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Do Moderators of the Optimistic Bias Affect Personal or Target Risk Estimates? A Review of the Literature

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The optimistic bias is defined as judging one's own risk as less than the risk of others. Researchers have identified numerous personal and situational factors that moderate the extent to which people display the bias. It is unclear, however, whether these moderators affect the bias by influencing people's personal risk estimates or their risk estimates for a target. A review of moderators of the optimistic bias reveals evidence for both influences. Moderators associated with negative affect (negative mood, dysphoria, trait and state anxiety, event severity, and proximity of feedback) and control related moderators (perceived control and prior experience) appear primarily to affect personal risk estimates. Positive mood affects target risk estimates. Finally, moderators that surround the comparison process appear to have different effects. Specifically, the type of comparison target appears to affect target risk estimates, whereas attention to personal risk-related behaviors affects personal risk estimates.

Among the most robust findings in research on social perceptions and cognitions over the last two decades is the *optimistic bias*—the tendency for people to report that they are less likely than others to experience negative events and more likely than others to experience positive events. The optimistic bias has been shown for a variety of events. For example, people believe that they are less likely to be victims of auto accidents (McKenna, 1993), crime (Perloff & Fetzer, 1986), and earthquakes (Burger & Palmer, 1992; but see Helweg-Larsen, 1999), and that they are less likely than others to fall prey to illness (Perloff & Fetzer, 1986), depression (Kuiper, MacDonald, & Derry, 1983), unwanted pregnancies (Burger & Burns, 1988; Whitley & Hern, 1991), and a host of other negative health events (see Weinstein, 1980).

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This article focuses on two related issues. The first issue is how researchers define and measure the optimistic bias, and the second issue is the identification of moderators of the optimistic bias. We argue that what is traditionally defined as the optimistic bias may represent two distinct sources and that the most common method of measuring and reporting the optimistic bias confuses these two sources. Further, we propose that the traditional approach to measuring and reporting the optimistic bias produces problems for exploring and identifying moderators of the optimistic bias. Our review focuses on the optimistic bias with regard to negative events because most studies examining the optimistic bias have focused on negative rather than positive events and because an optimistic bias for negative events potentially has implications for risky and precautionary behavior. In addition, positive and negative events are psychologically different and are at least in part independent (Hoorens, 1996).

Measuring the Optimistic Bias

Indirect and Direct Methods

Although there are a variety of methods for assessing the broader concept of optimism (see Armor &

Taylor, 1998), the most common method for looking specifically at the optimistic bias involves having participants estimate their likelihood of experiencing an event relative to an appropriate peer or peer group such as the average person of the same age and sex. These estimates are typically assessed either directly or indirectly (Weinstein & Klein, 1996). With the direct method, the method most frequently used in the past, participants rate their likelihood of experiencing some event on a single scale anchored, for example, by *much less likely than the average person my same age and sex*, and *much more likely than the average person my same age and sex*. Researchers using the direct method of measuring the optimistic bias typically include a midpoint on the scale labeled *the same as the average person*. For negative items, the optimistic bias is operationalized as a mean response below the scale midpoint (indicating that one's own likelihood of experiencing the event is less than the average person's likelihood). For positive items, the optimistic bias is operationalized as a mean response above the scale midpoint (indicating that one's own likelihood of experiencing the event is greater than the average person's likelihood). Thus, for example, participants might respond to an item asking, "Compared to other people your age and sex, how likely are you to experience _____ in your lifetime?" Responses are typically anchored by –3 = *Much less likely than most people* and +3 = *Much more likely than most people.*

In contrast to the direct method for measuring the optimistic bias is the indirect method. With the indirect method, participants rate the likelihood that they personally will experience an event on one item and rate the likelihood that the average person their age and sex will experience the same event on a second item. Typically, responses to each item are made on a scale ranging from 1 (*very unlikely*) to 7 (*very likely*), or on a 0 to 100 probability scale. When rating negative outcomes, the estimate of the participant's own likelihood estimate is then subtracted from the peer person or group's likelihood (for positive outcomes, the peer's estimate is subtracted from the participant's estimate) to yield a difference score. The optimistic bias is operationalized as a positive difference score. The larger the difference score, the greater the optimistic bias. Some evidence suggests that the direct method tends to produce greater bias than the indirect method and that fewer response choices on the scale result in greater bias than a greater number of response choices (Otten & van der Pligt, 1996; although see Welkenhuysen, Evers-Kiebooms, Decruyenaere, & van den Berghe, 1996).

Of course, with both methods it is difficult to know whether any one individual is being optimistic, realistic, or pessimistic. For some risks such as smoking, one can conclude that smokers are being optimistically biased if they rate their risk of smoking as less than nonsmokers. However, it is less clear whether smokers are optimistically biased when they say that their risk is less than the risk of other smokers. It is also unclear in the absence of knowledge about a given person's risk factors whether a person is optimistically biased when he or she says he is less at risk than average for events such as suicide, heart disease, and unwanted pregnancy. As such, many researchers have defined the optimistic bias at the group level rather than the individual level. Because not everyone can be better off or less at risk than the average, the responses tell us whether the respondents as a group are optimistically biased. That is, if on average, people rate their own risk as less than that of the average person who is similar in age and sex, then there is evidence of bias. This point is particularly important to keep in mind when comparative risk judgments are correlated with other variables such as a personality difference. For example, if depression and the optimistic bias are negatively correlated, we can only conclude that depressed people see their own and other people's risk as more similar than do nondepressed people. We cannot conclude that depressed people are less optimistic about their risks. To determine the accuracy of people's risk estimates, we must compare their risk estimates with their actual risk. Research that provides objective data by comparing actual risks with estimated risks seems to indicate that the bias arises more from people overestimating other people's risk than from underestimating their own risk (Burger & Burns, 1988; Rothman, Klein, & Weinstein, 1996; K. M. Taylor & Shepperd, 1998).

Identifying and Assessing Moderators of the Optimistic Bias

We consider a given variable to be a moderator of the optimistic bias if it produces differences (either across conditions or across people) in people's optimistic bias reports. Our use of the term *moderator* departs somewhat from the standard use of the term. According to Baron and Kenny (1986), a moderator is a variable that "affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable" (p. 1174). We are examining variables that affect the direction and size of the optimistic bias. The optimistic bias reflects a difference between two variables (or more accurately, estimates): personal risk estimates and target risk estimates. Although our use of the term *moderator* does not strictly adhere to the standard definition provided by Baron and Kenny, we feel the term best captures the variables that influence the optimistic bias.

In the quest to identify moderators of the optimistic bias researchers have examined a variety of intrapsychic and individual difference variables that are

associated with more or less optimistic bias. Researchers have expended considerable effort identifying moderators of the optimistic bias. Some of the effort toward identifying moderators of the optimistic bias likely stems in part from the realization that identifying when a phenomenon occurs can enhance our understanding of the phenomenon. Thus, from a theoretical standpoint, explicating when people are and are not optimistically biased is the first step in explaining why the bias occurs.

In addition, at least some of the effort toward identifying moderators of the optimistic bias likely stems from the possible negative consequences of being unrealistically biased. People who are unrealistically optimistic presumably may be at risk for disappointment, inappropriate persistence, and personal endangerment because of viewing their own risk as less than average. Indeed, two lines of evidence suggest that optimistic biases may interfere with preventive behavior. First, perceptions of personal susceptibility are included in almost all major theories of preventive action (Cummings, Becker, & Maile, 1980). For example, one popular model of health behavior, the Health Belief Model (Becker, 1974), shows argument that the perception of susceptibility to illness (along with severity of illness, benefits of taking action, and barriers to action) leads to health preventive behaviors (Cleary, 1987). Moreover, the Health Belief Model has received considerable support (Becker & Rosenstock, 1987; Janz & Becker, 1984). To the extent that people underestimate their personal risk, either in an absolute sense or relative to others, they may fail to take adequate precautions or engage in risky behavior.

Second, evidence that the optimistic bias may interfere with precautionary behaviors comes from several correlational studies. For example, some research reveals that people who believe that their risk is less than the risk of their peers' are less likely to use contraception (Burger & Burns, 1988) or receive inoculation for influenza (Larwood, 1978), and are more likely to engage in high risk sex (Sheer & Cline, 1994). Finally, some preliminary experimental evidence suggests that perceiving oneself at greater risk than others may increase precautionary behaviors. Specifically, participants who were led to believe that their risk of causing an automobile accident was above (as opposed to below) average were more likely to indicate intentions to use seat belts, to drive slower on the freeway, and to use public transportation (Klein, 1997; McKenna, Stainer, & Lewis, 1991). Thus, from a practical standpoint, to the extent that unrealistic optimism gives rise to risky behaviors, identifying moderators of the optimistic bias is the first step in finding ways to reduce the optimistic bias.

Unfortunately, the most frequent approach to measuring the optimistic bias (i.e., the direct method) is problematic in that it confuses two distinct sources of the bias. With the difference between personal and target risk estimates combined within a single item, it is impossible to determine whether a moderator of the optimistic bias moderates the bias by affecting personal risk estimates, target risk estimates, or both. Knowing how a moderator independently affects personal and target risk estimates has both theoretical implications (as already discussed) and practical implications. If a moderator changes only the risk estimates made for other people, then it may have little or no effect on personal behavior (although it is also possible that relative risk and not just absolute risk influences risk behavior). A solution to this problem might be to compare perceived risk with actual risk, but only a few studies have taken this approach (e.g., Kreuter & Strecher, 1995; Rothman et al., 1996; Shepperd, Ouellette, & Fernandez, 1996; K. M. Taylor & Shepperd, 1998).

