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The where and when of likely and unlikely events

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ABSTRACT

Do people think likelihood is distributed evenly or do they have an intuition about the types of contexts in which likely and unlikely events tend to occur? Drawing on a probability-as-distance framework, the current research suggests that people relate probability to other distance dimensions, expecting unlikely events to more often happen in distant contexts and likely events in near contexts. Evidence for this association emerges using within-subject designs where participants directly assign low and high likelihood events to near and distant contexts (Studies 1 and 2), as well as between-subjects designs that focus on a variety of related judgments, including willingness to bet on favorites and long-shots (Study 3), decisions about insurance purchases (Study 4), and expectations regarding games of chance (Study 5). Results appear consistent across outcomes of differing valence (Study 5). Implications and future research directions are discussed.

Introduction

Probability is a fundamental dimension of experience. Events ranging from the large and consequential ("Will this investment be profitable?"; "Will this merger succeed?"), to the mundane and everyday ("Will the train be on time?"; "Will broccoli be on sale this week?"), are characterized by a lack of certainty, falling instead along a continuum of likelihood. An event's likelihood is widely regarded as critical in influencing the choices and decisions one makes regarding the event (e.g., we are more likely to buy a lotto ticket if we have a high, vs. low, likelihood of winning the jackpot). A large literature has therefore developed to examine processes by which people assess this highly relevant dimension. For example, ground-breaking work by Tversky and Kahneman (1974) heralded the heuristics-and-biases approach, pointing to various heuristics (e.g., representativeness, availability) that people use in probability judgment, which result in systematically non-normative probability estimates. Indeed, supporting the notion that probability judgment is an intuitive process, a variety of contextual factors has been found to influence probability judgments. For example, a decision-maker's current mood state can exert a broad influence on the probability judgments he or she makes (Johnson & Tversky, 1983; Wright & Bower, 1992), as can the way in which an event is depicted (e.g., packed vs. unpacked descriptions; Tversky & Koehler, 1994).

Contextual information may even play a role in probability judgment in the presence of direct likelihood information. For example, numeric interpretations of phrases such as "slight chance" or "quite likely" are influenced by the event's severity and by whether the event has a high base rate (Wallsten, Fillenbaum, & Cox, 1986; Weber & Hilton, 1990). Moreover, measures of perceived certainty reveal such context effects even when available probability information is in the form of precise numeric forecasts. For example, an event's location can establish a context that makes the event either representative or not (e.g., a rainless day in Madrid vs. London). When a depicted event is representative of the context, individuals appear to intuitively feel that the event is likely to happen, even while acknowledging the numeric likelihood. That is, a person can believe that there is a 5% chance of rain occurring in both Madrid and London, while at the same time feeling more optimism about a rainless day in Madrid than a rainless day in London (Windschitl & Weber, 1999).

Building on this literature, the current paper explores whether people have a general intuition about the types of contexts in which likely and unlikely events tend to occur; in particular, where and when these events tend to happen. Rather than focusing on information relayed by the idiosyncrasies associated with any *particular* location or time point (e.g., London's connotation of rainy weather), the current focus is on a context's distance from one's current environment. Using a probability-as-distance framework, I argue that people associate probability with other distance dimensions and expect unlikely events to happen in distant places and at distant time points, but likely events to happen in nearby places and at proximal time points. In what follows, I first describe this distance approach to probability in more detail, along with recent evidence supporting it. I then discuss the implications of this perspective for probability-related judgments, along with prior findings that are broadly consistent with these predictions.

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Probability as psychological distance

According to a recent framework called construal-level theory (for reviews, see Henderson & Wakslak, 2010; Trope & Liberman, 2010), an event can be said to be psychologically distant when it is not part of one's direct experience. Psychologically distant events belong to the past or future rather than the present, take place in distant rather than near locations, or occur to other people rather than to oneself. That is, the greater the temporal, spatial, or social distance from an event the more distal it appears to be. Different dimensions of psychological distance are presumed to share a common psychological meaning in that they are each different ways of diverging from direct experience.

Likelihood, too, can be conceptualized as a psychological distance dimension (Wakslak, Trope, Liberman, & Alony, 2006). Independent of their spatiotemporal and social distance, events are more removed from direct experience (and therefore more distant) when they are possible but not certain, hypothetical vs. actual. For example, owning a new gadget would be more distant when the gadget is something one might buy, rather than something one has bought. Likelihood is a continuum that connects certainty and hypotheticality; thus, the lower an event's likelihood is, the more it belongs to the realm of hypotheticality and the more distant it should be. Continuing the above example, the lower the likelihood of getting the gadget, the more distant it should seem. Indeed, perhaps reflecting this connection between probability and other distances, people often use words associated with distance to describe likelihoods, referring to an unlikely event as a "far chance" or "remote possibility," etc. Notably, this conceptualization of probability is also consistent with the empirical similarity of intertemporal and risky decisions (Keren & Roelofsma, 1995; Prelec & Loewenstein, 1991), as well as the suggestion of researchers commenting on this that the processes of intertemporal and probabilistic discounting might be related to a single underlying psychological process (e.g., Fehr, 2002; Rachlin, Raineri, & Cross, 1991).

Recent empirical research, as well, supports a probability-as-distance conceptualization. For example, work by Wakslak and colleagues (2006; see also Wakslak & Trope, 2009) points to a relationship between an event's probability and the way it is mentally construed (i.e., cognitively represented) that mirrors the relationship that exists between other psychological distance dimensions and mental representation. Specifically, as an event grows increasingly unlikely, people tend to represent it in a more abstract, essentialized fashion – a pattern that mirrors that which occurs for events that are temporally (Liberman, Sagristano, & Trope, 2002), spatially (Henderson, Fujita, Trope, & Liberman, 2006), and socially distant (Liviatan, Trope, & Liberman, 2008).

