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Probability as a psychological distance: Construal and preferences

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Abstract

We argue that probability, like space and time, instantiates psychological distance. Unlikely outcomes may seem more remote than likely outcomes and may therefore be construed at a relatively high level. Specifically, when the probability of an outcome is low, ends-related primary features should be more salient than means-related secondary features, but as the probability of the outcome increases, means-related features may become no less and even more salient than ends-related features. Thus, increases in probability should increase the weight of means-related features *relative to* the weight of ends-related features in decisions, thereby decreasing (or even reversing) the preference for a more desirable/less feasible outcome over a less desirable/more feasible outcome. We observed this pattern in two experiments. Analyses of judgments, monetary decisions, and self-reported reasons for decisions showed that the weight of means-related features was more sensitive to changes in probability than the weight of ends-related features in decisions.

Keywords: Judgments; Decision making; Construal; Probability; Psychological distance

Referring to an unlikely event as a *remote* possibility is perfectly understandable in ordinary language. In this paper, we argue that this way of thinking about probability is not just an interesting metaphor but that it has important implications for how people make decisions about likely and unlikely outcomes. Normatively, the probability of an outcome should not affect our preferences. For example, if a person prefers outcome (A) to outcome (B), the preference for (A) over (B) should not change as a function of the probability of obtaining the outcome. Whether the probability of obtaining the outcome is low (e.g., .01) or high (e.g., .99), outcome (A) should be more attractive than outcome (B). However, we argue that the probability of an outcome affects how its attributes are weighted in the decision and, ultimately, the value of the outcome.

Consider the following two events, either of which will occur with some known probability once chosen:

(A) Obtaining 10 free CDs after spending 15 min filling out information on the internet.
(B) Obtaining 1 free CD after a single click on a website.

Each event can be characterized on two dimensions: the number of CDs or what the person is getting and the effort involved in obtaining the CDs or how the person is getting it. At low probability, we hypothesize that people would base their decisions about the attractiveness of the outcome on the central attribute (what the person is getting) ignoring the secondary attribute (how the person is getting it). However, at high probability, both attributes will be important for the decision.[1]

[1] Other attributes may be affected similarly by probability. The same predictions can be made for primary and secondary features of an outcome. For example, at low probability people could prefer a product with 2 positive features central for its quality and 4 negative but inessential features to a product with 2 negative central features and 4 positive but inessential features. CLT predicts that at high probability, the preference could be reversed. The current research focuses on desirability and feasibility because (a) these two aspects are commonly associated with desired products or consumer goods and (b) have been shown to be differentially weighted in time-dependent decisions (Liberman & Trope, 1998).

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We derive our predictions from construal level theory (CLT; Liberman, Sagristano, & Trope, 2002; Liberman & Trope, 1998; Trope & Liberman, 2000, 2003). According to CLT, how people construe events depends on their psychological distance from these events. Construal of psychologically remote events emphasizes their superordinate or central features, whereas construal of psychologically proximate events emphasizes their subordinate or secondary features. For example, compared to imminent activities, remote activities are more likely to be represented in terms of end-states (desirability features) than in terms of specific means for reaching those end-states (feasibility features). Similarly, according to Lewin (1951), when psychological distance is reduced, costs become increasingly relevant.

We argue that the probability of an event is one dimension of psychological distance, and, like other such dimensions (e.g., temporal and spatial distance), may affect the construal level of the event. This reasoning is consistent with research suggesting that the effects of time (delay) and probability (risk) on preferences are equivalent (Keren & Roelofsma, 1995; Prelec & Loewenstein, 1991; Rachlin, Castrogiovanni, & Cross, 1987; Rachlin, Raineri, & Cross, 1991; Weber & Chapman, 2005). According to CLT, these effects are equivalent because they are rooted in psychological distance.

In this view, unlikely outcomes may seem more remote than likely outcomes and may therefore be construed at a relatively high level. The probability of an outcome may thus affect the salience of ends-related superordinate features of outcomes (e.g., getting free CDs), relative to the salience of means-related subordinate features of outcomes (e.g., spending 15 annoying minutes on the web). Specifically, when the probability of an outcome is low, ends-related features should be more salient than means-related features, but as the probability of the outcome increases, means-related features may become no less and even more salient than ends-related features. Thus, when the probability is low, people focus on the "what" aspects of the outcome ("what am I getting?"), whereas when the probability is high, people focus on the "how" aspects ("how am I getting it?"). CLT predicts that increases in probability should increase the weight of means-related features *relative to* the weight of ends-related features in decisions, thereby decreasing (or even reversing) the preference for a more desirable/less feasible outcome (e.g., the 10 free CDs) over a less desirable/more feasible outcome (e.g., one free CD).

It should be emphasized that the probability of an outcome can change the relative salience of attributes. For example, it is not the case that feasibility considerations matter only at high probability whereas desirability considerations matter only at low probability. Primary considerations (e.g., desirability) are likely to be weighted at all levels of probability because they are a source of greater value than secondary considerations. Sagristano, Trope, and Liberman (2002) showed that desirability and feasibility considerations are asymmetric in decisions. Interest in desirability is less dependent on feasibility than interest in feasibility is dependent on desirability. In other words, people assess first the "what" aspects of the outcome ("what am I getting?") and then the "how" aspects ("how am I getting it?"). This finding suggests that feasibility considerations should be more sensitive to changes in probability than desirability considerations.

