

# Automatic Optimism: The Affective Basis of Judgments About the Likelihood of Future Events

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People generally judge that the future will be consistent with their desires, but the reason for this desirability bias is unclear. This investigation examined whether affective reactions associated with future events are the mechanism through which desires influence likelihood judgments. In 4 studies, affective reactions were manipulated for initially neutral events. Compared with a neutral condition, events associated with positive reactions were judged as likely to occur, and events associated with negative reactions were judged as unlikely to occur. Desirability biases were reduced when participants could misattribute affective reactions to a source other than future events, and the relationship between affective reactions and judgments was influenced when approach and avoidance motivations were independently manipulated. Together, these findings demonstrate that positive and negative affective reactions to potential events cause the desirability bias in likelihood judgments and suggest that this effect occurs because of a tendency to approach positive possibilities and avoid negative possibilities.

*Keywords:* desirability bias, automatic optimism, affect heuristic, risk judgments, unrealistic optimism

People are inundated with information about potential danger from the environment, their own behavior, and other people. Despite the abundance of information about what is beneficial and deleterious to well-being and health, people often fail to make the recommended choices, to the chagrin of the researchers and professionals whose job it is to inform people about the risks. One potential reason that people do not make recommended changes is that they simply do not believe that they will personally experience negative outcomes. Whenever people are faced with information about risks, such as those connected with terrorist threats, potential natural disasters, or health behaviors, they base their actions on their subjective view of the likelihood that the event will affect them personally. Thus, judgments about the likelihood of future events have implications for the length and quality of human life. Yet relatively little is understood about how people make judgments about potential future events. A consistent finding is that judgments about the likelihood of future events tend to be consistent with desires or preferences. It is not known, however, whether desire causally influences judgments and, if so, how this occurs. The purpose of this investigation was to address these fundamental, but unanswered, questions.

Judgments about the likelihood of future events have been a focus of investigation for psychologists and economists because of the central role they play in decisions. Historically, judgments about the likelihood of an event were considered to be separate from the value of the event (Edwards & von Winterfeldt, 1986; Luce & Raiffa, 1957). According to a number of expectancy-value

theories, for example, decisions can be predicted by multiplying the value of the event by the perceived likelihood of the event. Central to this equation is the assumption that the value of the future outcome is independent of the perceived likelihood of that outcome. Violations of this assumption should result in decisions that are less than optimal and difficult to predict. Evidence suggests, however, that judgments about the likelihood of future events are frequently biased in the direction of desire. People generally judge that they are likely to experience desirable events and unlikely to experience undesirable events (e.g., Klar, Meding, & Sarel, 1996; Marks, 1951; McKenna, 1993; Weinstein, 1980). This bias appears to be so pervasive that it has been described as one of the central characteristics of normal human thought (Taylor & Brown, 1988). Interventions designed to reduce this desirability bias and encourage accurate decisions have been attempted (and have typically failed) in multiple areas, including health, clinical, occupational, academic, and economic domains. In order to further research on and application of decision making principles, there is a need to clarify whether predictions are biased by desires.

## Are Predictions Biased by Desires?

Hundreds of research studies have documented that judgments about the likelihood of potential life events tend to be biased in the direction of desires, and this plethora of evidence suggests that it must be known that the desirability of an outcome causes bias in judgments about the likelihood of that outcome. It may thus come as a surprise that the research cannot, in fact, support this claim. Studies typically ask people to rate the likelihood that they will experience various inherently desirable (winning awards) and undesirable (developing cancer) life events. These studies reveal that people generally judge that they are at above average risk to experience desirable events and below average risk to experience undesirable events (see Chambers & Windschitl, 2004, for a re-

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view). This effect has been termed *unrealistic optimism* because, statistically, not everyone can be better off than their average peer (Weinstein, 1980). Several aspects of this methodology make it impossible to determine if the desirability of the event is causally related to the bias or even to verify that judgments are biased. Most importantly, the studies are correlational in nature and it is impossible to investigate the causal role of desire or moderators of the effect. In addition, although the judgments are statistically unrealistic, it is unknown whether any particular individual is making biased judgments. Findings that severe negative events are judged to be less likely than moderate negative events suggest that judgments are influenced by desirability (Weinstein, 1980), but severe events are less objectively likely than moderate events. Thus judgments that appear biased may actually be a reflection of realistic differences in risk.

Although interest in the desirability bias is motivated by a desire to understand how people judge the likelihood of real-world events, the strongest evidence available that suggests desire causes bias comes from studies that give the same chance event a positive or negative value in a game. For example, participants might win or lose points in a game on the basis of whether they receive a marked card (Lench & Ditto, 2008; Marks, 1951). Participants in these studies judge that they are more likely to receive the card if it signals a positive rather than a negative outcome. This effect is generally limited to intermediate levels of probability with, for example, a 50% chance of receiving the marked card (Krizan & Windschitl, 2007). Although these studies have employed the experimental rigor necessary to determine whether desire causes bias, they have been criticized on the grounds that the methodology is dissimilar in several respects from real-world judgments. First, participants are explicitly told that each outcome is equally likely—a situation that seldom actually occurs (Schneider, 2001). Second, winning or losing a game is not as rewarding or threatening as, say, getting married or developing cancer. It is thus unclear if desire is influencing likelihood judgments beyond tipping judgments toward desires in games with a 50% chance of either outcome.

To summarize, past research has demonstrated that predictions tend to be biased in directions consistent with desires, and there is evidence that desires can cause bias for games with ambiguous probabilities, but there is no evidence that desire is the cause of bias in judgments about potential life events. Indeed, studies on unrealistic optimism and optimistic bias are typically not considered as demonstrations of the desirability bias because no studies have manipulated the desirability of life events (see Krizan & Windschitl, 2007, for an example of the justification for separating the two literatures). To address this critical gap in the literature and the criticisms leveled at previous studies, the first goal of the present investigation was to determine whether desire is causally related to biased likelihood judgments for potential life events by experimentally manipulating the desirability of life events.

A second, related, goal of the present investigation was to examine whether the desirability of both positive and negative events creates the desirability bias in judgment. Even in studies that have manipulated the desirability of outcomes in games of chance there is no neutral condition. Thus it is unclear whether the desirability bias is driven by judgments about the likelihood of positive events, negative events, or both. In early correlational studies of unrealistic optimism, results suggested that desirability

made an independent contribution to judgments about the likelihood of positive events but did not make an independent contribution to judgments about the likelihood of negative events (Weinstein, 1980). However, across a variety of judgments and tasks, negative information is more motivating than positive information (see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001, for a review). To the extent that greater motivation results in greater bias, the desirability bias may result from motivation to judge that negative events are unlikely to occur rather than equal motivation to judge that negative and positive events are respectively unlikely or likely to occur. Thus the present investigation manipulated the desirability of a variety of potential future events and included neutral conditions to examine whether the desirability bias is driven by positive or negative reactions.

### Defining Desire

One issue that has probably become clear in the discussion of the desirability bias thus far is that it is not typically clear what is meant by *desirability*. In her theoretical review of studies that demonstrate people engage in motivated reasoning to arrive at desired conclusions, for example, Kunda (1990, p. 480) stated that “by motivation I mean any wish, desire, or preference that concerns the outcome of a given reasoning task, and I do not attempt to address the thorny issue of just how such motives are represented.” In studies that manipulate the desirability of outcomes in games of chance and offer the strongest evidence that desires relate to bias, the consequences are typically intuitively desirable outcomes (e.g., winning the game, chances to win money) or intuitively undesirable outcomes (e.g., losing the game, losing money). These studies, however, do not typically include a definition of *desirability* or a measure of the degree to which any particular participant desired the assigned consequences. This approach is likely the result of economic theories that define *value* as a constant (and often monetary) factor; however, it is now clear that people’s motivations and current state influence the value of any outcome (e.g., Hsee & Rottenstreich, 2004; Kahneman & Tversky, 1979). Further, the lack of conceptual definition has made it difficult to determine why or how the desirability of outcomes might influence judgments about the likelihood of those outcomes.