Probability and other distances

If probability in fact serves as a dimension of psychological distance, as suggested by the work described above, than we might expect people to relate it to other distance dimensions. Indeed, construal-level theory posits that because psychological distance is reflected in different dimensions and because these dimensions have similar psychological consequences, the dimensions themselves are mentally associated with one another. Supporting this idea, Bar-Anan and colleagues (2007) demonstrated an automatic association between spatial distance and other distance dimensions using a series of picture-word Stroop tasks (Stroop, 1935). Participants in these studies viewed perspective pictures containing an arrow that was pointing to either a proximal or distal point on the landscape shown in the picture; inside the arrow was printed a word denoting either a psychologically proximal entity (e.g., tomorrow, we, sure) or a psychologically distal entity (e.g., year, others, maybe). In a spatial discrimination version of the task, participants had to indicate whether the arrow pointed to a proximal or distal location. In a semantic discrimination version, participants had to indicate the word that was printed on the arrow. In both tasks, and across the distance dimensions, participants were faster when the distance connoted by the word was congruent with the spatial distance of the arrow (e.g., 'we' printed on a spatially proximal arrow) than when it was incongruent (e.g., 'we' printed on a spatially distal arrow).

Also focusing on the interplay between distance dimensions, Zhao and Xie (2011) recently demonstrated that a match between temporal and social distance influences the impact of others' product recommendations: while close others' recommendations had more influence over near-future preferences, distant others' recommendations had more influence over distant-future preferences. Based on the "fit" literature (e.g., Higgins, Idson, Freitas, Spiegel, & Molden, 2003; Lee & Aaker, 2004), which argues that an external stimulus has the greatest impact when it fits a person's internal mindset, Zhao and Xie reasoned that because the opinions of distant others are construed abstractly, which is congruent with the abstract construal people generally adopt of the distant future, these opinions will have a larger effect on distant-future decision making, as compared to near-future decision-making (where there is a relative lack of congruency). This perspective can be viewed as an elaboration of the shared association between distances discussed by Bar-Anan, Liberman, Trope, and Algom (2007) and Trope and Liberman (2010). That is, the idea underlying both the Bar-Anan et al. (2007) Stroop effect findings and the Zhao and Xie (2011) fit findings is that there is a "match" when two distances are congruent; inasmuch as multiple distance dimensions similarly impact mental representation, they share a common meaning and are seen as fitting together. This fit influences how fluently stimuli are processed (e.g., Bar-Anan, Liberman, Trope, & Algom, 2007) and how relevant they are seen as being to particular contexts (Zhao & Xie, 2011).

What implications might this association between distance dimensions have for explicit probability related judgments? To date, research has not addressed this question. Extrapolating from extant findings on the interplay between distance dimensions, however, we might expect that unlikely events will be intuitively seen as "matches" for distant contexts, such as distant times and locations, whereas likely events will be seen as "matches" for proximal contexts. That is, given that distant times and locations are thought about abstractly, people might feel that an improbable possibility, which is also thought about abstractly, fits these distant contexts. Thus, people may have an intuition that when unlikely events occur, they tend to do so in distant contexts, such as distant times and locations; likely events, in contrast, should be seen as more likely to occur in proximal contexts than distal ones.

Intriguingly, this prediction is consistent both with prior theoretical perspectives and prior empirical findings. For example, it is consistent with a perspective offered by Rachlin and colleagues, who suggest that improbable events are experienced as more temporally remote, because on average they occur at more distant time points (Rachlin, Raineri, & Cross, 1991). To offer an example: if one is playing a slot machine, the lower the probability of any given outcome, the more times, on average, one would have to play the machine to get that outcome. Assuming each trial is independent, however, this logic does not suggest that a low probability outcome is actually more likely to occur on the one-hundredth vs. first time one plays the machine; however, it does suggest that people might link probability with distance in time and consequently make this judgment. From a psychological distance perspective, we would expect this same type of effect should occur across a variety of distance dimensions, not only temporal distance.

Also consistent with the current predictions is empirical research examining probabilities and the self/other distinction,

which can be conceptualized from the current perspective as a dimension of social distance. Within this area, a number of recent papers (e.g., Chambers, Windschitl, & Suls, 2003; Kruger & Burrus, 2004) suggest that people believe frequent events are more likely to happen to them then to others, but rare events are more likely to happen to others than to themselves, a pattern that holds for both positive and negative events. Although motivated by cognitive egocentric and focalism accounts and not by the current framework, this pattern of findings is highly consistent with the present argument that people associate unlikely events with distant contexts (in this case, other people) and likely events with near contexts (in this case, the self).

Building upon this prior research, the current paper focuses on temporal and spatial distance, examining the judgments people make about likely and unlikely events when they are proposed to take place in near or distant time points or locations.[1] The idea that people expect unlikely events to happen in distant times and locations, and likely events to happen in proximal times and locations, is examined across a series of five studies. The first two of these studies use a within-subjects design to examine the direct assignment of likely and unlikely events to near and distant locations and time-points. The following three studies then examine more naturalistic judgments where participants considered an event occurring in either a proximal or distal context, and made related judgments including their willingness to bet on favorites and long-shots (Study 3), recommend insurance purchases (Study 4), and feelings of certainty or surprise over likely and unlikely games of chance outcomes (Study 5). Because outcome valence has been presumed to be an important variable that may activate motivational concerns resulting in a "desirability bias" (for a recent review see Krizan & Windschitl, 2007), the majority of the studies use stimuli that are relatively neutral in valence. The final study (Study 5), however, systematically varies outcome valence to ensure that the described effects operate consistently across events that are positive, neutral, and negative in valence.

