Negative (failing to rebook the flight)	Distant/Negative (failing to rebook the flight)
Probability estimate (*1 = Not at all likely, 7 = Very likely*)	4.75 (1.42)	4.15 (1.31)	3.73 (1.56)	4.34 (1.37)

Main findings: Consumers estimated a positive outcome to be more likely if near than distant, and a negative outcome to be less likely if near than distant.

Study 2: Online certificate program ($N = 434$; Amazon Mechanical Turk)

	Near/Positive (passing a course)	Distant/Positive (passing a course)	Near/Negative (failing a course)	Distant/Negative (failing a course)
Probability estimate (*1 = Not at all likely, 7 = Very likely*)	5.12 (1.39)	4.43 (1.46)	4.14 (1.53)	4.65 (1.47)

Main findings: Replicates the proximity bias in a different consumer context.

Study 3: Proximity bias in an incentive-compatible context

Study 3: Money offer in a Dictator Game ($N = 761$; Amazon Mechanical Turk)

	Near/Positive (a fair or generous offer)	Distant/Positive (a fair or generous offer)	Near/Negative (an unfair offer)	Distant/Negative (an unfair offer)
Probability estimate (*1 = Not at all likely, 7 = Very likely*)	3.90 (1.85)	3.29 (1.78)	4.50 (1.64)	5.19 (1.54)

Main findings: Replicates the proximity bias in an incentive-compatible setting and tests the mediation by perceived outcome (un) desirability.

Studies 4–6: Boundary conditions and testing of wishful thinking as process

Study 4: Disease contraction ($N = 624$; Amazon Mechanical Turk)

	Near/Mildly Undesirable (mild infection)	Distant/Mildly Undesirable (mild infection)	Near/Highly Undesirable (severe infection)	Distant/Highly Undesirable (severe infection)
Probability estimate (*0%–100%*)	46.35% (25.18)	45.91% (23.41)	37.79% (24.72)	45.12% (25.63)

Main findings: Tests the proposed account by manipulating an outcome's undesirability: the proximity bias is stronger the more an outcome is undesirable.

Study 5: Online dating ($N = 409$; laboratory)

	Near/Highly Desirable (highly attractive date)	Distant/Highly Desirable (highly attractive date)	Near/Mildly Desirable (mod. attractive date)	Distant/Mildly Desirable (mod. attractive date)
Probability estimate (*0%–100%*)	58.69% (22.43)	50.98% (23.87)	48.97% (26.45)	46.42% (25.16)

Main findings: Tests proposed account by manipulating an outcome's desirability: the proximity bias is stronger the more an outcome is desirable.

Study 6: Job interview ($N = 1441$; Amazon Mechanical Turk)

	Self (self-getting or not getting a job offer)		Relevant Other (a competitor getting or not getting a job offer)		Irrelevant Other (a stranger getting or not getting a job offer)	
Probability estimate (*1 = Not at all likely, 7 = Very likely*)	Near/Positive	Distant/Positive	Near/Positive	Distant/Positive	Near/Positive	Distant/Positive
	4.87 (1.21)	3.99 (1.47)	4.02 (0.89)	4.5 (0.92)	4.42 (1.23)	4.28 (1.19)
	Near/Negative	Distant/Negative	Near/Negative	Distant/Negative	Near/Negative	Distant/Negative
	3.92 (1.35)	4.66 (1.15)	4.32 (0.97)	4.00 (0.87)	3.99 (1.15)	4.21 (1.31)

Main findings: Tests the proposed account by manipulating outcome target: the proximity bias emerges for relevant outcomes happening to the self, reverses for relevant outcomes happening to competing others, and attenuates for irrelevant outcomes happening to others.

in and of itself lead to a main effect of outcome valence on probability estimates. However, this is not a key concern given that our interest is not on this main effect but rather on the interaction between outcome valence and spatial distance (H1). Indeed, the results of study 5 showed that the results replicate when using the same wording in all conditions.

As a manipulation check of spatial distance, participants indicated if the event described in the scenario occurred someplace that was near or far from them (1 = *very far from you*, 7 = *very close to you*). Following these measures, we embedded an attention check question requiring participants to check a certain number on a scale (Oppenheimer et al., 2009). We employed this same attention check in all subsequent studies.

Results and discussion

We excluded 50 participants (14.7%) who failed to pass the attention check, leaving a final sample of 290 participants (no difference across conditions, $\chi^2(3, N = 340) = 1.22$, $p = 0.75$).

Manipulation check[1]

A two-way ANOVA on perceived proximity revealed a main effect of proximity ($F(1, 286) = 38.59$, $p < 0.001$, $\eta_p^2 = 0.12$). Participants in the near condition perceived the focal decision as physically closer ($M = 5.36$, SD = 1.79) than participants in the distant condition ($M = 4.00$, SD = 1.92). No other significant effects emerged (main effect of valence: $F(1, 286) = 1.73$, $p = 0.19$, $\eta_p^2 < 0.01$; valence × spatial distance interaction: $F(1, 286) = 0.72$, $p = 0.40$, $\eta_p^2 < 0.01$).

Probability estimates

A two-way ANOVA on the dependent variable, probability estimates revealed a significant main effect of outcome valence ($F(1, 286) = 6.16$, $p = 0.014$, $\eta_p^2 = 0.02$) qualified by a significant two-way interaction between spatial distance and valence ($F(1, 286) = 13.00$, $p < 0.001$, $\eta_p^2 = 0.04$). As predicted, planned contrasts revealed that participants estimated that successfully getting on the next flight was more likely if the rebooking decision took place somewhere that was nearby than far away ($M_{near} = 4.75$, $SD_{near} = 1.42$ vs. $M_{distant} = 4.15$, $SD_{distant} = 1.31$; $F(1, 286) = 6.53$, $p = 0.011$, $\eta_p^2 = 0.02$). By contrast, participants estimated that failing to get on the next flight was less likely if the rebooking took place nearby than far away ($M_{near} = 3.73$, $SD_{near} = 1.56$ vs. $M_{distant} = 4.34$, $SD_{distant} = 1.37$; $F(1, 286) = 6.47$, $p = 0.011$, $\eta_p^2 = 0.02$; see Figure 1).

Thus, the results of study 1 supported H1 and provided initial evidence of the predicted proximity bias: participants estimated a positive outcome to be more likely if near than distant, and a negative outcome to be less likely if near than distant.

Study 2: Passing an exam

Method

Four hundred and thirty-four respondents ($M_{age} = 36.44$, $SD_{age} = 11.55$; 43.1% female) recruited from the states of California and New York through Amazon Mechanical Turk participated in this study in exchange for monetary compensation. This study employed a 2 (spatial distance: near vs. distant) × 2 (outcome valence: positive vs. negative) × 2 (participant location: California vs. New York) between-subjects design.