In Experiment 1, we constructed highly desirable but less feasible outcomes (HD_{LF}) and less desirable but highly feasible outcomes (LD_{HF}) so that the former were preferred to the latter in a direct comparative evaluation. Thus, in all cases the feasibility aspect was relatively minor and readily dismissed in a direct comparison. Then, we presented participants with these outcomes at different levels of probability in separate evaluations. Normatively, as in the direct evaluation, participants should prefer HD_{LF} outcomes to LD_{HF} outcomes at both high and low probabilities. According to CLT, this should be the case only when probability is low. When probability is high, participants should be more likely to weight means-related (feasibility) features in their decisions and this weighting could reduce the perceived value of highly desirable but less feasible outcomes, as well as increase the perceived value of less desirable but highly feasible outcomes. Consequently, participants could either be indifferent between HD_{LF} outcomes and LD_{HF} outcomes, or even prefer the latter to the former.

In Experiment 2, we presented HD_{LF} outcomes and LD_{HF} outcomes to participants in direct comparative (joint) evaluations at low and high probabilities. Research shows that joint and separate evaluations can often elicit different preferences (Bazerman, Loewenstein, & White, 1992; Hsee, 2000; Hsee, Loewenstein, Blount, & Bazerman, 1999; Hsee & Zhang, 2004). Specifically, in direct or joint evaluations participants can compare outcomes on the attributes that are deemed more important and quantitatively different (e.g., 1 CD vs. 10 CDs; see Hsee & Zhang, 2004). This process should produce a preference for HD_{LF} outcomes to LD_{HF} outcomes, especially in cases where feasibility costs are minor (as in the current problems). Moreover, because probability is the same for both outcomes and, thus, irrelevant to the comparison of attributes, changes in probability should not affect preferences. In this context, it is interesting to note that Weber and Chapman (2005) failed to find effects of time delay and risk on choices in joint evaluations.

Although differences in feasibility of outcomes can be dismissed in joint evaluations, they can affect decisions in separate evaluations. In Experiment 3, we manipulated both ends-related features (desirability) and means-related features (feasibility) of outcomes. Because central ends-related features are considered at both high and low probabilities, we expected that high desirability outcomes would be more attractive than low desirability outcomes independent of probability. However, because means-related features are likely to be considered only when probability is high, we expected that high feasibility outcomes would be more attractive than low feasibility outcomes only when probability is high. In this experiment, we also measured

the relative weights of ends-related and means-related reasons in participants' decisions. If probability affects construal of the outcomes, ends-related reasons should predict participants' decisions at both levels of probability, but means-related reasons should predict these decisions only when probability is high.

Experiment 1

Participants were asked to make decisions about four different outcomes that were presented as either likely or unlikely. Each outcome could be characterized on two attributes: its desirability (the central attribute in the decision) and its feasibility (the secondary attribute). We constructed these outcomes so that if the desirability was high, the feasibility was low (HD_{LF}), and if the desirability was low, the feasibility was high (LD_{HF}).

Method

Participants

Forty-one undergraduates at New York University (NYU) volunteered for the study. Participants were approached in an NYU dormitory and asked to fill out a questionnaire. In addition, seventeen undergraduate students were asked to directly compare the outcomes.

Procedures

Participants were told that a number of companies in New York had started promotional campaigns for their products and services geared at young people, and that some of them had offered a special promotional plan to NYU students. Each participant was presented with four different descriptions of promotional campaigns. These were described as campaigns sponsored by Tower Records, Metro Transit Authority (MTA), Barnes and Noble, and Loews Theaters—all highly recognizable companies in NYC. After reading the description of each promotional campaign, participants rated their willingness to sign up for the campaign on a scale from 1 (not at all willing) to 10 (extremely willing). At the end of the study, all participants were debriefed.

The design was a 2 (probability: high vs. low) × 2 (outcome: HD_{LF} vs. LD_{HF}) within-subjects ANOVA. Each of the four descriptions of promotional campaigns—Tower Records, MTA, Barnes and Noble, and Loews Theaters—presented to participants represented one of the cells of the experimental design. Four different versions of each campaign were created (high or low probability combined with HD_{LF} or LD_{HF} outcomes), and the content of the descriptions was counterbalanced across participants such that participants in different conditions received different combinations of probability and features for any given campaign. The order of the descriptions was randomized for each participant.

Under high probability, participants were told that if they signed up for the campaign, they were almost certain to receive a voucher for the company's products. Under low probability, participants were told that they would have about a 1 in 100 chance of receiving a voucher. Within each probability level, the campaign was described as offering either an HD_{LF} outcome or an LD_{HF} outcome. For example, in the Tower Records description, the highly desirable outcome entailed receiving 10 CDs. However, for the student to claim the CDs, the voucher had to be presented at the Tower Records store located on 65th Street and Broadway in Manhattan—an inconvenient option for NYU students, whose campus is around 4th Street, about a 30-min ride away by subway. The less desirable outcome was receiving one CD, but the CD could be claimed at any Tower Records store—a highly convenient option, because one of the Tower Records stores is located on 4th Street and Broadway.