Study 1: east coast/west coast cats

According to the logic outlined above, people should expect low likelihood events to happen in distant contexts and high likelihood events to happen in proximal contexts. The current study examines this prediction as it relates to spatially distant and proximal locations. Participants read about two proteins that could potentially be found in the blood of household cats, one of which was likely and the other of which was unlikely. Participants were asked to indicate whether a friend's cat in a distant location or a friend's cat in a nearby location had the unlikely or likely proteins. I expected participants to link the unlikely protein with the cat in the distal location and the likely protein with the cat in the nearby location.

Method

Participants

Twenty-eight students in an East Coast university (19 women; 9 men) participated in partial fulfillment of a course requirement.

[1] These predictions are consistent with previously mentioned research on self/other probability judgments, but neither the egocentrism or focalism accounts presumed to explain these prior findings (Chambers et al., 2003; Kruger & Burrus, 2004) would lead to the current predictions because (a) in the current studies participants do not make estimates about the self, but rather always make judgments about events happening to other people, and (b) the current studies do not present a focal (vs. less focal) target, but rather examine these ideas using between subject designs where the judgment is not comparative across distal and proximal contexts, or by asking for participants' direct assignment of outcomes to near and distant contexts, but counterbalancing the options such that no single choice is a consistently focal option.

Materials and procedure

Participants completed a short survey. To minimize potential concerns of participants that they did not have enough information to appropriately respond to the questions in the survey, they began by reading a brief introductory passage that included the following: "...It is possible that you will feel that you do not have enough information to adequately respond to the questions. If this occurs, do not worry. There are no right or wrong responses to the questions; we are just interested in your intuitive judgments." Participants then saw the following scenario about cat blood proteins which described two possible proteins that may exist in the blood of household cats. To ensure the outcome was neutral in nature, participants were explicitly told that it was not better or worse for one or the other protein to be found in a cat's blood. The scenario was completely fabricated, although it was modeled on evolving medical techniques for use in humans. Participants did not object to the implausibility of the scenario.

> "A number of veterinary science research studies have found that approximately 85% of household cats have a particular protein X in their blood. The other 15% of household cats have a slightly different protein Y in their blood. Research suggests that it is not a "good" or "bad" thing to have protein X or Y, but that it is useful to know which protein is in the blood so that veterinarians can prescribe the medications that have been found most effective for cats with that blood type.
>
> You have two friends who own cats. One friend lives on the East Coast, around 3 miles from here. The other friend lives on the West Coast, around 3000 miles from here. Both friends take their cats to their vets to find out which protein their cats have in their blood. It turns out that one friend's cat has protein X (as is the likely case, given that a large proportion of cats have this protein) and the other friend's cat has protein Y (as is the unlikely case, given that only a small proportion of cats have this protein)."

After reading this scenario, participants were asked to respond to the following forced choice items: "Do you think the cat belonging to your friend who lives close by: Has Protein X (like 85% of cats) vs. Has Protein Y (like 15% of cats)" and "Do you think the cat belonging to your friend who lives far away: Has Protein X (like 85% of cats) vs. Has Protein Y (like 15% of cats)".

Finally, in order to ensure that the names of the proteins (X and Y) did not influence results, materials were counterbalanced such that half of the participants read the scenario as it is written above (85% of cats have protein X and 15% protein Y), while the other half read a modified version which claimed that 15% of cats have protein X and 85% protein Y. Counterbalancing of names made no difference in the results and will therefore not be discussed further.

Results and discussion

Allocation of the common and uncommon cat to the nearby and distant location was assessed via chi-square tests. As hypothesized, participants' judgments significantly differed from chance, with 71% of people selecting their nearby friend as the owner of the cat with the common blood protein and their far away friend as the owner of the cat with the uncommon protein, and only 29% of people making the reverse judgment, $\chi^2(1, N = 28) = 5.14$, $p < .05$. This study thus illustrates that judgments of probability relate to spatial distance information. In the following study, I move onto examine the relationship between probability and temporal distance, asking people for their intuitions about when likely and unlikely events occur.

Study 2: poker night

Study 2 extends the findings of Study 1, focusing on the link between probability judgments and temporal distance. Participants

read about a 10-round poker game in which a player gets a very common hand and a very uncommon hand at two different points in the evening, and were asked to guess during which round of poker each of these two events occurred. I expected participants to indicate their expectation for the uncommon event to occur at a more temporally distant time point (i.e., a later round of the poker game) than the common event. Importantly, this context addresses a potential limitation of Study 1, namely, that it is possible that people have less information about things occurring in distant places and that this lack of knowledge is responsible for linking these remote contexts to unlikely cases. Given that the temporal distance in the current study is a question of time points within a single evening of play, it is hard to argue that participants were less knowledgeable about some of these time points than others.

Method

Participants

Thirty-nine students (23 women; 16 men) participated in partial fulfillment of a course requirement.

