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The effect of regulatory focus on the shape of probability-weighting function: Evidence from a cross-modality matching method☆

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Abstract

Prospect theory (Kahneman & Tversky, 1979, 1984) suggests that when people are presented with objective probabilities they (a) underweight high probabilities (e.g., behave as if 99% likelihood of an event is lower than 99%), (b) overweight low probabilities, and (c) are relatively insensitive to differences among moderate probabilities. We hypothesized that these biases will be found under prevention focus (Higgins, 1997), which can be triggered by security needs, and monetary considerations; but reversed under promotion focus (Higgins, 1997), which can be triggered by self-actualization needs. To test the hypothesis, we developed a cross-modality matching task that allows tapping probability transformations independently from the value of an event. In two studies, participants ($N = 116$ and $N = 156$) drew portions of circles that represented their transformations of 13 different stated probabilities regarding three scenarios (either promotion or prevention). Results in the prevention condition were consistent with prospect theory—providing validity for the cross-modality matching method. Results in the promotion condition indicated both a general elevation (overweighting), which was most evident for moderate and moderate-high probabilities, and minor underweighting for probabilities larger than .80. In the second study, we also assessed chronic-regulatory focus which yielded effects similar to the manipulated-regulatory focus. In both studies, some individuals in the promotion focus groups yielded probability weighting functions with a curvature opposite the predictions of prospect theory; and within each experimental condition there were additional significant differences in the transformation yielded by the putatively similar three scenarios. The results indicate that our cross-modality matching method is very sensitive to context effects and hint at the possibility of applying similar cross-modality matching methods to explore other decision-making processes such as value functions (Kahneman & Tversky, 1979).

Introduction

Prospect theory (Kahneman & Tversky, 1979, 1984) suggests that people psychologically transform stated (objective) probabilities (p) into weighted probabilities ($w(p)$) in a non-linear fashion. Specifically, people overweight very low probabilities ($w(p) > p$) and underweight very high probabilities ($p > w(p)$). The transformed probabilities are not observed directly, but can be inferred from choice decisions, and hence are called decision weights. For example, most respondents (72%) prefer a gamble of receiving 5000 pounds with a probability of .001 rather than receiving 5 pounds for sure (Kahneman & Tversky, 1979; Problem 14). If

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people behaved according to normative prescriptions they would evaluate each prospect by its value and expectancy (by multiplying the value with its probability). If people would follow this prescription they should show indifference between the prospects of 5×1.00 and $5000 \times .001$ because they carry the same expected value (5). But the modal choice suggests that people have a clear preference for the gamble. If people treated monetary gains in a linear fashion, one could infer that $w(.001) > .001$ because $5/5000 = .001$. However, it is accepted that psychological value (v) of money is also psychologically transformed with a concave function such that $1000 \times v(5) > v(5000)$. Thus, the more concave is the value function, the stronger is the bias that can be inferred in $w(.001)$. Similar phenomena can be demonstrated for large values of p.

To explain this effect, two constructs are evoked: reference points and diminishing sensitivity (e.g., Tversky & Fox, 1995). The reference points on the weighing-probability function are certainty and impossibility. As one moves away from the reference points one loses sensitivity to change in probability. Thus, people are most sensitive to changes in probabilities nearest to the endpoints.

The predicted bias in $w(p)$ relative to p received substantial support (Camerer & Ho, 1994; Gonzalez & Wu, 1999; Tversky & Fox, 1995; Tversky & Kahneman, 1992; Wu & Gonzalez, 1996). However, the magnitude of the effect was predicted to vary slightly for probabilities framed as successes versus failures (Tversky & Fox, 1995). Moreover, the transformation bias was shown to be affected by the degree of the context emotionality (Rottenstreich & Hsee, 2001). We further suggest that context with high emotionality (both regarding success and failure) will influence $w(p)$ differently as a function of regulatory focus (Higgins, 1997). The typical research of $w(p)$ involves probabilities associated with monetary gains and losses. Contexts that involve money are likely to evoke either power or security needs (Ronen, 1994, Chapter 5). Security needs, and to some degree power needs, are likely to evoke prevention focus where the dominant goal is *to avoid* pain (Higgins, 1997, 1998). In contrast, needs such as self-actualization are likely to evoke promotion focus where the dominant goal is *to approach* pleasure (Higgins, 1997, 1998). Given that self-actualization needs are typically absent from decision-making research, the key goal of this paper is to develop and test hypotheses regarding the varying effects of underlying motivations on probability transformation.

Testing the effect of needs on the probability transformations with the standard method is problematic because the standard method relies on inferring $w(p)$ from choices regarding quantifiable prospects. To overcome the difficulty in assessing $w(p)$ for non-monetary prospects, the second goal of this paper is to develop a cross-modality matching method to estimate $w(p)$ directly.

To derive the hypotheses, we first review the pertinent motivational literature.

Higgins's self-regulation theory

Higgins (1997, 1998) proposed that people have two basic self-regulation systems. One system regulates the achievement of rewards and focuses people on a promotion goal. In contrast, the other system regulates the avoidance of punishment and focuses people on a prevention goal. The focus of self-regulation—prevention or promotion—is determined by at least three antecedents (Higgins, 1998): prevention focus is activated by security needs, strong obligations, and the framing of the situations in "loss versus non-loss" terms; promotion focus can be triggered by growth and development needs (Brockner & Higgins, 2001; labeled nurturance needs in prior works), strong ideals and the framing of the situations in "gain versus non-gain" terms.

Each focus has different consequences for perception, for decision-making, and for emotions (Higgins, 1997, 1998). Under prevention focus people are more likely to be sensitive to the presence or absence of punishment, use avoidance strategies, monitor errors of commission, and experience emotions ranging from agitation to quiescence. In contrast, under promotion focus, people are more likely to be sensitive to the presence or absence of rewards, use approach strategies, monitor errors of omission, and experience emotions ranging from elation to dejection.

Two feature of Higgins's theory are relevant here. First, one important feature is the prediction that security needs evoke prevention focus and hence sensitivity to punishments, and that growth and development needs evoke promotion focus and hence sensitivity to rewards. This motivational dichotomy is well recognized in the decision-making literature in the form of security versus aspiration or potential-mindedness (Lopes, 1987, 1995). Second, the regulatory foci are thought of as rich syndromes that differ from each other on multiple variables. The activation of a focus entails changes in perceptual process such as eagerness versus vigilance in signal detection, physiological processes such as the flexion versus tension of arm pressure (Forster, Higgins, & Idson, 1998), affective processes (Brockner & Higgins, 2001) and cognitive processes. Thus, rather than searching for the core variable that either induce or is influenced by these foci, we assume that multiple variables operate in differentiating these foci and that by considering the nature of the needs inducing these foci, we would better understand the total effect of the sets of variables induced by each focus.

Accordingly, we next review the relevant need literature.

Promotion and prevention in needs and values

Higgins proposed that the prevention focus system relates to duties and obligations (oughts) and satisfies security needs, whereas the promotion focus system relates to accomplishments and aspirations (ideals) and satisfies nurturance needs (Higgins, 1997) and growth needs (Brockner & Higgins, 2001). Higgins specifically refers to Maslow's need hierarchy theory (Maslow, 1965) and argues that Maslow's security needs are linked with prevention focus and that Maslow's self-actualization needs are linked with growth needs and with promotion focus.

Maslow's (1965) theory has two elements: taxonomy of needs and an argument about a hierarchy among the needs, where only the taxonomy is relevant to our investigation. The putative basic needs are physiological, safety (security), belongingness (love), esteem, and self-actualization needs. Early reviews rejected the five-need taxonomy, but recognized a possibility of two classes of needs: (Wahba & Bridwell, 1976): deficiency needs (safety, love, and respect from others) versus growth needs (self-respect, achievement and self-actualization). An alternative two-level classification and hierarchy—Wahba and Bridwell's (1976)—suggests maintenance needs (physiological and safety) versus growth needs (belongingness, esteem, and self-actualization). It is also interesting to note that a two-class dichotomy similar to the prevention-promotion dichotomy also appears in Maslow's early writing (Wahba & Bridwell, 1976).

More recent lines of research on motivation and values are more supportive of Maslow's taxonomy. Researchers who applied smallest space analysis (a type of non-metric multidimensional scaling) to 14 work-related needs found four groups of needs: Physical and Security, Self Actualization, Social and Esteem (Ronen, 1979; Ronen & Kraut, 1980; Ronen, Kraut, Lingoes, & Aranya, 1979; Ronen & Shenkar, 1986; Shenkar & Ronen, 1987). In review, Ronen (1994) indicated that work needs in 15 different cultures yield similar two-dimensional maps of needs containing four distinct regions conforming to the a priori classification. In these analyses, security items were clustered in the same region and were most separated from self-actualization items that were clustered in a different region. The extremes of the smallest space analysis maps found by Ronen are shown schematically in Fig. 1. Fig. 1 also shows other constructs that are likely to correspond to Maslow's constructs, consistent with Ronen (1994) who recognized the similarity between various need theories.

A structure similar to Fig. 1 is proposed in value theory (Schwartz, 1992) that was developed and tested independently from need research. Values are considered to be desirable, trans-situational goals reflecting both biological needs and conformity to social pressures that serve as guiding principles in one's life (Schwartz,

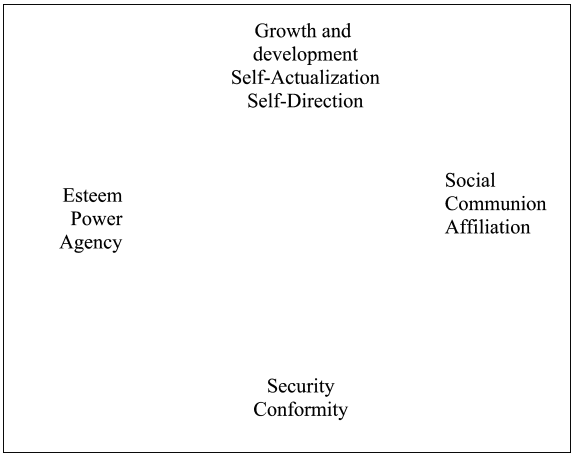

Fig. 1. A schematic map of the dimensions that underlie Ronen's (1994) and Schwartz's (1992) empirical findings regarding the structure of needs and values.

Lehmann, & Roccas, 1999). The theory (Schwartz, 1992) postulates ten values organized as a circle: Power, Security, Conformity, Tradition, Benevolence, Universalism, Self-Direction, Stimulation, Hedonism, and Achievement. Adjacent values tend to be compatible whereas values in opposing positions tend to be in conflict. For example, "the pursuit of novelty and change (stimulation) is likely to undermine preservation of time-honored customs (tradition)" (Schwartz et al., 1999, p. 110). The value circle is organized by two sets of higher-order values that are in conflict: change (stimulation and self-direction) versus conservation (security, conformity, and tradition) and self-enhancement (power, achievement, and hedonism) versus self-transcendence (universalism and benevolence).