Participants imagined that they were enrolled in an online business analytics certificate program accredited by a private university in the United States. Participants from California read that the university was located either in the same state of California (near condition) or in the faraway state of New York (distant condition). Participants from New York read the reverse: the university was in New York in the near condition and in California in the distant condition. Participants further read that they were one course short of receiving the certificate and they were currently enrolled in a course called Data Visualization, and that to pass this course and receive the certificate, they would have to get an A- or higher on the final examination. In the positive condition, participants read that if they passed the course, they would earn the certificate, which in turn would significantly raise their chance of getting a more stable, higher-paying job. In the negative condition, participants read that if they did not pass the course and got a grade lower than A-, they would not receive the certificate and would have to pay additional tuition to register for another class next term, which would also cost them another semester. Participants read that the instructor based in either California or New York had started grading their final examination. A post-test reported in the MDA confirmed that participants in the near condition perceived the instructor grading the examination to be physically closer to them than did participants in the distant condition. The key dependent variable was participants' estimate of the likelihood of passing the course and thus getting the certificate (positive condition) or not passing the course and thus not getting the certificate (negative condition) on the final examination (1 = *not at all likely*, 7 = *very likely*).

Results and discussion

We excluded 38 (8.8%) participants because their latitude and longitude indicated that they were actually neither in California nor in New York, and 32 participants (7.3%) as they did not pass the attention check. After these exclusions, we had a final sample of 364 participants (no difference across conditions, $\chi^2(7, N = 434) = 8.93$, $p = 0.26$).

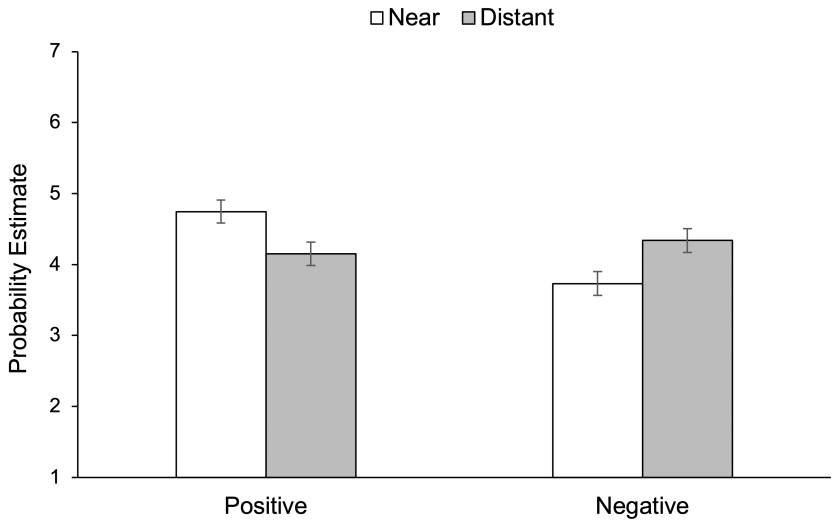

FIGURE 1 Results of Study 1. Mean probability estimates of an outcome as a function of spatial distance, presented separately for a positive outcome (getting a seat on the next flight) and a negative outcome (not getting a seat on the next flight).

A three-way ANOVA on the dependent variable, probability estimates, revealed no significant effect of participant location ($F(1, 356) = 0.82$, $p = 0.37$, $\eta_p^2 < 0.01$) and no two-way or three-way interaction with participant location (spatial distance × location interaction: $F(1, 356) = 0.77$, $p = 0.38$, $\eta_p^2 < 0.01$; valence × location interaction: $F(1, 356) = 0.98$, $p = 0.324$, $\eta_p^2 < 0.01$; three-way interaction: $F(1, 356) = 0.46$, $p = 0.50$, $\eta_p^2 < 0.01$). The main effect of valence was significant ($F(1, 356) = 61.15$, $p = 0.014$, $\eta_p^2 = 0.02$), indicating that participants predicted they were more likely to pass the course ($M = 4.78$, SD = 1.46) than to fail it ($M = 4.40$, SD = 1.55). More importantly, this main effect was qualified by a significant outcome valence × spatial distance interaction ($F(1, 356) = 14.97$, $p < 0.001$, $\eta_p^2 = 0.04$). As predicted, planned contrasts indicated that participants estimated that they would be more likely to pass the course if the instructor was near than distant ($M_{near} = 5.12$, $SD_{near} = 1.39$ vs. $M_{distant} = 4.43$, $SD_{distant} = 1.46$; $F(1, 356) = 9.66$, $p = 0.002$, $\eta_p^2 = 0.03$), and less likely to fail the course if the instructor was near than distant ($M_{near} = 4.14$, $SD_{near} = 1.53$ vs. $M_{distant} = 4.65$, $SD_{distant} = 1.47$; $F(1, 356) = 5.59$, $p = 0.019$, $\eta_p^2 = 0.02$; see Figure 2).

Study 2 replicated the results of study 1 in a different context and provided further evidence for the proximity bias. The next study sought to test the proposed explanation based on wishful thinking via mediation.

STUDY 3: MEDIATION VIA OUTCOME (UN)DESIRABILITY

The goal of study 3 was twofold. First, we sought to provide evidence that the proximity bias is a manifestation of wishful thinking. We expected the proximity bias to be more pronounced with greater spatial distance between a person and where an outcome is expected to occur, an effect driven by greater perceptions of desirability in case of a positive outcome, and greater perceptions of undesirability in case of a negative outcome. To test this model, we manipulated (i) the valence of a focal outcome (receiving a favorable vs. unfavorable money allocation), (ii) the spatial distance between participants and where the focal outcome is decided, and we then measured perceptions of the desirability of the outcome. Second, this study tested the proximity bias in an incentive-compatible paradigm.

Method

Study 3 employed a 2 (spatial distance: near vs. distant) × 2 (outcome valence: positive vs. negative) × 2 (participant location: California vs. New York) between-subjects design. Seven hundred and sixty-one respondents ($M_{age} = 38.39$, $SD_{age} = 12.09$; 53.7% female) recruited from the states of California and New York through Amazon Mechanical Turk participated in the study in exchange for monetary compensation.