Materials and procedure

Participants were asked to consider the following situation:

> "You and a group of friends are playing poker one evening. Different hands of poker have different odds associated with them. Some poker hands are very rare, whereas others are very common. For example, the odds of getting a straight flush in five cards is 1 in 72,193.33. The odds of getting a four of a kind is 1 in 4165.00. In contrast, other hands are much more common. For example, the odds of getting two pairs is 1 in 21.03. The odds of getting one pair is 1 in 2.36, while the odds of getting a no pair (high card) hand is 1 in 1.99.
>
> During the evening, you and your friends play 10 rounds of poker. At one point in the evening, your friend Sam gets dealt a four of a kind. This is a very uncommon hand (odds: 1 out of 4165 or .024%), which contains four cards of one rank, and an unmatched card of another rank (e.g., **9♣ 9♠ 9♦ 9♥ J♥**). At a different point in the evening, Sam gets dealt a one pair hand. This is a fairly common poker hand (odds: 1 out of 2.36 or 42.27%) that contains two cards of the same rank, plus three other unmatched cards (e.g., **4♥ 4♠ K♠ 10♦ 5♠**)."

After reading this scenario, participants were asked to respond to the following open response items: "If you were to guess in which round of poker Sam got dealt the unusual four of a kind hand, what round would you guess it happened in?" and "If you were to guess in which round of poker Sam got dealt the common one pair hand, what round would you guess it happened in?"

Results and discussion

Responses made by two participants were higher than 10 (the alleged total number of poker rounds), suggesting that they misunderstood the scenario; these were therefore excluded from the analyses.[2] The remaining participants' intuitions about the rounds where the unusual and common hands would occur were analyzed using a paired *t*-test. As expected, participants believed that the uncommon hand would occur during a later round (i.e., at a more temporally remote time point; $M = 5.22$; $SD = 2.93$) than the common hand ($M = 3.54$; $SD = 2.63$), $t(36) = 2.05$, $p < .05$, $d = .60$ (see Fig. 1).

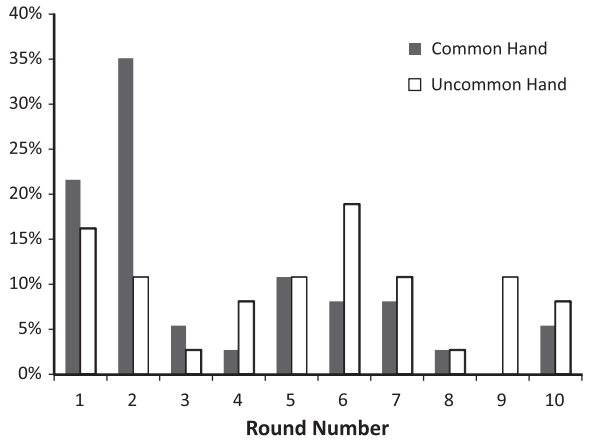

Fig. 1. Percent of participants placing common and uncommon hands in rounds 1–10 (Study 2).

Moreover, this result persisted when responses were dichotomized to reflect a single judgment, namely, that the uncommon event occurs after the common event or vice versa. Judgments significantly differed from chance, with 67.57% of participants indicating that they would expect the uncommon event to occur after the common event, and only 32.43% that they would expect the uncommon event to occur before the common event, $\chi^2(1, N = 37) = 4.57$, $p < .05$. Thus, within a single run of events to occur on a given night, individuals seem to link probability to temporal distance, expecting an unlikely event to occur at a later time point than a likely event.

Study 3: I'll bet on that!

Studies 1–2 used a within-subjects design that explicitly asked participants to relate probability to spatial and temporal distance. While successful in establishing the basic link in question, these results are limited in that (a) they force a choice, (b) the context may feel contrived and removed from typical, real-world processing, and (c) the relationship under investigation may be easy to ascertain given the within-subjects manipulation. In order to address these issues, Studies 3–5 use between-subject designs and everyday contexts that are relevant to the processes under investigation. Study 3, in particular, focuses on spatial distance and the amount one would be willing to bet on a favorite vs. an underdog. If participants expect an unlikely event to occur in a remote (vs. near) location, this should impact their bets such that they should increasingly bet on the underdog (vs. the favorite) when the event occurs in a distant (vs. near) locale.

Method

Participants

Fifty-one students (26 women; 24 men; 1 gender unknown) participated in partial fulfillment of a course requirement and were randomly assigned to condition.[3]

[2] Winsorizing the extremes to ten instead of dropping this data leads to the same overall conclusion, with all *p* values corresponding to those reported in the text remaining <.05. I thank an anonymous reviewer for suggesting this approach.

[3] Two participants explicitly reported that they believed the study was investigating the relationship between the odds and the distance mentioned; their data was excluded from reported analyses. In addition, one participant indicated that he would put more money on the underdog than the favorite, suggesting he might have mistakenly completed the survey; this response qualified statistically as an outlier and was excluded from the analysis.

Materials and procedure

Participants were asked to consider two boxers fighting for the championship title, one of whom was given a 19/20 chance of winning, while the other was given a 1/20 chance of winning. Participants in the proximal condition were told that the fight itself would happen in a well-known arena right nearby, around 3 miles away. Those in the distant condition were told the fight would happen in a well-known arena across the country, around 3000 miles away. All participants were told to consider having 100 dollars to place on the match, and were asked to split the money into bets placed upon each of the two fighters.

Results and discussion

Results suggest that the amount of money placed on the underdog (vs. favorite) differs as a function of the venue's spatial distance. As expected, participants were willing to place more money on the underdog (and consequently less money on the favorite) when the fight was to occur in a distant location (M = \$17.26; SD = 13.70) as opposed to a near location (M = \$10.08; SD = 10.86), $t(49) = 2.06$, $p < .05$, $d = .58$. These findings thus suggest that the differences in probability judgments the current studies illustrate may have important, practical implications. While there is no actual reason to believe that the result of the fight will be different based upon whether it occurs in a near or distant location, individuals' perceptions of where likely or unlikely events will happen can lead them to shift betting behavior.