One component of attitudes that intuitively seems linked to desirability is affective evaluation of stimuli. This evaluative component appears to be marked by immediate affective reactions to stimuli that reflect the perceived goodness or badness of the stimuli (e.g., Damasio, 2003; Slovic & Peters, 2006). Preliminary evidence suggested that affective reactions might relate to the desirability bias in judgments. Lench and Ditto (2008) demonstrated that people rate positive outcomes as more likely than negative outcomes, even when the two outcomes have the same objective likelihood of occurrence. This desirability bias was not influenced by incentives for accuracy in a game of chance. In addition, judgments about the likelihood of future life events were more biased when predictions were made quickly and when participants made judgments while they were told to ignore words designed to elicit incidental affect that were also present on the screen. Together, these findings suggest that the desirability bias is due to a mechanism that is difficult to correct, relatively fast, and influenced by incidental affect. Reliance on affective reactions to

future events to make judgments would be just such a mechanism, but prior studies did not directly test this possibility.

The present investigation focused on the possibility that immediate affective reactions that mark events as either positive and desirable or negative and undesirable are sufficient and necessary to cause the desirability bias in judgments about the likelihood of positive and negative potential future events. The general prediction was that, relative to events that elicit neutral reactions, events associated with positive affective reactions would be judged as likely to occur and events associated with negative affective reactions would be judged as unlikely to occur. This is not to say that affective reactions and desire are necessarily equivalent, but rather that affective reactions are likely one component of desires and that it is plausible that affective reactions are critical to the desirability bias.

### Related Theoretical Accounts

Two groups of theoretical accounts suggest that the relationship between affective reactions and bias in judgments about the likelihood of future events would be either nonexistent or the opposite of the proposed relationship for negative affect. Prior explanations are reviewed in broad classifications based on the predictions they make for the influence of affect on judgments (each theoretical account described within a classification differs in the proposed mechanism or in details of process). There is empirical evidence that supports each of these theoretical accounts, and there is frequently some evidence indicating that these accounts are unlikely to account for all manifestations of the desirability bias. Each remains a viable alternative explanation for the potential relationship between affective reactions and likelihood judgments, however, and is thus reviewed here.

The first alternative theoretical account suggests that the desirability bias evidenced in studies that examine optimism about the likelihood of future life events is the result of nonmotivational factors (see Chambers & Windschitl, 2004, for a review), and thus affective reactions are unlikely to be the cause of the desirability bias in judgments about future life events. According to these nonmotivational accounts, the desirability bias results from methodological factors in the studies themselves and biases in how people consider others while making judgments. The typical methodology is for participants to rate their chances of experiencing various positive and negative events relative to an average peer, their same age and gender, at some point in the future (e.g., Weinstein, 1980). This question format itself can result in what appear to be biased judgments about the likelihood of future events. For example, Kruger and Burrus (2004) demonstrated that people tend to judge that they are more likely than average to experience common events and less likely than average to experience rare events. This finding appears to result from a tendency to ignore factors associated with other people when making comparative judgments and can lead to what appears to be unrealistic optimism or pessimism. If optimism is driven solely by these methodological and cognitive factors, there is no reason to expect that, as predicted, affective reactions would result in bias in likelihood judgments.

The second alternative theoretical account suggests that negative affect or specific negative emotions (i.e., sadness or fear) should lead to more pessimistic judgments about the likelihood of

future events. Studies that have examined the impact of incidental negative affect or emotion (unrelated to the potential future event that is later judged) have typically supported this assertion (e.g., Johnson & Tversky, 1983; Lerner & Keltner, 2001). For example, Johnson and Tversky (1983) found that participants who read a sad story made more pessimistic estimates about the likelihood of experiencing future negative events compared with participants who read stories designed to elicit other mood states. Sadness had a similar effect on judgments regardless of whether the judged events were closely related to the content of the sadness-eliciting story or unrelated. The risk-as-feelings account makes the same prediction that negative emotions should result in greater pessimism because people have anticipatory emotional reactions, such as anxiety and dread, to potential future events, and these emotional reactions cause the event to be judged as likely to occur (e.g., Loewenstein, Weber, Hsee, & Welch, 2001). For example, a person who is anticipating an upcoming airline flight with dread is likely to judge all airline-related negative incidents as relatively likely to occur. Recent work on the affect heuristic, whereby people use their immediate emotional responses as cues about the likelihood of future events, also suggests that negative affective reactions should lead people to judge that negative events are relatively likely to occur (see Slovic & Peters, 2006, for a review). In contrast to the prediction derived from this group of theoretical accounts, the prediction made in the present investigation is that events that elicit negative affective reactions will be judged as relatively unlikely to occur.

Of course, the desirability bias in judgment is likely multiply determined, and thus no one account can explain all instances of bias in judgment about the likelihood of future events. If a similar motivational factor underlies most instances of the desirability bias, however, it would provide one reason that the bias appears to be so pervasive and ubiquitous and provide a common theoretical ground from which to discuss various occurrences of the desirability bias.

### The Influence of Affect on Likelihood Judgments

If the component of desire that includes affective reactions is causally related to the desirability bias in likelihood judgments, as proposed, how might this effect occur? This question is relevant to any study that measures bias in likelihood judgments. Two theoretical accounts that offer different perspectives on how affective reactions might influence judgments about the likelihood of future events are reviewed. One group of accounts suggests that incidental affect unrelated or related to future events has a general effect on judgments or judgmental processes. Several of these accounts predict that positive mood leads to positive judgments and negative mood leads to negative judgments (e.g., Bower, 1981; Forgas, Bower, & Krantz, 1984; Schwarz & Clore, 1983). The mood-congruent judgment model, for instance, suggests that happy people expect a sunny day and sad people expect a rainy day and that happy people judge that they have more control over events than do sad people (e.g., Bower, 1981). Others of these accounts state that affective reactions influence judgments by changing the quantity or quality of cognitive processing (e.g., Ditto & Lopez, 1992; Kunda, 1990). For example, Ditto and Lopez (1992) demonstrated that participants spent more time and effort examining nonpreferred (negative) feedback than preferred (positive) feedback. Kunda and Sanitioso (1989) demonstrated that the quality of

cognitive processing can be biased by motivation, as participants recruited reasons that they were likely to have allegedly desirable (affectively positive) traits. This group of theories offers two specific predictions about the relationship between affect and judgments about the likelihood of future events. First, affect operates through a general mechanism, and it is general affect or mood that influences judgments or the judgmental processes that underlie judgment. To examine this possibility, the present investigation assessed the relationship between self-reported general affect and judgments about the likelihood of target events as well as the time spent making judgments. In addition, conscious awareness was limited to reduce the possibility that participants could or would recruit biased information. Second, any judgment, including but not limited to likelihood judgments about any and all future events, should be similarly influenced by affect. To examine this possibility, the present investigation assessed the degree to which manipulations of affective reactions had an impact on judgments about the likelihood of future events (vs. only the event that elicited the reaction).

Another untested possibility, suggested by recent work demonstrating the powerful impact of affective reactions on behavior (Damasio, 2003; Peters & Slovic, 2000), is that people base their likelihood judgments directly on affective reactions to potential future events. Positive affective reactions to stimuli elicit approach responses, whereas negative affective reactions to stimuli elicit avoidance responses (e.g., Damasio, 2003; Frijda, 1987; Peters & Slovic, 2000). For example, people respond to unconscious negative affective reactions by avoiding risky choices during a gambling task, and patients who are unable to react affectively do not learn to avoid the risky choices (Bechara, Damasio, Tranel, & Damasio, 1997). It is proposed that, on the basis of this work demonstrating the powerful impact of affective reactions on behavior, affective reactions to events are likely to influence judgments about the likelihood of those events because people can approach positive events and avoid negative events by judging them to be likely or unlikely to occur in their personal future. The simplest way to approach or avoid a potential event is simply to say that it is or is not going to happen—this judgment does not even require that the person take action to change the likelihood of the event. The proposed account, then, allows for two predictions that contrast with the group of theories outlined previously. First, affective reactions to potential events operate through a specific mechanism by encouraging the approach or avoidance of those events. In the present investigation, this possibility is examined through the consequences of manipulated affective reactions for likelihood judgments (Studies 1–4) and by manipulating tendencies to approach or avoid stimuli independently of affective reactions (Study 4). Second, the influence of affective reactions to potential future events should be limited to likelihood judgments about the target event. This possibility is examined through inclusion of likelihood judgments about nontarget events (Studies 1 and 2).