Participants first indicated their age, gender, and the state in which they lived at the time (California or New York). We informed participants that they would be playing a modified version of the Dictator Game (Forsythe et al., 1994) with another study participant located elsewhere in the United States and whose identity would not be revealed except for their location. Participants learned that each player was granted a bonus of $1.00, which across players totaled $2.00, and that each player would be randomly assigned to one of two roles: Dictator or Recipient. The Dictator would decide how to split the $2.00 bonus with the Recipient and could choose one of the following three outcomes: (i) evenly split the bonus compensation, (ii) allocate more money to the Dictator and less to the Recipient, or (iii) allocate less money to the Dictator and

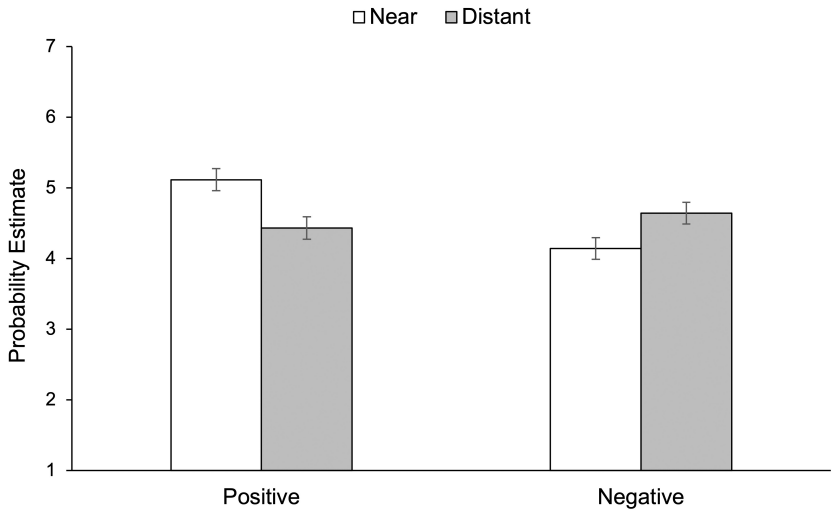

FIGURE 2 Results of Study 2. Mean probability estimates of an outcome as a function of spatial distance, presented separately for a positive outcome (passing the course) and a negative outcome (failing the course).

more to the Recipient. To reinforce the valence manipulation, participants indicated which would be the most positive or negative outcome of the three to the Recipient. In the positive condition, participants could proceed to the study after they had correctly reported the third option as the answer, whereas in the negative condition, participants could proceed only after they indicated the second option as the answer. If they reported incorrect answers, participants were instructed to carefully read the passage again and select a different option.

To ensure that participants believed that they were playing the game against a real opponent, we made the game more interactive as follows. We first asked participants to indicate the role they preferred to take and informed them that the opponent also preferred to take the same role as they did. We then told participants that the role would be randomly assigned by a virtual coin toss and had them choose between heads and tails. After participants made the decision, they saw a GIF (an animated image) of a coin toss. We preprogrammed the GIF to show the results that would assign all participants to the Recipient role. After the roles were assigned, participants read that the Dictator was making the decision right at that moment and saw an image of a map that included both the Recipient's and the Dictator's locations. Participants from California were informed that the opponent was located either in the same state of California (near condition) or in the far away state of New York (distant condition). Participants from New York saw the reverse; the opponent was in New York in the near condition and in California in the distant condition. As confirmed by a post-test reported in the MDA, participants in the near (vs. distant) condition perceived the opponent making the allocation decision to be physically closer to them.

As the key dependent variable, participants in the positive condition estimated the likelihood of receiving a fair or generous allocation (i.e., \$1.00 or more) and in the negative condition an unfair allocation (i.e., less than \$1.00) from the Dictator (1 = *not at all likely*, 7 = *very likely*). To measure the proposed mediator, perceived outcome desirability, we had participants indicate how desirable they found the respective outcome to be on a 7-point scale (1 = *extremely undesirable*, 7 = *extremely desirable*). We then told participants that the Dictator had assigned a fair allocation (i.e., \$1.00). At the end of the study, we debriefed participants about the research hypotheses and rewarded them with a bonus compensation of \$1.00.

Results and discussion

We excluded 68 (8.9%) participants because their latitude and longitude indicated that they were actually neither in California nor New York, and 44 participants (5.7%) as they did not pass the attention check. After these exclusions, we had a final sample of 649 participants (no difference across conditions, $\chi^2(7, N = 761) = 7.14$, $p = 0.42$).

Probability estimates

A three-way ANOVA on the dependent variable probability estimates revealed no significant effect of participant location ($F(1, 641) = 1.36$, $p = 0.25$, $\eta_p^2 < 0.01$) and no two-way or three-way interaction with participant location (spatial distance × location interaction: $F(1, 641) = 0.48$, $p = 0.49$, $\eta_p^2 < 0.01$; valence × location interaction: $F(1, 641) = 1.23$, $p = 0.27$, $\eta_p^2 < 0.01$; three-way interaction: $F(1, 641) = 1.13$, $p = 0.29$, $\eta_p^2 < 0.01$). The main effect of valence was significant ($F(1, 641) = 86.72$, $p < 0.001$, $\eta_p^2 = 0.12$). Overall, participants predicted that the opponent would be more likely to allocate an unfair amount of the bonus money (i.e., less than \$1.00; $M = 4.84$, SD = 1.60) than

a fair or generous amount (i.e., $1.00 or more; $1.00; M = 3.61, SD = 1.84). More importantly, this main effect was qualified by a significant valence × spatial distance interaction (F(1, 641) = 23.83, p < 0.001, η_p^2 = 0.04). As predicted, planned contrasts indicated that participants estimated that the likelihood of receiving a fair or generous allocation would be higher when the opponent was physically close to (vs. far from) them (M_{near} = 3.90, SD_{near} = 1.85 vs. $M_{distant}$ = 3.29, $SD_{distant}$ = 1.78; F(1, 641) = 10.88, p = 0.001, η_p^2 = 0.02). Conversely, participants predicted that the likelihood of receiving an unfair allocation would be lower when the opponent was nearby than distant (M_{near} = 4.50, SD_{near} = 1.64 vs. $M_{distant}$ = 5.19, $SD_{distant}$ = 1.54; F(1, 641) = 12.38, p < 0.001, η_p^2 = 0.02; see Figure 3).

Mediation via outcome desirability

As stated in H2, we also expected the proximity bias to be driven by the degree of desirability of a positive outcome, or undesirability of a negative outcome, which should be greater the more an outcome occurs spatially close to the estimator. To test the full model depicted in Figure 4, we conducted a bootstrapping analysis for moderated mediation (PROCESS model 8; Hayes, 2017) by including probability estimates as the dependent variable, and outcome valence as the moderator between the independent variable (spatial distance) and the mediator (perceived outcome desirability). We used model 8 as it tests both whether the moderation effect is mediated and whether the mediation processes are moderated (Ilyuk & Block, 2016; Lisjak & Lee, 2014; Preacher et al., 2007; Samper & Schwartz, 2013).