Study 4: to insure or not to insure

Study 4 explores an additional applied area that might be impacted by people's expectations about likely and unlikely events: the decisions people make about insurance purchases. Specifically, Study 4 examines whether differences in the likelihood of an event for which insurance is being sold can influence people's intuitions about the likelihood of that event in a near or distant context and related insurance purchase recommendations. The idea is that unlikely events will seem to fit better in distant contexts (such as temporally distant time points) and buying insurance to protect against them will make more sense in such contexts. Likely events, in contrast, will seem to fit better in proximal contexts (such as temporally near time points) and buying insurance to protect against them will make more sense in these contexts.

Method

Participants

Fifty-two people, (25 women, 27 men), some of whom were undergraduate business school students and others member of an online panel, participated as part of either a course requirement or in exchange for a small cash payment.

Materials and procedure

Participants completed an online survey[4] in which they read a scenario about a person named Sam who is considering whether to buy renters' insurance. In the temporally close condition, Sam was facing this dilemma in 1 day from now; in the distant condition, in 1 year from now. Those in the high likelihood [low likelihood] condition read as follows:

> "In a year (day) from now, Sam rents a house and is considering whether or not to purchase renters' insurance. Renters' insurance offers coverage for a variety of mishaps that can occur to people renting a home. A surprisingly large [very small] percentage of people who buy such insurance actually collect money on it."

After reading the scenario, participants were asked to estimate (as a percent) the likelihood that Sam would experience an event that renters' insurance would cover. They also indicated whether Sam should purchase the renters' insurance (1 = definitely no; 7 = definitely yes). Finally, to make sure there were no differences based on distance in the degree to which one might be trying to offer good advice or feel accountable for their recommendation, participants also completed two follow-up items about these issues, each on seven-point scales: "To what degree were you trying to make a good decision when responding?" and "To what degree did you feel accountable for the decisions that you made?"

Results and discussion

A 2 (probability) × 2 (temporal distance) ANOVA revealed the expected two-way interaction on estimates of Sam's likelihood of experiencing an event renters' insurance would cover, $F(1,47) = 6.82$, $p < .05$, $\eta_p^2 = .13$ (see Table 1). Follow-up analyses suggested that participants told that collecting on the insurance was a fairly likely occurrence judged the likelihood of Sam's experiencing an insurable event higher when they considered a near (M = 58.75%; SD = 18.72) vs. distant (M = 41.92%; SD = 24.79) time point, $t(23) = 1.90$, $p = .07$, $d = .77$. In contrast, when participants were told that collecting on the insurance was relatively unlikely, this pattern reversed, with participants judging the likelihood of Sam's experiencing an insurable event higher when considering a distant (M = 28.67%, SD = 21.86) vs. near (M = 15.29%; SD = 16.37) time point, $t(24) = 1.78$, $p < .1$, $d = .69$. Advice about whether Sam should purchase the renters' insurance exhibited a similar interactive pattern, $F(1,47) = 3.94$, $p = .05$, $\eta_p^2 = .08$. When told that a large percentage of people collect on such insurance, participants thought Sam should purchase the insurance more when considering a near situation (M = 5.58; SD = .79) than a distant situation (M = 4.83; SD = .83), $t(22) = 2.26$, $p < .05$, $d = .93$. However, when told only a small percentage of people collect on such insurance, participants thought Sam should purchase the insurance more when considering a distant situation (M = 4.85; SD = 1.41) than a near situation (M = 4.14; SD = 1.79), although this latter effect did not reach significance ($p = .27$).

Finally, to ascertain that this effect was not due to differential motivation when offering advice to near and distant others, I examined potential effects of likelihood and distance on how good a decision participants claimed they were trying to make and how accountable they felt for their decision. There were no main or interactive effects of decision quality or accountability, and neither of these was a significant predictor of likelihood estimates or purchase recommendations. Furthermore, controlling for these as covariates in the 2 × 2 analyses reported above did not considerably change the reported effects. Thus, it seems unlikely that any differences in these variables were responsible for the described effects.

Study 5: spatial distance effects across outcomes differing in valence

Studies 1–4 suggest that people tend to expect likely events to happen in proximal contexts and unlikely events to happen in

[4] Because the data was collected online and could be completed from any computer, there was a reasonable possibility that participants would not attend to the stimuli. I therefore included a manipulation check item asking when the situation was going to take place, and excluded participants who provided nonsensical or incorrect responses. In addition, data from one participant was excluded because he correctly identified a connection between temporal distance and probability as the issue of interest and recommendation data of a second participant was excluded because he indicated that his recommendation would only apply in a spatially proximal location (a variable related to the current investigation).

Table 1
Study 4: Mean likelihood judgments and insurance purchase recommendations (standard deviations in parentheses).