### The Present Investigation

The present investigation was designed to make two fundamental contributions to the understanding of the desirability bias in judgments and models of the relationship of affect to cognition. First, no previous study has demonstrated that positive and negative affective reactions to potential life events cause the desirability bias in judgment about the likelihood of those events. In four

studies, the consequences of affective reactions for judgments about the likelihood of events were examined. Second, the present investigation offers a novel conceptualization of the link between affect and judgments about future events based on tendencies to approach or avoid potential future events through likelihood judgments. Studies 1–3 provide evidence that affective reactions are sufficient and necessary to create the desirability bias, and Study 4 directly addresses the possibility that tendencies to approach or avoid events contribute to the desirability bias.

### Study 1

Methods employed in previous studies have suggested that desire creates bias in judgments about the likelihood of future events, but these findings were open to multiple alternative explanations because they were correlational in nature (e.g., examining predictions about inherently negative events such as cancer and inherently positive events such as winning awards). In addition, previous studies have been unable to establish whether the desirability of an event influences likelihood judgments for both positive and negative events. Study 1, therefore, was designed to manipulate affective reactions to initially neutral events. Evaluative conditioning, whereby neutral stimuli are paired repeatedly with positive or negative stimuli, was employed to create positive, negative, or neutral affective reactions to an initially neutral potential life event. Evaluative conditioning has been shown to influence judgments about the positivity of the conditioned stimulus (e.g., Olson & Fazio, 2001).

This study also utilized a popular question format that asks participants to compare their chances of experiencing a future event with their peers' chances (e.g., Weinstein, 1980). Research demonstrating optimism by using similar question formats has been excluded from considerations of the desirability bias on the grounds that these studies do not manipulate the desirability of the event, as is typical in studies that use games of chance (e.g., see Krizan & Windschitl, 2007, for the justification of this exclusion). The lack of studies that manipulate the desirability of future events has meant that there is no evidence that desire creates biases in judgments about real life events. Further, there is empirical evidence that methodological factors and psychological factors related to the way people process comparative questions can alone create undue optimism or pessimism in judgments (e.g., Chambers & Windschitl, 2004; Kruger & Burrus, 2004). Study 1 thus manipulated positive, negative, and neutral affective reactions to an initially neutral potential future life event, and participants judged their chances relative to a peer's.

### Method

*Participants.* Participants were 94 undergraduate students who took part in small groups for partial course credit ( $M_{\text{age}} = 19$  years, 59% female). Participants viewed a series of images on individual computer terminals. They sat approximately 16 in. from Dell LCD monitors and were instructed to remain seated and facing forward throughout the series presentation. Sixteen participants were removed because of computer or experimenter error. Participants judged the likelihood that they would own a white car in the future. This potential future event was chosen because pilot participants ( $n = 16$ ) rated that they were about as likely as the average student to own

a white car ( $M = 3.63$ ,  $SD = 0.89$ ),  $t(15) = 1.66$ ,  $ns$  (compared with a rating of average on the scale). Twelve participants were removed because they responded on debriefing questions that they currently owned a white car and/or had strong opinions about white cars (e.g., rated that they loved or hated them).

**Stimuli.** The images were selected from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, 1995; Lang, 1995). Pilot participants ( $n = 31$ ) rated the images on a scale ranging from 1 (*extremely negative*) to 7 (*extremely positive*). Based on these ratings, chosen images included neutral filler images of landscapes and clouds ( $M = 4.83$ ,  $SD = 0.67$ ), positive images of puppies and an attractive woman ( $M = 6.38$ ,  $SD = 0.98$ , and  $M = 6.03$ ,  $SD = 0.91$ , respectively), negative images of a snarling dog and a man with a gun ( $M = 1.69$ ,  $SD = 0.93$ , and  $M = 2.00$ ,  $SD = 1.05$ , respectively), and neutral images of an electrical plug and a truck ( $M = 4.04$ ,  $SD = 0.69$ , and  $M = 4.00$ ,  $SD = 0.28$ , respectively). The positive and negative images did not differ in terms of familiarity on a 7-point scale ( $M_{\text{pos}} = 2.00$ ,  $SD = 0.02$ , and  $M_{\text{neg}} = 1.97$ ,  $SD = 0.18$ , respectively),  $t(30) = 1.00$ ,  $p = .33$ , or arousal on a 7-point scale ( $M_{\text{pos}} = 3.29$ ,  $SD = 1.83$ , and  $M_{\text{neg}} = 3.79$ ,  $SD = 1.79$ , respectively),  $t(30) = 1.14$ ,  $p = .27$ .

**Procedure.** Each participant was presented with two series of images that contained the neutral filler images, the target image, and the paired image, and images forwarded automatically after 2 s. The target image was an image of a white car that was neutral ( $M = 4.25$ ,  $SD = 1.13$ , in a pilot study with  $n = 16$ ). In each series, three to six filler neutral images were presented, followed by the target neutral image. Following the target neutral image, a negative image (a snarling dog in Series 1; a man with gun in Series 2) was presented to participants in the negative condition, a positive image (puppies in Series 1; an attractive woman in Series 2) was presented to participants in the positive condition, and a neutral image (the electrical plug in Series 1; the truck in Series 2) was presented to participants in the neutral condition. This pairing occurred five times during the series. Specifically, the sequence of images was (with IAPS numbers): four neutral images (5870, 5760, 5720, 5300), the target image followed by the valenced image; six neutral images (5720, 5870, 5760, 5300, 5300, 5870), the target image followed by the valenced image; three neutral images (5300, 5760, 5870), the target image followed by the valenced image; three neutral images (5760, 5300, 5760), the target image followed by the valenced image; four neutral images (5300, 5720, 5300, 5760), the target image followed by the valenced image; and two neutral images (5870, 5720).

To reduce participants' awareness of the true purpose of the study, the series was presented as a test of memory, and participants judged the likelihood that various neutral images would appear next in the series. Because the sequence was identical for all participants, they viewed the target neutral image an equal number of times. The valenced paired images (positive, negative, neutral) appeared below the threshold for conscious awareness (50 ms determined from pilot tests presented 100 ms into the presentation of the neutral image to mask the image with similar contrast patterns; during debriefing, 5 participants reported seeing images but could not identify those images, and 5 participants reported seeing images and identified part of the image; analyses remained identical when these 10 participants were removed).

At the conclusion of the series, participants began an allegedly separate task and judged the likelihood that they would experience two minor positive events (e.g., winning an award) and two minor negative events (e.g., arthritis), compared with an average student their same age and gender, on a scale of 1 (*much less likely than average*) to 7 (*much more likely than average*; Weinstein, 1980). Participants then judged the likelihood that they would own a white car in the future by using the same question format. They also reported their affective reactions to white cars on a 7-point scale ranging from 1 (*hate*) to 7 (*love*) and the intensity of their current happiness, sadness, and anxiety on scales ranging from 1 (*not at all*) to 7 (*extremely*).

## Results and Discussion

To examine the relation between condition and judgments, an analysis of variance (ANOVA) was conducted with condition (positive, neutral, negative) as a between-subjects factor and target (white car, other events) as a repeated-measures factor. Consistent with predictions, there was an interaction between condition and target,  $F(2, 91) = 13.63$ ,  $p < .001$ ,  $\eta^2 = .23$ . As shown in Figure 1, the judged likelihood of owning a white car differed between conditions,  $F(2, 91) = 12.09$ ,  $p < .001$ ,  $\eta^2 = .21$ . Participants judged that they were more likely to own a white car if they had viewed a white car paired with positive images ( $M = 4.46$ ,  $SD = 1.07$ ) than if it had been paired with neutral images ( $M = 3.42$ ,  $SD = 1.62$ ),  $t(57) = 2.82$ ,  $p < .01$ ,  $d = 0.75$ , or negative images,  $t(59) = 5.73$ ,  $p < .001$ ,  $d = 1.49$ . They also judged that they were marginally less likely to own a white car if it had been paired with negative images ( $M = 2.77$ ,  $SD = 1.19$ ) than neutral images,  $t(66) = 1.90$ ,  $p = .06$ ,  $d = 0.47$ . The consequences of the manipulation were limited to the target event. Minor positive and negative events were rated as equally likely across conditions,  $F(2, 91) = 0.23$ ,  $ns$ ,  $\eta^2 = .01$ , and  $F(2, 91) = 0.83$ ,  $ns$ ,  $\eta^2 = .03$ , indicating that the subliminal presentation of images did not influence unrelated likelihood judgments. These findings, using a question format similar to that employed in previous studies of unrealistic optimism, demonstrate that affective reactions influence likelihood judgments about potential future events in one's own life.