We found a main effect of valence on desirability: not surprisingly, participants found the positive outcome to be more desirable than the negative outcome ($M_{positive}$ = 5.58, $SD_{positive}$ = 1.23 vs. $M_{negative}$ = 2.31, $SD_{negative}$ = 1.33; B = 1.62, SE = 0.05, t = 32.91, p < 0.001, 95% CI [1.53, 1.73]). This main effect was qualified by a significant valence × spatial distance interaction (B = −0.23, SE = 0.05, t = −4.71, p < 0.001, 95% CI [−0.33, −0.14]). Participants found the positive outcome to be more desirable when it was taking place somewhere nearby than distant (M_{near} = 5.74, SD_{near} = 1.20 vs. $M_{distant}$ = 5.41, $SD_{distant}$ = 1.34; B = −0.16, SE = 0.06, t = −2.34, p = 0.02, 95% CI [−0.30, −0.03]), and the negative outcome to be more undesirable when it was nearby than distant (M_{near} = 2.01, SD_{near} = 1.18 vs. $M_{distant}$ = 2.62, $SD_{distant}$ = 1.39; B = 0.30, SE = 0.07, t = 4.31, p < 0.001, 95% CI [0.16, 0.44]). More importantly, the index of moderated mediation was significant (B = −0.29, SE = 0.07, 95% CI [−0.42, −0.16]). The conditional indirect effect of spatial distance on the probability estimate via lessened desirability (or enhanced undesirability) was significant for the negative outcome (B = 0.19, SE = 0.05, 95% CI [0.09, 0.28]). For the positive outcome, this indirect effect was directionally reversed (B = −0.10, SE = 0.04, 95% CI [−0.19, −0.02]). The results of the mediation analysis did not change even when we controlled for participant location—California versus New York—as a covariate (see MDA for full analysis).

The results of study 3 provided further evidence for the predicted proximity bias, which was robust to probability estimates made under incentive compatibility. More importantly and corroborating the role of wishful thinking, perceived outcome (un)desirability mediated the interactive effect of spatial distance and valence on the subjective likelihood of outcomes.

STUDIES 4 AND 5: MODERATION BY OUTCOME (UN)DESIRABILITY

The goal of studies 4 and 5 was to test our wishful thinking account by directly manipulating the relevance of the

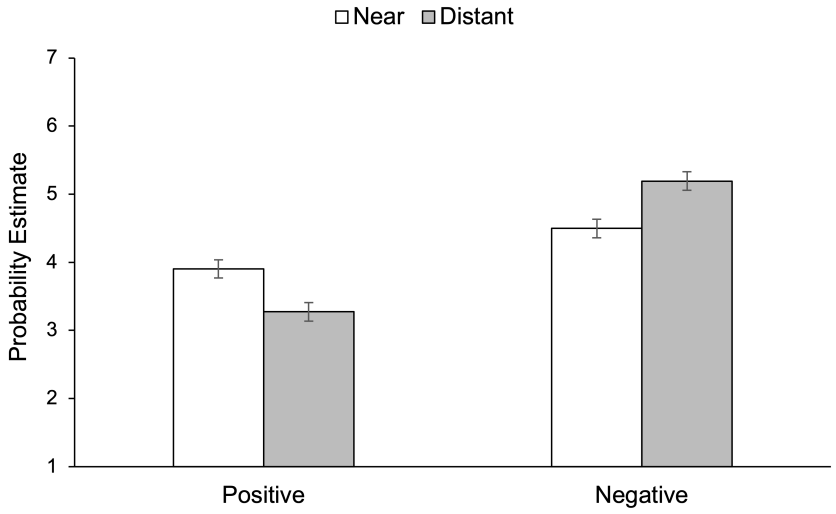

FIGURE 3 Results of Study 3. Mean probability estimates of an outcome as a function of spatial distance, presented separately for a positive outcome (receiving fair/generous allocation) and a negative outcome (receiving an unfair allocation).

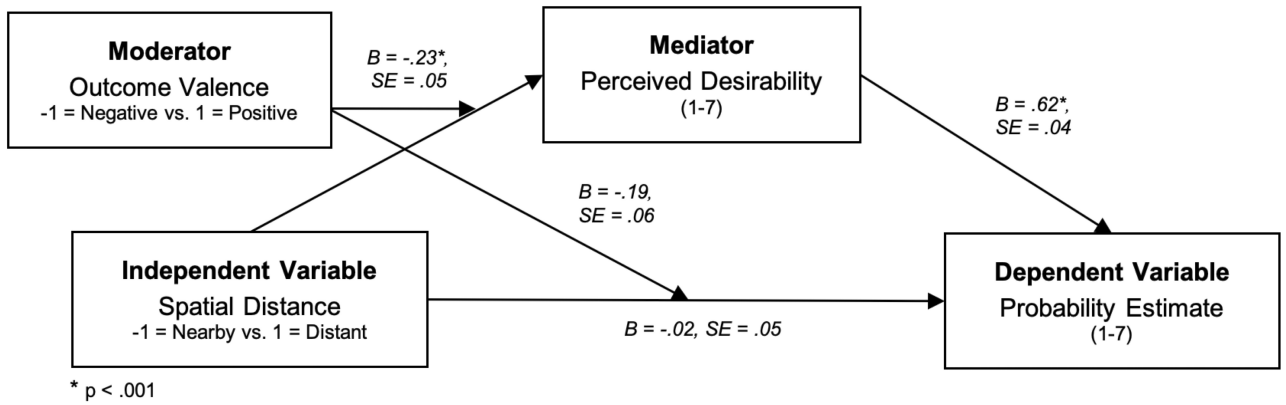

FIGURE 4 Moderated Mediation Model in Study 3

outcome to the self-based on the intensity of the undesirability (study 4) and desirability (study 5) of an outcome. As stated in H3, we reasoned that if the proximity bias is indeed due to wishful thinking, the bias should emerge more strongly for outcomes that are more intensely undesirable than for outcomes that are less intensely undesirable (i.e., neutral) in terms of implications for the self. Similarly, the proximity bias should emerge more strongly for outcomes that are more intensely desirable than for outcomes that are less intensely desirable (i.e., neutral) in terms of implications for the self. We tested these hypotheses in studies 4 and 5.

Study 4: Mildly versus highly undesirable outcome

Method

Six hundred and twenty-four respondents (M_{age} = 36.4, SD_{age} = 12.1; 49.7% female) from Amazon Mechanical Turk participated in exchange for monetary compensation. This study employed a 2 (spatial distance: near vs. distant) × 2 (outcome undesirability: mildly undesirable vs. highly undesirable) between-subjects design.