	Near time point	Distant time point
Likelihood judgments		
Large percentage collect	58.75% (18.72)	41.92% (24.79)
Small Percentage collect	15.29% (16.37)	28.67% (21.86)
Purchase recommendations		
Large percentage collect	5.58 (.79)	4.83 (.83)
Small percentage collect	4.14 (1.79)	4.85 (1.41)

Note: Likelihood judgments were provided as percentages. Purchase recommendations were made on a scale ranging from 1 (definitely no) to 7 (definitely yes).

distal contexts, a pattern that has implications for probability-related judgments. However, given a large body research pointing to the ego-protective nature of probability judgments (for overviews, see Helweg-Larsen & Shepperd, 2001; Weinstein & Klein, 1996), an important question is whether the effects described here would apply similarly across outcomes of differing valence (but see Chambers et al., 2003; Harris & Hahn, 2011; Kruger & Burrus, 2004 for cautionary notes about this literature). That is, much as it may be ego-protective to think of negative things happening more to others, and positive things more to the self, it may be ego-protective to think of negative things happening in faraway times and places that are more distal to the self's current context, and positive things happening in proximal times and places. This alternative idea is addressed to a certain degree across Studies 1–4, which use outcomes that differ at least somewhat in valence. In Study 5, however, this is examined more directly by systematically manipulating outcome valence within a single context. Participants considered a person playing a game of chance in a proximal or distal location, for which a likely or unlikely card draw would result in a negative, positive, or neutral outcome (a loss of money, a gain of money, or no monetary impact). In addition to indicating their expectations regarding the card draw, participants indicated how surprised they would be at the alternative draws and which way they would bet if they were so inclined. If likely events fit better in near (than distant) contexts, and unlikely events in distant (than near) contexts, participants should increasingly expect the likely event to happen over the unlikely event when the event will occur in a proximal (rather than a distal) location. Likewise, participants should be more surprised by an unlikely relative to likely outcome in a near context, as opposed to a distal context, and should increasingly want to place any bets on the likely outcome. Furthermore, if this reflects a general tendency rather than a process of ego-protection, these effects should not be dependent on outcome valence.

Table 2
Study 5: Expectations and betting preference as a function of distance and outcome valence (standard deviations in parentheses).

	Near location	Distant location
Expectation unlikely outcome will occur		
Positive outcome	2.94 (.96)	3.60 (1.17)
Neutral outcome	3.15 (.78)	4.05 (1.06)
Negative outcome	3.25 (.79)	3.77 (1.44)
Betting preference in favor of unlikely outcome		
Positive outcome	2.88 (1.78)	4.70 (2.67)
Neutral outcome	2.70 (1.83)	3.64(2.11)
Negative outcome	2.70 (2.21)	3.27 (2.00)

Note: Expectations for the unlikely event happening were provided on a nine point scale, with higher numbers reflecting a greater expectation that the unlikely event (Sam selecting an ace) would happen. Betting preference was provided on a nine point scale, where higher numbers reflecting betting for vs. against the unlikely outcome.

Method

Participants

Seventy-two business-school undergraduate students attending a West Coast university (37 women, 35 men), participated as part of a course requirement.

Materials and procedure

Participants completed a survey in which they read about a person named Alex who was located in a casino on either the East Coast (distant condition) or West Coast (near condition). Participants in the neutral outcome condition read the following:

> "Alex is being dealt a card from a deck of cards. There are fifty-two cards in a deck, and only four aces. The question is if Alex will be dealt an ace. This is just a practice round, where no money is at stake."

In the positive outcome condition, the final sentence was replaced with, "If the card is an ace, Alex will win $2." In the negative outcome condition, the final sentence was replaced with, "If the card is an ace, Alex will lose $2."

After reading the scenario, participants indicated their relative expectations about the unlikely event happening by indicating what they thought about Alex getting an ace (1 = certain won't happen; 9 = certain will happen) and how surprised they would be if Alex gets an ace (1 = not at all surprised; 9 = very surprised). The surprise question was reverse-coded and the two items averaged together to create an index of participants' expectations about the unlikely event happening ($r = .39$, $p = .001$).[5] In addition to expectations about the event, participants were also asked the following: "If you were betting on what happened, would you bet for or against Alex getting an ace?" (1 = completely against; 9 = completely for).

Results and discussion

A 2 (spatial distance) × 3 (outcome valence) ANOVA conducted on the expectation index revealed a main effect of spatial distance, $F(1,62) = 7.11$, $p = .01$, $\eta_p^2 = .10$, such that participants' expectations that the unlikely event (picking an ace) would happen was higher when the event would occur in a distal context ($M = 3.81$, $SE = .19$) than when it would occur in a proximal context ($M = 3.11$, $SE = .18$; see Table 2). Furthermore, there was no main effect of outcome valence ($p = .55$), nor was the distance effect qualified by an interaction with outcome valence ($p = .85$). A similar pattern emerged for participants' stated intentions to bet for or against Alex getting an ace (the unlikely outcome). Participants were increasingly interested in betting on the unlikely, as opposed to likely, outcome when the event was happening in a distal location ($M = 3.87$, $SE = .37$) than when it was happening in a proximal location ($M = 2.76$, $SE = .36$), $F(1,62) = 4.68$, $p < .05$, $\eta_p^2 = .07$. As in the earlier analyses, there was no main effect of valence ($p = .40$), nor evidence of a two-way interaction between valence and distance ($p = .58$).