Empirical maps of 57 values obtained with smallest space analysis across different national cultures (for a recent report that contains already 57 cultures see Sagiv & Schwartz, 2000) uncovered a circumplex structure. In this structure, security value conflicts with the value of self-direction, defined as "independent thought and action-choosing, creating, exploring" (Schwartz et al., 1999). This structure is very similar to a circumplex found in the analysis of needs (Ronen, 1994) where security needs are most different from self-actualization need (Ronen, 1994).

In summary, two different approaches to the content of human motivations—an empirical tests of Maslow's theory (Ronen, 1994) and values theory (Schwartz, 1992)—have yielded a similar two-dimensional space representation. One dimension or axis ranges from security needs, and security values, to self-actualization, and self-direction. We suggest that this axis in the structure of needs and values reflects Higgins's differentiation between security and development needs, which are considered in his theory as precursors of prevention and promotion focus. Thus, activating

security needs should yield behaviors that characterize the prevention system, whereas activating self-actualization needs should yield behaviors that characterize the promotion system. In contrast, activating needs that can be projected to the middle of this axis—belongingness (affiliation) and esteem (power) needs—can activate either promotion or prevention focus. Hence, needs and values that lie in the middle of this axis are likely to yield mixed effects.

Importantly, if need for money (salary) is projected on the two-dimensional space into an imaginary axis ranging from security to self-actualization it will be found on a point in between the extremes of security on the one hand and self-actualization on the other hand (see Ronen, 1979, 1994; Ronen & Kraut, 1980; Ronen et al., 1979). Similarly, the value of power (containing items such as wealth) is also located on a point between values representing change such as self-direction and values representing preservation such as security with a greater proximity to security (Schwartz, 1992). Yet, on the basis of empirical data ($N > 10,000$), power and security are generally more correlated than either of them is with self-direction; and self-direction is less positively correlated with security than with power (Schwartz & Boehnke, 2004). Thus, choice problems involving money are likely to induce a mix focus, where prevention focus is more likely to dominate monetary decisions for most people under most situations. This suggests that issues involving money cannot create a pure promotion focus. Indeed, several researchers in the domain of risk-taking proposed that decision makers oscillate between fear (prevention) and hope (promotion) and thus their decisions should be modeled as a mixture of these motives (Lopes, 1987). Interestingly, prospect theory was demonstrated "mainly with monetary outcomes" but was argued to be "readily applicable to choices involving other attributes, e.g., quality of life" (Kahneman & Tversky, 1979, p. 288). Yet, Tversky and Kahneman (1991) noted that "loss aversion appears to be more pronounced for safety than for money ... and more pronounced for income than for leisure" (p. 1054). Similarly, scenarios regarding security (life and death) produce stronger framing effects than scenarios regarding money and property (Wang, 1996). This pattern seems like traversing between security values to hedonism and self direction values on Schwartz's map which might reflect decisions largely driven by prevention focus to decisions largely driven by promotion focus. This pattern suggests that pure promotion focus may lead to biases not typically explored in the decision-making literature.

Before we develop our hypotheses, it is important to note that context effects are well recognized in the literature (for a comprehensive review see Rettinger & Hastie, 2001). Context may differ not only in their motivational properties, but also in the ease of constructing a narrative account of scenarios. Moreover, some motivational biases are predictably orthogonal to those considered here. For example, choices involving moral dilemmas are likely to invoke unique decision processes (Rettinger & Hastie, 2001). Yet, moral issues are likely to be orthogonal to regulatory focus because some moral issues are more about prevention (the obligation to help a needy family member) where others are more about promotion of ideals (teaching writing and reading in other nations or helping "doctors without borders"). Therefore, our hypotheses can be useful for organizing one set of contextual features that is likely to have an important contribution to the decision-making process, but cannot account for all the known contextual effects on decision making.

Hypotheses

Under prevention focus, people are likely to have heightened sensitivity to information near the reference points of impossibility and certainty. When one is concerned with avoiding a threat, assurance of 99% safety is not enough and 1% threat is too big to tolerate. Similarly, even 1% chance of avoiding harm will not be ignored and 99% chance of a loss will still keep people hopeful to avoid disaster. Paying special attention to extreme probabilities may be evolutionary advantageous. For example, transforming one's knowledge of 1 person out of 100 dying after eating mushrooms into a weighted probability of 30% may be advantageous. Similarly, transforming one's knowledge of 99 persons out of 100 succeeding to swim across a river with strong currents into a weighted probability of 70% may also be advantageous. In both cases, the weighted probability would lead a person to be extra cautious and the bias may pay off in terms of survival. Thus, under prevention focus the shape of $w(p)$ predicted by prospect theory (Kahneman & Tversky, 1984) is likely to prevail.

However, under promotion focus, people may have low sensitivity to information near the reference points of impossibility and certainty. When people are driven by self-actualization needs to learn, to explore and to master their environment they may seek diagnostic tasks and circumstances. A task with moderate success probability is more diagnostic of one's ability and environmental contingencies. Hence, a person who will consistently chose tasks with moderate-success probabilities, is likely to gain better diagnosis of one's abilities and use this information to set challenges. In parallel, ignoring extreme probabilities may be evolutionary advantageous for promotion goals. Approaching a goal with a stated probability of 99% is not useful for one who wants to gauge one's improvement in competence because of the likely lack of informational gain. Similarly, approaching a goal with a probability of 1% may be perceived as a waste of resources needed to gain

mastery and competence. Therefore, when people are driven by self-actualization needs, a statement that one has 99% chance that a goal will be met would be perceived as certainty whereas 1% chance of meeting these goals will be perceived as useless and practically nil.

This analysis suggests that promotion focus, relative to prevention focus, will lead people to be more sensitive to differences among moderate probabilities and less sensitive to extreme probabilities. Moreover, under promotion focus, the cognitive-reference point may be at some intermediate level (we have no theory to justify any intermediate value as an exact reference point, but suggest that possibilities may at times serve as cognitive standards).

Parenthetically, the possibility that self-actualization needs and promotion focus evoke possibility as a cognitive standard is consistent with investigations in the motivation literature. Ronen (1994) suggested that Maslow's self-actualization need largely overlaps with the construct of need of achievement (McClelland, 1961). McClelland (1961), in turn, suggested that people high in need of achievement set goals with a probability of .5, whereas people with low need of achievement set goals at the extremes (as to avoid a diagnosis of their ability). A review of pertinent data (Shapira, 1989) suggests that people tend to set goals with moderate difficulty (perceived likelihood of success around .3). These observations suggest that at times people pay attention to possibilities, which may serve as cognitive anchors.

Thus, if our argument is valid, people distort stated probabilities as argued by Kahneman and Tversky (1984), but the direction of the distortion is also determined by the operating regulatory focus.

Note that some of the differences in sensitivity to probability changes in the moderate region versus the extreme regions can be accounted by statistical effect size (amount of information). For example, the statistical effect size of changing from 1 to 2% is $\phi = .338$ or an odd ratio 2.02, whereas the effect size of changing from 51 to 52% is $\phi = .02$ or odd ratio of 1.04. Thus, some of the 'bias' in probability weighting may only be a function of natural transformation into a more informative scale—an issue which is beyond the scope of this paper. Our hypotheses, however, suggest that beyond any cognitive transformation that is due to differences in information carried by different probabilities, motivated biases driven by adaptation forces are likely to affect probability perceptions. Specifically:

Hypothesis 1. For high stated probabilities ($p \geqslant .8$), contexts pertaining to self-actualization and invoking promotion focus will lead to overweighting of p, that is, $w(p) > p$; contexts pertaining to security and invoking prevention focus will lead to underweighting of p, that is $p > w(p)$.

Hypothesis 2. For moderate stated probabilities ($.2 < p < .8$), contexts pertaining to self-actualization and invoking promotion focus will lead to greater sensitivity than contexts pertaining to security and invoking prevention focus. That is, the slope of $w(p)$ in the moderate region will be steeper for promotion focus than for prevention focus.

Hypothesis 3. For low stated probabilities ($p \leqslant .2$), contexts pertaining to self-actualization and invoking promotion focus will lead to underweighting of p, that is, $w(p) < p$; contexts pertaining to security and invoking prevention focus will lead to overweighting of p, that is $p < w(p)$.

Our hypotheses are shown graphically, without commitment to exact function, in Fig. 2. The hypotheses at this stage do not differentiate between losses and gains in the two foci because Tversky and Fox (1995) predicted that losses versus gains would only slightly change the curve, but would not change the general properties of underweighting of large probabilities and overweighting of small probabilities. It should be expected though, that it will be easier to induce pure prevention focus with a loss frame and pure promotion focus with a gain frame because the prevention system is compatible with avoiding punishment and the promotion focus is compatible with obtaining rewards (Higgins, 2000).

Indirect versus direct estimations of $w(p)$

The second goal of this paper is to demonstrate a novel method, based on cross-modality matching, to directly assess psychological transformation of probabilities. Weighted probability or $w(p)$ were typically assessed by various methods of extracting certainty equivalents (Gonzalez & Wu, 1999) which involves asking participants to accept or reject various monetary

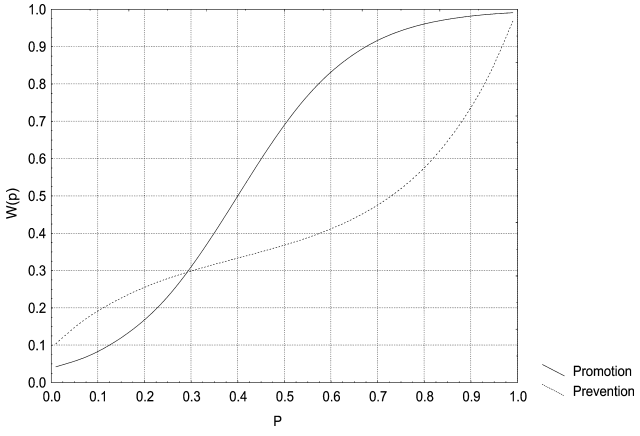

Fig. 2. Hypotheses: $w(p)$ as a function of p and self-regulation focus.

prospects. Specifically, people are asked to choose between certain amounts of payment and gambles that potentially provide a higher payment (with smaller-than-unity probabilities). Based on the choices, aided by some assumptions, the weighted probability used by the respondent is inferred from the decision(s). This procedure has two limitations. First, the use of money as part of the stimulus may divert motivation away from self-actualization needs and promotion focus. Second, the estimations of the decision weights are based on assumptions (e.g., the shape of the value function). To overcome this limitation, some authors suggested the construct of gut feeling of probability (Windschitl & Young, 2001). Measuring feeling of probability can allow both to gauge probability transformation in non-monetary domains and to avoid the use of assumptions.