The direct method for assessing the relative risk has merit: It is likely easier to understand for people unfamiliar with using numerical rating scales, and it requires fewer items and less response time, which in some settings may be of critical importance. Moreover, if researchers are merely attempting to identify whether differences in risk estimates exist in a particular setting, for a particular population, or for particular events, then the direct approach may be reasonable. However, researchers can identify how a moderator affects optimistic beliefs only when using the indirect method and only then when treating the personal and target estimates separately rather than examining the difference score. Unfortunately, few studies meet both criteria.

We review studies of moderators that meet both criteria to determine how the moderators affect the optimistic bias. We label moderators that affect people's personal estimates as *personal risk moderators*. We label moderators that affect people's estimates of the average person's risk as *target risk moderators*. We also note those cases in which the moderator affects both personal and target risk estimates. We organize our discussion of moderators around the presumed process driving the effect of the moderator. The first section involves affect-related moderators of the optimistic bias. In this section, we discuss happy and sad mood, dysphoria, state and trait anxiety, event severity, and proximity of feedback. The second section involves control-related moderators. In this section, we discuss perceived control and prior experience. The third section involves circumstances of the comparison such as the target characteristics and attentional focus. Our organizational schema is analogous to that of a factor analysis. As will become apparent, the first factor is relatively unambiguous and the results are strong and consistent. The second factor is also relatively strong,

but other processes in addition to control might also influence the moderators in this section. Finally, the last factor is the fuzziest. Affect and control, as well as other factors, may influence circumstances surrounding the comparison process.

Our discussion of each moderator proceeds as follows. First, we describe the presumed moderator and theoretical reason proposed by researchers for why the moderator should influence the optimistic bias. Included is a discussion of whether the moderator should hypothetically function as a personal moderator or a target moderator. Second, we review the studies examining the moderator. Third, we evaluate the moderator according to whether it acts consistently with the theoretical rationale provided by researchers and conclude whether the moderator functions as a personal moderator, a target moderator, or both.

Affect and the Optimistic Bias

A number of studies have examined whether various affective states and traits contribute to the optimistic bias. In this section, we examine the effects of happy and sad moods, depression, and state and trait anxiety on the optimistic bias. We also examine the effect of two anxiety-mediated variables (event severity and proximity of feedback) on the optimistic bias.

Mood

Five studies (Abele & Hermer, 1993; Drake, 1984, 1987; Drake & Ulrich, 1992; Salovey & Birnbaum, 1989) have examined whether the optimistic bias varies as a function of mood. Each revealed that people display less optimistic bias when induced to experience a negative mood and more optimistic bias when induced to experience a positive mood. Three of the studies (Drake, 1984, 1987; Drake & Ulrich, 1992) manipulated mood in a novel way by activating the left or right brain hemisphere. According to Drake (1984), for right handed people, positive emotions are related to activity in the left hemisphere, and negative emotions are related to activity in the right hemisphere. Activities such as turning the head rightward yet gazing to the far left activate the right hemisphere and produce a negative mood. Likewise, activities such as turning the head leftward yet gazing to the far right activate the left hemisphere and produce a positive mood. Each of these studies found greater optimistic bias when the left hemisphere was activated (i.e., when participants were presumably in a positive mood) than when the right hemisphere was activated (i.e., when participants were presumably in a negative mood). Unfortunately, these studies lacked a no-activation, neutral mood condition against which these findings could be compared. In addition, the studies included no manipulation checks to insure that the activation manipulations actually produced the presumed changes in mood. Thus, we do not discuss these studies further.

Both of the remaining studies (Abele & Hermer, 1993; Salovey & Birnbaum, 1989) used the indirect method to examine the relation between mood and the optimistic bias. In both studies students induced to experience a sad, happy, or neutral mood rated their own and the typical student's risk of experiencing a variety of negative events. Although the relevant data were collected in both studies, neither study reported the statistical analyses necessary to examine whether happy and sad mood affected personal risk estimates or target risk estimates. We thus obtained the relevant data from the first authors of each study. For ease of presentation, we discuss the results of sad and happy mood separately.

Sad mood. Drawing on the research and theorizing of Pyszczynski and Greenberg (1985, 1986, 1987), Salovey and Birnbaum (1989) argued that sad moods increased self-focused attention and greater attention to bodily symptoms. They further argued that moods enhanced the availability of mood-congruent information (see Gilligan & Bower, 1984). The mood-congruent information presumably exercises a corresponding influence on judgments. Thus, people in a sad mood should display greater recall of negative memories about the self, and these negative memories should in turn color subsequent judgments. The consequence is that people in a sad mood should be more likely than people in a neutral mood to judge that they are at risk for experiencing negative events. The emphasis on self-focused attention implies that sad mood moderates personal estimates rather than target estimates.

Data from Salovey and Birnbaum's (1989) study appear in Table 1. The data come from Study 3, in which healthy participants made risk estimates for negative events. Unfortunately, the small sample size provides little power to examine the effects. Nevertheless, the results revealed that personal risk estimates were higher among sad mood participants than among neutral mood participants, $t(19) = 1.96$, $p = .08$, $\eta^2 = .17$. In addition, however, the target risk estimates were also higher among sad mood participants than among neutral mood participants, $t(19) = 1.97$, $p < .07$, $\eta^2 = .17$. The results from Salovey and Birnbaum's study provide tentative evidence that sad mood reduces the optimistic bias by increasing personal risk estimates. At the same time, however, sad mood increases the optimistic bias by increasing risk estimates for targets. When the personal and target risk estimates are viewed alongside each other, it appears from Salovey and

Birnbaum's study that sad mood produces no net change in optimistic bias.

Data from Abele and Hermer's (1993) study appear in Table 2 and partially replicate Salovey and Birnbaum's (1989) findings. Specifically, sad mood participants were again more likely than neutral mood participants to judge themselves at risk for experiencing negative events, $t(62) = 3.05$, $p < .05$, $\eta^2 = .13$. However, sad mood and neutral mood participants did not differ in their risk estimates for the average student, $t(62) = 1.30$, $p < .20$, $\eta^2 = .03$.

When viewed together, these two studies (Abele & Hermer, 1993; Salovey & Birnbaum, 1989) suggest that sad mood functions consistently as a personal risk moderator (leading to greater personal risk estimates) and inconsistently as a target risk moderator (occasionally leading to greater target risk estimates). The finding that sad mood increases personal risk estimates is consistent with the notion that sad mood facilitates the availability of mood-congruent, negative thoughts and these thoughts color subsequent judgments. The finding that sad mood might also increase the risk estimates for the target suggests that sad mood not only prompts negative thoughts about the self, but also possibly (and to a lesser extent) prompts negative thoughts about others.

Happy mood. As with sad mood, happy mood should facilitate access to mood-congruent information; this in turn should color subsequent judgments. The consequence should be that people in a happy mood should be less likely than people in a neutral mood to judge that they are at risk for experiencing negative events.

Examination of Salovey and Birnbaum's (1989) data (Table 1) reveals that happy mood had no effect on personal estimates, $t(19) = .35$, $p = .73$, $\eta^2 = .01$, yet resulted in an increase in risk estimates for the average student, $t(19) = 3.20$, $p < .005$, $\eta^2 = .35$. Abele and Hermer (1993) found similar results (see Table 3). Specifically, whereas happy and neutral mood participants did not differ in their personal risk estimates, $t(62) = .87$, $p = .39$, $\eta^2 = .01$, risk estimates for the average student were higher among happy mood than neutral mood participants, $t(62) = 3.95$, $p < .0001$, $\eta^2 = .20$.

Thus, both studies provide consistent evidence that happy mood is a target risk moderator but not a personal risk moderator. These results are inconsistent with the proposed mechanisms for why happy mood influences risk perceptions. According to the explanation, a happy mood should increase availability of positive thoughts, which in turn should influence judgments about the future. That is, people in a happy mood presumably should be more likely than people in a neutral mood to estimate that negative outcomes will not happen to them. However, rather than reporting a lowered likelihood of personally experiencing negative outcomes, participants reported that others were more likely to experience negative events. This unexpected finding is intriguing and merits further study.

Table 1. *Means of Perceived Risk for Negative Events as a Function of Induced Mood*

	Mood Condition					
	Sad[a]		Neutral[b]		Happy[a]	
Risk Estimates	***M***	***SD***	***M***	***SD***	***M***	***SD***
Self	3.3	0.48	2.7	0.91	2.8	1.20
Student	3.5	0.41	3.1	0.60	3.8	0.50
Difference	0.20	0.40	0.4[c]	0.62	1.0[c]	1.33

Note: Reanalyzed data from Salovey and Birnbaum (1989) from Study 3 negative events only. Ratings were made on a 7-point scale ranging from 1 (*extremely unlikely*) to 7 (*extremely likely*).
[a]$n = 12$. [b]$n = 9$. [c]Differences are significantly different from zero at $p < .05$ using a dependent t test.