General discussion

The current paper describes five studies that examine whether people match probability with distance in time and space. When assigning probable and improbable events to near and distant

[5] Although intended to both be measures of expectation, the certainty and surprise items did not initially reveal a significant correlation ($r = .19$; $p = .12$). A closer look at the data, however, revealed four participants whose scores were outliers on one of the two items. Removing these responses dramatically increased the correlation, suggesting these unusual participants may have misunderstood or not carefully read the questions; these outlying responses were therefore excluded from the dataset.

locations and time points, participants indeed appear to exhibit this tendency, expecting the unlikely event (more than the likely event) to happen in a remote location (Study 1) and at a later point in time (Study 2). Moreover, these effects persist in cases where the task is not to assign likely and unlikely events to different contexts, but to consider a context and an outcome, and to make a related judgment. For example, results of Study 3 indicate that people are more likely to bet on an underdog when a sporting match occurs in a distant (vs. a near) venue, a finding that presumably arises because one expects the unlikely outcome (the underdog winning) to be relatively more likely to occur in a distant place. Likewise, Study 4 points to changes in people's expectations and advice in relation to whether to purchase insurance at a proximal or distal time-point. When collecting on the insurance is likely, people expect the event to occur more at a proximal time point, than a distal one; when collecting on the insurance is unlikely people expect it to occur more at a distal, than proximal, time point, a pattern reflected in their insurance purchase recommendations. Finally, Study 5 demonstrates that these effects are not dependent on outcome valence, with likely (vs. unlikely) outcomes increasingly expected in spatially proximal contexts, compared with spatially distal contexts, regardless of whether the unlikely outcome represents a positive, negative, or neutral event.

These findings are consistent with previous work on interrelations among distances, including research suggesting that the concept of spatial distance is activated at the same time as other distance dimensions (Bar-Anan, Liberman, Trope, & Algom, 2007), as well as recent research pointing to a fit between social distance and temporal and spatial distance, such that information from more socially distant others is used to inform judgments relevant to a more temporally remote context (Zhao & Xie, 2011). It is also broadly consistent with research on self-other probability judgments, which suggests that people see rare events as happening more to other (distal) people, and common events as happening more to the (proximal) self (Chambers et al., 2003; Kruger & Burrus, 2004). This work is distinct from both streams of this previous research, however, by linking explicit probability judgments about events external to the self with distance in time and space.

Implications and future directions

Given the relevance of probability to so many important outcomes (e.g., risk assessments; financial and medical decision making; project planning, etc.) it is especially important to understand how people experience this dimension and how this shapes their decision making. By supporting the notion that people relate probability to other distances, the current set of studies helps to substantiate the perspective that gave rise to its predictions, i.e., the idea that probability serves as a psychological distance dimension by which unlikely events are remote and likely events proximal (Wakslak, Trope, & Liberman, 2006; see also Rachlin et al., 1991). This perspective offers insights into how probability shapes mental representation (Wakslak et al., 2006), how it shapes preference (Todorov, Goren, & Trope, 2007), and how it is itself assessed in the absence of any objective likelihood information (Wakslak & Trope, 2009).

Furthermore, much as probability is a highly ubiquitous dimension, temporal and spatial distance are likewise broadly relevant dimensions that are becoming increasingly pertinent to organizational contexts as technological developments makes it easier for individuals and organizations to work across geographical distance and to make plans far into the future. Thus, for example, a manager may lead a dispersed group and make associated probability judgments about employees located at proximal and distal locations; an organization may make a bid on a project across the globe or right in their backyard and consider the probability of success; a CEO or corporate strategist formulating a short-term vs. long-term strategy may consider the likelihood of a set of obstacles, and a risk manager might consider how to interpret and react to a forecast made for a near or distant time point. In all of these cases (and countless others), the current findings suggest that likelihood judgments will be influenced by distance. So, for example, the low likelihood of an employee not finishing a project might not seem as low when distantly supervised, a project bid with a low chance of acceptance might seem more likely when the project would take place in a distant location, a relatively unlikely set of obstacles (e.g., a severe market downturn, a freak accident) might be given more weight when considering a long-term, rather than short-term, time frame, and an unlikely risk may seem more relevant when an output of a long term projection. In contrast, likely outcomes will seem even more likely with increased proximity. Being aware of this tendency may provide a useful check for decision-makers and managers, who may gain by asking themselves whether they might respond differently within a context if the context was closer or farther away.

Moreover, the broad relevance of distance is not only a matter of the many domains in which temporal and spatial distances are relevant, but also the types of temporal and spatial distances that may exhibit similar effects. That is, while the current studies relate probability to straightforward manifestations of temporal and spatial distance, recent research has connected more and more concepts to these distance dimensions (e.g., past distance in time, mere physical presence; for a recent review see Trope & Liberman, 2010), suggesting that the effects demonstrated here represent the surface of a more widespread phenomenon. Likewise, although the current investigation did not focus on social distance given existing research on self/other probability judgment that already established a similar empirical pattern (e.g., Chambers et al., 2003; Kruger & Burrus, 2004), this dimension should broadly relate to probability judgment as well, even when social distance is not operationalized as self/other distinctions. Thus, likely things should feel like matches for similar others, others we are close to emotionally, and others we are culturally connected to, whereas unlikely things should feel like matches for dissimilar others, others we are distant from emotionally, and others we are culturally distinct from. In a related point, while the current studies' focus was on whether likely and unlikely events are differentially associated with contexts that differ in objective distance (e.g., a location 3 miles away vs. one 3000 miles away), it may also be possible to emphasize an event's proximity or distance (i.e., to manipulate *psychological* distance separately from actual distance; see Alter & Oppenheimer, 2008, for a description of one methodology that accomplishes this), in an attempt to influence these judgments. Thus, for example, one might be able to influence the bets made about an event occurring in a fixed location by emphasizing the location's proximity (e.g., "only a short taxi ride away") vs. the location's distance (e.g., "an extremely long 3 hour walk away").