Participants read a scenario describing either a mildly undesirable or a highly undesirable outcome. Specifically, participants read that the lid of the jar of tomatoes they used to cook a meal had suspicious black sediments on it, and that they were experiencing symptoms that could indicate either a mild bacterial infection that would naturally wash out of their system (mildly undesirable condition) or a severe bacterial infection that would not (highly undesirable condition). Participants then read that to assess whether they had contracted the infection or not, they had taken a blood test. The sample had been sent to a medical center that was either 2 miles away from where participants lived (near condition) or 200 miles away (distant condition). A post-test reported in the MDA confirmed that participants in the near condition perceived the center where the testing was conducted to be physically closer to them than did participants in the distant condition.

As the key dependent variable, participants in the mildly undesirable condition estimated the likelihood of having contracted the mild bacterial infection and participants in the highly undesirable condition estimated the likelihood of having contracted the severe bacterial infection using slider scales ranging from 0% to 100%.

Results and discussion

We excluded 17 participants (2.7%) who failed the attention check (no difference across conditions, $\chi^2(3, N = 624) = 3.46$, $p = 0.33$), resulting in a final sample consisted of 607 participants.

A two-way ANOVA on probability estimates revealed a significant main effect of outcome undesirability: participants estimated that they would be less likely to contract a severe bacterial infection ($M = 41.68$, SD = 25.44) than a mild one ($M = 46.16$, SD = 24.29; $F(1, 603) = 4.84$, $p = 0.028$, $\eta_p^2 = 0.01$). More importantly, this main effect was qualified by a significant spatial distance × undesirability interaction ($F(1, 603) = 4.24$, $p = 0.040$, $\eta_p^2 = 0.01$). Replicating prior results, participants predicted that they would be less likely to contract a severe bacterial infection when the blood results were analyzed at a nearby medical center compared with a distant one ($M_{near} = 37.79$, $SD_{near} = 24.72$ vs. $M_{distant} = 45.12$, $SD_{distant} = 25.63$; $F(1, 603) = 7.66$, $p = 0.006$, $\eta_p^2 = 0.01$). Supporting H3, this proximity bias did not manifest when participants estimated their chance of having contracted a mild bacterial infection ($M_{near} = 46.35$, $SD_{near} = 25.18$ vs. $M_{distant} = 45.91$, $SD_{distant} = 23.41$; $F(1, 603) = 0.02$, $p = 0.88$, $\eta_p^2 < 0.01$; see Figure 5).

Thus, the results of study 4 supported H3 and indicated that the proximity bias did not manifest for an outcome that was mildly undesirable in terms of its consequences for the self. The next study manipulated the intensity of desirability (rather than undesirability) of an outcome.

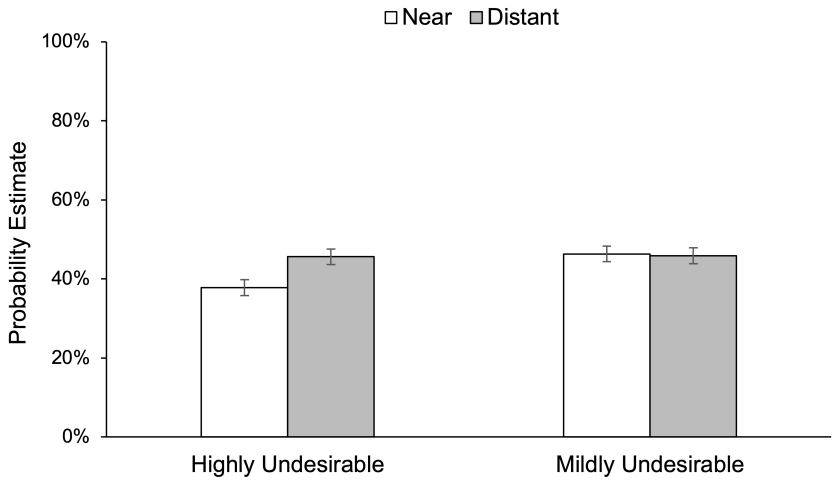

FIGURE 5 Results of Study 4. Mean probability estimates of an outcome as a function of spatial distance, presented separately for a highly undesirable outcome (contracting a severe disease) and a midly undesirable outcome (contracting a mild disease).

STUDY 5: MILDLY VERSUS HIGHLY DESIRABLE OUTCOME

Method

Four hundred and nine undergraduate students (M_{age} = 19.9, SD_{age} = 1.2; 58.4% female) from a US university completed this study in exchange for course credit. This study employed a 2 (spatial distance: near vs. distant) × 2 (outcome desirability: mildly desirable vs. highly desirable) mixed design, in which we manipulated spatial distance between-subjects and intensity of outcome desirability within-subjects.

Participants read they would be testing a new online dating application that was similar to *Tinder*. To do so, participants first expressed their preferences for the gender and race of a potential date. Based on those preferences, they then viewed the profiles of two potential dates. We pretested the profiles of these potential dates so that one potential date was highly attractive (highly desirable condition) and the other potential date was moderately attractive (mildly desirable condition). In the near condition, participants read that these potential dates were currently one mile away from them, whereas in the distant condition, these potential dates were 25 miles away. A post-test reported in MDA confirmed that participants in the near (vs. distant) condition perceived the potential dates to be physically closer to them. In both conditions, we told participants that the dates lived in the same neighborhood (i.e., midtown) to control for the feasibility of meeting the prospective dates.

After reviewing the profile of the potential dates, and to measure our key dependent variable, participants estimated the probability of successfully being matched to each of the potential dates out of 100 percent. The order in which they viewed and rated the two potential dates was counterbalanced.

Results and discussion

Eighteen participants failed to pass the attention check and seven participants refused to participate in the study due to their relationship status at the time. Excluding these participants (6.1%) left us with a final sample of 384 participants (no difference between conditions, $\chi^2(1, N = 409) = 0.17$, $p = 0.83$).