Hierarchical regression analyses were conducted to supplement the theoretical explanation supported by the main analyses reported above and to examine the viability of various explanations for the above finding. If affective reactions to the potential future event influenced likelihood judgments, as predicted, then affective reactions should mediate the relationship between condition and the judged likelihood of the target event.<sup>1</sup> The positive and nega-

<sup>1</sup> Note that these mediational analyses were supplementary to the main analyses with condition because affective reactions were manipulated through evaluative conditioning and self-reported affective reactions were measured at the conclusion of the study. This delayed measurement was necessary to avoid unintentionally drawing participants' attention to their affective reactions, which can change affective processes. It is also important to note that the reported mediational effect could have been due to condition influencing affective reactions and likelihood judgments, rather than condition influencing likelihood judgments through affective reactions. Study 3 presents evidence that affective reactions are necessary to the desirability bias in judgments and avoids the potential issues with the mediational analyses in Studies 1 and 2.

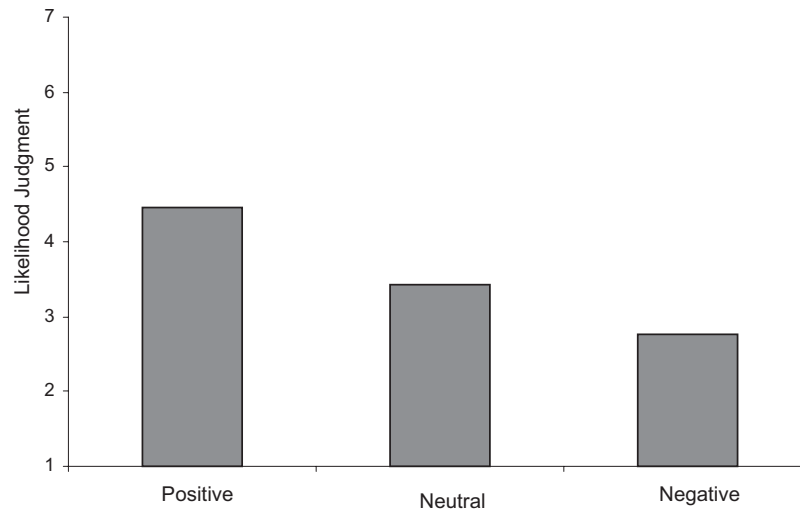


Figure 1. Participants judged that they were more likely to experience an otherwise neutral future event if images of the event were subliminally paired with positive stimuli rather than neutral stimuli and less likely to experience the event if it had been paired with negative stimuli rather than neutral stimuli.

tive conditions were included in these analyses because the various explanations of biased judgments make clear predictions for these two groups. Consistent with the interpretation of the main analyses, condition related to judgment ( $\beta = .60, t = 5.73, p < .001$ ), and this relationship was reduced ( $\beta = .48, t = 4.10, p < .001$ ) when affective reactions were included as a predictor of judgment ( $\beta = .23, t = 2.00, p = .05, Sobel = 1.82, p = .06$ ). If affect or anxiety had a general effect on likelihood judgments, then self-reported general affect (i.e., sadness and happiness) or anxiety should mediate the relationship between condition and the judged likelihood of the target event. Condition did not predict happiness ( $\beta = .11, t = 1.07, p = .29$ ), and happiness did not predict judgments ( $\beta = -.08, t = -0.81, p = .42$ ). Sadness did predict judgments ( $\beta = .20, t = 2.07, p < .05$ ), but condition did not predict sadness ( $\beta = -.14, t = -1.39, p = .17$ ), and the relationship between condition and judgments was not reduced by the inclusion of sadness ( $\beta = .24, t = 2.37, p < .05$ ). Condition did not predict anxiety ( $\beta = -.05, t = -0.49, p = .63$ ), and anxiety did not predict judgments ( $\beta = -.04, t = -0.36, p = .72$ ). Participants in the three conditions also did not differ in their response times when judging the likelihood of owning a white car,  $F(2, 91) = 1.07, ns$ .

Study 1 demonstrated that manipulated affective reactions to a relatively neutral potential future event were sufficient to create the desirability bias. This finding is particularly noteworthy because there is no prior evidence that manipulated reactions to life events can result in the desirability bias in judgments about the likelihood of those events (Krizan & Windschitl, 2007). An alternative explanation—that affective reactions may be seen as a legitimate source of information about the likelihood of life events—could be offered for Study 1. When asked whether they were likely to own a white car, participants may have asked themselves how much they liked white cars and inferred that they would or would not buy a white car based on how much they liked the car. This is a potential alternative account for any study that utilizes real life events, as people typically believe that they have control over most life events (e.g., McKenna, 1993). However,

judgments of likelihood and controllability are separable (Lench & Levine, 2005). Study 2 examined the impact of affective reactions on judgments about the likelihood of future events over which participants could not realistically expect that they had any control.

## Study 2

Study 1 demonstrated that affective reactions to a potential event can influence likelihood judgments about the occurrence of that event. Study 2 examined whether a similar effect would be evident in a situation where people had no prior beliefs about the likelihood of the event, they could not infer that they had control over the occurrence of the event, and the event was universally regarded as neutral. It is difficult to imagine real-world life events that are universally regarded as neutral, but the task used in Study 2 afforded that opportunity. This judgment task was not intended to be similar to what people might actually face when judging the likelihood of future events in daily life but rather to create a minimal situation in which participants were exposed to exactly the same objective information that indicated likelihood (e.g., Rosenhan & Messick, 1966). The study was again presented as an investigation of memory, and all participants saw the same sequence of images, from which they were asked to infer the likelihood that a target image would occur.

## Method

**Participants.** Participants were 102 undergraduate students who took part in small groups for partial course credit ( $M_{age} = 18$  years, 63% female). Participants viewed a series of images on individual computer terminals. They sat approximately 16 in. from Dell LCD monitors and were instructed to remain seated and facing forward throughout the series presentation.

**Procedure.** Participants again saw two series of images, as described in Study 1. Each series contained a different target neutral image. The target neutral images (a white bowl; a blue cup)

were chosen because they were rated neutral with little variation ( $M = 4.00$ ,  $SD = 0.41$ , and  $M = 4.26$ ,  $SD = 0.59$ , respectively). The target images were again paired with positive, negative, or neutral images, as described in Study 1. The paired images were presented subliminally; however, during debriefing, 5 participants reported seeing images but could not identify those images, and 8 participants reported seeing images and identified part of the image. Analyses remained identical when these 13 participants were removed. The task was again presented as a memory task, and all participants saw the same series of images and had the same information from which to judge whether any particular image was likely to occur next in the series.

After each series, participants reported whether three images (two neutral filler images and the target image) would appear next in the series. The computer program recorded the time that participants took to make their judgments to the millisecond. At the conclusion of the series, participants rated their affective reactions to the target image on a scale ranging from 1 (*strongly dislike*) to 7 (*strongly like*). Participants also reported the intensity of their current happiness, sadness, and anxiety on scales ranging from 1 (*not at all*) to 7 (*extremely*).