LD_{HF} and HD_{LF} prospects were manipulated as follows: Tower Records (claiming 1 CD at a convenient store vs. 10 CDs at an inconvenient store); Loews Theaters (tickets for old movies for a week at any theater vs. tickets for new releases for three months at a specific theater); Barnes and Noble ($15 for books at any store vs. $150 at an inconvenient store); Metro Transit Authority (one-week subway card claimed at any station vs. three-month card claimed at an inconvenient location).

Results and discussion

Direct joint evaluations

Seventeen undergraduates, who did not participate in the experiment, were presented with each pair of HD_{LF} and LD_{HF} outcomes and asked to rate them on a scale from 1 (not valuable at all) to 10 (extremely valuable). For each campaign, the HD_{LF} outcome was perceived as more valuable than the LD_{HF} outcome, $ts(16) > 3.00$, $ps < .008$. Across campaigns, the mean rating for HD_{LF} was 8.06 ($SD = 1.50$) and the mean rating for LD_{HF} was 5.74 ($SD = 1.86$), $t(16) = 5.24$, $p < .001$.

Separate evaluations

As shown in Table 1, whereas under low probability participants preferred HD_{LF} to LD_{HF} outcomes, they preferred LD_{HF} to HD_{LF} outcomes under high probability, $F(1,40) = 4.00$, $p < .05$, for the interaction of probability and type of outcome. The main effect of probability was significant, $F(1,40) = 11.31$, $p < .002$, indicating that participants preferred high probability ($M = 8.05$, $SD = 1.95$) to low probability outcomes ($M = 6.87$, $SD = 2.37$). However, while the attractiveness of LD_{HF} outcomes increased significantly as the probability increased, $t(40) = 3.49$, $p < .001$, the attractiveness of HD_{LF} outcomes did not increase significantly, $t(40) = 1.26$, $p > .21$.

These findings suggest that means-related features were (over)-weighted in decisions when probability was high but not when probability was low. In terms of CLT and consistent with the Lewinian analysis of conflict (Lewin, 1951),

Table 1
Attractiveness of highly desirable but less feasible outcomes (HD_{LF}) and less desirable but more feasible outcomes (LD_{HF}) as a function of probability of obtaining the outcome

Experiment	Probability	Outcome		
		HD_{LF}	LD_{HF}	Difference
Experiment 1				
Judgments	Low	7.15 (2.52)	6.59 (3.01)	.56
	High	7.68 (2.47)	8.41 (2.00)	−.73
Experiment 3				
Judgments	Low	6.59 (2.45)	5.23 (2.26)	1.36
	High	6.17 (2.49)	6.12 (2.67)	.05
Tickets purchased	Low	5.18 (2.90)	3.82 (2.62)	1.36
	High	4.10 (2.92)	4.26 (2.74)	−.16

Note. Standard deviations (SD) are shown in parentheses. In Experiment 1, judgments measured willingness to sign up for the promotional campaign on a scale from 1 (not at all willing) to 10 (extremely willing). In Experiment 3, judgments measured attractiveness of outcomes on a scale from 1 (not at all) to 10 (extremely) and participants could purchase between 0 (none) and 8 ($2) tickets.

when psychological distance was reduced, the costs of obtaining the outcome become more relevant. As a result, the preference order as revealed in the direct joint evaluations matched participants' preferences only when the probability of obtaining the outcome was low.

Experiment 2

As predicted by CLT, when participants evaluated the outcomes in separate evaluations, they preferred HD_{LF} to LD_{HF} outcomes at low probability, but the preference reversed at high probability. At the same time, in joint evaluations under certainty participants preferred HD_{LF} to LD_{HF} outcomes. If one assumes that the procedure for eliciting preferences (separate vs. joint evaluations) reveals the same preferences, this pattern of results is puzzling. The small increase in probability from .99 to 1 causes a preference reversal. Although prospect theory predicts that small increases in probability leading to certainty can have large effects on decisions (e.g., the certainty effect, see Kahneman & Tversky, 1979), it is unlikely that the increase from .99 to 1 was weighted more heavily than the increase from .01 to .99. More likely, as described in the introduction, the pattern of results can be explained by the different procedures of preference elicitation (Hsee et al., 1999; Hsee & Zhang, 2004).

To test this hypothesis, we presented participants with HD_{LF} and LD_{HF} outcomes in joint evaluations at low and high probabilities. In joint evaluations, participants can compare the outcomes on the primary desirability attribute. Further, because feasibility concerns were minor, differences in feasibility can be discounted. Finally, because the probability of the outcomes is the same, it can be edited out (Weber & Chapman, 2005). These processes should lead to preference of HD_{LF} to LD_{HF} outcomes at both levels of probability.

Method

Participants

Fifty-one undergraduates at Princeton University volunteered for the study. Participants were approached at the main student center at Princeton University and asked to fill out a two-page questionnaire.

Procedures

Participants were informed that the study was concerned with "how people value opportunities as a function of probability," and that it is very important to "consider the likelihood (probability) of winning when responding." In order to further emphasize the importance of probability and reduce the chance that participants would ignore its role in the questions, they were given a simple analogy between the chance of winning (1 or 99%) and what that would entail in terms of getting the winning card in a deck of 100 cards that had the words "win" or "lose" on them in the corresponding proportions.

Participants were then instructed to treat the subsequent series of 10 binary choice options as "lotteries" in which they have a certain chance (1 or 99%) of winning but must first select one option out of each pair before they could "play". The 10 choices included: (1) a Borders Books gift-card, (2) a computer, (3) dinner with a famous speaker, (4) computer furniture, (5) free dinner-for-two at a restaurant, (6) free tickets to a concert, (7) free DVDs from Tower Records online, (8) vacation at an Outer Banks, NC beach-house, (9) an MP3 digital music player, and (10) a cell phone.