Table 2. *Means of Perceived Risk for Negative Events as a Function of Induced Mood*

	Mood Condition					
	Sad[a]		Neutral[a]		Happy[a]	
Risk Estimates	***M***	***SD***	***M***	***SD***	***M***	***SD***
Self	33.4	16.54	22.8	10.32	20.7	9.75
Student	29.7	9.84	27.0	6.70	35.4	10.11
Difference	3.6	12.60	–4.1[b]	10.07	–14.8[b]	8.52

Note: Reanalyzed data from Abele and Hermer (1993). Ratings were made on a 101-point scale ranging from 0 (*zero percent probability*) to 100 (*100 percent probability*).
[a]$n = 32$. [b]Differences are significantly different from zero at $p < .05$ using a dependent t test.

Table 3. *Summary of Moderators*

Moderator	Effect on Personal Risk Estimates	Evidence	Effect on Target Risk Estimates	Evidence	Articles
Affect Related Moderators					
Negative Mood	Increases personal risk estimates	Negative mood associated with greater personal risk estimates	Inconsistent	Solovey & Birnbaum (1989) found marginally greater target risk estimates for negative mood Abele & Hermer (1993) found no evidence linking negative mood with target risk estimates	Salovey & Birnbaum, 1989[a] Abele & Hermer, 1993[a]
Positive Mood	None		Increases target risk estimates		Salovey & Birnbaum, 1989[a] Abele & Hermer, 1993[a]
Dysphoria	Increases personal risk estimates		Inconsistent	Pyszczynski, Holt, & Greenberg (1987) found that dysphoria is associated with greater target risk estimates[b] Alloy & Ahrens (1987) and Pietromanoco & Markus (1985) found no evidence linking dysphoria with target risk estimates	Alloy & Ahrens, 1987 Pietromonaco & Markus, 1985 Pyszczynski et al., 1987
State Anxiety	Increases personal risk estimates		Inconsistent	Dewberry & Richardson (1990)[b] (but not Butler & Mathews, 1987) found that state anxiety is associated with greater target risk estimates	Butler & Matthews, 1987 Dewberry & Richardson, 1990
Trait Anxiety	Increases personal risk estimates		None		Butler & Mathews, 1987
Event Severity	Inconsistent	In one experimental study, more severe events associated with greater personal risk estimates. In correlational studies, event severity is unrelated to personal risk estimates	None		Eiser, Eiser, & Pauwels, 1993 van der Velde, Hooykaas, & van der Pligt, 1992 van der Velde, van der Pligt, & Hooykaas, 1994 Weinstein, 1982 Weinstein, 1987 Weinstein, Sandman, & Roberts, 1990 Welkenhuysen et al., 1996 Heine & Lehman, 1995 K. M. Taylor & Shepperd, 1998[a]

(Continued)

Table 3. *(Continued)*

Moderator	Effect on Personal Risk Estimates	Evidence	Effect on Target Risk Estimates	Evidence	Articles
Proximity of Feedback	Increases personal risk estimates		None		K. M. Taylor & Shepperd, 1998[a] Shepperd, 2000
Control Related Moderators					
Control	Increases personal risk estimates		Inconsistent	2 studies with high-risk target show greater control is associated with lower target risk estimates; 3 studies with low-risk targets show no effect of control on target risk estimates	See Table 4
Prior Experience	Increases personal risk estimates		None		van der Velde, van der Pligt, & Hooykaas, 1994 (4 samples) Burger & Palmer, 1992
Moderators Involving Circumstances Surrounding the Comparison					
Type of Comparison Target	None		Increases target risk estimates	In three of four studies, participants provided higher risk estimates for distant targets than for close targets. Only Hoorens & Buunk (1993) found no effect for target closeness	Perloff & Fetzer, 1986[a] Alicke, Klotz, Breitenbecher, Yurak, & Vredenburg, 1995[a] Harris & Middleton, 1994[a] Hoorens & Buunk, 1993[a]
Attention to Risk Related Behaviors	Decreases own risk estimates	Increased focus on own risk increases optimistic bias by reducing own risk estimates	None		Gerrard, Gibbons, & Warner, 1991[a]

[a]Denotes that study experimentally manipulated the moderator variable. [b]Target risk estimates were weaker than personal risk estimates.

Dysphoria

Three studies (Alloy & Ahrens, 1987; Pietromonaco & Markus, 1985; Pyszczynski, Holt, & Greenberg, 1987) have examined the effect of nonclinical depression (dysphoria) on the optimistic bias. Consistent with the research on sad mood, each study found that high scores on the Beck Depression Inventory (Beck, 1967) were associated with less optimistic bias. Our reading of the studies suggests two different explanations for why people suffering from depression display less optimistic bias than nondepressed people do. Alloy and Ahrens (1987) argued that people suffering from depression believed they were uniquely unable to obtain desired outcomes and that their low perceived personal control led them to display less optimistic bias. Other researchers (Pietromonaco & Markus, 1985; Pyszczynski et al., 1987) explained the difference in level of optimistic bias between people who

were and were not depressed using the same cognitive argument offered by researchers examining sad mood and the optimistic bias. Specifically, the easily accessible negative schemas of people with depression influence their perceptions and judgments, directing them toward more negative risk estimates relative to others. Pyszczynski et al. (1987) argued further that people with depression were generally highly self-focused, making their negative schemas chronically accessible. If people with depression, however, are induced to focus their attention externally, their negative self-schemas are less accessible and they will display the same level of optimism as people who are not depressed. The explanation offered by Alloy and Ahrens suggests that depression could function as a personal and target risk moderator (raising personal risk estimates and lowering target risk estimates), whereas the explanations offered by Pietromonaco and Marcus and by Pyszczynski et al. suggest that depression functions solely as a personal risk moderator.

In the study by Alloy and Ahrens (1987), nondysphoric participants displayed an optimistic bias for ten hypothetical negative events, whereas dysphoric participants did not. More important, examination of the means revealed that the difference was primarily due to differences in personal risk estimates. Nondysphoric participants rated their own likelihood of being put on academic probation as lower than did dysphoric participants. Pietromonaco and Markus (1985) also found that nondysphoric participants rated their own risk for negative events as less than the risk of others, whereas dysphoric participants did not. Indeed, dysphoric participants were pessimistically biased. Similar to Alloy and Ahrens, examination of the means revealed that dysphoric and nondysphoric participants differed in their personal risk estimates but not in their risk estimates for the target.

Pyszczynski et al. (1987) examined the relation between dysphoria risk estimates in two studies. In Study 1, both dysphoric and nondysphoric participants were optimistically biased, rating their own risk of experiencing 10 negative events as lower than that of others. However, the difference was greater among nondysphoric participants ($\eta^2 = .65$) than among dysphoric participants ($\eta^2 = .34$). In addition, both the personal and target risk estimates of dysphoric participants were greater than the personal and target risk estimates of nondysphoric participants.

In sum, the research on dysphoria consistently reveals that dysphoria is associated with greater personal risk estimates and thus functions as a personal risk moderator. The two investigations by Pyszczynski et al. (1987) revealed that dysphoria also moderated target risk estimates, suggesting that dysphoria may prompt negative thoughts about the self, but also (and to a lesser extent) negative thoughts about others. It is notable that greater target risk estimates serve to sustain the optimistic bias. However, the overall effect is one of less optimistic bias among participants with dysphoria because dysphoria is more strongly related to personal risk estimates than target risk estimates.

The findings from the investigations by Pyszczynski et al. (1987) offer support for the notion that the easily accessible negative schemas of people suffering from dysphoria influence their perceptions and judgments, prompting greater personal risk estimates than from people who do not suffer from dysphoria. Moreover, the finding that the relation between dysphoria and risk estimates disappears when participants are directed to focus externally suggests that the lower optimistic bias found among people with dysphoria reflects an inordinate internal focus of attention. According to Pyszczynski et al., when attention was focused internally, the negative schemas of dysphoric people were activated and they displayed less optimistic bias in their predictions. When attention was focused externally, however, their negative schemas were less accessible and dysphoric people were just as optimistically biased as nondysphoric people.

The three studies just described (Pietromonaco & Markus, 1985; Pyszczynski et al., 1987) yielded an interesting inconsistency in the relation of personal risk estimates to target risk estimates among people with dysphoria. Although the theoretical explanations guiding the three studies implied that dysphoric participants would display a pessimistic bias, only one of the studies (Pietromonaco & Markus, 1985) found evidence for a pessimistic bias. Pyszczynski et al. (1987) found that dysphoric participants continued to display an optimistic bias (albeit weaker than the bias of nondysphoric participants), whereas Alloy and Ahrens (1987) found that dysphoric participants showed no optimistic bias. Clearly, the inconsistency in the difference between personal and target risk estimates among dysphoric participants deserves further study.

It is worth noting that research by Dunning and Story (1991) suggested that people who were dysphoric compared with people who were nondysphoric were less realistic in their predictions about future events. Differences arose in part because the dysphoric participants actually experienced more negative events and fewer positive events than did the nondysphoric participants. Of importance, Dunning and Story (1991) did not measure relative risk estimates; their primary dependent measures were accuracy and confidence. Nevertheless, their study is relevant in that it reminds us that the actual behavior or event probability of dysphoric and nondysphoric participants might be very different. For example, Alloy and Ahrens (1987) examined risk estimates for "being put on academic probation" and found that dysphoric students rated probation as more probable. However, without knowing the actual likelihood of being placed on academic probation (an event that might reasonably be more likely for a dysphoric student), it is impossible to deter-

mine which students were being accurate in their estimates and which were not. It is possible that the dysphoric students were in fact realistic, or perhaps even pessimistic in their estimates (underestimating the likelihood of this happening).