### Results and Discussion

To examine the impact of affective reactions on judgments about the likelihood of target and filler neutral items, an ANOVA was conducted with condition (positive, negative, neutral) as a between-subjects factor and stimulus (target, neutral filler) as a repeated-measures factor. Consistent with predictions, there was an interaction between condition and stimulus,  $F(2, 99) = 4.02$ ,  $p < .05$ ,  $\eta^2 = .08$ . The number of times participants judged that the image would occur differed in the positive, negative, and neutral conditions,  $F(2, 99) = 16.79$ ,  $p < .001$ ,  $\eta^2 = .25$ . As can be seen in Figure 2, the target images were judged as more likely to occur if they had been paired with positive images ( $M = 1.50$ ,  $SD = 0.62$ ) than if paired with neutral images ( $M = 1.09$ ,  $SD = 0.62$ ),  $t(64) = 2.69$ ,  $p < .01$ ,  $d = 0.67$ . The target images were also rated as less likely if they had been paired with negative images ( $M = 0.67$ ,  $SD = 0.53$ ) than neutral images,  $t(68) = 3.05$ ,  $p < .01$ ,  $d = 0.74$ , or positive images,  $t(66) = 5.94$ ,  $p < .001$ ,  $d = 1.46$ . The three conditions did not differ in likelihood ratings for the two filler neutral images in each series,  $F(2, 99) = 1.19$ , *ns*, indicating

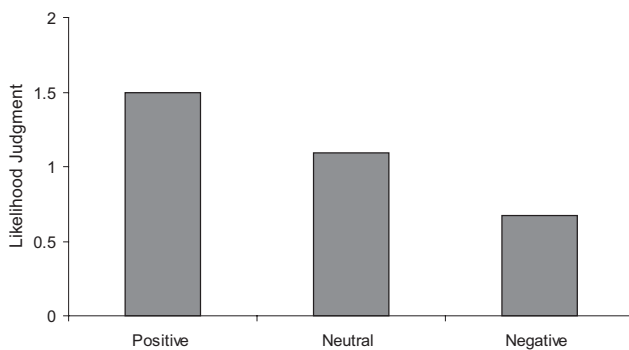


Figure 2. Initially neutral stimuli were rated as more likely to occur if subliminally paired with positive stimuli rather than neutral stimuli and less likely to occur if paired with negative stimuli rather than neutral stimuli.

that there was no general tendency for participants in the two conditions to rate images as more or less likely. This finding is consistent with Study 1 and the proposal that likelihood judgments are based on affective reactions to potential future events. This finding is not consistent with theories that suggest affect should influence judgments about both target and nontarget events.

Mediational analyses were again conducted to supplement the main analyses by examining whether condition changed affective reactions to the images and whether self-reported general affect predicted likelihood judgments. Consistent with predictions, condition related to judgments about the likelihood of the target event occurring ( $\beta = .59$ ,  $t = 5.94$ ,  $p < .001$ ), but this relationship was reduced ( $\beta = .49$ ,  $t = 5.40$ ,  $p < .001$ ) when affective reactions to the target image were included as predictors of judgment ( $\beta = .39$ ,  $t = 4.21$ ,  $p < .001$ , *Sobel* = 1.91,  $p = .06$ ). As in Study 1, the relationship was not mediated by general affect or anxiety. Condition did not predict happiness ( $\beta = .08$ ,  $t = 0.64$ ,  $p = .52$ ), and happiness did not predict judgments ( $\beta = .14$ ,  $t = 1.43$ ,  $p = .16$ ). Condition also did not predict sadness ( $\beta = .11$ ,  $t = 0.88$ ,  $p = .38$ ), and sadness did not predict judgments ( $\beta = -.11$ ,  $t = -1.15$ ,  $p = .26$ ). Condition was also not a predictor of anxiety ( $\beta = .01$ ,  $t = 0.04$ ,  $p = .97$ ), and anxiety did not predict judgments ( $\beta = -.08$ ,  $t = -0.82$ ,  $p = .41$ ). If negative affective reactions were triggering additional analytic processing aimed at rejecting information, then participants in the two conditions should differ in the time spent making their judgments. Participants in the two conditions, however, did not differ in the time spent making judgments,  $F(2, 99) = 0.16$ , *ns*, indicating that positive or negative reactions did not elicit additional processing. To summarize, the results of Study 2 supported the prediction that affective reactions to an event led to the desirability bias and did not support other accounts.

### Study 3

Studies 1 and 2 provided evidence that positive and negative affective reactions were sufficient to create the desirability bias. A critical question that remained was whether affective reactions are, as proposed, a necessary component to create the desirability bias in most situations. Certainly other nonmotivated and motivated factors can contribute to or moderate the desirability bias in judgments, but the question was whether desire, in the form of affective reactions, is at the core of the bias. Study 3 examined whether the desirability bias in judgments about the likelihood of life events was eliminated or reduced if affective reactions were discounted. A misattribution paradigm was used to examine this possibility (e.g., Fazio, Zanna, & Cooper, 1977; Schwarz & Clore, 1983). Participants were given reason to expect that affective reactions were due to contextual factors rather than the potential future events being evaluated. This sort of misattribution paradigm has been shown to reduce the impact of incidental and related affect on subsequent judgment because people essentially discount their affective reactions. If the desirability bias were due to people relying on their affective reactions to judge the likelihood of future events, then the bias should be reduced or eliminated when people are led to discount their affective reactions.

Study 3 also addressed the possibility that affective reactions lead to a tendency to respond in a particular way to any likelihood question regardless of the implications of the response. Positive affective reactions might lead people to respond positively to any

likelihood judgment regardless of whether that response indicates that the event is likely or unlikely to occur and vice versa for negative affective reactions. To examine whether this was a possible explanation for the findings, participants judged the likelihood that the event would occur and the likelihood that the event would not occur.

### Method

**Participants.** Participants were 89 undergraduate students who took part in small groups for partial course credit ( $M_{\text{age}} = 19$  years, 53% female). Participants viewed a series of images and made judgments on individual computer terminals, as described in Study 1.

**Procedure.** Participants viewed two series of images and words that included the neutral filler images described in Study 1 and neutral nouns (e.g., *decision*, *bowl*). Each image or word forwarded automatically after 2 s. The target word *relative* was paired with affectively valenced words. Specifically, *relative* would appear for 1 s, followed by a flash that contained positive words (e.g., *love*, *smile*) or negative words (e.g., *hate*, *loss*), followed by the word *relative* for 1 s. Words were used in this study because preliminary testing indicated that the contrast between a word and images was too high, resulting in many participants' seeing the images that were intended to be subliminal. The flash appeared for 50 ms, and the words appeared in the same location on the screen, so that *relative* served as a mask for the subliminally presented word (no participants reported awareness of the subliminally presented words). The experiment was presented as a test of memory, and participants made judgments about the likelihood of various images occurring after each series in order to reduce participant awareness of the true purpose of the study.

At the conclusion of the two series, the experimenter presented participants with instructions for a second task concerned with judgments about the likelihood of future events. Toward the end of these instructions, the experimenter casually remarked about the extinguished overhead lights that s/he had intended to mention that they were doing electrical work on just that circuit for the next hour. The experimenter then made one of three remarks to encourage participants to misattribute positive and negative reactions to the lack of light in the room or to offer no such misattribution (Fazio et al., 1977; Schwarz & Clore, 1983). In the no misattribution conditions, s/he commented that participants should have plenty of light to see during the study. In the misattribution conditions, s/he commented that some participants had been reporting that it made them feel good and relaxed/bad and tense. Participants were offered a reason only to misattribute the evaluatively conditioned response, so that participants in the positive conditions were given reason to misattribute their positive reactions and participants in the negative conditions were given reason to misattribute their negative reactions. This partially crossed design was used in order to highlight the conditions about which predictions could be made. Although some studies have shown a reversal of effects such that participants have a more intense reaction if they are expecting the opposite response (e.g., Fazio et al., 1977), this finding is inconsistent, and a lack of such an effect would be difficult to interpret. For this reason, only the misattribution conditions relevant to the affective reactions were included.

Participants then made a series of likelihood judgments. First, they judged the likelihood that they would experience two minor positive events (e.g., receive a compliment) and two minor negative events (e.g., run late to a meeting), compared with an average student their same age and gender, on a scale of 1 (*much less likely than average*) to 7 (*much more likely than average*; Weinstein, 1980). These items were included only as filler items and to allow participants practice with the task. Second, participants judged the likelihood that they would work for a relative in the future and not work for a relative in the future by using the same question format. Third, participants judged the likelihood that they would experience a variety of positive life events (win an award, be happily married, receive a promotion) and negative life events (develop arthritis, lose an important computer file, drop out of college) by using the same question format. Participants in the positive misattribution conditions judged the likelihood of positive events first, and participants in the negative misattribution conditions judged the likelihood of negative events first. This was done so that they first answered questions about future events likely to elicit the affective reaction they had reason to misattribute and to avoid any potential affective conflict had they first considered events of an opposite valence.