Each choice involved one HD_{LF} and one LD_{HF} version. For example, one of the choices was between "a $50 Borders Books gift-card, but you have to fill out an online customer survey for 20 min" (HD_{LF}) vs. "a $10 Borders Books gift-card, but you have to fill out an online customer survey for 5 min" (LD_{HF}). For each choice, participants indicated their preference for the option on the left or the one on the right. HD_{LF} and LD_{HF} options were switched such that the HD_{LF} option was on the right for half of the choices and on the left for the other half, with the trials shuffled such that the more desirable option appeared on the same side at least once every three options.

Participants were given a "1% chance of winning" five of the options and a "99% chance of winning" the other five. Probability and choices were counterbalanced across participants. For example, the choices presented at 1% for half of the participants were presented at 99% for the other half. The choices were blocked by probability (e.g., 5 choices at 1% followed by 5 choices at 99%) and the blocks were counterbalanced across participants. The two counterbalancing schemas created 4 versions of the questionnaire and participants were randomly assigned to one of the versions.

Results and discussion

At both levels of probabilities, participants clearly preferred HD_{LF} outcomes to LD_{HF} outcomes. At low proba-

bility, participants chose the HD_{LF} outcome in 82% of the cases, $t(50) = 12.97$, $p < .001$ (tested against 50%, a baseline of indifference). At high probability, participants chose the HD_{LF} outcome in 83% of the cases, $t(50) = 13.01$, $p < .001$. The two proportions at low and high probabilities were not significantly different from each other, $t < 1$, indicating that the change in probability did not affect participants' preferences.

The results of Experiments 1 and 2 suggest that changes in probability can affect the weighting of attributes in decisions in separate but not in joint evaluations. Although we emphasized to participants that they should pay attention to the probability of the outcomes, it is possible that the probability was edited out in the joint evaluation (Weber & Chapman, 2005). It is also possible that differences in feasibility were discounted in light of differences in desirability. The findings are consistent with research demonstrating that methods of preference elicitation affect the expression of preferences (Hertwig & Chase, 1998; Hsee et al., 1999; Slovic, 1991; Tversky, Sattath, & Slovic, 1988; Tversky & Simonson, 1993).

Experiment 3

Experiment 3 had two objectives: to provide a more complete analysis of the underlying processes and to extend the findings to a more realistic setting, involving not only judgments, but also monetary decisions. The outcomes were presented as part of a lottery in separate evaluations and participants were given the opportunity to purchase lottery tickets. As in Experiment 1, we expected that the increase in probability should increase the weight of means-related features relative to ends-related features in participants' decisions, thereby reducing the difference in attractiveness—and in this study, money spent—between HD_{LF} and LD_{HF} outcomes.

In order to provide a more complete analysis of the underlying processes, we manipulated both ends-related and means-related features, creating 4 types of outcomes (HD_{HF}, HD_{LF}, LD_{HF}, and LD_{LF}), and measured the participants' reasons for their decisions. This allowed us to see how desirability and feasibility contributed independently to participants' preferences, because they were manipulated jointly in Experiment 1. We also manipulated probability between participants rather than within participants, because the latter design might make the probability manipulation transparent and artificially increase the consistency of participants' decisions (Shafir, 1998).

Because central ends-related features are always weighted in decisions, we expected that participants would prefer HD to LD outcomes at both low and high probability. However, participants should prefer HF to LF outcomes only when the probability is high, because means-related features are more likely to be weighted in decisions with the increase in probability. In short, the weight of means-related features should be more sensitive to changes in probability than the weight of ends-related features. This pattern of results would explain the preference reversal observed in Experiment 1.

We also attempted to provide more direct evidence that feasibility and desirability reasons are weighted differentially in participants' decisions as a function of probability. After participants made their decisions, we asked them to list the reasons for these decisions. The participants' reasons were coded in terms of ends-related and means-related aspects. Then, we regressed the decisions on these two types of reasons. If, as we argue, the weight of means-related features increases relative to the weight of ends-related features when probability increases, means-related reasons should be highly predictive of actual decisions when the probability of the outcome is high, but should not predict these decisions when the probability is low.

Method

Participants

One-hundred and forty-six undergraduate students at Princeton University participated in the study for partial fulfillment of a course credit requirement. Eighty-six students participated in the main study and sixty students participated in the joint evaluation study.

Procedures

Participants were run one at a time, in separate rooms equipped with a PC. Participants were told that the Undergraduate Student Government (USG) at Princeton was collaborating with the Psychology Department in an effort to find ways to engage students in campus activities. Participants were told that the USG had made funds available for several promotional opportunities (i.e., the lottery scenarios described below), and we gave each participant \$8 (a bag with 32 quarters) with which to play.