The point that deserves repeating is that a difference in the mean relative risk estimate of subgroups of a population, such as people who are dysphoric and nondysphoric, should not be interpreted as evidence that one group is biased and the other is not or that one group is more biased than the other. Nor should one conclude that a subgroup is not biased because the personal risk estimates of the subgroup do not differ from the "average." The actual risk may differ by group, and in the absence of data indicating a person or group's actual risk, it is impossible to tell who is actually biased and who is not. Thus, short of actually measuring the likelihood of the events in question, researchers must be cautious in concluding that dysphoric people are realistic or pessimistic. At the same time, it is worth noting that Pyszczynski et al. (1987) showed that dysphoric participants behaved similarly to nondysphoric participants when instructed to focus externally. That changing focus of attention can alter risk perceptions suggests that it is self-focused attention that is driving the difference and not actual differences in experience. Clearly, more research is needed and we renew our call for researchers to consider risk perceptions in the context of actual risk likelihood.

Anxiety

A number of studies have examined whether the optimistic bias varies as function of worry or anxiety (either situational or dispositional). Although a few studies found no relation between anxiety and the optimistic bias (Nesse & Klaas, 1994; Welkenhuysen et al., 1996), in general, greater anxiety is associated with less optimistic bias (Butler & Mathews, 1987; Dewberry, Ing, James, Nixon, & Richardson, 1990; Dewberry & Richardson, 1990; Eysenck & Derakshan, 1997; Linville, Fischer, & Fischhoff, 1993; Myers & Brewin, 1996; Vaughan, 1993; Weinstein, 1982, 1983, 1987). As is often the case, however, only a handful of these studies examined the relation between anxiety and the optimistic bias using the indirect method. For ease of presentation, we examine state and trait anxiety separately.

State anxiety. According to Butler and Mathews (1987), anxiety influences cognitions in much the same way that sad mood influences cognitions. That is, anxiety about a given event primes anxious thoughts, making them more available to memory where they can color subsequent judgments. In addition, Butler and Mathews argued that the effects of anxiety should occur primarily for self-ratings and not target ratings because people have less information about events for other people coded in memory, and any such information is at best weakly associated with anxiety.

We found three studies (Butler & Mathews, 1987; Dewberry et al., 1990; Dewberry & Richardson, 1990) using the indirect method to examine the effect of state anxiety on the optimistic bias. Unfortunately, one of the studies (Dewberry et al., 1990) did not report personal and target risk estimates separately. In addition, the authors reported no longer having their data. Thus, we were unable to examine whether the correlation between the optimistic bias and anxiety resulted from differences in personal risk estimates, target risk estimates, or both.

Both of the remaining two studies (Butler & Mathews, 1987; Dewberry & Richardson, 1990) found that greater anxiety was associated with less optimistic bias. In the first of these studies (Butler & Mathews), students who were or were not sitting for an important exam rated their risk of experiencing a variety of exam-related and exam-unrelated negative events. Exam students estimated their risk on three occasions: 1 month prior to the exam, 1 day prior to the exam, and 1 week after the exam. Four findings are noteworthy. First, there was a close correspondence between anxiety and risk estimates. Among exam students, anxiety and risk estimates were higher just prior to the exam than 1 month prior to the exam or 1 week after the exam. Second, just prior to the exam (when they were most anxious), exam students rated their personal risk of doing poorly on the exam as higher than did nonexam students. The two groups of students, however, did not differ in their estimates for the target. Thus, state anxiety appears to be a personal but not a target risk moderator.

In the second study (Dewberry & Richardson, 1990), students estimated their own and another student's likelihood of experiencing a variety of events either immediately prior to taking an important year-end exam or 2 to 3 weeks after taking the exam. Postexam students reported less anxiety than did preexam students. In addition, postexam students were optimistically biased, whereas preexam students were pessimistically biased.[1] Examination of the means revealed that anxious and nonanxious participants differed from each other in both their personal risk estimates and in their risk estimates for the average student. Of importance, the difference in estimates for the

[1]Dewberry and Richardson (1990) combined the results of positive and negative events. However, examination of the results of the individual events reveals that the effect was due almost entirely to the negative events rather than the positive events.

average student was small, $\eta^2 = .07$, whereas the difference in personal risk estimates was much larger, $\eta^2 = .34$. In addition, similar to the results for sad mood and dysphoria, greater anxiety was associated with higher rather than lower target risk estimates. As noted earlier, greater risk estimates for the target would serve to sustain rather than reduce the optimistic bias. However, because the effect of anxiety on target risk estimates was relatively weak, the overall effect was lower optimistic bias among anxious than nonanxious participants. Thus, anxiety in this second study appears primarily to moderate personal risk estimates and, to a much lesser extent, target risk estimates.

In summary, similar to sad mood and dysphoria, state anxiety appears to function primarily as a personal risk moderator, in that people who are anxious provide higher personal risk estimates than people who are not anxious. State anxiety also appears to function as a target moderator, but to a lesser degree.

Trait anxiety. According to Butler and Mathews (1987), people high in trait anxiety should have shown a dispositional tendency to be less optimistically biased in their risk estimates because threatening cognitions are chronically more accessible and thus can color judgments independent of situational primes. In addition, Butler and Mathews argued that people high in trait anxiety have broad, elaborate structures in memory for threatening information that ease the spread of activation of memories. Consequently, people high in trait anxiety should show less optimistic bias for a variety of events, and not just for events primed by a given situation.

Although we found five studies (Butler & Mathews, 1987; Eysenck & Derakshan, 1997; Myers & Brewin, 1996; Nesse & Klaas, 1994; Welkenhuysen et al., 1996) examining trait anxiety and the optimistic bias, only three used the indirect method to assess the optimistic bias. One of the studies (Welkenhuysen et al., 1996) found no relation between trait anxiety and the optimistic bias among fifth graders estimating their risk and a random couple's risk of having a newborn child with a genetic disease. Of importance, the comparison target in the Welkenhuysen et al. study was a random couple rather than a same age and sex classmate. The inappropriateness of the comparison target may have somehow obscured the relation between trait anxiety and the optimistic bias. The remaining two studies (Butler & Mathews, 1987; Eysenck & Derakshan, 1997) however, found that trait anxiety was associated with lower optimistic bias. The first study was described earlier and involved students making estimates about an exam (Butler & Mathews). In addition to measuring state anxiety, the authors included a measure of trait anxiety. The results reveal that trait anxious students showed less optimistic bias than nontrait anxious students did, and that the lower optimistic bias was due entirely to lower personal risk estimates. Anxious and nonanxious students did not differ in their target risk estimates. The second study (Eysenck & Derakshan) also found that anxious participants displayed significantly less optimistic bias than did nonanxious participants for all events. More important, anxiety appeared exclusively to affect personal risk estimates, suggesting again that anxiety functions as a personal risk moderator.

In summary, the data from these studies (Butler & Mathews, 1987; Eysenck & Derakshan, 1997; Welkenhuysen et al., 1996) are generally consistent. Although one (Welkenhuysen et al.) found no relation between anxiety and the optimistic bias, two (Butler & Mathews; Eysenck & Derakshan) found greater anxiety among trait anxious participants than among nonanxious participants. Moreover, consistent with the rationale provided by Butler and Mathews, anxiety functioned as a personal risk moderator.

Anxiety Driven Moderators

Two other moderators deserve discussion under the topic of anxiety specifically and affect more generally. Although neither moderator represents a type of affect per se, empirical studies suggest that both moderators are driven by anxiety. These moderators are proximity of feedback and event severity.

Event severity. Several studies examining the optimistic bias have included measures of perceived severity of the events being examined or have manipulated event severity. In general, the rationale guiding this research is that people should show greater optimistic bias for events with serious or severe consequences. Accordingly, events with serious consequences are more threatening and thus elicit a greater defensive denial, that is, a stronger belief that one is personally invulnerable to the event (Kirscht, Haefner, Kegeles, & Rosenstock, 1966).

We uncovered nine studies examining whether the optimistic bias varies with severity. Eight of these studies were correlational, examining risk estimates and participants' reports of perceived severity for a variety of events. The consistent finding for seven of the eight studies (Eiser, Eiser, & Pauwels, 1993; van der Velde, Hooykaas, & van der Pligt, 1992; van der Velde, van der Pligt, & Hooykaas, 1994; Weinstein, 1982, 1987; Weinstein, Sandman, & Roberts, 1990; Welkenhuysen et al., 1996) was that event severity was unrelated to the optimistic bias. The remaining correlational study (Heine & Lehman, 1995), however, found some evidence that

greater severity was associated with greater optimistic bias. Specifically, Heine and Lehman (1995) assessed risk estimates in Japanese and Canadian students across two studies using both the direct and indirect method. In three of the four samples, greater perceived severity was associated with greater optimistic bias. It is noteworthy, however, that perceived severity was related to the optimistic bias only when the bias was measured directly. Severity was unrelated to the optimistic bias when the bias was measured using the indirect method. We are unsure what to make of this inconsistency across measures of the optimistic bias.