### Results and Discussion

To examine the relation between condition and judgments, an ANOVA was conducted with evaluative conditioning (positive, negative) and misattribution (misattribution, no misattribution) as between-subjects factors. As described previously, this design was partially crossed such that participants in the positive condition were given reason to misattribute their positive reactions or not, and participants in the negative condition were given reason to misattribute their negative reactions or not. There were no main effects of evaluative condition or misattribution. As can be seen in Figure 3 and consistent with predictions, there was an interaction between evaluative conditioning and misattribution,  $F(1, 85) = 28.49$ ,  $p = .007$ ,  $\eta^2 = .08$ . When participants could not misattribute their affective reactions, the desirability bias was evident in judgments, and participants judged that they were more likely to work for a relative if the word *relative* had been paired with positive stimuli rather than negative stimuli,  $t(44) = 2.38$ ,  $p = .02$ ,  $d = 0.72$ . This bias disappeared, however, when participants could misattribute their affective reactions to a source other than the potential future event,  $t(41) = 1.56$ , *ns*. In addition, participants judged that they were marginally more likely to work for a relative if the word had been paired with positive stimuli and they could not misattribute their positive reactions than if they could misattribute their reactions,  $t(44) = 1.79$ ,  $p = .08$ ,  $d = 0.54$ . Similarly, participants judged that they were less likely to work for a relative if the word had been paired with negative stimuli and they could not misattribute their negative reactions than if they could misattribute their reactions,  $t(41) = 2.12$ ,  $p = .04$ ,  $d = 0.66$ . Thus, the desirability bias was reduced when participants could misattribute their affective reactions to something other than potential future events.

Participants were also asked the reversed question: How likely were they not to work for a relative—and the effects were similar (note that these results sometimes involve an unavoidable double negative). As in the primary analysis, there was a significant



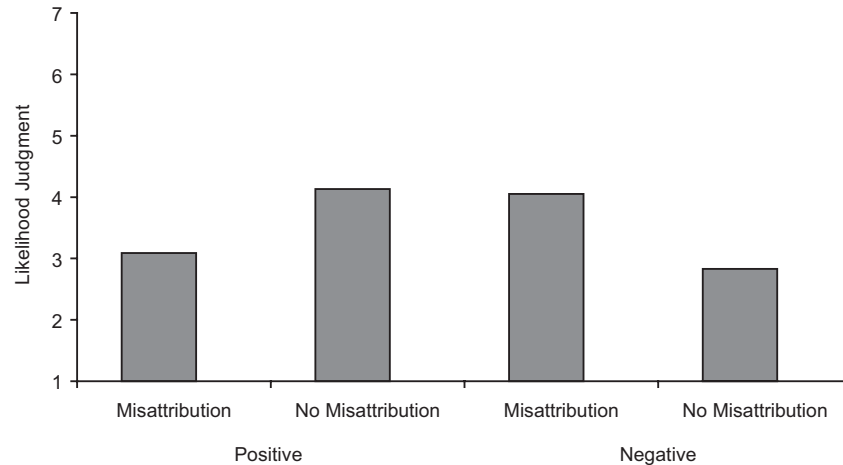


Figure 3. The desirability bias was reduced when participants misattributed their affective reactions to a source other than the future event.

interaction between evaluative conditioning and misattribution,  $F(1, 85) = 6.21, p = .02, \eta^2 = .07$ . When participants could not misattribute their reactions, there was a desirability bias such that they judged they were less likely not to work for a relative if the word had been paired with positive stimuli ( $M = 3.65, SD = 2.01$ ) rather than negative stimuli ( $M = 4.91, SD = 1.65$ ),  $t(44) = 2.32, p = .03, d = 0.70$ . When participants could misattribute their reactions, there was no significant difference between judgments that they would not work for a relative when the word had been paired with positive stimuli ( $M = 4.35, SD = 1.61$ ) or negative stimuli ( $M = 3.75, SD = 1.68$ ),  $t(41) = 1.18, ns$ . These results are consistent with those reported in the primary analysis and suggest that the effects of condition were not due to a general tendency to respond *yes* to questions about positive events and *no* to questions about negative events.

To examine whether the misattribution conditions influenced judgments about other inherently positive and negative future events, a mixed ANOVA was conducted with valence (positive, negative) as the repeated-measures factor and misattribution condition (misattribution, no misattribution) as the between-subjects factor. Consistent with previous research demonstrating a strong desirability bias, there was a main effect of valence such that participants judged that they were more likely to experience positive events ( $M = 4.74, SD = 0.85$ ) than negative events ( $M = 3.28, SD = 0.88$ ),  $F(1, 87) = 114.10, p < .001, \eta^2 = .57$ . This was qualified by an interaction between valence and misattribution condition,  $F(1, 87) = 7.39, p = .008, \eta^2 = .08$ . Participants judged that they were marginally less likely to experience positive future events if they could misattribute positive affective reactions ( $M = 4.39, SD = 1.04$ ) rather than if they could not misattribute their reactions ( $M = 4.90, SD = 0.81$ ),  $t(44) = 1.85, p = .07, d = 0.56$ . Participants also judged that they were more likely to experience negative future events if they could misattribute negative affective reactions ( $M = 3.70, SD = 0.74$ ) rather than if they could not misattribute their reactions ( $M = 3.19, SD = 0.80$ ),  $t(41) = 2.17, p = .04, d = 0.68$ .

Overall, then, the desirability bias was reduced when participants could misattribute their affective reactions to a source other

than potential future events. This finding is consistent with the proposal that affective reactions are necessary to the desirability bias in judgment. It is important to note that although the misattribution paradigm rests on the assumption that a cognitive process can modify an affective process, it does not indicate that the initial process is itself cognitive. Similarly, cognitive strategies, such as positive reappraisal, can be employed to reduce the impact of emotional reactions on judgments and behaviors, but the emotional experience being modified is not necessarily the result of cognitive processes (Gross, 1998).

#### Study 4

Tendencies to approach or avoid are separable from, but related to, emotional experience. It was proposed that positive and negative affective reactions lead people to approach or avoid potential future events by judging that the events are likely or unlikely to occur, respectively. If affective reactions lead people to approach or avoid events, providing other cues that encourage approach or avoidance responses is likely to enhance or mitigate the tendencies that result from affective reactions. In Study 4, therefore, participants engaged in arm extension or flexion while making judgments about the likelihood of future events. Physical arm movements were chosen because they influence evaluative processes linked to affect but do not appear to influence nonevaluative judgments (Cacioppo, Priester, & Berntson, 1993; Forster & Strack, 1997, 1998). These movements are not synonymous with affective experiences, however, and people associate arm flexion and extension with the terms *approach* and *withdraw*, respectively, but not *pleasant* or *unpleasant* (Cacioppo et al., 1993). In past studies, arm movements (flexion, extension) compatible with emotional state (positive, negative) resulted in judgments that were more aligned with affective state than with incompatible arm movements (Centerbar & Clore, 2006; Forster & Strack, 1996; Neumann & Strack, 2000). Thus, arm extension and flexion offered a method to manipulate the tendency to approach or avoid in such a way that participants were unlikely to be aware of the intended effects of the manipulation, and the manipulation of the tendency to approach

and avoid was not affective in nature and was independent of affective manipulations.

### Method

**Participants.** Participants were 100 undergraduate students who took part in small groups for partial course credit ( $M_{\text{age}} = 18$  years, 74% female). Participants again viewed a series of images and made judgments on individual computer terminals, as described in Study 1.

**Procedure.** The method was identical to that of Study 3, with a few exceptions. First, the target word that was paired with valenced words during the series of images was *garden*, and participants were subsequently asked to judge the likelihood that they would plant a garden. Second, immediately before making judgments about their chances of experiencing the target event and various future life events, participants were instructed to engage in arm flexion or extension. Foam was placed on the top (arm extension) or bottom (arm flexion) of the computer table. Participants pressed on the foam with their dominant hand. To encourage participants to exert similar pressure in both conditions, participants were instructed to press until they could feel the table through the foam and to hold that position for 5 s (Dru & Cretenet, 2008).