Each participant was presented with four descriptions of prizes: (1) a gift certificate for Borders, an online book retailer; (2) free compact discs from Tower Records, an online music store; (3) a free ticket to "Uncle Vanya," a play by Anton Chekhov; and (4) a free dinner-for-two at a restaurant. After reading each description, participants were asked to rate the attractiveness of the promotion on a scale from 1 (not at all) to 10 (extremely), and then to indicate the number of tickets they wished to purchase, from 0 (none) to 8 (\$2). We asked participants to place the amount of money corresponding to the number of 25¢ tickets purchased (as indicated on computer) into the appropriate bin (one of four bins labeled "Tower," "Borders," "Restaurant," and "Uncle Vanya"—the play). Participants were limited to a maximum expenditure of \$2 per lottery and could choose to put no money down. Participants were limited to \$2 per scenario in order to prevent floor effects in some conditions, should they horde and then use all of their funds on one or two scenarios. At the end of the study, participants were debriefed and informed that the USG was

not associated with the experiment and that the lotteries were not real.[2]

The design was a 2 (probability: high vs. low) × 2 (desirability: high vs. low) × 2 (feasibility: high vs. low) mixed factorial with probability manipulated between participants. The prizes were described either as an almost certain win or a "1 in 100 chance" of being won. The contents of four different versions (LD_{LF}, LD_{HF}, HD_{LF}, and HD_{HF}) of each lottery were counterbalanced across participants. The outcome features were manipulated as follows: Borders, an online book retailer ($50 gift card with a lengthy claiming process vs. $10 with a simple process); Tower Records (10 CDs with a complicated claiming process and a $3.95 shipping and handling fee vs. 2 CDs with a simple claiming process); a play (with famous cast at an inconvenient location vs. local cast at the local theater); restaurant (a dinner-for-two at a fancy restaurant 30 min away vs. two free entrées at a local restaurant).

After obtaining participants' decisions for all scenarios, we then prompted them with each scenario and asked them to explain why they chose as they did. Two judges, blind to the experimental conditions, coded the free-response text data for any mention of means-related (feasibility) or ends-related (desirability) reasons. Desirability responses were coded as either "−1" (item not desired), "0" (no mention of desirability), or "1" (item desired). Feasibility responses were coded as either "−1" (item considered not feasible), "0" (no mention of feasibility), or "1" (item considered feasible). For example, in the case of the book gift certificate scenario, "I love books for myself and as gifts for others" was coded as a positive desirable response (1). "It was going to take too much effort" was coded as a negative feasibility response (−1). The correlations between the two judges' coding for desirability reasons ranged from .81 to .86 across the four scenario types, and the range of agreement was from 89.5 to 91.9%. The correlations for feasibility reasons ranged from .93 to 1, and the range of agreement was from 94.2 to 100%. For the final analyses, disagreements in coding were resolved by discussion.

Results and discussion

Direct joint evaluations

To verify that the HD_{LF} prospects were more valuable than the LD_{HF} prospects, we presented these pairs of prospects to 60 students who did not participate in the experiment and asked them to estimate the overall dollar value of each prospect, in addition to choosing the preferred prospect in each pair. In all four cases, the dollar value of the HD_{LF} prospect was higher than the value of the LD_{HF} prospect, $ts > 6.65$, $ps < .001$. The mean value for the HD_{LF} prospect was $97.70 and the mean value for the LD_{HF} prospect was $25.90, $t(58) = 14.93$, $p < .001$. In 70% of the cases, participants preferred HD_{LF} to LD_{HF} prospects, $t(59) = 6.86$, $p < .001$ (tested against 50%, a baseline of indifference).

Separate evaluations

Before we report the analysis on the complete design, we report the analysis for the mixed outcomes, because this part of the experimental design replicates Experiment 1. As shown in Table 1, the pattern for the mixed outcomes (HD_{LF} and LD_{HF}) was similar to the pattern found in Experiment 1. Participants preferred HD_{LF} outcomes to LD_{HF} outcomes only when the probability was low—$t(43) = 3.11$, $p < .003$ for attractiveness judgments and $t(43) = 2.55$, $p < .014$ for purchased tickets—but they were indifferent when the probability was high, $ts < 1$. As in Experiment 1, these findings suggest that means-related features were (over) weighted in decisions when probability was high but not when probability was low.

This interpretation is consistent with the analysis of the complete design. The triple interaction of probability, desirability, and feasibility was not significant, $F < 1$ for both attractiveness judgments and purchased tickets. As shown in Fig. 1a, participants preferred HF outcomes ($M = 6.26$, $SD = 1.82$) to LF outcomes, ($M = 5.59$, $SD = 1.64$), $F(1, 84) = 10.17$, $p < .001$, but this preference was significant only at high probability, $F(1, 84) = 3.43$, $p < .067$, for the interaction of probability and feasibility. Whereas the LF and HF outcomes did not differ under low probability,