A limitation of all of these correlational studies is that the events examined by the researchers varied on many dimensions in addition to severity, including preventability, population prevalence, and degree of heritability. These added differences might have obscured any effect of severity. In addition, many of the events may have produced a ceiling effect in judgments of severity (e.g., the seriousness of birth defects; Welkenhuysen et al., 1996), which also may have obscured any effect of severity on personal predictions. Finally, severity was measured rather than manipulated.

The one study (K. M. Taylor & Shepperd, 1998) that examined severity and the optimistic bias in an experimental setting found that event severity is strongly related to risk estimates. The rationale driving this study, however, stands in marked contrast to the rationale prompting the inclusion of severity in the prior studies. According to K. M. Taylor and Shepperd, severe events such as lung cancer, serious injury, and HIV infection can impose dramatic life changes and thus are often quite threatening. Moreover, these events are likely to be regarded as particularly upsetting if they are unexpected. K. M. Taylor and Shepperd thus argued that people should display less optimistic bias in their risk estimates for events with severe consequences than for events that are relatively inconsequential. The impact of event severity on risk estimates should be particularly strong when people anticipate learning if the event will happen to them (for example, while being testing for a medical condition such as HIV) and should affect personal risk estimates rather than target risk estimates. It is important to note that the relation between event severity and the optimistic bias proposed by K. M. Taylor and Shepperd (i.e., greater event severity is associated with less optimistic bias) is exactly the opposite of the relation proposed by earlier researchers (i.e., greater event severity is associated with greater optimistic bias).

K. M. Taylor and Shepperd (1998) led participants to believe they would or would not be tested for a medical condition (thioamine acetylase; TAA deficiency) with or without severe consequences. Although most participants were optimistic, participants anticipating feedback about a medical condition with severe consequences were not, estimating that they were just as likely as the average student to test positive for TAA deficiency. Further analysis revealed that severity affected personal risk estimates rather than target risk estimates. Thus, severity appears to function exclusively as a personal risk moderator. Finally, the effect of event severity on risk estimates was driven entirely by negative affect. When differences in affect were removed statistically, severity was no longer related to risk estimates.

This experimental study (K. M. Taylor and Shepperd, 1998) differed from the correlational studies in that students anticipated learning by the end of the experiment whether they tested positive for TAA deficiency. It is possible that event severity influences risk estimates only when people anticipate receiving feedback about the outcome for which they are making estimates. Consistent with this possibility is the finding in the TAA study that participants who believed they were not being tested for TAA deficiency were optimistic in their predictions regardless of whether the consequences of TAA deficiency were described as severe or not severe (K. M. Taylor & Shepperd, 1998).

Proximity of feedback. Several studies found that optimistic predictions vary as a function of the closeness of feedback about the predictions. The rationale guiding this research is that feedback represents a potential challenge to one's optimistic outlook, prompting greater conservatism in personal predictions. The conservatism stems from the fact that people find unexpected negative feedback particularly aversive (Shepperd & McNulty, 2000). People display less optimism when feedback is near to avoid the feelings of disappointment and negative affect associated with predictions or expectations exceeding one's outcomes (Shepperd et al., 1996).

Two studies (Shepperd, 2000; K. M. Taylor & Shepperd, 1998) have varied the timing of testing or the timing of feedback and have collected participants' estimates for the average student in addition to their personal estimates. In the first study (Shepperd, 2000), participants supplied exam estimates for an upcoming exam on two occasions: 3 weeks prior to the exam (Time 1), and just minutes prior to the exam (Time 2). Participants estimated that they would receive a higher grade than would the average student on both occasions. However, the degree of optimistic bias was smaller at Time 2 than at Time 1. More important, participants lowered their estimates of their own scores from Time 1 to Time 2, but did not change the estimate of the score of the average student.

The second study (K. M. Taylor & Shepperd, 1998) was described earlier and involved participants estimating their likelihood of testing positive for a medical

condition (TAA deficiency) for which they were or were not being tested and that had or did not have serious consequences. At the beginning of the experiment, participants who anticipated being tested believed they would receive their test results in 3 to 4 weeks. At the end of the experiment, these participants suddenly learned that they would receive their test results in a few moments. Participants were generally optimistic in their risk estimates, estimating that they were less likely than the average student to test positive for TAA deficiency. However, when participants learned that they would receive immediate feedback regarding a medical condition with severe consequences, they abandoned their optimism, estimating that their risk of testing positive was the same as the risk of the average student. Moreover, analyses revealed that the feedback timing manipulation (in conjunction with a severity manipulation) affected participants' estimates of their own risk rather than their estimates of the average student's risk. Finally, the effect of feedback timing was driven entirely by anxiety. When differences in anxiety were controlled statistically, feedback timing was no longer related to risk estimates.

Both of these studies (Shepperd, 1997; K. M. Taylor & Shepperd, 1998) suggested that timing of feedback was a personal risk moderator of the optimistic bias. As feedback or the behavior that would lead to feedback drew near, participants altered their personal predictions, yet did not change their predictions for the average student. Moreover, the results are consistent with the explanation that people are less optimistic when outcomes draw near because they are concerned with disappointment arising from personal estimates falling short of expectations. One could argue that participants lowered their personal estimates because they did not want to appear to the experimenter either as overly confident or as unable to predict personal outcomes, or because they did not want to "jinx" themselves by overestimating. However, other research (see Shepperd et al., 1996) on exam performance estimates suggested that students lowered their estimates at the decisive moment to avoid disappointment.

One final study (Middleton, Harris, & Surman, 1996) examining estimates of the risk of injury among novice bungee jumpers merits mention. Although the study did not examine proximity of feedback per se, it did examine risks associated with discrete events that differed in temporal proximity. Specifically, in a between-subjects design, jumpers estimated their risk and the average jumper's risk of injury either on arriving at the jump site (Time 1 jumpers) or immediately prior to jumping (Time 2 jumpers). Although the pattern of means suggested less optimistic bias among Time 2 jumpers than Time 1 jumpers, the difference was not significant. The absence of an effect of proximity in the bungee study may stem from a number of factors, such as using a between-subjects design rather than a more powerful within-subjects design or from something unique about the event and the people who choose to bungee jump.

Summary

A summary of the effect of affective processes on risk estimates is provided in Table 3. First, sadness, dysphoria, and state and trait anxiety (as well as event severity and proximity of feedback) function as personal risk moderators. That is, the various negative traits and states (e.g., anxiety, sadness, dysphoria) are all associated with lower optimistic bias, and the lower optimistic bias arises primarily from participants supplying greater personal risk estimates. Second, there was some evidence that sadness, dysphoria, and state anxiety also function as target risk moderators, although weakly and less consistently. Of importance, in all cases these affective experiences were associated with greater rather than lower risk estimates for the target. Although greater target risk estimates would serve to sustain the optimistic bias, the fact that the effect of these affective variables on target risk estimates was notably weaker than their effect on personal risk estimates resulted in an overall decrease in the optimistic bias. Third, event severity and proximity of feedback also functioned as personal risk moderators. However, their influence on personal risk estimates was driven entirely by negative affect.

Finally, the research reviewed provides consistent evidence that good mood functions exclusively as a target risk moderator, having no effect on personal risk estimates but leading to greater risk estimates for the target.

Control

The second group of moderators includes variables that influence the optimistic bias primarily through perceived control. This group includes perceived control and prior experience.

Controllability

A consistent finding within the optimistic bias literature is that greater perceived control over an event or its outcome is associated with greater optimistic bias (Harris, 1996). A recent meta-analysis of 21 studies examining the relation between control and the optimistic bias revealed that control has a large effect on risk perceptions, effect size $r = .49$ (Klein & Helweg-Larsen, 2000). For example, if a

woman believes she has a great deal of control over becoming HIV infected, she is more likely to view her own HIV risk as relatively low. In fact, people prefer controllable risks over less dangerous uncontrollable risks because they think they are better able than other people to control dangerous outcomes (Klein & Kunda, 1994). Presumably people display greater optimistic bias for controllable events because they believe that they are more likely than others to take precautions that prevent the occurrence of the event. The idea that one is more likely than others to take precautions to avoid controllable events suggests that control more likely influences personal risk estimates rather than target risk estimates.

Researchers examining the optimistic bias typically assess control using one of four approaches. The first approach is to use the event as the level of analysis. Events that differ in perceived controllability (typically based on ratings made by other participants) are compared. For example, Quadrel, Fischhoff, and Davis (1993) compared controllable events (such as being injured in an auto accident or becoming alcohol dependent) with uncontrollable events (such as becoming sick because of air pollution or pesticides). In a similar study McKenna (1993) compared risk estimates of a car accident in low control (e.g., a tire blowout) and high control (e.g., going round a sharp bend). A drawback of comparing events that differ in controllability is that the events may also differ on other dimensions, such as severity and population prevalence. Thus, any difference in ratings between controllable and uncontrollable events could be due to a difference across events on some dimension. Thus, for this analysis we have not included studies that use this method.