However, the typical measures used to assess feeling of probabilities are based on rating scales. For example, respondents can be asked to rate their gut feeling on a 9-asterisk horizontal scale where the ends are whether one feels that their chances (of winning a raffle for example) are 'not good at all' to 'very good.' Such scales suffer from vagueness of the meanings of the extremes which are very subjective (for a comprehensive review see Bartoshuk et al., 2003) and may lack sensitivity for within-subject comparisons of feeling regarding a wide range of probabilities. The classical solution to this measurement problem is to use one of S.S. Stevens's direct-scaling methods (Bartoshuk et al., 2003). The best known method of this family of measurement tools is the cross-modality matching (Gescheider, 1988), in which a respondent matches intensity of one modality (e.g., pain), which is not directly accessible, with the intensity of another modality (e.g., loudness) that can be measured objectively. A precursor of this method is the Visual Analogue Scale (VAS), which is presented as vertical line with labeled extremes. The respondent is asked to match his internal feelings as a point on the "thermometer". VAS is very popular in medicine (e.g., pain estimation): PubMed search yielded over 15,000 citations of VAS from 1967 to 2001 (Bartoshuk et al., 2003) but Social Science Citation Index showed less than 50 citations from 1963 to 2003 mostly in health-related journals. The weakness of VAS relatively to cross-modality matching is that like a rating scale it depends on subjective definitions of extremes. Yet, VAS could be superior to cross-modality matching for assessing probabilities because the extremes have clear meaning (impossibility and certainty). Thus, VAS can serve as a tool to obtain cross-modality matching as a visual analogue of feelings of probabilities.

In choosing the visual analogue we opted to use circles, rather than lines or 'thermometers' on a hunch that due to synaesthesia—dedifferentiation of two modalities (Glicksohn, Steinbach, & Elimalach-Malmilyan, 1999)—expression of feelings, as opposed to logical percepts, would be easier on a circle than on a line. This hunch is consistent with findings that 100% of people match the pair of words soft-hard with the shapes of circle-square, sphere-cube, and with the term curved-angular (Liu, 1997; Liu & Kennedy, 1997). That is, we initiated this research with circles, assuming that it would be easier for people to match feelings to a circle than to a straight line which may, in turn, signal a requirement to be logical and accurate (i.e., reflect probabilities as exact proportion of the line, rather than express feelings).

To measure $w(p)$ directly we asked respondents to express the *feeling* of certainty that an event will occur given a stated probability. If our measurement approach captures the same biases captured in deriving $w(p)$ from choices, then we should be able to replicate prospect theory's $w(p)$ function, at least in the prevention domain.

Finally, as in prospect theory, we do not refer to subjective probability (one's estimates for a probability of an event for which the probability is unknown to the decision maker), but we seek to gauge how people transform stated probabilities.

Study 1

Method

Participants

A total of 116 students (51 males), with mean age of 22.7 years, from The Hebrew University and Tel Aviv University participated in the main experiment in exchange for experimental credit. Students were drawn from various departments. In addition, 45 students were approached during class time, with instructor permission, and were asked to participate in the control experiment.

Measures

Weighted probability—$w(p)$. For each stated p, we asked participants to express their *feelings of certainty* that the event will occur by marking the proportion of circle that corresponds to their feelings, on a continuum ranging from "the event is absolutely impossible" to "the event will certainly occur" (see Fig. 3). Participants were trained with three examples. The marked portion of the circumference of the circles (in degrees out of 360) was used to measured $w(p)$. Two judges measured a sample of circles and obtained practically complete agreement. Therefore, one person was used to measure $w(p)$ for the entire sample.

Procedure

Participants were randomly assigned to estimate $w(p)$ for either three sets of promotion scenarios ($N = 59$) or three sets of prevention scenarios ($N = 57$). For each set of the three scenarios, they were asked to estimate $w(p)$

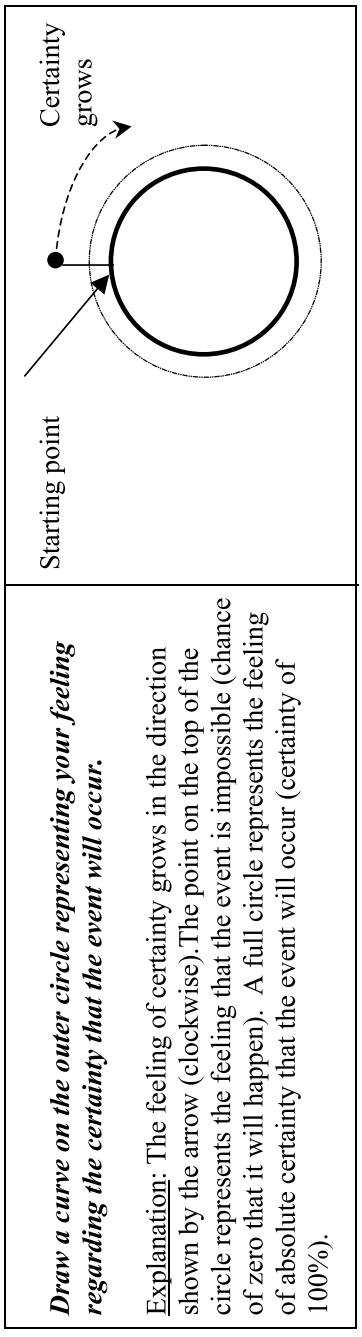

Fig. 3. Scales used to gauge participants' $w(p)$'s.

of 13 different values of p: 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99%. Therefore, each participant responded to 39 scenario combinations (3 scenarios $\times$ 13 p's). The order of presentation was completely randomized with EDGAR (Experimental Design Generator And Randomizer) software (Brown, 2000). The $w(p)$'s of all three scenarios were averaged within each level of p.

Participants in the control experiment were presented with two sets of scenarios designed to test the effect of non-motivational content on $w(p)$. Nine participants failed to comply with instructions and were removed (yielding $N = 36$). The compliance problem stemmed from asking students to volunteer to respond to a questionnaire in the end of class time; in the experiment the students received experimental credit and there were no compliance problems. The control study participants answered 26 scenario combinations each. (2 scenarios $\times$ 13 p's). The $w(p)$'s of the two scenarios were averaged within each level of p.

The scenarios in the prevention condition were developed to reflect safety and security concerns. The three scenarios were (1) "You are checking your expanded car insurance policy at your insurance agency. According to your agent, the probability that the insurance company will cover the cost of vandalism is ___%. Draw the curve that represents your feeling regarding the certainty that the insurance company will cover the damages caused by vandalism"; (2) "A serious flu has begun spreading in the state. You encounter a vaccine advertisement by your medical center suggesting that the vaccine prevents infection in ___% of the cases among your age group. Draw the curve that represents your feeling regarding the certainty that the vaccine will prevent your infection"; and "The Ministry of Health announces the results of a new and comprehensive study suggesting that a ___% of the citizen will lose their body flexibility during their twenties or thirties. Draw the curve that represents your feeling regarding the certainty that you will lose body flexibility."

Two of the scenarios in the promotion conditions were developed to reflect self-actualization need and one to reflect desire, which is not a sample of a self-actualization need but intuitively could trigger promotion focus. The two promotion scenarios were (1) "You are working on idea generation in an area of your expertise. Following an evaluation progress you have done with a friend, it appears that the probability that you will meet the deadline you set for yourself is ___%. Draw the curve that represents your feeling regarding the certainty that you will meet your deadline"; (2) "You choose a hobby that for years you were yearning to try. After an initial attempt, your guide suggests that the probability that you will turn into a skilled amateur who enjoys the hobby is ___%. Draw the curve that represents your feeling regarding the certainty that you will become a skilled amateur"; and (3) "You are courting a potential

date and finally dare to ask him/her to go out on a date. The potential date says that she/he will gladly join you if they succeed to excuse themselves from a formerly scheduled family event. The potential date adds that there is a ___% chance that they will be able to excuse themselves. Draw the curve that represents your feeling regarding the certainty that the potential date will succeed in excusing her/himself to go out with you.''

The scenarios in the control experiment were developed as not to induce personal motivations. One scenario was (1) ''Below are the chances of rain for the months November–December based on a satellite forecast. Express your feeling regarding the likelihood for rain in a given day by drawing the curve around the circle. Note: the letter symbolizing the date is random. The probability for rain on day Y is X%''. The other control scenario was very similar and concerned the likelihood that a TV advertising campaign of a food product will increase product Y Company's sales.

Results

Table 1 and Figs. 4 and 5 present the results of both the control study and the experimental conditions. The results of the control study suggest that respondents are capable of circling a portion of the circle that almost perfectly matches the objective probability (see Fig. 4). However, even in the control experiment there is evidence for overweighting small p's and underweighting large p's (see Table 1). The difference in standardized units between p and $w(p)$ is consistent with this conclusion for all p's except for .80.

As expected, the prevention manipulation yielded overweighting of small p's, underweighting of large p's, and low sensitivity to changes for moderate p's. Contrary to our hypotheses, the promotion manipulation also yielded an overweighting of small p's and underweighting of large p's. Yet, the pattern of biases in $w(p)$ differed between the experimental conditions. First, for all p's except for 1%, the $w(p)$ of the promotion condition was larger than the $w(p)$ of the prevention condition. Second, as can be seen in Table 1, the difference in the biases between the groups is largest for p's $> .30$. Indeed, the correlation between p and the d-statistics comparing the experimental groups is .87 ($p < .001$ with $N = 13$). Another way to test this interaction is with ANOVA.

A mixed ANOVA with the 13 levels of p as the within factor and the two experimental conditions as the between factor yielded main effects for p ($F(12, 103) = 566.16$, $p < .001$; partial $\eta^2 = .83$) and experimental condition ($F(1, 114) = 20.25$, $p < .01$; partial $\eta^2 = .15$) as well as a significant interaction effect ($F(12, 103) = 7.38$, $p < .01$; partial $\eta^2 = .06$). That is, $w(p)$ is a monotonic function of p, promotion scenarios increased the average $w(p)$ relative to prevention scenarios, and the specific effects of p's on $w(p)$'s are dependent on the regulatory focus.