A two-way repeated-measure ANOVA on probability estimates revealed a significant main effect of valence ($F(1, 382) = 38.12$, $p < 0.001$, $\eta_p^2 = 0.09$): participants predicted they had a greater chance of being matched to the highly attractive ($M = 54.84$, SD = 23.45) than to the moderately attractive date ($M = 47.70$, SD = 26.30). This main effect was qualified by a significant interaction ($F(1, 382) = 5.20$, $p = 0.023$, $\eta_p^2 = 0.01$). For the highly attractive date, participants predicted they would be more likely to be successfully matched if the potential date was nearby ($M = 58.69$, SD = 22.43) than far away ($M = 50.98$, SD = 23.87; $F(1, 382) = 10.63$, $p = 0.001$, $\eta_p^2 = 0.03$), replicating the proximity bias demonstrated in prior studies. However, the proximity bias did not manifest for the moderately attractive date ($M_{near} = 48.97$, $SD_{near} = 26.45$ vs. $M_{distant} = 46.42$, $SD_{distant} = 25.16$; $F(1, 382) = 0.90$, $p = 0.34$, $\eta_p^2 < 0.01$; see Figure 6).

Together, studies 4 and 5 provided support for H3 with respect to moderation of the proximity bias by outcome relevance to the self: whereas the proximity bias emerged for a highly undesirable (study 4) or a highly desirable outcome (study 5), the bias did not manifest when an outcome was mildly (un)desirable. These findings lend support to our account based on wishful thinking as mild outcomes that are less relevant or consequential to the self should have less of an effect. The next study tested moderation of the proximity bias in a different way, further examining the role of outcome relevance to the self and testing our proposed mechanism underlying the proximity bias.

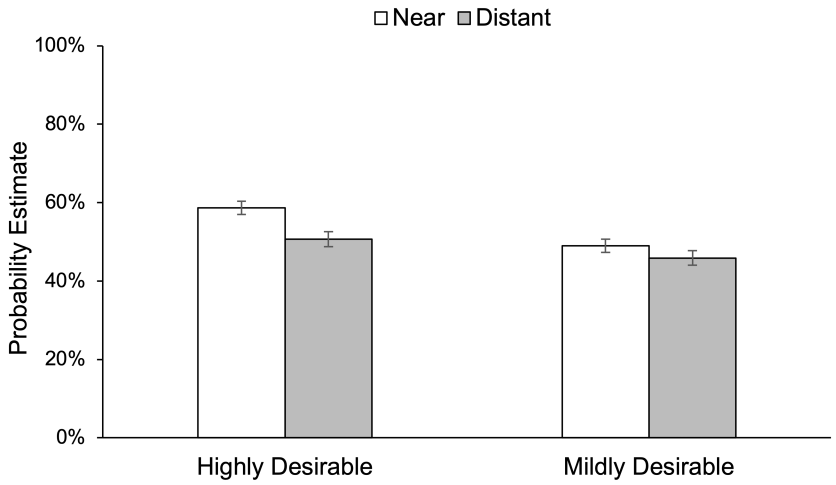

FIGURE 6 Results of Study 5. Mean probability estimates of an outcome as a function of spatial distance, presented separately for a highly desirable outcome (getting matched to a highly attractive date) and a midly desiarable outcome (getting matched to a moderately attractive date).

STUDY 6: MODERATION BY SELF-RELEVANCE OF THE OUTCOME TARGET

The goal of study 6 was to test H4 and a second boundary condition for the proximity bias: the outcome occurring to an irrelevant target. Wishful thinking, which we hypothesized to underlie the proximity bias, stems from one's desire to self-enhance with respect to desirable, positive outcomes and self-protect with respect to undesirable, negative outcome. It then follows that this bias should emerge when estimating the likelihood of self-relevant outcomes but not for self-irrelevant outcomes, such as estimates about an irrelevant other that do not yield any positive or negative consequence for the self (Eiser et al., 2001). To test this hypothesis, we manipulated whether participants made a prediction about an outcome that was self-relevant, as the outcome was happening either to the participant themselves or to a self-relevant other person (e.g., a person who is competing with them), or whether participants made a prediction about an outcome that was self-irrelevant, as it was happening to another person without consequences for them (i.e., a person who is not competing with them). We expected to replicate the proximity bias when participants would estimate the likelihood of an outcome that would happen to the self. We expected the proximity bias to *not* emerge when participants estimated an outcome happening to a self-irrelevant other (e.g., a non-competing candidate receiving or not receiving a job offer), as in this case the focal outcome had no consequence for the self. Finally, we expected the proximity bias to *emerge* and *reverse* if the focal outcome affected someone else but was still consequential and relevant to the self (e.g., a competing candidate receiving or not receiving a job offer instead of the self). When a relevant other's positive or negative outcome yields reversed consequences for the self, the proximity bias should reverse, with a positive outcome being less likely to occur if near than far, and a negative outcome being more likely to occur if near than far.

Method

Fourteen hundred and forty-one respondents (M_{age} = 40.68, SD_{age} = 12.78; 49.2% female) from Amazon Mechanical Turk participated in exchange for monetary compensation. This study employed a 2 (spatial distance: near vs. distant) × 2 (outcome valence: positive vs. negative) × 3 (outcome target: self vs. relevant other vs. irrelevant other) between-subjects design.

Participants read a scenario in which a person was applying for a highly sought-after job at a Fortune 500 tech company. In the two conditions that were relevant for the participant—the self and relevant other conditions—the applicant was described as the participant themselves, whereas in the irrelevant other condition, the applicant was described as an arbitrary person named Riley. We informed participants that they (self and relevant other conditions) or Riley (irrelevant other condition) had just finished a phone interview with a representative of the company's Human Resources.

Next, only in the relevant other condition, participants read that there was another candidate who also had finished an interview with the same HR team for the same position they applied to. Participants further read that this competing candidate shared similar characteristics as the participants themselves—including their locations. Participants in the self and irrelevant other condition were not exposed to this information.

All participants read that even though the new job would be located at a branch close to where the applicant in the scenario lived, Human Resources would

make the hiring decision at the company's headquarters. To manipulate spatial distance, we informed participants in the near condition that the headquarters were located 15 miles from where the applicant was, whereas in the distant condition, the headquarters were located 1500 miles from where the applicant was. This time, the applicant was described as the participants themselves (self-condition), the competing candidate (relevant other condition), or Riley (irrelevant other condition). A pretest reported in the MDA confirmed that participants in the near (vs. distant) condition perceived that the hiring decision took place somewhere physically closer to the applicant described in the scenario.

To measure the key dependent variable, we had participants in the self-condition estimate the probability of themselves receiving an offer (positive condition) or not receiving an offer (negative condition) on a scale from 1 (*not at all*) to 7 (*very likely*). In the relevant other condition, participants estimated the probability for the competing candidate. Finally, in the irrelevant other condition, participants estimated the probability for a non-competing, arbitrary candidate, Riley.

Results and discussions

Our final sample consisted of 1409 participants after excluding 32 participants (2.2%) who failed the attention check (no difference across conditions, $\chi^2(11, N = 1441) = 11.81, p = 0.38$).