A second approach to measuring control is to use the person as the unit of analysis. Here, participants rate events in terms of controllability as well as their risk relative to the average person, and the ratings are correlated. A third approach is to assess general control beliefs using an individual difference measure (such as a locus of control scale) and then compare optimistic bias beliefs for individuals scoring low versus high in the individual difference measure. The fourth approach involves manipulating controllability experimentally and assessing the optimistic bias across experimental conditions.

Of studies using the indirect method to assess the optimistic bias, we found six (Hoorens & Buunk, 1993; Miller, Ashton, & McHoskey, 1990; van der Velde et al., 1992; van der Velde & van der Pligt, 1991; van der Velde et al., 1994; Vaughan, 1993) that used the person as the unit of analysis. Three of the studies (Miller, Ashton, & McHoskey, 1990; van der Velde & van der Pligt, 1991; Vaughan, 1993) did not report the relevant results and we were unable to reach the authors to obtain the data. Of the remaining three studies, two (van der Velde et al., 1992; van der Velde et al., 1994) used the person as the unit of analysis, and one (Hoorens & Buunk, 1993) used an individual difference measure of control. The studies are summarized in Table 4 and reveal that control (or more accurately, lack of control) functions as a personal risk moderator. In all three studies, lower perceived control was associated with higher personal risk estimates.

Table 4 reveals inconsistent evidence as to whether control affects estimates of the target's risk. Specifically, van der Velde et al. (1994) found that low perceived control was associated with greater target risk estimates in two samples, but was unrelated to target risk estimates in a third sample.[2] Although low perceived control led to an increase in target risk estimates, the effect was greater on personal risk estimates, resulting in less optimistic bias among low perceived control participants than among high perceived control participants. The remaining two studies presented in Table 4 also report no relation between control and target risk estimates.

In sum, the research on controllability and the optimistic bias reveals that controllability functions as a personal risk moderator. This finding is consistent with the explanation that people are more optimistic with regard to events for which they believe they can engage in behaviors that will prevent the occurrence of the event. The results also revealed that controllability occasionally affects target risk estimates.

Control Driven Moderator: Prior Experience

A number of studies have examined the effect of prior experience on the optimistic bias. One might imagine that prior experience with a negative outcome might lead people to be more optimistically biased in their risk estimates to the extent that they believe that "lightning never strikes twice" or vow that they will not make the same mistake twice. However, the consistent finding is that prior experience is associated with less optimistic bias (e.g., Weinstein, 1980), and there are several possible reasons why this is the case. First, experience with a negative event may decrease the perception, or perhaps illusion, of personal control over outcomes, leading people to perceive that they have no more control than others over events and thus are equally likely to experience unwanted outcomes. Second, prior experience with a negative event makes it easier for people to imagine themselves in the victim role due to the "availability" of the prior victim experience (Frieze, Hymer, &

[2]As noted elsewhere, van der Velde et al. (1994) surveyed a fourth sample from the general population. However, the authors did not report results relevant to controllability for this fourth sample.

Table 4. *Control and the Optimistic Bias*

Person as Level of Analysis					
Study	**Sample**	**Events**	**Control Measure**	**Personal Risk**	**Target risk**
van der Velde, van der Pligt, & Hooykaas (1994)	1. 241 low risk, heterosexual sample 2. 147 high risk, gay male sample 3. 493 high risk, heterosexual sample	Became infected with HIV because of sexual behavior	Personal	1. $r = -.14$, $p < .05$ 2. $r = -.28$, $p < .001$ 3. $r = -.24$, $p < .001$	1. $r = -.10$, *ns* 2. $r = -.29$, $p < .001$ 3. $r = -.10$, $p < .05$
van der Velde, Hooykaas, & van der Pligt (1992)	535 heterosexual visitors to an STD clinic, high risk	Personally becoming infected with HIV in the future	Personal	Low-risk $M = 3.95$; high-risk $M = 3.43$, $p < .001$	Low-risk $M = 3.85$; high-risk $M = 3.68$, *ns*
Hoorens & Buunk (1993)	84 Dutch high school students (15–18 years old)	Drinking problem, contracting AIDS, heart attack, suicide, cancer	Dutch version of Locus of Control scale[a]	$r = -.33$, $p < .01$	$r = .05$, *ns*

Note: STD = sexually transmitted disease.
[a]Dutch version of Locus of Control scale (Andriessen & van Cadsand, 1983).

Greenberg, 1987). To the extent that people then fail to recognize that the factors that place them at risk also apply to similar others, they may even come to view their own risk as greater than the risk of others. People may also come to overestimate the base rate of a negative event after experiencing it and thus believe it more likely to recur than the actual base rate would warrant (Weinstein, 1989). Third, prior experience with a negative event may constrain beliefs about the future, leading people to acknowledge that if it happened in the past, it can happen again, that bad events can be random and are not just the fate of bad people. In a sense, this is a variation on the first explanation in that it increases awareness that some outcomes are less controllable than previously believed.

Although no study has examined empirically why prior experience might reduce the optimistic bias, two of the explanations emphasize changes in perceptions of control that come with experience, and thus we discuss the effect of prior experience under control. Of importance, regardless of which explanation one favors, all three suggest that prior experience will affect personal risk estimates and thus function as a personal moderator. However, prior experience may also function, albeit to a lesser degree, as a target moderator to the extent that prior experience leads people to overestimate the population incidence of a negative event—the false consensus effect (Marks & Miller, 1987).

Researchers have operationalized prior experience in terms of geographic location, such as living in an area that recently experienced an earthquake (e.g., Helweg-Larsen, 1999); exposure to a victim, such as a close friend or sibling undergoing cancer treatment (e.g., Blalock, DeVellis, & Afifi, 1990); losing money or suffering personal injury (Helweg-Larsen, 1999); or having prior personal experience with an event, such as testing positive for a sexually transmitted disease (van der Velde et al., 1992). We found a number of studies demonstrating that prior experience with a negative event decreases optimistic bias for that event. As is typical, however, many of these studies examined only personal risk estimates (e.g., Stapel & Velthuijsen, 1996) or used the direct method to assess the optimistic bias (e.g., Blalock et al., 1990; Helweg-Larsen, 1999; Larwood, 1978; Larwood & Whittaker, 1977; Weinstein, 1980, 1982, 1987).

We found five studies (Burger & Palmer, 1992; Dolinski, Gromski, & Zawisza, 1987; van der Velde et al., 1992, 1994; Welkenhuysen et al., 1996) that used the indirect method to assess the optimistic bias. Although one of the studies (Welkenhuysen et al., 1996) found no evidence that prior experience reduces the optimistic bias, the remaining four found strong evidence that prior experience reduces the optimistic bias. Unfortunately, two of the remaining studies lacked information for determining whether prior experience affected personal risk estimates or target risk estimates. Specifically, one of the studies (Dolinski et al., 1987) lacked a no-prior experience control group, and the second (van der Velde et al., 1992) did not present means separately for self and target for participants with and without prior experience.

The remaining two studies (Burger & Palmer, 1992; van der Velde et al., 1994) provided sufficient evidence for determining whether prior experience affected per-

sonal or target risk estimates. Both studies reveal that prior experience functions as a personal risk moderator and not a target risk moderator. The first study (van der Velde et al., 1994) compared the risk estimates for AIDS of four samples that varied in risk behavior. Two of the samples were labeled *low-risk samples.* The first consisted of a representative sample of the general population (Sample 1) and the second consisted of heterosexuals with multiple, private (nonprostitute) partners from non-AIDS risk groups (Sample 2). The remaining two samples were labeled *high-risk samples.* The first comprised gay men with multiple partners (Sample 3). None of the gay men had tested positive for HIV at the time of the data collection. The second comprised visitors to a sexually transmitted disease (STD) clinic who had engaged in prostitution contact (Sample 4). Twenty-five percent of Sample 4 had one or more STDs at entry of the study, 48% had history of STDs in the preceding 5 years, and 25% reported sexual contacts with HIV-risk groups in the preceding 5 years. Regression analyses revealed that prior experience with an STD was associated with less optimistic bias. Additional analyses revealed that prior experience predicted personal risk estimates but not target risk estimates.

The second study (Burger & Palmer, 1992) examined risk estimates following an earthquake. Three days after the Loma Linda, California earthquake, undergraduates enrolled in a university near the quake's epicenter supplied risk estimates for nine events, including the likelihood of being seriously hurt in a natural disaster (flood, earthquake, or storm). A second group of students from the same university made the same estimates 3 months after the earthquake. Both groups of participants generally showed an optimistic bias for the various events. An exception, however, occurred for natural disasters. Whereas the group surveyed 3 months after the earthquake showed an optimistic bias for natural disasters such as earthquakes, the group surveyed 3 days after the earthquake did not. Moreover, the two groups differed in their personal risk estimates but not their target risk estimates.

In sum, although a number of studies have examined the effect of prior experience on the optimistic bias, only two (Burger & Palmer, 1992; van der Velde et al., 1994) provided sufficient evidence to examine whether prior experience functions as a personal moderator, a target moderator, or both. In both studies, prior experience affected personal risk estimates but not target risk estimates, a finding consistent with the various explanations proposed to account for the effect of prior experience on risk estimates.