Finally, as can be seen in Fig. 5 and in ANOVA results, p has expectedly a strong monotonic effect on $w(p)$. However, according to prospect theory this effect should not be linear. Therefore, we computed quadratic and cubic regressions where the predictor was p and the criterion was mean $w(p)$ within each of the experimental

Table 1
Study 1: Means and standard deviations of $w(p)$'s in percents, standardized deviations from objective probabilities and d-statistics for the difference between the experimental groups by 13 probability levels

P%	Control study ($N = 36$)			Prevention condition ($N = 59$)			Promotion condition ($N = 57$)			Difference between conditions
	Mean	SD	$d_{w(p)-p}$	Mean	SD	$d_{w(p)-p}$	Mean	SD	$d_{w(p)-p}$	d
1	2.3	2.66	.50	13.1	15.47	.78**	12.0	12.54	.88**	−.08
5	5.7	3.53	.19	14.9	16.19	.61*	18.2	13.91	.95**	.21
10	10.7	5.56	.13	17.8	14.57	.54*	21.5	14.44	.80**	.26
20	19.2	5.94	−.14	25.1	14.52	.35*	29.4	14.84	.63*	.29
30	29.3	6.59	−.10	28.3	13.34	−.13	32.9	15.73	.18	.32
40	37.5	6.80	−.37	34.5	13.41	−.41	43.3	13.56	.25	.66**
50	48.9	6.40	−.17	44.2	13.61	−.43	51.9	12.06	.16	.60**
60	57.8	9.27	−.24	47.7	14.00	−.88**	59.4	15.50	−.04	.79**
70	66.7	7.88	−.42	54.3	18.12	−.87**	69.3	14.69	−.05	.91**
80	80.3	8.09	.04	63.4	19.18	−.87**	81.6	14.92	.10	1.06**
90	87.5	7.67	−.32	70.6	19.39	−1.00**	82.7	14.46	−.51	.70**
95	91.7	8.13	−.41	71.4	21.91	−1.08**	88.1	11.21	−.62*	.95**
99	95.5	4.94	−.70*	78.4	21.08	−.98**	90.0	11.71	−.77**	.68**
Mean	48.7	0.67		43.4	1.39		52.3	1.42		
Slope	.96	.009		.65	.015		.80	.018		

Note. For means and slopes the values in the SD columns are standard errors.
* $p < .05$.
** $p < .01$.

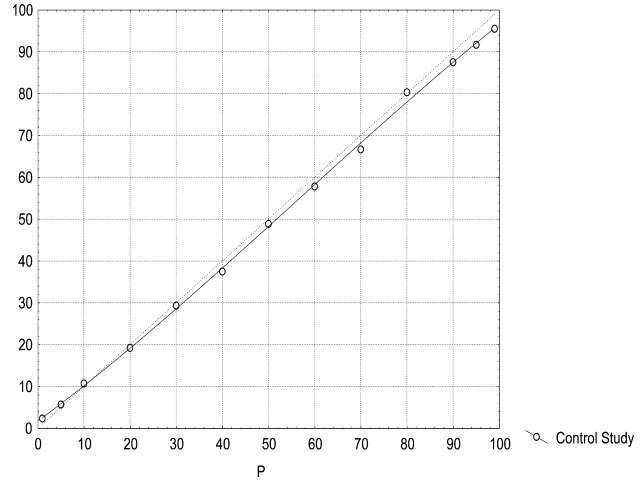

Fig. 4. Study 1: Average $w(p)$ as a function of p for the control group and a fitted polynomial-regression line.

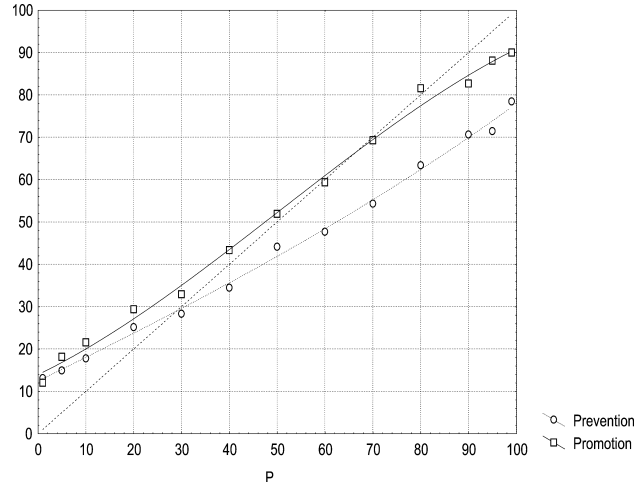

Fig. 5. Study 1: Average $w(p)$ across three scenarios as a function of p and regulatory focus and fitted polynomial-regression lines.

groups ($N = 13$ p values). To fully support prospect theory, one should find a cubic effect showing two inflections points. However, it is clear that the using regression here has very low statistical power to detected non-linear trends, given the small number of p values tested here. Indeed, in both experimental conditions, adding a cubic function to a regression with linear and quadratic terms did not improved the fit to the data. Yet, in the prevention condition, adding a quadratic term to a linear term in the regression yielded a t value of 2.80 ($p < .05$, two-tailed), and in the promotion condition it yielded a t value of .10 ($p < .90$, two-tailed). As can be seen in Fig. 5, the prevention condition yields a slightly convex line that shows minimal sensitivity to changes in p in the moderate region, as predicted in prospect theory. However, in the promotion condition, the line is more linear and showing greater sensitivity to p's across the entire range.

Auxiliary analyses

One striking feature of Table 1 is the differences between the control group and the experimental groups in the $w(p)$'s' variances. This may suggest that the motivational manipulations in the experiment increased the variance. Therefore, we probed two potential sources for the variance: differences among the scenarios within each experimental condition and individual differences.

To test the variability of scenarios, we ran a repeated-measure ANOVA with 13 levels of p's and three levels of scenarios within each experimental group. The results indicated that there was a significant variation both in elevation and in slope among the scenarios within each experimental group. Specifically, ANOVA in the prevention condition yielded a main effects for p ($F(12, 45) = 198.89$, $p < .001$; partial $\eta^2 = .78$) and scenario ($F(2, 55) = 13.25$, $p < .01$; partial $\eta^2 = .17$) as well as a significant interaction effect ($F(24, 33) = 2.78$, $p < .05$; partial $\eta^2 = .05$); and the ANOVA in the promotion condition yielded a main effects for p ($F(12, 42) = 418.67$, $p < .001$; partial $\eta^2 = .88$) and scenario ($F(2, 52) = 23.19$, $p < .01$; partial $\eta^2 = .30$) as well as a significant interaction effect ($F(24, 30) = 2.78$, $p < .01$; partial $\eta^2 = .09$).

To evaluate the differences among the scenarios, we report the $w(p)$'s for each scenario (Table 2), as well as the mean of the 13 $w(p)$'s (expected to equal .5 under a null hypothesis of no elevation bias), and the linear regression weight of p as a predictor of $w(p)$. To facilitate interpretations of the differences among the scenarios, we asked psychology students, with random assignment, to rank the degree of threat evoked by each of prevention scenarios ($N = 34$) or the degree of enthusiasm evoked by each promotion scenarios ($N = 33$). The average rankings were significantly different from each other (indicated by within-subject ANOVAs) both for the prevention scenarios and the promotion scenarios. The dating scenario was rated on average as the one evoking the most, and the hobby scenario the least, amount of enthusiasm. The flu scenario was rated as evoking the most, and the car insurance, the least amount of threat. As can be seen in Table 2, the scenarios that evoked most threat (flu) and most enthusiasm (date) hardly differ either in elevation or in slope. In contrast, the other scenarios showed steeper slope for promotion focus (more sensitivity) and higher elevation. This result indicates the possibility that some scenarios evoke both promotion and prevention foci. That is, dating could be desirable yet scary. Similarly, loss of flexibility may be a threat but if not materialized it may be desirable. To test this possibility, we asked a group of business students (both undergraduates and MBA students; $N = 39$) to rate each of the six scenarios on the degree to which each scenario induces both threat and enthusiasm on a 0 to 6 scale, where 0 meant not at all and 6 very much. The results are presented in Table 3.

Table 2
Study 1: Means (Standard Errors) of $w(p)$'s in percents by scenario and probability

P (in %)	Prevention focus			Promotion focus		
	Flu vaccine	Car insurance	Flexibility loss	Hobby skill	Idea generation	Potential date
1	9.37 (2.11)	8.83 (3.12)	21.15 (3.85)	16.76 (2.99)	12.47 (2.62)	6.87 (2.14)
5	13.51 (2.39)	10.52 (2.89)	20.81 (3.74)	24.6 (3.24)	18.33 (2.84)	11.62 (2.26)
10	17.14 (2.4)	11.18 (2.02)	24.6 (3.71)	29.55 (3.35)	22.34 (2.55)	12.77 (2.1)
20	25.25 (2.29)	18.16 (2.12)	31.59 (3.74)	32.98 (3.05)	33.4 (2.89)	21.24 (2.66)
30	26.56 (1.85)	20.27 (2.01)	37.71 (3.65)	39.02 (2.83)	36.71 (2.84)	22.97 (2.4)
40	34.95 (2.39)	26.68 (1.97)	41.81 (3.30)	49.35 (2.64)	49.17 (2.74)	31.45 (2.22)
50	45.53 (2.35)	37.04 (2.20)	49.9 (3.56)	55.68 (2.33)	60.4 (2.67)	39.69 (2.58)
60	49.8 (2.10)	38.25 (2.25)	55.06 (3.26)	65.11 (2.59)	66.0 (2.87)	47.02 (3.00)
70	58.77 (2.94)	45.56 (2.54)	58.6 (3.67)	73.1 (2.57)	46.87 (2.54)	57.86 (3.05)
80	66.52 (3.29)	55.21 (2.83)	67.1 (3.82)	77.77 (2.7)	83.47 (2.32)	83.45 (2.34)
90	76.91 (3.26)	62.04 (2.99)	72.9 (3.57)	81.94 (3.01)	89.51 (2.09)	77.01 (2.65)
95	78.59 (3.39)	63.28 (3.66)	72.4 (3.96)	87.73 (2.19)	93.54 (1.59)	82.89 (2.69)
99	85.38 (3.28)	67.1 (3.77)	83.44 (3.43)	89.89 (2.24)	96.12 (1.26)	84.09 (3.09)
Mean	45.19 (1.65)	35.87 (1.53)	49.12 (3.02)	56.05 (1.96)	56.13 (1.77)	44.20 (1.64)
Slope	.76 (.020)	.61 (.020)	.61 (.017)	.72 (.019)	.86 (.017)	.83 (.046)

Table 5
Study 2: Means (Standard Errors) of w(p)'s in percents by scenario and probability