A three-way ANOVA on probability estimates revealed a significant two-way spatial distance × outcome valence interaction ($F(1, 1397) = 10.65$, $p = 0.006$, $\eta_p^2 < 0.01$). Regardless of whom participants were estimating the probability for, not receiving an offer seemed less likely to occur when the hiring decision was expected to take place somewhere nearby ($M = 4.08$, SD = 1.25) than distant ($M = 4.28$, SD = 1.16; $F(1, 1397) = 5.17$, $p = 0.023$, $\eta_p^2 < 0.01$). The difference was directionally reversed when participants estimated the probability of receiving an offer (i.e., positive outcome; $M_{near} = 4.42$, SD = 1.17 vs. $M_{distant} = 4.25$, SD = 1.24), but it did not reach statistical significance ($F(1, 1397) = 3.75$, $p = 0.10$, $\eta_p^2 < 0.01$). More importantly, this two-way interaction was qualified by a significant three-way interaction with outcome target ($F(1, 1397) = 31.22$, $p < 0.001$, $\eta_p^2 = 0.04$). In line with our predictions, simple effect analyses revealed a significant two-way spatial distance × outcome valence interaction in both the self ($F(1, 1397) = 56.85$, $p < 0.001$, $\eta_p^2 = 0.04$) and relevant other conditions ($F(1, 1397) = 13.99$, $p < 0.001$, $\eta_p^2 = 0.01$), but not in the irrelevant other condition ($F(1, 1397) = 2.71$, $p = 0.13$, $\eta_p^2 < 0.01$).

In the self-condition, participants estimated that they would be more likely to get a job offer when the hiring decision was made at a near than at a distant location ($M_{near} = 4.87$, $SD_{near} = 1.21$ vs. $M_{distant} = 3.99$, $SD_{distant} = 1.47$; $F(1, 1397) = 33.46$, $p < 0.001$, $\eta_p^2 = 0.02$), replicating the proximity bias. Conversely, participants estimated that they would be less likely to *not* get a job offer when the hiring decision was made at a near than at a distant location ($M_{near} = 3.92$, $SD_{near} = 1.35$ vs. $M_{distant} = 4.66$, $SD_{distant} = 1.15$; $F(1, 1397) = 23.81$, $p < 0.001$, $\eta_p^2 = 0.02$), also replicating the proximity bias. This pattern was reversed in the relevant other conditions. When participants predicted the prospect of another competing candidate, the likelihood of the candidate receiving an offer—a positive outcome for the candidate but potentially a negative outcome for the participant—was estimated to be lower when the hiring decision was made at a nearby than at a distant location ($M_{near} = 4.02$, $SD_{near} = 0.89$ vs. $M_{distant} = 4.50$, $SD_{distant} = 0.92$; $F(1, 1397) = 9.89$, $p < 0.001$, $\eta_p^2 = 0.01$). By contrast, the chance of the competing candidate not getting an offer—a negative outcome for the candidate but potentially a positive outcome for the participant—was estimated to be higher when the hiring decision took place somewhere nearby ($M = 4.32$, SD = 0.97) than distant ($M = 4.00$, SD = 0.87; $F(1, 1397) = 4.58$, $p = 0.006$, $\eta_p^2 = 0.01$). These effects did not emerge when estimating the hiring likelihood for a noncompeting candidate, Riley whose prospect was irrelevant for participants (positive outcome: $F(1, 1397) = 0.82$, $p = 0.40$, $\eta_p^2 < 0.01$; negative outcome: $F(1, 1397) = 2.03$, $p = 0.19$, $\eta_p^2 < 0.01$; see Figure 7).

Overall, the results of study 6 provided further evidence of another boundary condition consistent with the notion that the proximity bias may be explained by wishful thinking: whether an outcome is relevant or irrelevant for the self.

GENERAL DISCUSSION

Our research identifies a novel proximity bias in probability judgments, whereby spatial distance and outcome valence systematically interact in determining probability judgments. Six hypothetical and incentive-compatible experiments provided evidence of the proximity bias, an underlying explanation based on wishful thinking, and demonstrated theory-relevant boundary conditions. Across a range of decision contexts, a positive outcome was estimated to be more likely to occur when it was decided someplace near versus distant, whereas a negative outcome was estimated to be less likely to occur when decided somewhere near versus distant (studies 1–6). The proximity bias was explained by wishful thinking and thus perception of outcome desirability (study 3). Finally, the proximity bias did not manifest when an outcome was less relevant for the self: for moderately undesirable (study 4) or moderately desirable outcomes (study 5) with little consequence for the self, or when estimating outcomes for others who are irrelevant to the self (study 6).

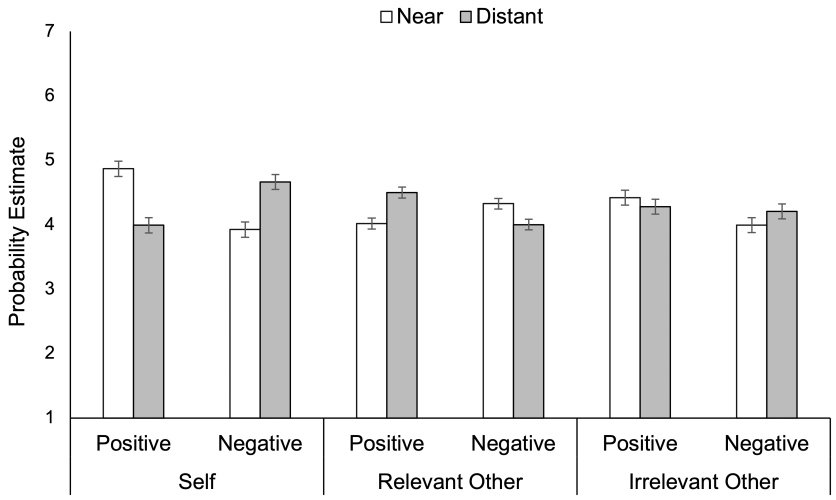

FIGURE 7 Results of Study 6. Mean probability estimates of (1) an outcome happening to the self, (2) an outcome happening to a relevant other (a competing candidate), and (3) an outcome happening to an irrelevant other (a non-competing, arbitrary candidate) as a function of spatial distance, presented separately for a positive outcome (receiving a job offer) and a negative outcome (not receiving a job offer).