Summary

The evidence from studies examining the effect of control on the optimistic bias suggests that perceived control functions as a personal risk moderator. As perceptions of control decline, so too does the optimistic bias because estimates of personal risk increase. This finding holds regardless of whether perceptions of control (a) are measured as an individual difference variable, (b) are assessed based on participants' ratings of the controllability of a given event, or (c) are inferred from prior experience. We also found some evidence that control affects target risk estimates, with lower perceived control occasionally leading to greater target risk estimates. This effect happened in some studies but not others and tended to be weaker than the effect of perceived control on personal risk estimates. Finally, it is important to note that no published study has examined the effect of perceived control (or prior experience) on the optimistic bias experimentally. Experimental research seems an important next step for researchers to undertake.

Circumstances Surrounding the Comparison

When people make risk estimates, they presumably make a comparison between personal and target risk estimates, a process that to some extent involves making a social comparison. Other researchers have investigated aspects of social comparison as an important factor related to relative risk estimates (for a review, see Klein & Weinstein, 1997). The final group of moderators reflects circumstances surrounding this comparison, including the type of comparison target and attention to risk-related behaviors. These moderators are less well understood and may reflect multiple underlying processes that may overlap with or include affect and control. We divide these moderators into two groups: the nature of the comparison target and the focus of attention.

Type of Comparison Target

A consistent finding is that characteristics of the comparison target can have a tremendous influence on the degree to which people display an optimistic bias in their risk estimates. Researchers have manipulated the characteristics of the target by varying the closeness, similarity, and specificity of the target. The typical finding is that people display greater optimistic bias when comparing themselves to distant, dissimilar, and vague targets such as the average person than when comparing themselves with close, similar, and specific targets such as a close friend. According to Perloff and Fetzer (1986), the ambiguity of comparisons with an average person allows people considerable leeway in the selection of social comparison targets, allowing

people to select targets who are especially at risk for misfortune. Thus, when judging relative to the average college student their risk of experiencing negative events such as divorce, injury in a car accident, or having an unwanted pregnancy, people chose to compare themselves with targets who were especially at risk for these misfortunes. By so doing, they insured a favorable social comparison. When constrained to make comparisons with a specific target such as a close friend or specific family member, the freedom to select high risk targets for comparison is removed and, as a consequence, differences between personal and target risk estimates disappear. Of course, specific people such as a close friend or family member differ from the average person in other ways as well. For example, people possess more information about the precautionary behavior of close friends and family members and are more likely to be similar to them as well. Alicke, Klotz, Breitenbecher, Yurak, and Vredenburg (1995) showed in a series of experiments that the optimistic bias is reduced when the comparison target is individuated and personal contact is established with the target.

Alicke et al. (1995) proposed that the optimistic bias arose at least in part from a heuristic to regard oneself as better than an abstract average. These authors argued that the decline in optimistic bias observed when people compared themselves with a specific target resulted from the individuation of the target, which disengages people from making heuristic judgments. Along similar lines, Klar, Medding, and Sarel (1996) argued that people used different judgmental mechanisms when evaluating the risk of familiar versus abstract targets. All suggested that the reduction in optimistic bias resulting from comparisons with close targets arises from changes in target estimates rather than changes in personal estimates.

We found several studies (Alicke et al., 1995; Harris & Middleton, 1994; Hoorens & Buunk, 1993; Klar et al., 1996; Perloff & Fetzer, 1986; Quadrel et al., 1993; Regan, Snyder, & Kassin, 1995; Whitley & Hern, 1991; Zakay, 1984; Zakay, Zur, & Tsal, 1996) examining whether the optimistic bias varies as a function of the psychological closeness of the target. Two of these studies (e.g., Alicke et al., 1995, Experiments 3–5; Regan et al., 1995) used the direct method and thus did not permit an examination of whether the optimistic bias moderates personal or target estimates. In several of the remaining studies (e.g., Burger & Burns, 1988; Klar et al., 1996; Linville et al., 1993; Quadrel et al., 1993; Whitley & Hern, 1991; Zakay et al., 1996), participants estimated their own risk and the risk of numerous targets who varied in closeness (e.g., best friend, acquaintance, average student). Although having a single participant estimate the risk of multiple targets is efficient, it forces by design any moderator effect to occur in ratings of the target. Thus, we excluded these studies from further examination. What remained were four studies (Alicke et al., 1995, Experiment 6; Harris & Middleton, 1994; Hoorens & Buunk, 1993; Perloff & Fetzer, 1986) using the indirect method to examine risk estimates as a function of closeness. Three of these studies (e.g., Alicke et al., 1995, Experiment 6; Hoorens & Buunk, 1993; Perloff & Fetzer, 1986) had participants estimate their own risk and the risk of one of several possible targets who differed in closeness. The fourth study (Harris & Middleton, 1994) had participants provide estimates either for themselves or for one of several targets varying in closeness.

For three of the studies (e.g., Alicke et al., 1995, Experiment 6; Harris & Middleton, 1994; Perloff & Fetzer, 1986), the results were quite consistent, with closeness affecting target estimates rather than personal estimates. Across the three studies, participants did not differ in their personal risk estimates regardless of the nature of the target. Where participants differed was in the risk estimates for the target. The more distant the target, the more participants rated the target as being at risk for experiencing the negative event. Thus, these three studies suggest that closeness functions as a target risk moderator and not a personal risk moderator.

The study by Hoorens and Buunk (1993) was the only exception to this general pattern. Hoorens and Buunk had participants estimate their own risk and the risk for a best friend, the average student, or an arbitrary student across five negative events. A multivariate analysis of variance (MANOVA) on the risk estimates for their five events showed no overall effect of closeness of target. In general, all targets were rated as at greater risk than the self. One exception was for one of the negative events—risk of getting AIDS. This finding is inconsistent with the findings from the other studies. We are quick to caution that the effect occurred for only one of the five negative events and that the overall MANOVA was not significant.

In sum, the explanations offered by Perloff and Fetzer (1986), Alicke et al. (1995), and Klar et al. (1996) suggested that psychological closeness should function as a target moderator. The results from several studies reveal that closeness does operate as a target moderator. The results from the study by Hoorens and Buunk (1993), which largely found no effect of closeness, are anomalous and stand as the lone exception to this general finding.

One final study (Helweg-Larsen, 1994) deserves mention in our discussion of the nature of the comparison target. In this study different groups of participants appeared to think about different targets when making estimates or to regard similar targets quite differently. Specifically, Helweg-Larsen (1994) had American and Danish college students make risk estimates for three risks simultaneously (risk of unplanned pregnancy, STDs, and HIV) and found a greater optimistic bias

among Americans than among Danes. A reanalysis of the results from her study using a MANOVA revealed a marginally significant effect of culture on participants' personal estimates, Wilks's $\lambda = .91$, $F(3, 81) = 2.51$, $p = .07$, $\eta^2 = .09$, indicating that personal risk estimates were about the same among Americans and Danes. Analysis also revealed a significant effect of culture on participants' estimates for the average student, Wilks's $\lambda = .48$, $F(3, 81) = 28.66$, $p < .001$, $\eta^2 = .51$. As Table 5 indicates, the target risk estimates made by Americans were greater than the target risk estimates made by Danes.

Several pieces of evidence suggest that the Danish and American participants (Helweg-Larsen, 1994) regarded the targets of comparison differently and that Americans were better able than Danes to generate cognitions that allowed them to conclude that their risk was markedly different from the risk of the average person. First, although birth control use was identical in the two samples, the estimated birth control use for the average student was lower among Americans than among Danes. Second, when asked to think of a specific high-risk friend in a follow-up study, Americans and Danes thought of friends who were equally risky. Nevertheless, American participants judged their personal risk as lower than did Danes. Third, when asked to think of a high-risk friend (e.g., a friend most likely to have unprotected intercourse) for comparison in the follow-up study, Danes were more likely than Americans to report that they had no high-risk friends. One interpretation of this final finding is that Americans are more adept than Danes at generating examples of high-risk targets, thereby leading to higher risk estimates for targets.

Attention to Risk-Related Behaviors

Several studies have examined the extent to which focusing of attention on either personal or target risk-related behaviors influences relative risk estimates. The findings indicate that focus of attention can lead to an increase or decrease in the optimistic bias depending on whether people focus on their risk-increasing or risk-decreasing behavior, or on the risk-increasing or risk-decreasing behavior of others. For example, one study (Weinstein, 1980) found that participants were less optimistically biased when led to focus on their own risk behaviors. A second study (Weinstein, 1983) revealed that people were less optimistically biased when they received information about where other students fell on a list of risk factors. A third study (Weinstein & Lachendro, 1982) revealed that people showed less optimistic bias when directed to take the perspective of the comparison target. These studies show that focusing on one's own risk-increasing behavior or on the risk-decreasing behavior of others can reduce the optimistic bias. Unfortunately, these three studies used the direct method, making it impossible to determine if the changes in the optimistic bias resulted in changes in personal or target risk estimates.

A fourth study (Gerrard, Gibbons, & Warner, 1991) used the indirect method and found that participants led to focus on their personal risk-related behaviors displayed a greater optimistic bias than did participants who were not led to focus on their personal risk-related behaviors. Specifically, Gerrard et al. had female Marines review or not review their sexual history prior to supplying risk estimates for an unplanned pregnancy. The review involved having participants review their sexual and contraceptive behavior (listing every sexual intercourse episode and the contraceptive measure taken). Marines who reviewed their sexual history were more optimistically biased. More important, the review had no effect on target risk estimates. Rather, it led participants to lower their personal risk estimates. Gerrard et al. explained their findings by arguing that participants focused primarily on the behaviors they undertook to avoid pregnancy, leading to lower personal risk estimates. Consistent with this explanation was the finding that Marines who reviewed their history underestimated their actual risk as determined by the pregnancy rate of a comparable sample of Marines.