P (in %)	Promotion focus			Prevention focus		
	Social order	Terror	AIDS	Discover an opportunity	Rule-of-thumb	Breakthrough
1	23.3	23.6	1.4	18.9	13.2	1.8
	3.4	3.3	0.2	2.1	1.8	0.2
5	26.8	28.3	9.7	27.7	21.3	9.1
	3.3	3.3	0.5	2.2	2.1	0.5
10	27.2	29.4	32.8	30.7	25.2	32.8
	3.2	3.0	3.1	2	2.1	2.2
20	32.3	30.7	36.7	36.6	30.9	37.5
	3.1	2.4	3.0	2	2.2	2.2
30	34.8	36.2	38.8	42.7	35.5	44.4
	2.8	2.6	2.6	2.1	2.1	1.9
40	38.8	39.1	48.9	50.1	39.7	52.2
	3	2.5	2.8	2	2.3	2.2
50	40.3	45.8	56.4	60.6	46.7	58.9
	2.9	2.8	2.8	2.1	2.5	2.1
60	42.8	50.0	59.6	66.5	53.4	65.8
	3	3.1	2.8	2.1	2.6	1.9
70	47.1	55.1	62.4	72.8	60.3	73.1
	3.3	3.2	2.9	2.2	2.8	2
80	50.6	57.9	69.1	78.3	66.8	80
	3.5	3.2	3.0	2.2	2.9	1.9
90	51	61.6	75.5	83.5	72	82.1
	3.6	3.4	2.9	2.4	3	2.4
95	53.1	63.7	78.3	87.6	73.2	88.9
	4	3.4	2.9	2.1	3	1.9
99	60.2	66.6	81.5	92	75.6	91.2
	3.8	3.8	3.1	1.8	3.4	1.9
Mean	40.05 (2.33)	46.53 (2.38)	50.45 (1.77)	57.72 (2.19)	46.48 (2.23)	55.54 (1.65)
Slope	.32 (.014)	.42 (.010)	.69 (.059)	.70 (.016)	.60 (.015)	.80 (.058)

All scenarios, except for the flu scenario, yielded means as expected. Importantly, a within-subject ANOVA indicated that there was a significant interaction between the content of the scenario (promotion set versus the prevention set) and the type of question (threat versus enthusiasm). That is, on average the three prevention scenarios yielded more threat than enthusiasm and vice versa for the promotion scenarios. Yet, the rating produced different order among the scenarios than did the ranking. The car scenario that was clearly ranked as the least threatening (only 3% found it the most threatening) appeared as a good operationalization of

Table 3
Means and standard errors of threat and enthusiasm ratings for each scenario

Focus	Mean	*SE*
Prevention		
Flu vaccine		
Threat	2.22	0.28
Enthusiasm	2.81	0.28
Flexibility loss		
Threat	2.86	0.30
Enthusiasm	0.92	0.27
Car insurance		
Threat	3.00	0.35
Enthusiasm	1.58	0.32
Promotion		
Potential date		
Threat	1.67	0.26
Enthusiasm	4.58	0.29
Idea generation		
Threat	2.92	0.34
Enthusiasm	3.61	0.36
Hobby skill		
Threat	1.75	0.27
Enthusiasm	4.33	0.31

Note. The scenarios are presented according to the rank (from most to least threatening prevention scenarios and from most to least enthusiasm inducing promotion scenarios).

prevention in the ranting. In concert, the rating and the ranking manipulation checks may suggest that there are real differences among the scenarios which may depend on the manner in which they are presented and on individual differences in their interpretations.

Finally, we probed the individuals $w(p)$'s pattern to see if any individual fully conformed to our hypothesis. Indeed, we found few individuals who showed an absolute pattern of $w(p)$ that fits our prediction for promotion focus, mostly in the promotion condition (see an example of three respondents' reactions to the idea-generation scenario in Fig. 6).

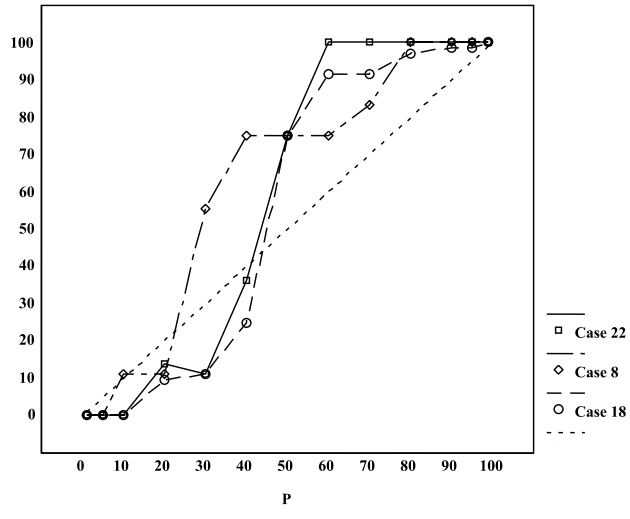

Fig. 6. Study 1: $w(p)$ as a function of p for three individuals in the idea-generation scenario.

Discussion

The results suggest that on average people overweight small probabilities and underweight small probabilities both in the control scenarios and in the experimental conditions. However, the control study suggests that the bias is relatively minor when motivation is not induced and that people are largely capable of accurately mapping stated probabilities with our cross-modality matching technique. Second, the prevention scenarios yielded a much stronger pattern of biases in probabilities than the control group. These results corresponded very well with prospect theory. The combined results of the control experiment and the prevention focus scenarios suggest that it is possible to capture the transformation in probabilities not only with decision weights that are derived from choices, but also in a direct manner afforded by the cross-modality matching.

However, the promotion scenarios yielded a pattern of biases in probabilities that deviated from both our hypotheses and prospect theory: overweighting for small values of p, minor overweighting for the moderate values of p (for p's $<.90$), and minor underweighting for large values of p. That is, the promotion focus manipulation caused both a general elevation bias (Gonzalez & Wu, 1999) and an increase in sensitivity (slope) in the entire spectrum of p.

Moreover, the variability both among the promotion scenarios and among the prevention scenarios reduces the confidence in our interpretation of the results. Several features of Experiment 1 might have prevented us from obtaining support to our hypothesis regarding the effects of promotion focus on $w(p)$. First, the scenarios were not clearly mapped to a theory. Second, p's in the prevention conditions were presented as facts while in the promotion focus p's were presented as subjective probabilities. Third, the scenarios might have had varying relevance to the lives of different respondents (date, flu) and thus might have induced large variance due to personal input to the reporting of $w(p)$. Finally, the data indicates that there are likely to be large individual differences in $w(p)$. Thus, Study 2 was designed to address these limitations and to re-test our hypotheses.

To address the limitations of Study 1, we used Schwartz's value theory to both map the content of the scenarios and individual differences. Armed with value theory, we predict that our hypotheses regarding $w(p)$ differences would be supported both when scenarios are carefully mapped to values that tap either the promotion or the prevention domain, and when we consider individual differences on the very same values.

Study 2

Method

Participants

A research assistant recruited 156 respondents from several occupations including economists (29), clerks (11), security guards (10), accountants (10), computer programmers (5), and variety of other professions (e.g., social worker, psychologist, beautician, and pianist). The respondents had a mean age of 32.1 years; 15 years of education on average; and included 53% males. This sampling was intended to increase the variance in individual differences. Another assistant recruited 67 respondents for the control study from similar populations.

Measures

Weighted probability—w(p) was measured as in Study 1.

Chronic-promotion focus. To assess chronic-promotion focus, we used 44 items from the 57-item Schwartz's value questionnaire, omitting a few questions from each of the 10 value types to reduce the questionnaire length. To assess chronic-promotion focus we calculated the mean response to items tapping self-direction, stimulation and hedonism (10 items). To assess chronic prevention focus we calculated the mean response to the items tapping security, tradition and conformity (14 items). We removed responses that showed failure to follow instructions of the value questionnaire, and hence had complete data only for 149 individuals on these measures. The two indexes correlated −.73 and yielded similar (and opposite) results. Thus, we subtracted the chronic-prevention scale from the chronic-promotion scale to yield one chronic-promotion scale.

Procedure

Participants received a questionnaire that contained the value questionnaire followed by the experimental material as in Study 1. They were randomly asked to estimate 13 *p*'s for either three promotion scenarios ($N = 84$) or three prevention scenarios ($N = 72$).

Participants in the control group received the value questionnaire and then were asked to draw as accurately as they could the percent of the circle that match a given probability. As in Study 1, they were asked randomly to estimate each of the 13 *p*'s twice. Unlike Study 1, no cover story was given and the task was to draw accurate proportions of the circle. Two respondents failed to understand instruction as their data showed that they tried to convert percents to degrees (for 99% they marked approximately 99° of the circle). They were removed from the analyses yielding an *N* of 65.

Three promotion scenarios and three prevention scenarios were constructed as to mimic self-direction values and security values, respectively. Below are the scenarios and the value they were designed to tap (in parentheses).

The three prevention scenarios were (1) "Demography researchers argue that given the high birth rate among non-Jews and continued immigration of non-Jews on the basis of existing laws, in the end of the year 2025 there will be no Jewish majority in the country. Historians show that based on past data the probability that the *social order* will change (official language, form of government, education programs, etc.) in countries where the majority reversed is of ___%. Draw the curve that represents your feeling regarding the certainty that a change in social order will happen in Israel." (Social Order); (2) "Statistical analyses were carried on various terror acts around the country (light ammunition; suicide attacks, explosive devices, etc.) weighing the number of victims and type of wounds. The analyses show that if you will be involved in any terror attack, your chance of being *severely wounded* is ___%. Draw the curve that represents your feeling regarding the certainty that if you will be involved in a terror attack you will be severely wounded" (Personal Safety); and (3) "Your family members went to an organized trip in several African counties. During the trip one of the family members was wounded in a car accident and was admitted to a local hospital, where he got a blood transfusion. Data collected by the American Department of Health during the past year on this hospital suggest that blood tainted with AIDS-causing virus was used there. The data show that there is a chance of ___% that the blood received by your family is *tainted with the AIDS-causing virus*. Draw the curve that represents your feeling regarding the certainty that your family member received blood tainted with the AIDS-causing virus" (Family Safety).

The three promotion scenarios were (1) You have been given an opportunity to work on a fascinating job that challenges you very much. As part of this job you are requested to identify novel and attractive opportunities for your organization. Based on the organization's experience from the past ten years, the chance of *discovering a novel attractive opportunity* during one job term is ___%. Draw the curve that represents your feeling regarding the certainty of discovering a novel attractive opportunity by you" (Curiosity); (2) "A company for developing creative solution found that there are structured methods to crack riddles. These methods are sort of rules-of-thumb. Tens of rules-of-thumb were sent to the internet site of this company in recent years. Out of all the rules that were sent, the company reported that ___% of the rules were perceived as *creative-problem solutions*. You are trying to find a rule-of-thumb. Draw the curve that represents your feeling regarding the certainty that you will find a creative rule-of-thumb to solve a problem." (Creativity); and (3) "As part of your job you were offered to handle

a novel and futuristic project of your company, which greatly peaks your curiosity. This project requires independent thought and creativity, because no research was conducted in this area thus far. Company data, gathered across years, show that within the framework of novel and futuristic projects the chances for a *breakthrough* is ___%. You got the project. Draw the curve that represents your feeling regarding the certainty that the there will be a breakthrough in the project which you will work on'' (Independence, creativity, curiosity).