Theoretical contributions

Given that probability estimation affects judgment and decision-making, understanding the way in which people make probability judgments has become a critical research question over the course of the last four decades (Fox & Rottenstreich, 2003; Monga & Rao, 2006; Tversky & Kahneman, 1974, 1981; Tversky & Koehler, 1994). Prior research has focused on examining the effect of *either* spatial distance (Touré-Tillery & Fishbach, 2017; Wakslak, 2012; Wakslak & Trope, 2009; Yan, 2014) *or* outcome desirability (Buehler et al., 1995; Krizan & Windschitl, 2009; Perloff & Fetzer, 1986; Weinstein, 1980; Windschitl et al., 2010) on probability estimation. Our research builds on and extends prior literature by incorporating *both* spatial distance *and* outcome desirability to understand probability estimates. In doing so, our research makes contributions to the following literatures.

First, we extend research on wishful thinking (Krizan & Windschitl, 2007). Prior research in this area has suggested that because of their inherent motives to self-enhance and self-protect, people tend to predict that positive outcomes are more likely to occur than negative ones. The current findings suggest that this difference may vary as a function of the spatial distance between a person and a focal outcome. Thus, we introduce a moderating effect of spatial distance on this well-established relationship between outcome desirability and probability estimation.

Second, we extend research on psychological distance (Henderson & Wakslak, 2010; Trope & Liberman, 2010; Wakslak & Trope, 2009; Yan, 2014). We examined the relationship between spatial distance and probability estimation and suggested that spatially close outcomes are estimated to be *more* likely to happen than distant outcomes (Touré-Tillery & Fishbach, 2017; Wakslak, 2012; Wakslak & Trope, 2009; Yan, 2014). By accounting for the role of wishful thinking in influencing probability judgments, we showed when the reverse effect may occur—in the case of negative, undesirable outcomes, for which with spatially close outcomes are estimated to be *less* likely to happen than distant ones. Additionally, we showed moderation by outcome irrelevance and demonstrated that egocentrism is not a prerequisite for a near (vs. distant) outcome to be seen as more probable. Therefore, our research contributes to the extant literature on construal-level theory by highlighting the effects of novel moderators (i.e., outcome desirability and irrelevance).

Managerial implications

Our research also has practical implications. Prior studies have suggested that there are indeed downstream consequences to inaccurately estimating the likelihood of various outcomes (Glaser et al., 2012; Mekawi & Bresin, 2015). For example, inaccurately estimating the chance of side effects may mislead patients when making important medical decisions. In stock markets, inaccurate predictions may result in substantial monetary loss. In purchase contexts, inaccurate predictions about how prices may change over time may result in paying higher prices.

Given the numerous mistakes consumers make based on probability estimation, examining the factors that cloud probability judgments is important. The results of the current studies show that seemingly innocuous factors—spatial distance and outcome valence—may have a substantial impact on these judgments. As such, future research should explore whether the proximity bias actually prompts consumers to make inferior, suboptimal decisions. If so, the next important task for researchers would be to identify prescriptive methods that

can potentially mitigate the proximity bias and guide people in making optimal decisions.

Potential limitations and directions for future research

One potential limitation of the current research is the use of different verbiage to measure probability judgments in the positive and negative conditions. We did so to ensure that participants would focus only on the consequences of a positive or negative outcome and would therefore estimate the likelihood of either a positive or a negative outcome—and not both or a combination. Although we asked different questions on a variable level, these questions capture the same construct—probability judgments. Nonetheless, as we might have varied other dimensions beyond valence, it would be of interest to use the same verbiage for the dependent variable to corroborate our findings and/or to address any potential alternative explanation.

The current research focused on investigating the effect of spatial distance on probability estimates, which is another form of psychological distance. As such, a path that future research can take is to explore whether the proximity bias also emerges in other types of psychological distances—notably, in temporal and social distances. Taken at face value, since any type of psychological distance can intensify affective judgments (Williams et al., 2014), it seems plausible that consumers may be more optimistic about outcomes that occur sooner (vs. later) or to close (vs. distant) others. The current findings and past research, however, suggest that the impact of desirability on psychological distances may not be as straightforward. For social distance, outcomes happening to close others may not be seen to be as relevant to the self as such outcomes may not directly impact the self. For temporal distance, other factors documented to impact time perception such as perceived control (Han & Gershoff, 2018) and loss aversion (Bilgin & LeBoeuf, 2010) may interact with outcome desirability. As such, future research should take these factors into account and further test when the proximity bias arises in other psychological distances besides spatial distance.

Another direction for future research is to further investigate the motivational factors that can potentially impact the proximity bias. Though we focused on wishful thinking to explain the mechanism underlying the proximity bias, people may also engage in more deliberate motivational processes like motivated reasoning. However, it has been documented that strategic thinking—such as motivated reasoning—can also lead to defensive pessimism (Monga & Houston, 2006), suggesting that people may overestimate the likelihood of negative outcomes to prepare themselves for unfavorable outlooks. This would predict a reduction in probability estimates for near, undesirable outcomes which we did not observe in our studies. Nevertheless, given that motivated reasoning can also, albeit indirectly lead to optimistic predictions (Kunda, 1990; Simon & Shrader, 2012), the current empirical evidence does not allow us to fully rule out an account based on motivated reasoning. Future research may further examine the relative contributions of wishful thinking and motivated reasoning on the proximity bias and examine the extent to which this bias emerges on a conscious level.

HIGHLIGHT PARAGRAPH

Across six hypothetical and incentive-compatible studies, our research proposes and tests a novel proximity bias, whereby spatial distance and outcome valence jointly influence probability judgments. When estimating the probability of negative outcomes (e.g., failing a class and contracting a disease), people judge near outcomes as less likely to occur than distant ones. Conversely, when estimating the probability of positive outcomes (e.g., passing a class and meeting an attractive date), people judge near outcomes as more likely to occur than distant ones. The proximity bias is a manifestation of wishful thinking which stems from people's desire to approach positive outcomes and be near to them and avoid negative outcomes and be far from them. This paper bridges the literatures on probability estimates and wishful thinking. Our account offers a nuanced perspective on the effect of spatial distance on probability estimates and extends prior literature on wishful thinking and psychological distance.

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ENDNOTE

[1] Note that with the current manipulation check measure, it is possible that participants were uncertain about what was the focal outcome in the scenario given that they were simply instructed to indicate how near (vs. far) the "event" took place from them. We intended that event to be the decision of whether or not the flight would be rebooked and we intended for our proximity measure to be based on the location of where this decision would be made. However, some participants could have instead thought of the event as traveling to the faraway destination of Iceland, whereas others could have thought of it as the flight being canceled at the local airport. To address this, we conducted a post-test (N = 109) using an alternative measure that specified the focal outcome as the rebooking decision. We ran similar post-tests in all subsequent studies to ensure that the spatial distance manipulation was indeed successful. Complete stimuli and results of all post-tests are available in the MDA.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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