Conclusion

Drawing on a probability-as-distance account, the current studies suggest that people relate probability to other distances, linking unlikely outcomes with distant times and locations, and likely outcomes with proximal times and locations. This research adds to prior findings which point to a shared activation of distance concepts, exploring implications of this for the highly consequential outcome of probability judgment. Such judgments were measured directly, as well as via a number of important judgments that should be influenced by shifts in likelihood-related intuitions (e.g., betting behavior, insurance purchase recommendations, and surprise in reaction to likely and unlikely events). Given the wide relevance of probability and the many different ways in which

contexts can be more or less remote, a presumably far wider range of decisions, judgments, and evaluations can be influenced by the association focused on here. Future research should examine such possibilities, more fully exploring implications of a probability-as-distance framework for the judgments and decisions that individuals make on a daily basis.

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References

Alter, A. L., & Oppenheimer, D. M. (2008). Effects of fluency on psychological distance and mental construal (or why New York is a large city, but New York is a civilized jungle). *Psychological Science, 19*, 161–167.

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.

Chambers, J. R., Windschitl, P. D., & Suls, J. (2003). Egocentrism, event frequency, and comparative optimism: When what happens frequently is "more likely to happen to me". *Personality and Social Psychology Bulletin, 29*, 1343–1356.

Fehr, E. (2002). The economics of impatience. *Nature, 415*, 269–272.

Harris, A. J. L., & Hahn, U. (2011). Unrealistic optimism about future life events: A cautionary note. *Psychological Review, 118*, 135–154.

Helweg-Larsen, M., & Shepperd, J. A. (2001). Do moderators of the optimistic bias affect personal or target risk estimates? A review of the literature. *Personality and Social Psychology Review, 5*, 74–95.

Henderson, M. D., Fujita, K., Trope, Y., & Liberman, N. (2006). Transcending the 'here': The effect of spatial distance on social judgment. *Journal of Personality and Social Psychology, 91*(5), 845–856.

Henderson, M. D., & Wakslak, C. J. (2010). Over the hills and faraway: The relationship between physical distance and abstraction. *Current Directions in Psychological Science, 19*, 390–394.

Higgins, T., Idson, L. C., Freitas, A., Spiegel, S., & Molden, D. (2003). Transfer of value from fit. *Journal of Personality and Social Psychology, 84*, 1140–1153.

Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology, 45*, 20–31.

Keren, G., & Roelofsma, P. (1995). Immediacy and certainty in intertemporal choice. *Organizational Behavior and Human Decision Processes, 63*, 287–297.

Krizan, Z., & Windschitl, P. D. (2007). The influence of outcome desirability on optimism. *Psychological Bulletin, 133*, 95–121.

Kruger, J., & Burrus, J. (2004). Egocentrism and focalism in unrealistic optimism (and pessimism). *Journal of Experimental Social Psychology, 40*, 332–340.

Lee, A., & Aaker, J. (2004). Bringing the frame into focus: The influence of regulatory fit on processing fluency and persuasion. *Journal of Personality and Social Psychology, 86*, 205–218.

Liberman, N., Sagristano, M., & Trope, Y. (2002). The effect of temporal distance on level of mental construal. *Journal of Experimental Social Psychology, 38*, 523–534.

Liviatan, I., Trope, Y., & Liberman, N. (2008). Interpersonal similarity as a social distance dimension: Implications for perception of others' actions. *Journal of Experimental Social Psychology, 44*, 1256–1269.

Prelec, D., & Loewenstein, G. (1991). Decision-making over time and under uncertainty: A common approach. *Management Science, 37*, 770–786.

Rachlin, H., Raineri, A., & Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behavior, 55*, 233–244.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology: General, 18*, 643–662.

Todorov, A., Goren, A., & Trope, Y. (2007). Probability as a psychological distance. Construal and preference. *Journal of Experimental Social Psychology, 43*, 473–482.

Trope, Y., & Liberman, N. (2010). Construal level theory of psychological distance. *Psychological Review, 117*, 440–463.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*, 1124–1131.

Tversky, A., & Koehler, D. J. (1994). Support theory: A nonextensional representation of subjective probability. *Psychological Review, 101*, 547–567.

Wakslak, C. J., & Trope, Y. (2009). The effect of construal-level on subjective probability estimates. *Psychological Science, 20*, 52–58.

Wakslak, C. J., Trope, Y., & Liberman, N. (2006). Seeing the forest when entry is unlikely: Probability and the mental representation of events. *Journal of Experimental Psychology: General, 135*, 641–653.

Wallsten, T. S., Fillenbaum, S., & Cox, J. A. (1986). Base rate effects on the interpretations of probability and frequency expressions. *Journal of Memory and Language, 25*, 571–587.

Weber, E. U., & Hilton, D. J. (1990). Contextual effects in the interpretations of probability words: Perceived base rate and severity of events. *Journal of Experimental Psychology: Human Perception and Performance, 16*, 781–789.

Weinstein, N. D., & Klein, W. M. (1996). Unrealistic optimism: Present and future. *Journal of Social and Clinical Psychology, 15*, 1–8.

Windschitl, P. D., & Weber, E. U. (1999). The interpretation of "Likely" depends on the context, but "70%" is 70%-Right? The influence of associative processes on perceived certainty. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 25*, 1514–1533.

Wright, W. F., & Bower, G. H. (1992). Mood effects on subjective probability assessment. *Organizational Behavior and Human Decision Processes, 52*, 276–291.

Zhao, M., & Xie, J. (2011). Effects of social and temporal distance on consumers' responses to peer recommendations. *Journal of Marketing Research, 48*, 486–496.