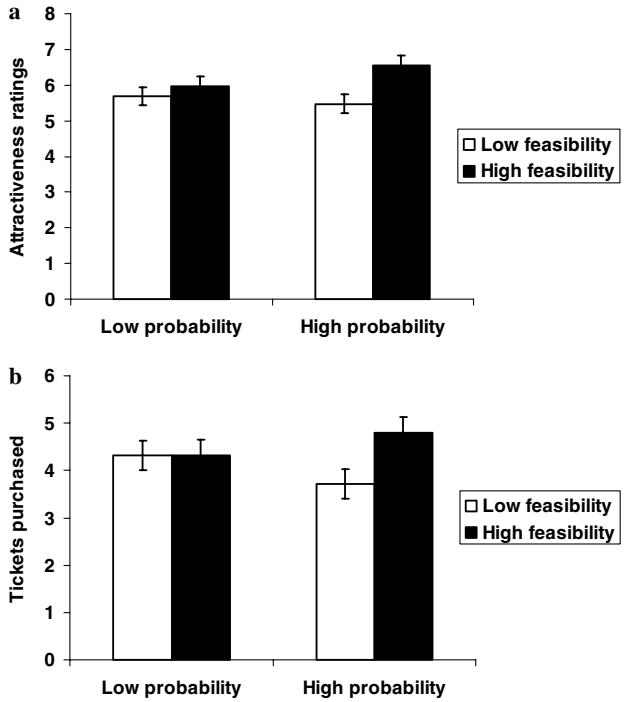

Fig. 1. (a) Attractiveness ratings as a function of probability and feasibility of outcomes. (b) Tickets purchased as a function of probability and feasibility of outcomes. (Data from Experiment 3. Error bars represent standard errors of the mean.)

[2] The reason the lotteries were presented as real was in order to maximize the impact and realism of the scenarios. However, university regulations prevented reimbursing participants who receive course credit with anything other than credit. Therefore, some deception was deemed necessary.

$t(43) = 1.08$, $p > .29$, they did differ under high probability, $t(41) = 3.19$, $p < .003$. As shown in Fig. 1b, the pattern was even clearer for the monetary decisions. Participants purchased more tickets for HF outcomes ($M = 4.55$, $SD = 2.15$) than for LF outcomes ($M = 4.02$, $SD = 2.03$), $F(1,84) = 4.66$, $p < .034$, but that was only the case at high probability, $F(1,84) = 4.66$, $p < .034$ for the interaction of probability and feasibility. LF and HF outcomes did not differ under low probability, $t < 1$, but did differ under high probability, $t(43) = 2.80$, $p < .008$.

As shown in Figs. 2a and b, participants rated HD outcomes ($M = 6.62$, $SD = 1.77$) as more attractive than LD outcomes, ($M = 5.23$, $SD = 1.90$), $F(1,84) = 30.26$, $p < .001$, and purchased more tickets for HD outcomes ($M = 4.86$, $SD = 2.10$) than for LD outcomes ($M = 3.72$, $SD = 2.08$), $F(1,84) = 19.69$, $p < .001$. Although the means suggest that, in contrast to the pattern for feasibility, the difference between HD and LD outcomes decreased with the increase in probability, the interaction of probability and desirability was not significant, $F(1,84) = 1.11$, $p = .30$, for attractiveness ratings, and $F < 1$ for tickets purchased.

Reasons for decisions: manipulation check

At the end of the experiments, participants reported the reasons for their decisions. It is important to show that these reasons reflected the manipulated features in the scenarios. The reasons were classified as desirability-related and feasibility-related, and then coded in terms of their valence (e.g., item not desired vs. item desired; item not feasible vs. item feasible). The range of the valence scores was from −1 to 1. The valence of the participants' reasons for their decisions was submitted to a 2 (Reasons: Desirability-related vs. Feasibility-related) × 2 (Desirability of outcome) × 2 (Feasibility of outcome) × 2 (Probability) mixed ANOVA.

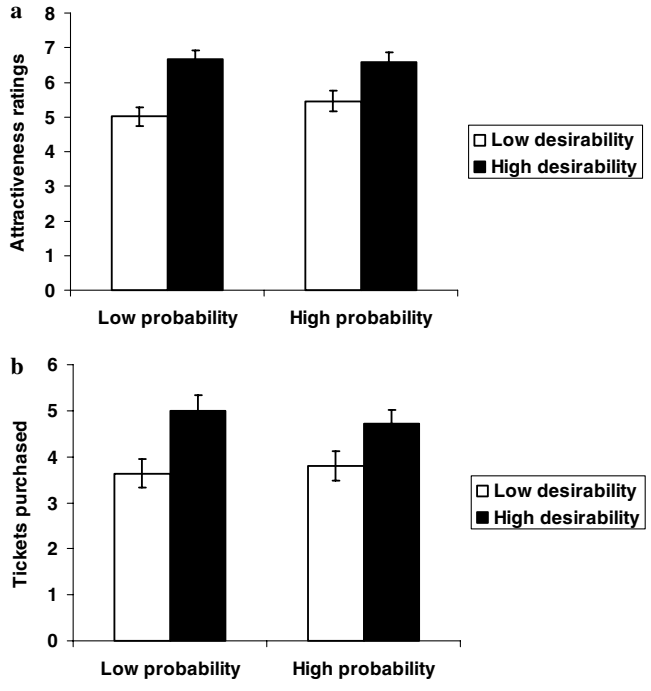

Fig. 2. (a) Attractiveness ratings as a function of probability and desirability of outcomes. (b) Tickets purchased as a function of probability and desirability of outcomes. (Data from Experiment 3. Error bars represent standard errors of the mean.)

Desirability reasons were more positive ($M = .35$, $SD = .38$) than feasibility reasons ($M = -.17$, $SD = .23$), $F(1,84) = 126.61$, $p < .001$, reflecting the difference between potential positive outcomes and the associated costs. Participants reported more positive reasons for HD ($M = .22$, $SD = .30$) than for LD outcomes ($M = -.04$, $SD = .39$), $F(1,84) = 21.00$, $p < .001$. This effect was qualified by interaction with the type of reason, indicating that the desirability manipulation affected more strongly desirability reasons than feasibility reasons, $F(1,84) = 6.38$, $p < .013$. Specifically, desirability reasons increased in positivity from .16 ($SD = .63$) for LD outcomes to .53 ($SD = .50$) for HD outcomes, $t(85) = 4.04$, $p < .001$, whereas feasibility reasons only increased from −.24 ($SD = .32$) to −.10 ($SD = .29$), although this difference was significant, $t(85) = 3.27$, $p < .002$.