Results

Table 4 and Figs. 7 and 8 present the results of both the control study and the experimental conditions of Study 2. As in Study 1, the control study suggests that respondents are capable of circling a portion of the circle that almost perfectly matches the objective probability (see Fig. 7). Also as in Study 1, even in the control there is evidence for overweighting small p's and underweighting of large p's (see Table 4). In comparison to Study 1, the control group showed stronger deviations (especially for 1 and 99%). Inspection of the data showed severe outliers. For example in the estimation of 1%, one responded marked 98% of the circle. Indeed, the median for 1% was 2.5 and for 99% it was 98. We decided to keep the outliers in all analyses as to demonstrate that relative to the experimental groups the pattern of bias is clearly different. Inspection of all analyses reported in Study 1 and 2 showed that controlling outliers (by using trimmed means or medians) increase differences among the experimental groups but do not change conclusions. Hence we kept all the data as it provided here the most conservative estimates.

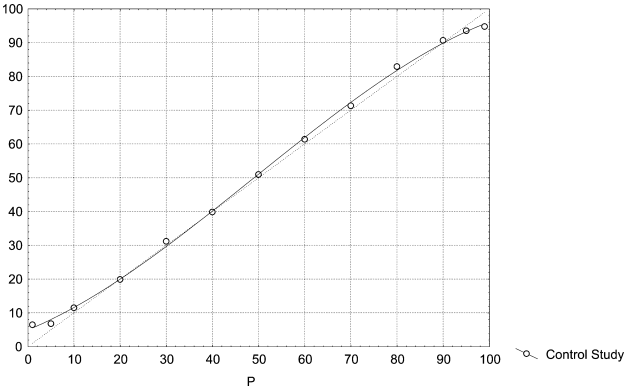

Fig. 7. Study 2: Average $w(p)$ as a function of p for the control group and a fitted polynomial-regression line.

As in Study 1, the prevention manipulation yielded a clear overweighting of small p's, underweighting of large p's, and low sensitivity to changes for moderate p's. Contrary to our hypothesis and is in Study 1, the promotion manipulations also yielded an overweighting of small p's and underweighting of large p's. Yet, the pattern of biases in $w(p)$ differed between the experimental conditions. First, for all p's except for 1%, the $w(p)$ of the promotion condition was larger than the $w(p)$ of the prevention condition. Second, as can be seen in Table 4, the difference in the biases between the groups is sig-

Table 4
Study 2: Means and standard deviations of $w(p)$'s in percents, standardized deviations from objective probabilities and d-statistics for the difference between the experimental groups by 13 probability levels

P%	Control study ($N = 65$)			Prevention condition ($N = 76$)			Promotion condition ($N = 82$)			Difference between conditions
	Mean	*SD*	$d_{w(p)-p}$	Mean	*SD*	$d_{w(p)-p}$	Mean	*SD*	$d_{w(p)-p}$	*d*
1	6.5	15.05	.37	16.0	16.50	.91**	11.2	10.48	.97**	−.35*
5	6.8	2.17	.82**	21.6	15.76	1.06**	19.3	11.17	1.28**	−.17
10	11.5	5.43	.28	29.9	19.75	1.01**	29.5	15.53	1.26**	−.02
20	19.9	5.48	−.03	33.1	17.75	.74**	35.0	15.76	.95**	.11
30	31.2	4.58	.26	36.7	18.26	.37**	40.9	14.27	.77**	.26
40	39.9	3.35	−.04	42.3	18.54	.12	47.3	15.43	.47**	.29
50	51.0	4.17	.23	47.7	18.01	−.13	55.4	15.97	.34**	.45**
60	61.4	4.27	.33	50.9	19.16	−.48**	61.9	15.56	.12	.63**
70	71.3	3.83	.34	54.9	21.83	−.69**	68.7	16.78	−.07	.71**
80	82.9	3.37	.87**	59.3	22.00	−.94**	75.1	16.62	−.30**	.81**
90	90.7	2.28	.31	62.9	22.35	−1.21**	79.2	18.34	−.59**	.80**
95	93.5	6.07	−.25	64.8	23.56	−1.28**	83.2	16.87	−.70**	.90**
99	94.8	8.28	−.51*	69.2	25.11	−1.19**	86.2	16.44	−.78**	.80**
Mean	50.9	0.23		45.3	1.62		53.3	1.54		
Slope	0.96	0.016		0.48	0.02		0.70	0.026		

Note. For means and slopes the values in the *SD* columns are standard errors.
* $p < .05$.
** $p < .01$.

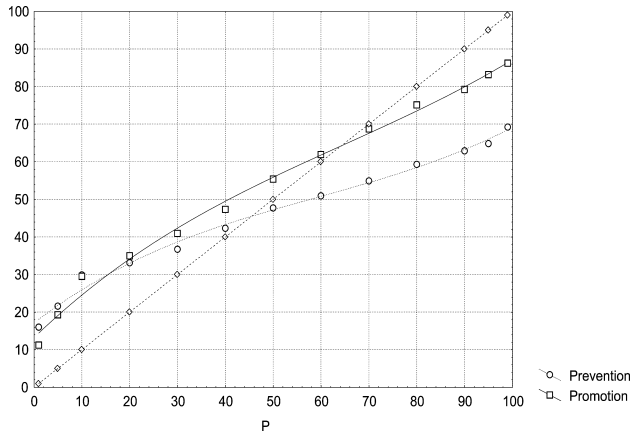

Fig. 8. Study 2: Average $w(p)$ across three scenarios as a function of p and regulatory focus and fitted polynomial-regression lines.

nificant for all p's $>.40$. Indeed, the correlation between p and the d-statistics comparing the experimental groups is .87 ($p < .001$ with $N = 13$). Another way to test this interaction is with ANOVA.

A mixed ANOVA with the 13 levels of p as the within factor and the two experimental conditions as the between factor yielded main effects for p ($F(12, 143) = 520.93$, $p < .01$; partial $\eta^2 = .77$) and experimental condition ($F(1, 154) = 12.63$, $p < .01$; partial $\eta^2 = .076$) as well as a significant interaction effect ($F(12, 143) = 18.89$, $p < .01$; partial $\eta^2 = .109$). That is, $w(p)$ is a monotonic function of p, promotion scenarios increased the average $w(p)$ relative to prevention scenarios, and the specific effects of p's on $w(p)$'s are dependent on the regulatory focus.

As in Study 1, we computed regressions adding a quadratic term to the linear term, and a cubic term to the linear and quadratic terms where the predictor was p and the criterion was mean $w(p)$ within each of the experimental groups ($N = 13$ p values). A full support for prospect theory was found in the prevention group with a cubic effect showing two inflections points: The t values of both the quadratic term and the cubic term were significant (t's $= -2.98$ and 2.56; with 10 and 9 df, p's $< .05$). In the promotion group only the adding of the quadratic term to the linear term was significant ($t(10) = -2.85$; $p < .05$), but the negative sign of the quadratic term was opposite to our hypothesis showing less sensitivity in the moderate region. However, the $w(p)$'s in the promotion condition showed, relative to the prevention condition, greater sensitivity to changes in p's across the entire range, as in Study 1.

Before testing the effect of chronic-promotion focus, we first sought to demonstrate that the chronic-promotion focus does not affect the results of the control group. We computed a mix ANCOVA with p's as within subject factor (13 levels) and chronic-promotion focus as a continuous between-subjects factor. Unexpectedly, chronic-promotion focus had a main effect on the mean of $w(p)$'s ($F(1, 62) = 4.63$, $p < .05$; partial $\eta^2 = .07$). Inspection of this effect showed a negative correlation between mean $w(p)$ and chronic-promotion focus ($r = -.26$; $p < .05$). However, chronic-promotion focus did not interact with level of p ($F(12, 51) = 0.52$, $p > .90$; partial $\eta^2 = .008$).

To test the interaction of chronic-promotion focus with p level and with the situational regulatory focus (promotion or prevention scenarios), we computed a mix ANCOVA with p's as within subject factor (13 levels), experimental condition as a between subject factor, and chronic-promotion focus as a continuous between-subjects factor. After controlling for the effect of p level, experimental group, and their interaction, we found no main effect for chronic-promotion focus ($F(1, 152) = 2.43$; $p > .10$; $\eta^2 = .016$) nor a two-way interaction of chronic-promotion focus with the experimental manipulation ($F(1, 152) = 0.30$; $p > .50$; $\eta^2 = .002$). However, there were both two-way interaction between chronic-promotion focus and p level ($F(12, 141) = 19.13$; $p < .01$; $\eta^2 = .112$) and a possibility of three-way interaction between chronic-promotion focus, p level, and the experimental manipulation ($F(12, 141) = 3.56$; $p < .05$; $\eta^2 = .016$). Yet, the results for the three-way interaction are both weak and unreliable; when degrees of freedom are adjusted for deviation of p level from the assumption of sphericity with the Huynh–Feldt correction, the effect is not clear and $p = .13$.

To interpret the interaction of chronic-promotion focus with p values, we divided the continuous chronic-promotion focus variable into quartile and compared results of the top quartile (high chronic-promotion focus) with the bottom quartile. We expected to conceptually replicate the results for the experimental manipulation of regulatory focus of both Study 1 and this Study. As can be seen in Fig. 9, pattern of the results is strikingly similar to the result found for the experimental factor. That is, individuals high in chronic-promotion focus showed, relative to individual low in chronic-promotion focus, higher elevation of $w(p)$s, steeper slope, less underweighting of large p's, but also less overweighting of small p's. An inspection of the results for the three-way interaction suggests that if this is real effect, the two-interaction of chronic-promotion focus with p is more pronounced in the experimental-prevention group than in the experimental-promotion group. However, the two-way interaction is apparent in both experimental groups.