**Independent effects of approach/avoidance.** A preliminary investigation was conducted to examine whether approach and avoidance manipulations had an effect on affective reactions. It was proposed that affective reactions create a tendency to approach or avoid stimuli, which influences likelihood judgments. In Study 4, approach and avoidance tendencies were manipulated independently of affective reactions to examine this potential relationship. Because these relationships were manipulated rather than measured, however, it was important to establish that the manipulation of approach and avoidance tendencies did not influence self-reported affective reactions. A separate group of participants ( $n = 50$ ) therefore viewed the same series of words and images described above except that the target neutral word was paired with neutral words rather than valenced words. They then engaged in arm extension or arm flexion, as described above, before judging their affective reactions to the target event on a scale ranging from 1 (*strongly dislike*) to 7 (*strongly like*). An ANOVA was conducted with proprioceptive cue (arm flexion, arm extension) as the between-subjects factor. The results confirmed that the approach and avoidance manipulation did not significantly influence self-reported affective reactions,  $F(1, 49) = 0.13$ ,  $p = .72$ . This finding supports the methodological assumption, based on prior research, that although affective reactions influence approach and avoidance tendencies, these tendencies are independent of and do not change affective reactions.

### Results and Discussion

To examine the relation between affect and arm movement, an ANOVA was conducted with evaluative conditioning (positive, negative) and proprioceptive cue (match, no match) as between-subjects factors. Arm flexion was considered a match for positive conditions, and arm extension was considered a match for negative conditions. There were no main effects of evaluative condition or proprioceptive cue. There was an interaction between evaluative

condition and proprioceptive cues,  $F(1, 96) = 8.45$ ,  $p = .005$ ,  $\eta^2 = .08$ . When proprioceptive cues matched the manipulated affective reactions, participants demonstrated the typical desirability bias and judged that they were more likely to plant a garden if it had been paired with positive stimuli ( $M = 3.52$ ,  $SD = 1.65$ ) rather than negative stimuli ( $M = 2.54$ ,  $SD = 1.47$ ),  $t(49) = 2.22$ ,  $p = .03$ ,  $d = 0.63$ . When proprioceptive cues did not match affective reactions, the desirability bias was reduced, and participants tended to judge that they were more likely to experience the event if it had been paired with negative stimuli ( $M = 3.50$ ,  $SD = 1.36$ ) rather than positive stimuli ( $M = 2.78$ ,  $SD = 1.28$ ),  $t(47) = 1.89$ ,  $p = .07$ ,  $d = 0.55$ . In addition, participants judged that they were marginally more likely to experience the event if the word had been paired with positive stimuli and they were flexing their arm rather than if they were extending their arm,  $t(48) = 1.74$ ,  $p = .09$ ,  $d = 0.50$ . Participants also judged that they were less likely to experience the event if the word had been paired with negative stimuli and they were extending their arm rather than if they were flexing their arm,  $t(48) = 2.39$ ,  $p = .02$ ,  $d = 0.69$ . Thus, the desirability bias was reduced when proprioceptive cues to approach or avoid did not match affective reactions to a potential future event.

Next, analyses were conducted to examine whether the proprioceptive cues influenced judgments about other positive and negative future events. Participants judged that they were marginally more likely to experience positive events when they had flexed their arm earlier ( $M = 5.21$ ,  $SD = 1.04$ ) rather than extended their arm ( $M = 4.84$ ,  $SD = 0.91$ ),  $F(1, 98) = 3.42$ ,  $p = .07$ ,  $\eta^2 = .03$ . Similarly, participants judged that they were marginally less likely to experience negative events when they had extended their arm earlier ( $M = 3.01$ ,  $SD = 0.68$ ) rather than when they had flexed their arm ( $M = 3.31$ ,  $SD = 0.94$ ),  $F(1, 98) = 3.31$ ,  $p = .07$ ,  $\eta^2 = .03$ . These effects were marginal but were in a direction consistent with the findings reported for manipulated affective reactions. There are multiple reasons that the effect of proprioceptive cues may have been weaker with judgments for inherently positive and negative events than with judgments for a relatively neutral event that was manipulated to be positive or negative. It is possible that affective reactions to inherently positive and negative events are sufficiently strong and compelling that the impact of proprioceptive cues is dwarfed by the impact of affective reactions on approach and avoidance tendencies. It is also possible that the influence of the proprioceptive cues had begun to fade by the time participants made their judgments about inherently positive and negative events.

## General Discussion

### *The Desirability Bias*

Two critical questions were the focus of this investigation. The first question was, Are judgments about the likelihood of future events biased by affective reactions to future events? The answer is a solid yes. Participants across studies predicted that the same event was more likely to occur if it had been paired with positive affective reactions rather than negative affective reactions. Explanations of the desirability bias and related phenomena frequently assume that desire influences judgments, but the present investigation directly assessed this assumed relationship with events

other than outcomes in games of chance. Further, this investigation was the first to establish that affective reactions to future events are the driving force behind the desirability bias and that both positive and negative affective reactions create the desirability bias. Across studies, manipulated positive reactions to potential events led to judgments that those events were more likely than neutral events, and manipulated negative reactions to events led to judgments that those events were less likely than neutral events. In addition, the desirability bias was reduced or eliminated when affective reactions were misattributed to a source other than the future events. The fact that affective reactions influenced likelihood judgments for potential future events suggests that the typically estranged lines of research on optimistic biases and desirability biases can be conceptually integrated because each type of judgment is influenced by the desirability of the future event.

The second question that was a focus of this investigation was, If judgments are biased by the desirability of future events, how does this occur? The proposal advanced in this investigation is that affective reactions to potential future events have a direct effect on judgments about the likelihood of those events, and this is, at least in part, due to the tendency they create to approach or avoid events. This proposal was supported by findings that initially neutral events that came to elicit positive affective reactions were judged to be more likely to occur than the same event that came to elicit negative affective reactions. Further, this effect was reduced when the tendency to approach or avoid was independently manipulated to conflict with the tendency created by negative and positive affective reactions. The manipulation of approach and avoidance tendencies used in this investigation, arm movements, has been shown to influence only approach and avoidance and not affective evaluations of positivity or negativity (Cacioppo et al., 1993; Forster & Strack, 1997), and this assumption was confirmed in Study 4. Thus these movements were likely to influence the relationship between affective reactions and likelihood judgments, without changing affective reactions themselves, suggesting a directional effect. This investigation suggests that approach and avoidance tendencies may be the mechanism through which affective reactions influence likelihood judgments, but future studies should directly assess this relationship, perhaps with physiological monitoring of areas known to be associated with approach and avoidance tendencies.

Recent studies in multiple areas of psychology have made clear that affective reactions can have a strong influence on behavior and allow for the quick categorization of stimuli (e.g., Damasio, 2003; Greenwald, McGhee, & Schwartz, 1998). Any time that people are making judgments about what will happen to them in the future, affective reactions are likely to guide their decisions. These reactions are unlikely to influence other frequency judgments (e.g., the number of people owning a white car), unless these judgments have implications for one's own future or the future of someone closely affiliated with the self (such as a child; Lench, Quas, & Edelman, 2006). Determining the consequences of affective reactions for judgments that have varying degrees of implications for the self is an interesting question for future research. Affective reactions appear fundamental in guiding interactions between the self and the world. It should be no surprise, therefore, that these automatic affective reactions guide relatively complex judgments about our futures.