Participants reported more positive reasons for HF ($M = .15$, $SD = .38$) than for LF outcomes ($M = .03$, $SD = .31$), $F(1,84) = 5.12$, $p < .026$. As in the case of the main effect of desirability, this effect was qualified by interaction with the type of reason, $F(1,84) = 25.24$, $p < .001$, indicating that the feasibility manipulation affected more strongly feasibility than desirability reasons. Feasibility reasons become more positive, changing from −.35 ($SD = .37$) to .01 ($SD = .33$); $t(85) = 6.45$, $p < .001$, whereas desirability reasons only increased from .29 ($SD = .63$) to .41. ($SD = .47$), $t(85) = 1.34$, $p = .18$.

Finally, reasons were also affected by the probability of outcomes, $F(1,84) = 3.05$, $p < .085$, for the interaction of probability and feasibility, mirroring the findings for the attractiveness and money decisions. When the probability was low, participants did not discriminate between HF and LF outcomes ($M = .10$, $SD = .38$ vs. $M = .07$, $SD = .35$), $t < 1$. However, when the probability was high, participants provided more positive reasons for HF ($M = .20$, $SD = .38$) than LF outcomes ($M = -.02$, $SD = .26$), $t(41) = 2.91$, $p < .006$.

The overall findings show that the reasons that participants reported for their decisions closely reflected the experimental manipulations. When the outcomes were more feasible, the positivity of feasibility reasons increased. When the outcomes were more desirable, the positivity of desirability reasons increased.

Reasons as predictors of decisions

Although the reasons reflected the experimental manipulations, it is not clear whether they predicted the actual decisions. More important, if means-related and ends-related features are weighted differentially in decisions as a function of probability, then desirability and feasibility reasons should play distinctive roles at different levels of probability. Specifically, both types of reasons should be

Table 2
Zero-order and partial correlations between decisions for attractiveness of outcomes and valence of desirability- or feasibility-related reasons

Judgments	Probability			
	Low		High	
	Zero-order	Partial	Zero-order	Partial
Desirability reasons[a]	.50***	.49***	.61***	.66***
Feasibility reasons[b]	.11	.05	.46***	.55***
Tickets purchased				
Desirability reasons[a]	.47***	.46***	.46***	.57***
Feasibility reasons[b]	.10	.04	.29*	.31**

[a] Partial correlations partial out the effects of feasibility reasons.
[b] Partial correlations partial out the effects of desirability reasons.
* $p < .10$.
** $p < .05$.
*** $p < .002$.

important for decisions when probability is high, but only ends-related reasons should be important when probability is low.

In fact, as shown in Table 2, whereas the valence of desirability reasons was highly correlated with both attractiveness and money decisions at both low and high probability, the valence of feasibility reasons was significantly correlated with these decisions only at high probability. To test whether the weights of desirability and feasibility reasons changed significantly from low to high probability, we regressed the attractiveness decisions on the probability of the outcomes, the valence of desirability reasons, the valence of feasibility reasons, the interaction of probability and desirability reasons, and the interaction of probability and feasibility reasons. This analysis showed that while the change in feasibility was significant with the increase in probability, $t(80) = 2.27$, $p < .026$, for the interaction of feasibility reasons and probability, the change in desirability was not significant, $t(80) = 1.12$, $p > .27$. These findings

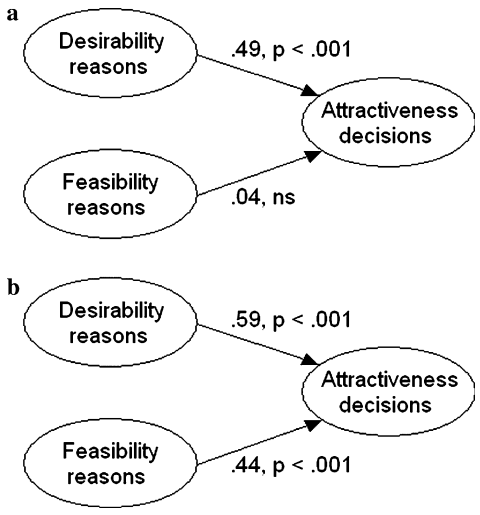

Fig. 3. (a) Standardized regression coefficients of valence of desirability and feasibility reasons as predictors of attractiveness decisions at low probability; (b) Standardized regression coefficients of valence of desirability and feasibility reasons as predictors of attractiveness decisions at high probability. (Data from Experiment 3.)

clearly suggest that means-related features were more sensitive to changes in probability than were ends-related features. The path diagrams (Figs. 3a and b) show the relative contributions of desirability and feasibility reasons in predicting participants' attractiveness decisions at different levels of probability. The pattern was the same for the tickets purchased (see also Table 2).