Auxiliary analyses

As in Study 1, the variance of $w(p)$'s in the experimental groups was much larger than the variance in the control group. This suggests that despite the theoretical

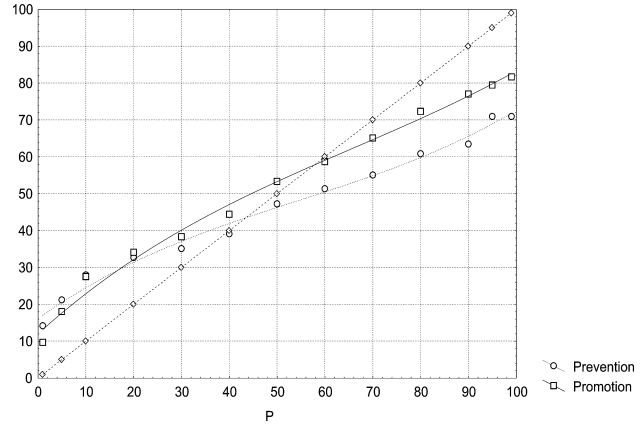

Fig. 9. Study 2: Average $w(p)$ as a function of p and chronic-regulatory focus across the experimental conditions (6 scenarios) and fitted polynomial-regression lines.

mapping of the scenarios to two sets of values, the scenarios produced different amount of promotion and prevention motivations. To test the variability of scenarios, we ran a repeated-measure ANOVA with 13 levels of p's and three levels of scenarios within each experimental group, as in Study 1. The results indicated that there was a significant variation both in elevation and in slope among the scenarios within each experimental group. Specifically, ANOVA in the prevention condition yielded a main effects for p ($F(12, 53) = 114.90$, $p < .001$; partial $\eta^2 = .64$) and scenario ($F(2, 63) = 9.62$, $p < .01$; partial $\eta^2 = .13$) as well as a significant interaction effect ($F(24, 41) = 17.68$, $p < .01$; partial $\eta^2 = .22$); and the ANOVA in the promotion condition also yielded a main effects for p ($F(12, 62) = 473.52$, $p < .01$; partial $\eta^2 = .87$) and scenario ($F(2, 72) = 19.77$, $p < .01$; partial $\eta^2 = .21$) as well as a significant interaction effect ($F(24, 50) = 14.91$, $p < .01$; partial $\eta^2 = .17$).

To evaluate the differences among the scenarios, we report the $w(p)$'s for each scenario (Table 5), as well as the mean of the 13 $w(p)$'s, and the linear regression weight of p as a predictor of $w(p)$. To facilitate interpretations of the differences among the scenarios, we asked a sample taken from the same population as the experiment, with random assignment, to rank the degree of threat evoked by each of prevention scenarios ($N = 30$) or the degree of enthusiasm evoked by each promotion scenarios ($N = 28$). The curiosity scenario was ranked on average as the one evoking the most, and the creativity scenario the least, amount of enthusiasm. Yet, informal debriefing suggests that the creativity scenario regarding rule-of-thumb was not clear to many respondents. The personal safety scenario was ranked as evoking the most, and the social order scenario the least, threatening. As in Study 1, the variance within scenarios may suggest that there are real differences among the scenarios which may depend on the manner in which they are presented and on individual differences in their interpretations. Importantly, the chronic-promotion focus measure did not interact with the scenarios or with the interaction of scenario with p level (three-way interaction) neither in the promotion group nor in the prevention group, suggesting that the effects of chronic-promotion focus are stable and do not depend on a particular scenario.

In Study 1, we showed that there were individuals that fully conformed to our hypothesis regarding the shape of the $w(p)$ function under promotion focus. Similar individuals were found in the current study. However, here we sought to determine if there are systematic conditions that conform to our hypotheses. Hence, we explored the result of the additive effects of the two-way interactions between p and situational-regulatory focus and p and the chronic-promotion focus. Specifically, we contrasted the mean $w(p)$ for respondents who were in the top quartile of chronic-promotion focus with the mean $w(p)$ for respondents who were in the bottom quartile of chronic-promotion focus (high in chronic-prevention focus) to the scenario that conformed best to our hypotheses (Fig. 10). That is, we plotted the mean $w(p)$ for people high and low in

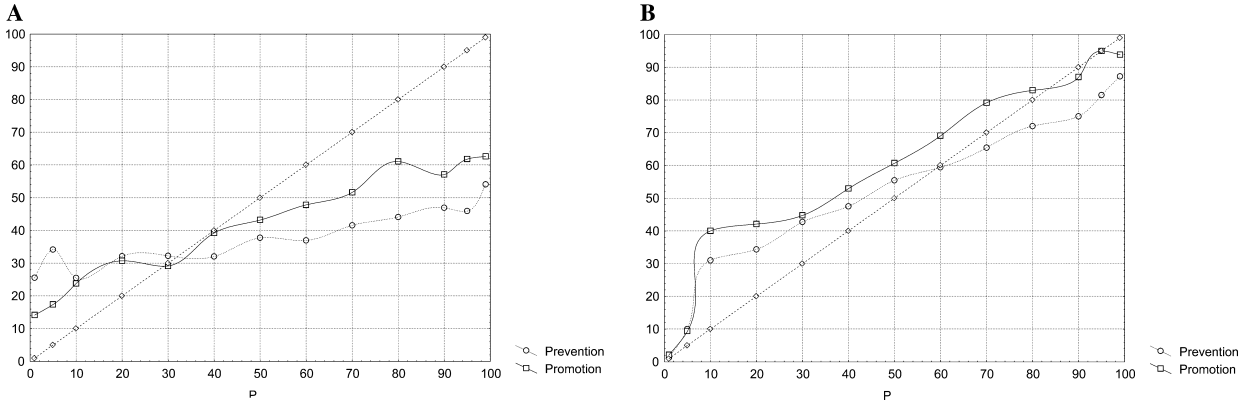

Fig. 10. Study 2: Average $w(p)$ as a function of p and chronic-regulatory focus and fitted-spline lines. (A) Demography scenario (prevention). (B) Breakthrough scenario (promotion).

chronic promotion focus for the best prevention scenario (social order) in Fig. 10A and for the best promotion scenario (curiosity) in Fig. 10B. When one compares the $w(p)$ for chronic-prevention individuals responding to prevention context (dashed line in Fig. 10A) with the $w(p)$ for chronic-promotion individuals responding to promotion context (solid line in Fig. 10B) dramatic differences appear. Specifically, the combined person-context prevention focus yielded sharp overweighting for small p's, sharp underweighting for large p's, and very mild slope (note all $w(p)$'s are within .25–.55 range). In contrast, the combined person-context promotion focus yielded much weak overweighting for very small p's (almost none for .01), almost no underweighting for large p's (expect for .90 and .99), and very steep slope ($w(p)$'s are within .03–.94 range). While the latter pattern does not fully conform to our hypotheses, the combined patterns clearly show that people under prevention focus show dramatically stronger biases in the extremes than people under promotion focus and that people under promotion focus show negligible absolute biases at the extremes.

General discussion

Theory

The results of Study 1 and Study 2, taken together, suggest two conclusions. First, the manipulation of *motivation*, relative to a control group, increases biases in transforming stated probabilities into felt probabilities. These results are in agreement with findings showing that emotional content of the problem increases the magnitude of the biases (Rottenstreich & Hsee, 2001). Second, both the manipulation of promotion versus prevention content of the scenarios (Study 1 and Study 2) and high versus low chronic-promotion focus (Study 2) elevated $w(p)$'s for high p values but not for low p values. Consequently, promotion focus creates higher sensitivity to changes in p than prevention focus.

Next, we discuss how our results (a) extend our understanding of context effects in decision making; (b) point to issue of elevation in $w(p)$; (c) raise question about the validity of our hypotheses; and (d) suggest that additional contextual factors may interact with p in affecting $w(p)$.

The current work suggests that regulatory focus effects can be found in feelings induced by stated probabilities. This finding joins a growing list of regulatory-focus effects in the domain of decision making. For example, promotion focus seems to reverse the endowment effect (Liberman, Idson, Camacho, & Higgins, 1999) and increase the accuracy of disjunctive probability estimates (Brockner, Paruchuri, Idson, & Higgins, 2002). Moreover, the classical-framing effect could be inverted when the context evokes promotion focus among individuals high in chronic-promotion focus (Kluger, Yaniv, & Kuhberger, 2001). Specifically, when providing participants with an Asian Disease like scenario involving teaching children music, people high in values of self-direction, and in artistic/science occupations are risk seeking in the positive frame, and risk averse in the negative frame (Kluger et al., 2001). In concert, these findings suggest that the operation of cognitive biases, including those predicted by prospect theory, should be considered in light of the regulatory-focus theory.

The present results contradict the idea that biases seen in the deviation of $w(p)$ from expressed p could be considered as general principles of psychophysics of a chance, emanating from some limitation of the cognitive machinery. Nor are the biases a mere function of the context's emotionality (Rottenstreich & Hsee, 2001). Rather, varieties of $w(p)$ functions reflect motivated biases. The biases seen in $w(p)$ are probably an adaptation of the brain for meeting various needs (that according to the theory are potentially in conflict).

This evidence may suggest that prospect theory is mostly valid for phenomena induced by prevention focus, and that self-regulation theory (Higgins, 2000) may be a better account for both phenomena traditionally dealt by motivation researchers, such as affect (for a review see Higgins, 1997) and, as well as phenomena traditionally considered by decision-making researchers. Therefore, we suggest that various phenomena in the decision-making literature be revisited while considering the capacity of the context to evoke either prevention or promotion. Contexts involving money and security may yield one pattern of behavior, but context involving curiosity, exploration, arts, and perhaps love, may yield a different pattern of risk and risk perception behavior.

Second, our findings consistently showed that promotion focus elevates the feeling of certainty for most stated probabilities—an effect that was not predicted. Importantly, Gonzalez and Wu (1999) suggested that existence of two independent bias effects: elevation and curvature. The elevation effect can be separated from the curvature effect. Gonzalez and Wu (1999) both modeled and demonstrated empirically variance between people in elevation of $w(p)$, independent of curvature. Our data suggest that chronic-promotion focus may be responsible for differences in elevation (Study 2) within a given context and that situational-promotion focus has yet another independent effect on elevation (Study 1 and Study 2).

The elevation effect caused by promotion focus may reflect the nature of promotion goals. Promotion goals are more likely to be linked to self-direction where one self-set goals. Self-set goals may be chosen on the basis of one's expertise and sense of control. This view is consistent with Brockner and Higgins (2001) who suggested that the constructs of promotion and prevention

foci are similar to the constructs of intrinsic and extrinsic motivations. Intrinsic motivation is about self-determination (Deci & Ryan, 1985). In contrast, some prevention goals may involve goals imposed by nature or by other people for which people feel less expertise and control, but yet a necessity of goal pursuit. The elevated control that may be involved in promotion focus may be responsible for the elevation bias (cf. Heath & Tversky, 1991). We will return to the issue of control in the limitation section (below). Yet, the effect size of promotion focus, relative to prevention focus, on $w(p)$ grows with p level. Thus, the data suggest that promotion focus, or sense of control, does not automatically elevate $w(p)$, but that the effect of promotion focus is more pronounced for high levels of p.