The proposed explanation that people have affective reactions to potential future events and that these reactions create tendencies to approach or avoid the event by judging that it is likely or unlikely to occur provides a parsimonious account for the desirability bias that is consistent with findings regarding the impact of affective reactions on other judgmental processes. Any alternative account would need to provide a compelling and parsimonious account for the present findings. These include the following:

1. Participants judged that they were more likely to experience exactly the same event, presumably associated with the same objective likelihood of occurrence, if it had been paired with positive stimuli rather than negative stimuli.
2. Participants judged that they were more likely to experience the same event if it had been paired with positive stimuli rather than neutral stimuli and less likely to experience the event if it had been paired with negative stimuli rather than neutral stimuli.
3. This effect was present for life events that participants could reasonably anticipate that they could control and for events that participants could not reasonably anticipate that they could control (i.e., images in a sequence).
4. The influence of manipulated affective reactions was limited to the target event that had been paired with valenced stimuli and did not extend to judgments about other events.
5. Manipulated affective reactions changed self-reported affective reactions, and self-reported reactions predicted bias in likelihood judgment.
6. General self-reported affect and anxiety did not mediate the relationship between condition and bias and for the most part did not relate to likelihood judgments (sadness predicted judgment in Study 1).
7. Participants took the same amount of time to make judgments about positive, negative, and neutral events.
8. The desirability bias was reduced for neutral events that were manipulated to elicit affective reactions and for inherently positive and negative events when participants could misattribute their affective reactions to a source other than the future events.
9. The effect of affective reactions on likelihood judgments was evident for both judgments that an event would occur and judgments that an event would not occur.
10. The desirability bias was reduced when participants received independent proprioceptive feedback indicating that they should approach or avoid stimuli that conflicted with manipulated affective reactions.

The proposed theoretical account is motivational in nature and highlights the importance of affective reactions and approach and

avoidance for likelihood judgments. From a dual process perspective, this account suggests that experiential processes are necessary and sufficient to create the desirability bias in judgment because they have a direct effect on these judgments without cognitive analysis. Multiple cognitive accounts and mechanisms could be offered as alternative or supplemental theoretical explanations, but these explanations are unlikely to be able to account for the evidence described above. One such account will be considered in detail as an example. Previous studies have suggested that the tendency to imagine outcomes is related to risk judgments (e.g., Sherman, Cialdini, Schwartzman, & Reynolds, 1985). One might posit that people spend more time or more effort imagining positive potential outcomes than negative potential outcomes and that this tendency causes positive events to be judged as more likely to occur than negative events. This account, however, is unlikely to explain the evidence presented in the current investigation. First, participants would have to spend time imagining the outcomes, and this would need to be disproportionately spent imagining positive outcomes compared with negative outcomes. It seems intuitively unlikely that participants spent time imagining the presentation of a white bowl (as in Study 2) or neutral events like working for a relative (as in Study 3) and that this imagining differed between conditions. Further, there were no differences in the time spent forming judgments in the positive, negative, and neutral conditions. Second, several studies have demonstrated that the desirability bias is increased when participants have less time to consider their judgments (Krizan & Windschitl, 2007; Lench & Ditto, 2008; Lench, Herpin, & Sweeney, 2009). If the desirability bias were due to differences in the tendency to imagine positive and negative outcomes, or any other cognitive mechanism, one would expect the bias to be reduced, not enhanced, when participants are forced to answer quickly and consequently have a reduced ability to engage in cognitive activity. Imagination was considered only as an example of alternative cognitive accounts that could be posited, but any cognitive account would face similar difficulties in explaining the desirability bias in judgment and the evidence presented in the current investigation.

Another question that may arise about the reported effects is whether the inferences are likely to generalize to judgments regarding real-world events. Reactions to real potential life events were manipulated in Studies 1, 3, and 4 and supported the inferences drawn. These were, however, relatively neutral events (i.e., owning a white car) that are dissimilar from many of the fears and hopes that participants may hold for their daily lives. Studies 3 and 4 demonstrated that similar processes appeared to be influencing judgments regarding outcomes that were experimentally manipulated to elicit affective reactions and inherently positive (win an award) or negative (drop out of college) life events. Such likelihood judgments about inherently positive or negative life events have been shown to predict behavior, and people who judge that they are at lower risk are less likely to take preventive action (Weinstein & Klein, 1995). In addition, a study that utilized an evaluative conditioning procedure similar to the present methodology demonstrated that affective reactions to the real-life hazard of formaldehyde exposure changed behaviors (Lench, 2008). Participants who learned of the risk as it was paired with negative stimuli recommended that their university spend less money to alleviate the hazard and were less likely to take information about reducing their personal risk compared with participants for whom

the risk was paired with positive or neutral stimuli. Thus, it seems likely that the inferences drawn in the present investigation would generalize to people's judgments about real-world potential positive and negative life events and influence important risk-related behaviors.

### *Relationship to Nonmotivational and Emotional Accounts*

Recent research related to optimism for future life events has focused heavily on nonmotivational factors (see Chambers & Windschitl, 2004, for a review). It is likely that mechanisms unrelated to the desirability of the event could in some situations cause the desirability bias in likelihood judgments, although such a bias could not accurately be called a desirability bias. Indeed, studies that demonstrate that people make optimistic judgments for future life events are typically considered separately from studies of the desirability bias in games of chance, primarily because studies have not manipulated the desirability of life events (e.g., Krizan & Windschitl, 2007). The primary nonmotivational explanation for optimistic biases is that people tend to ignore the base rate of events or other people's likelihood and focus only on their own chances of experiencing events. This can lead people to judge that they are more likely than average to experience common events, such as owning a car, but less likely than average to experience rare events, such as owning an airplane (e.g., Kruger & Burrus, 2004). To the extent that negative events are less common than positive events, this tendency alone could create a bias in likelihood judgments that appears to be the desirability bias. This type of nonmotivational explanation frequently depends, however, on the particular methodology and question format used. Although this is informative about how social information and base rates are considered in judgments, it is not informative about the mechanism underlying desirability biases. Further, explanations such as these that depend on particular methodology and question formats are unlikely to explain people's actual behavior, unless people happen to ask themselves the exact question that the researchers ask them. The present investigation will hopefully engender research on the mechanism presumed to underlie all findings of the desirability bias and optimism—that desire, captured in this investigation as affective reactions to events, influences judgments about the likelihood of future events.

Past studies that have considered the impact of affective reactions on likelihood judgments typically predict, and find, that negative affect or emotion (specifically sadness or fear) leads to pessimism about the likelihood of future events (e.g., Johnson & Tversky, 1983; Lerner & Keltner, 2001; Loewenstein et al., 2001). These theories focus on specific emotional reactions that involve an appraisal of goodness or badness (an affective reaction) and a number of additional appraisals, such as whether the event is imminent and controllable (Loewenstein et al., 2001; Scherer, 1999). Not only are specific emotions the result of specific appraisals, but also they make it more likely that events will be judged in ways that are consistent with the appraisals that elicited the emotion (Lerner & Keltner, 2001). Negative emotions, such as anxiety, lead people to judge that negative future events are likely to occur, in part because of the appraisals associated with the emotion (Lerner & Keltner, 2001; Loewenstein et al., 2001). Thus, simple positive and negative affective reactions to potential future events may lead to automatic optimism, but relatively more com-

plex specific negative emotions may lead to pessimism because of additional appraisals that accompany the emotions.

Although not the primary focus of this investigation, the findings relate to a more general conditioning perspective. The present findings have implications for understanding the impact of reactions that result from conditioning. Recent research has suggested that evaluative conditioning may provide the initial impetus for attitude formation (Olson & Fazio, 2001, 2006). The present findings suggest that the effects of evaluative conditioning may extend beyond judgments of positivity to judgments based on affective reactions. The fact that affective reactions had an effect that was specific to the target events, rather than a general effect on all likelihood judgments, is not surprising from a conditioning perspective. Effects of conditioning are generally limited to the target stimulus, although they can generalize to other similar targets.

### Future Directions and Conclusion

The findings offer insight into how people process and react to information about the world around them. Even simple organisms will move toward positive stimuli and away from negative stimuli (e.g., Damasio, 2003). Fascinatingly, this basic tendency influences complex cognitions in humans, including their judgments about the likelihood of future events. The present investigation integrates past research on likelihood judgments and will allow for investigation of factors likely to increase or decrease bias. Any time that there are significant costs to inaccurate decision making, the desirability bias can lead to suboptimal outcomes. The findings also suggest that novel methods will be required to reduce the impact of the desirability bias on the accuracy and efficacy of decisions. The most common practice of providing people with objective information about risk is unlikely to improve decisions when predictions are based on affective reactions.

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