Discussion

Deriving our predictions from CLT (Trope & Liberman, 2003), we argued that probability, like time and space, is one instantiation of psychological distance. In this framework, low probability events might be perceived as psychologically more distant than high probability events. The upshot is that the probability of an outcome could change how the features of the outcome are weighted in decisions, and could lead to predictable preference reversals at different levels of probability. Specifically, increases in probability should increase the weight of means-related features *relative to* the weight of ends-related features in decisions.

Consistent with this hypothesis, whereas participants preferred "highly desirable but not as feasible" outcomes to "not as desirable but highly feasible" outcomes at low probability, they either preferred the latter to the former or were indifferent at high probability. This was the case, even though the manipulation of means-related features or feasibility was minor and easily dismissed in a direct evaluative comparison of the outcomes. Thus, choices revealed in a direct comparison of the outcomes mapped onto participants' decisions only when the probability was low. These findings suggest that means-related features were weighted in decisions at high but not at low probability. Experiment 2 identified one boundary condition of this phenomenon. In joint evaluations, changes in probability did not affect participants' preferences.

Experiment 3 manipulated both ends-related and means-related features in separate evaluations. In the case of ends-related features, highly desirable outcomes were preferred to low desirability outcomes at both high and low probability. In the case of means-related features, highly feasible outcomes were preferred to low feasibility outcomes only when probability was high. Perhaps, the strongest evidence comes from the analysis of the participants' reasons for their decisions. This analysis showed that whereas ends-related reasons predicted decisions at both high and low probability, means-related reasons predicted decisions only at high probability. That is, the increase in probability affected the weighting of means-related features in decisions but did not affect the weighting of ends-related features.

Generally, the value of outcomes could be decomposed into value derived from ends and value derived from means. When probability is increased, psychological distance is decreased and value derived from means becomes more prominent in decisions. In the current experiments, costs became more relevant to the decision with the increase in

probability even though the costs were relatively minor, as shown in the direct evaluation of outcomes.

Implications for decision-making models

As noted in the introduction, several authors have argued that time and risk have similar effects on preferences (Keren & Roelofsma, 1995; Prelec & Loewenstein, 1991; Rachlin et al., 1987, 1991; Weber & Chapman, 2005). Although consensus has not been reached with respect to the relation between these two dimensions, with some authors arguing that time is the primary dimension (Rachlin et al., 1987, 1991) and others that risk is the primary dimension (Keren & Roelofsma, 1995), the findings of equivalent effects are consistent with the idea of a common psychological mechanism. We argued that in both cases of time and risk, the psychological dimension is distance to the outcome and that this distance affects how attributes are weighted.

Many decision models, e.g., expected utility and prospect theory (Kahneman & Tversky, 1979), assume that probability and value of an outcome are independent. If a person prefers outcome A to outcome B, the probability of obtaining the outcomes should be irrelevant to the preference ordering. Our experiments demonstrate a violation of the independence assumption. This violation has also been demonstrated in prior research (see for a review Weber, 1994) and traced to the difficulty of separating beliefs (probability) and desires (utility), a classic problem of decision analysis. In our research, the violation is traced to the differential weighting of attributes in decisions as a function of changes in probability. This process is independent of the separation of beliefs and desires.

An example of research demonstrating a violation of the independence assumption from a beliefs/desires point of view is Rottenstreich and Hsee's (2001) work. In their experiments, affect-rich outcomes (e.g., a $500 coupon for a vacation in Europe) were preferred to affect-poor outcomes (e.g., a $500 tuition coupon) when the probability was low, but the preference was reversed when the probability was high. These findings were explained in terms of stronger accentuation of the psychophysical S-function relating objective to subjective probabilities as posited by prospect theory (e.g., Kahneman & Tversky, 1979, 1984) for affect-rich than for affect-poor outcomes. In the psychophysics of chance, subjective probabilities or decision weights are modeled as overestimating objective probabilities for small probabilities and underestimating these probabilities for large probabilities. In the case of affect-rich outcomes, these tendencies are accentuated. Specifically, when probability is low, affect-rich outcomes invoke hope of obtaining the outcome, and this hope additionally inflates the subjective probability. When probability is high, affect-rich outcomes invoke fear of not obtaining the outcome, and the fear additionally deflates the subjective probability. These two processes lead to the preference reversal for affect-rich and affect-poor outcomes at different levels of probability. Rottenstreich and Hsee (2001) argued that probability-outcome independence might hold across monetary values but not across affective values (see also Loewenstein, Weber, Hsee, & Welch, 2001).

In the Rottenstreich and Hsee (2001) account, features of the outcome change the decisions, weights or the subjective probability. In our account, probability changes the assessment of the outcome's value. It would be interesting to explore whether these two accounts are complementary. It seems to us that ends-related features and means-related features are conceptually independent of affect. Given the existing data, it is fair to say that the existing experiments do not favor any of the theories.

Conclusions

The present findings and the construal account pose a challenge to normative models of decision-making. Given that superordinate features are a greater source of value, then their influence on choice, relative to that of subordinate features, should be greater for decisions regarding high probability than low probability outcomes. Contrary to this requirement, the present findings suggest that individuals' superordinate, primary concerns are more likely to guide preferences regarding low probability than high probability outcomes. It would seem that decisions are more likely to reflect individuals' true preferences when the probability of obtaining an outcome is low, rather than high. This surprising finding is consistent with our proposal that low probability outcomes are viewed from a mentally distant perspective—a perspective that better enables individuals to discriminate between what is important and what is less important to them.

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