If promotion focus elevates $w(p)$'s of large p's, one can predict the elimination or even the reversal of the classical Allais paradox. Prospect theory (Kahneman & Tversky, 1979) explains the Allais paradox by the underweighting of large probabilities (and the indifference to moderate probabilities). Yet, underweighting of large probabilities was largely eliminated here with promotion focus. Data consistent with this prediction showed that scenarios regarding gambling (prevention) replicate the Allais paradox, but scenarios either regarding a challenging project at work (where people may also feel in control) or enjoying a film festival (where people may feel less in control) showed a reversal of the Allais paradox, where the presence of certainty among the options increased the preference for high outcome and high risk alternative (Kluger, 2004). This suggests that "the certainty effect"—people's willingness to forego a prospect with high reward with some risk when presented with an option for low but sure reward—is not universal. Uncovering the condition for attenuating or reversing the certainty effect may shed new light on the behavior of decision-makers.

Third, the results overall did not support our hypothesis regarding the shape of $w(p)$ under promotion focus. Rather, the results appear pretty similar to the weighing pattern of (decumulative) probabilities proposed by Lopes (1995) for people who are *potential minded* (cf. Fig. 1.), where $w(p)$'s for moderately high p's are overweighed. However, the pattern that Lopes proposed for *security-minded* people does not show overweighting of small probabilities, which are both predicted by prospect theory and found here for prevention focus. Lopes proposed that the $w(p)$ curve of people with mix motive, who were labeled *cautiously hopefuls*, looks like the curve proposed by prospect theory. Our approach allows separating prevention (security) goals from promotion (potential) goals and suggests that security alone is sufficient to produce the curve proposed by prospect theory. We agree that the pattern of $w(p)$'s may reflect a mix motive, but propose post hoc that the pattern we observed for promotion focus is a mix of some people who are security minded for all stimulus and those that are chronically in promotion focused when they face promotion stimuli. That is, some people, as we found in both studies (see Fig. 6 and the solid line in Fig. 10B), may behave in a way compatible with our hypothesis regarding promotion focus. Hence, our original hypotheses for promotion focus could be valid under extreme promotion conditions. Perhaps, idiosyncratic methods of generating scenarios will provide better test of our hypotheses. Obviously, more research is needed to test this possibility.

Fourth, within each of our experimental conditions, we found unpredicted and meaningful differences in $w(p)$'s as a function of the individual scenarios. Even when we sampled scenarios from the Schwartz's value theory (Study 2) we obtained meaningful differences among scenarios designed to elicit the same focus. This observation suggests that context influences decision making to a very large extent and that additional context factors influence decision making, above and beyond the main effects of regulatory foci. These results join the growing literature pointing out the critical effects of contexts on decision making (Lopes, 1987, 1995; Payne, Bettman, & Luce, 1996; Rettinger & Hastie, 2001; Rottenstreich & Hsee, 2001; Wang, 1996).

Cross-modality matching

The cross-modality method offers a new approach of studying the putative elements of risky choices (transformation of probabilities and valuation of outcomes). The results of the control experiments suggest that biases in probability perceptions are pretty minor when motivational factors are not at work. Moreover, the minor biases may be overcome when studying groups of respondents by using some methods for eliminating the effects of few outliers (such as trimmed means). Also, it is possible that with additional training most respondents will be capable of producing unbiased representation of objective probabilities with our method. Therefore, results obtained in experimental conditions can be used to study the various effects of motivational states on the transformation of stated probabilities.

As per valuation of outcomes, it may well be possible to estimate a value function for different outcomes with a modification of the cross-modality matching method used here. In an initial pretest, the first author presented respondents with a circle on a computer screen and asked them to play with the computer mouse which created a new (and dashed) circle. They were first asked to increase the dashed circle by 20, 50, and 100%, and to repeat this exercise for a second time. The mean size of the circle was taken as a within-person control. Next, half the participants were randomly assigned to prevention focus (e.g., increase in insurance coverage) and promotion focus (e.g., increase in time one would spent

on interesting activity at work). Participants were then asked to increase the size of the dashed circle to reflect how good they will feel if the quantity of the given context grew by 20, 50, and 100%. The difference in circle sizes relative to control served as a value index. The value for prevention scenario was either similar or lower than the control, whereas the value for the promotion scenario was about 60% larger than the control. Moreover, as one moved from 20 to 50%, the prevention pattern showed diminishing return and for promotion it showed increasing return. Thus, it appears that the use of cross-modality matching methods may open the way to assess the value function and the probability function independently. These methods, however, may require calibration studies testing the biasing effects of the matching task itself.

Limitation

The present work used novel methods both to manipulate regulatory-focus and to measure probability transformations. Hence, our methods have potential threats to their construct validities. Our manipulation of promotion focus appears to involve scenarios that are more subjective in nature, requires more skill (or control) rather than luck, and is more realistic (higher subjective probability) than the prevention scenarios. Hence, although it is clear from the nature of our design (experiments) that our manipulations affected $w(p)$, our explanation for the theoretical cause may have alternative explanations. In addition, we have used values to operationalize chronic-regulatory focus. Finally, our measure of felt probabilities is suggested as a reflection of probability transformation that takes place in actual decisions. Thus, we next assess the implications of each threat to the validity of our constructs and suggest potential remedies, where needed.

First, the promotion scenarios in Study 1 were based on probability estimate of one person (e.g., ''your guide suggests that the probability'') while the prevention scenarios were based on frequencies (e.g., ''medical center suggesting that the vaccine prevents infection in ___% of the cases among your age group''). Thus, the elevation of $w(p)$ may have been caused by differences in probability trustworthiness, where one will avoid inflation of $w(p)$ when the source is public-frequency data. However, one prevention scenario in Study 1 was also based on personal statement (''According to your agent, the probability that the insurance company will cover the cost of vandalism is ___%''). This prevention scenario led, if anything, to stronger effects predicted for prevention focus. Moreover, in Study 2 all the promotion scenarios, like the prevention scenarios were based on frequency data (e.g., ''Company data, gathered across years, show that ...''). Thus, it seems that differences in the source of stated probability cannot account for our data.

Second, the promotion scenarios we used involved applying one's skills while the prevention scenarios we used involved passive reaction to some externally determined event. This is indeed an alternative explanation that can be tested in future studies. For example, promotion and prevention goals can be manipulated as to exclude the respondent's skill (e.g., use probabilities that teams of experts will identify all the talented artists in town versus all the people carrying SARS in town''). Alternatively, promotion and prevention goals can be manipulated as to require the respondent's control (e.g., probability that by applying physiotherapy regiment you will recover from serious injury or that by applying a tried method you will develop your own talent). While our data cannot exclude the possibility that it is mere control that caused the results in both Studies, there are indications that control is an integral part of a larger motivational syndrome linked to self-actualization (Maslow, 1965), self-determination (Deci & Ryan, 1985) and self-direction (Schwartz, 1992). Moreover, the interaction of our chronic-promotion focus that was based on Schwartz's value yielded similar effects to the experimental manipulation by the scenarios. This suggests that not only the specific content of the scenarios is responsible for the effect but the general need constructs that were derived from Schwartz's values and operationalized both with the scenarios and with individual differences. Yet, if the reader prefers the alternative (control) explanation, then one has to conclude that control influence $w(p)$ such that it deviates from the predictions of prospect theory and that control is likely to attenuate or reverse the certainty effect, or any other effect predicated on the assumption that people underweight large probabilities.

Third, the base-rates of the problems presented in our scenarios may appear subjectively different to our respondents and hence affect $w(p)$. Note, that we designed Study 2 to be less personally involving (see above) so as to reduce potential noise stemming from participants involvement with a topic (e.g., date or flu). To gauge this alternative explanation, we asked 47 respondents (students, clerks, and researchers) to read all 12 scenarios (from both Studies) where we left the blank of p to be filled out by the respondents according to their estimation. Their task was to simply complete the sentence with a number. Thus, we obtained for each scenario mean-subjective probability. The mean for the prevention scenarios was lower than the mean of the promotion scenarios in Study 1 (59.2 vs. 65%, respectively; t test for paired comparisons was $t(46) = -2.09$, $p < .05$) but higher in Study 2 (33.4 vs. 29.2%, respectively; t test for paired comparisons was $t(46) = 1.37$, $p > .15$). The differences between the experiments, though, suggest that Study 2 had significantly lower subjective probabilities (both promotion and prevention) than Study 1 (t-test for paired comparisons was $t(46) = 11.5$;

$p < .001$). Given that the differences in subjective p's in these two experiments are, if anything, in opposite direction and given that the pattern of $w(p)$ biases in these experiments are similar, one can exclude subjective p as an alternative explanation of our $w(p)$ data. Moreover, the similar $w(p)$ patterns observed in these two experiments combined with the differences in subjective p's between these experiments suggests that one can generalize the results at least within the range of subjective p's found here.

Another concern may be our measure of chronic-promotion focus that was based on Schwartz's values rather than on the reaction time measures used by Higgins and his associates. Yet, a recent theoretically-driven use of values as an operationalization of chronic-regulatory focus in research on feedback sign yielded results that were predicted from self-regulation theory (cf. Study 2 by Van-Dijk & Kluger, 2004). Moreover, it is likely that chronic-promotion focus strongly correlates with other well know individual differences (Kluger & Ganzach, in press) such as mastery-orientation (Levontin & Kluger, 2004). Thus, the success in using values for measuring regulatory focus in two different domains, and the hint that additional variables may largely overlap with chronic-regulatory focus suggests that additional individual differences will affect $w(p)$. For example, individuals who are high in mastery orientation are likely to show the promotion-focus effects observed here.

Finally, the current study used a cross-modality matching to assess how people experience or feel different probabilities. The drawback of this method is that it is separated from actual choice decisions that are traditionally used to assess how probabilities are weighted in actual decisions. The similarity of the curves we obtained for prevention focus to curves obtained for decision weights with monetary outcomes may suggest that the two methods do capture the same phenomena. However, to confirm that the cross-modality method indeed capture decision weights will require studying choices regarding promotion-focus goals. This may be a formidable task, because capturing decision weights requires the presentation of quantifiable values and it may be very difficult to quantify things such as curiosity, autonomy, and self direction. This is another challenge for future research.

Conclusion

In this study we hypothesize that regulatory focus has a systematic effect on feeling of probabilities. Under prevention focus, the feelings of probabilities measured with cross-modality matching technique closely replicated weighted probabilities predicted by prospect theory. Under promotion focus the pattern suggested a general elevation of felt probabilities, which is most apparent for high probabilities, and a possibility of a full inversion of the curvature of the weighted probability function predicted by prospect theory at least among some individuals.

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