Table 5. *Means of Perceived Risk Averaged for Unplanned Pregnancy, Sexually Transmitted Diseases, and HIV as a Function of Culture*

	Culture			
	U.S.[a]		Danish[b]	
Risk Estimates	***M***	***SD***	***M***	***SD***
Self	12.6_a	14.0	6.0_a	6.0
Student	47.0_a	19.2	13.6_b	10.1
Difference	34.4_a[c]	23.0	7.7_b[c]	8.8

Note: Reanalyzed data from Study 1 of Helweg-Larsen (1994). Ratings were made on a 101-point scale ranging from 0 (*certain not to happen*) to 100 (*certain to happen*). Within rows, means with different subscripts differ, $p < .001$.

[a] $n = 48$. [b] $n = 35$. [c] Differences are significantly different from zero at $p < .001$ using a dependent t test.

Summary

Research examining the circumstances surrounding the comparison can lead to greater or less optimistic bias by affecting personal or target risk estimates. Regarding the nature of the comparison target, the overwhelming evidence suggests that the closer, more similar, and more specific the target, the less people are optimistically biased. Moreover, the decline in bias stems exclusively from changes in target risk estimates. Regarding attention to risk-related behaviors, research using the direct

method suggests that focusing attention on personal or target risk behaviors can diminish the optimistic bias. However, the one study (Gerrard, Gibbons, & Warner, 1991) that used the indirect method found that attention to personal risk behavior produced an increase in the optimistic bias, presumably because people attended to their risk-avoiding behaviors rather than their risk-increasing behaviors. Clearly, this last group of moderators needs more research, both to establish when people will be more versus less optimistically biased and to identify more clearly the processes underlying the changes in risk estimates associated with these moderators.

Summary and Conclusions

Identifying the source of the optimistic bias and how moderators of the bias exert their influence is important for two reasons. First, we are in a strong position to understand the causes and purpose of the optimistic bias only if we understand the source of the optimism (i.e., Does the bias stem from a bias in personal estimates, a bias in the estimates for others, or both?). Second, to the extent that precautionary behavior is linked to perceptions of personal risk relative to some absolute standard, interventions that affect estimates of the average person's risk but have no effect on personal risk estimates may be ineffective. That is, even if the intervention makes people believe that their risk is similar to that of the average person, people may not alter their risk-related behavior if they continue regarding their own risk as low. On the other hand, it is possible that risk behavior is linked to perceptions of relative risk perception; people will engage in risky behavior if they perceive they are at relatively less risk than other people (Klein, 1997). If this alternative perspective is true, the moderators that close the gap between personal and target risk estimates, regardless of whether they affect people's personal estimates or their estimates for others, should produce a decrease in risky behavior and an increase in precautionary behavior.

Personal Risk Moderators

Our examination of various proposed moderators of the optimistic bias reveals several moderators that reduce or eliminate the optimistic bias exclusively by increasing perceptions of personal risk. As such, these moderators function as personal risk moderators. Sad mood, dysphoria, trait and state anxiety, prior experience, event severity, low perceived control, and proximity of feedback all function as personal risk moderators. That is, people experiencing a sad mood, dysphoria, state or trait anxiety, low control, or impending feedback are less optimistically biased than people not experiencing these states, traits, or situations. It is noteworthy that several of these moderators (e.g., negative mood, dysphoria, state anxiety, and control) also influenced risk estimates made for the target. However, rather than diminishing the optimistic bias by leading to the perception that the target is at lower risk, these moderators served to sustain or increase the optimistic bias by leading to the perception that the target is at even greater risk. In all cases, however, the moderator affected personal risk estimates more than target risk estimates, thereby producing an overall decrease in the optimistic bias.

Finally, directing attention to personal risk-related behavior also affected personal risk estimates, but it did so by leading people to decrease their personal risk estimates. The net result was an increase the optimistic bias.

Four of the personal risk moderators (negative mood, dysphoria, trait and state anxiety) represent negative affective experiences. In addition, the effects of two of the other personal risk moderators (event severity and proximity of feedback) appear to be driven by negative affect. That is, regression analyses revealed that the effects of event severity and proximity of feedback were attributable to greater negative affect among participants anticipating a severe event or imminent feedback about their standings on the event. These findings suggest that negative affect may play a central role in people's estimates of their personal risk. More specifically, manipulations or intervention strategies aimed at altering people's personal risk estimates may be effective only in so far as they make participants anxious or otherwise increase their negative affect.

Research examining the two remaining personal risk moderators (control and prior experience) did not include measures of negative affect or did not assess whether the effects of these moderators were attributable to differences in negative affect. Thus, it is unknown whether control and prior experience affect personal risk estimates by producing differences in negative affect. Clearly, the role that negative affect plays in the relation between these two moderators and personal risk estimates remains an important direction for future research.

Target Risk Moderators

Our analysis revealed that two of the proposed moderators of the optimistic bias affect the bias exclusively by influencing target risk estimates. First, people were less optimistic when comparing themselves with a target who was psychologically close to them, similar, or specific (e.g., a close friend or family member) than when comparing themselves with a tar-

get who was psychologically distant, dissimilar, or ambiguous (e.g., an acquaintance or the average student). More important, the effect was attributable to changes in risk estimates for the target rather than to changes in personal risk estimates. The second, happy mood, was associated with an increase in the optimistic bias. Specifically, people placed in a happy mood were more optimistically biased than were people in a neutral mood. Their greater optimistic bias was attributable entirely to changes in their target risk estimates (they perceived the target as more at risk) and not to changes in their personal risk estimates. As we noted earlier, however, the finding that people in a happy mood rate the target as more at risk than do people in a neutral mood is not easily explained and merits additional research.

Other Moderators

The moderators we discuss do not represent an exhaustive list of the potential moderators of the optimistic bias. Indeed, researchers have explored a variety of other moderators of the optimistic bias. For example, a number of studies have examined the effect of age on the optimistic bias (Cohn, Macfarlane, Yanez, & Imai, 1995; Gochman, Bagramian, & Sheiham, 1972; Hansen, Hahn, & Wolkenstein, 1990; Hansen & Malotte, 1986; Kreuter & Strecher, 1995; Weinstein, 1987). The results, however, are generally inconsistent. In some studies younger people were more optimistically biased than older people (e.g., Hansen et al., 1990; Kreuter & Strecher, 1995), in some studies older people were more optimistically biased than younger people (e.g., Cohn et al., 1995), and some studies showed no effect of age (e.g., Quadrel et al., 1993; Weinstein, 1987). These inconsistencies aside, examination of the studies reveals that they either used the direct method to assess the optimistic bias or failed to include items assessing both personal risk and target risk. Thus, we are unable to determine whether age moderates the optimistic bias by affecting personal risk estimates or target risk estimates. Finally, it is not clear why people of different ages display different levels of optimistic bias.

Likewise, a number of investigators have explored the effect of engaging in high-risk behavior on people's risk estimates (Burger & Burns, 1988; Cohn et al., 1995; Gerrard et al., 1991; Gerrard & Warner, 1994; Gladis, Michela, Walter, & Vaughan, 1992; Hansen et al., 1990; Hansen & Malotte, 1986; Klein, 1996, Study 2; Larwood, 1978; Lee, 1989; McKenna, Warburton, & Winwood, 1993; Miller et al., 1990; Moore & Rosenthal, 1991; Riche & Thelen, 1990; Sheer & Cline, 1994; Sparks, Shepherd, Wiering, & Zimmermanns, 1995; Strecher, Kreuter, & Kobrin, 1995; van der Velde et al., 1992, 1994; Weinstein, 1987; Whitley & Hern, 1991). Again, however, few of the studies used the indirect method. Also problematic in terms of interpretation is the fact that, because the research on high-risk behavior is nonexperimental, it is unclear whether engaging in high-risk behavior affects people's risk estimates or whether people's risk estimates affect their tendency to engage in high-risk behavior. Consequently, we chose to exclude high-risk behavior from our review of moderators of the optimistic bias.

One study (Heine & Lehman, 1995) examined the different risk perceptions that might result from living in a interdependent culture (Japan) compared with an independent culture (Canada). In general, people from independent cultures were more optimistically biased than people from interdependent cultures. The effect of culture on risk estimates seems an important direction for research, and we hope more studies will explore the effect of the cultural context on risk perceptions. Finally, one potentially interesting moderator is mindset. S. E. Taylor and Gollwitzer (1995) found that an implemental mind-set led to more optimistic bias than a deliberative mindset. More research is needed to thoroughly examine this variable and its effect on optimistic bias.

Perhaps the most important conclusion from our review is the need for future research to use the indirect method in assessing the optimistic bias. Although some evidence suggests that using the direct method to assess the optimistic bias yields stronger effects (Otten & van der Pligt, 1996), the direct method undermines our ability to determine the source of the bias when findings uncover differences across groups or conditions in people's risk estimates.

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