You May Worry, But Can You Recognize Threats When You See Them?; Neuroticism, Threat Identifications, and Negative Affect

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ABSTRACT The present studies sought to investigate the hedonic consequences of threat-identification skills at low and high levels of neuroticism. Such skills were assessed in terms of both speed (Study 1) and accuracy (Study 2) of identifying threatening objects in cognitive tasks. As predicted, threat-identification skills interacted with trait neuroticism in predicting subjective experiences. Specifically, individuals high in neuroticism experienced lower levels of negative affect during their everyday lives if they were also skilled in identifying threats in the cognitive tasks (Studies 1–2). Such skills did not matter at low levels of neuroticism. This interactive pattern was also replicated in the context of life domain satisfaction (Study 2). The results support the view that avoidance motivation encompasses multiple component processes, including some that are cognitive in nature, and specifically extends self-regulatory views of neuroticism. Of most importance, our data indicate that threat-identification skills can be hedonically beneficial, rather than costly, at high levels of neuroticism.

Superman and his fellow action heroes are constantly vigilant. Yet their success at thwarting evil enemies also depends on their ability to quickly identify the bad guys when they enter the scene. Similarly, regardless of how eager a mouse may be to avoid a hungry cat, it can only do so if it is quick to detect the presence of a cat within close

proximity. Such considerations suggest that the success of obtaining a certain goal may ultimately depend on the ability to recognize goal-related stimuli when they are present (Carver & Scheier, 1999; Gollwitzer, 1999). By contrast, motivation without motivation-relevant skills would likely undermine effective self-regulation.

We suggest that the ability to identify threats quickly may be beneficial for individuals who tend to worry about possible threats much of the time. We examine this idea within the context of trait neuroticism and the ability to recognize threat-relevant stimuli in cognitive tasks. We propose that these two individual difference variables—trait neuroticism and threat-identification skills—can either be consistent (e.g., a neurotic individual who is skilled at identifying threats) or inconsistent (e.g., a neurotic individual who is unskilled at identifying threats) as a self-regulation system. We further propose that trait-processing consistency of this type should be associated with hedonic benefits, a prediction that is broadly consistent with self-regulatory conceptions of subjective experience (Morris, 1999; Thayer, 1996).

The Comparator Function of Self-Regulation

According to control theories, self-regulation involves multiple components related to goals, perceptions, and actions (Carver, 2004; Carver & Scheier, 1999). More specifically, a self-regulation system can be depicted as a feedback loop that involves an input function, a reference value (i.e., a goal), a comparator, and an output function. When a certain input (e.g., a snake in the grass) is introduced to the system, the comparator function compares it to a reference value (e.g., a threat) and categorizes it as either matching the reference value (e.g., a snake in the grass is a threat) or not. This categorization process feeds into the output function to determine subsequent behavior (e.g., avoid the snake in the grass).

From this self-regulation viewpoint, once a goal (e.g., avoid threats) has been activated, it seeks confirmatory or matching input (Carver, 2004; Powers, 2004). The efficiency of this comparator function will determine the likelihood that one is successful in achieving the relevant goal, especially when imminent threats are involved (Öhman, 2001; Robinson, 1998). Therefore, the skilled identification of goal-relevant stimuli may carry important adaptive benefits (Higgins, 1997; Lang, Bradley, & Cuthbert, 1997). We

examined this prediction in the context of neuroticism, threat-iden-
tification skills, and individual differences in subjective experience.

Neuroticism, Avoidance Motivation, and Threat-Comparator Skills

At its core, neuroticism can be viewed as an individual difference
variable that closely relates to operations of the avoidance self-
regulation system (Carver, Sutton, & Scheier, 2000; Elliot & Thrash,
2002). Research has shown that neuroticism (a) is positively corre-
lated with other personality scales assessing avoidance motiva-
tion and (b) predicts reactivity to negative events in the laboratory
(e.g., Zelenski & Larsen, 1999) and in real life (e.g., Bolger & Schill-
ing, 1991). In addition, other data link neuroticism to negative af-
fective states somewhat specifically (Watson, Wiese, Vaidya, &
Tellegen, 1999), and correlations of this type are often seen to
reflect levels of avoidance motivation that differ between individu-
als (e.g., Carver et al., 2000).

Although the link between neuroticism and avoidance motivation
appears to be strong given available self-report data (e.g., Tellegen,
1985), some important distinctions are in order. One, neuroticism
represents an extremely broad, temperament-based tendency toward
avoidance and is not necessarily correlated with avoidance goals of
all types. Two, of particular relevance here, self-reported motivation,
in itself, does not constitute a self-regulation system in that self-
regulatory theories often highlight comparator skills responsible for
recognizing motive-relevant stimuli when they occur (Carver &
Scheier, 1999; Gollwitzer, 1999; Powers, 2004). Prior research in
our lab indicates that such skills can be measured by cognitive tasks
(e.g., Robinson, Meier, & Vargas, 2005) and that they are typically
unrelated to self-reported traits like neuroticism (e.g., Robinson,
Vargas, & Crawford, 2003).

Although traits and cognitive skills are typically independent of
each other, they often interact, and we have found that self-
regulation frameworks are an excellent way to conceptualize some
interactions of this type (e.g., Robinson & Wilkowski, in press; for a
review, see Robinson, in press). The specific hypothesis examined in
the present studies has not been the focus of systematic work. How-
ever, following the idea that motive-relevant skills are generally ben-
eficial to effective self-regulation (Robinson & Wilkowski, in press),

we specifically predicted that individuals high in neuroticism, who worry about potential threats much of the time (Watson & Clark, 1984), would benefit from high (relative to low) threat-comparator skills. Such skills would insure that avoidance motivation is channeled in accord with real, rather than poorly understood or illusory, threats to the self (Robinson et al., 2003), as is very common among chronic worriers (Borkovec, Ray, & Stöber, 1998).

We therefore predicted that threat-identification skills would be beneficial at high levels of neuroticism. Moreover, we predicted that this would be particularly true in relation to negative affect as threat-identification skills would allow neurotic individuals to worry about real, rather than illusory, threats to the self (Borkovec et al., 1998; Borkovec & Sharpless, 2004). By contrast, we expected threat-comparator skills to be largely irrelevant among individuals low in neuroticism, for at least two reasons. One, individuals low in neuroticism are not predisposed to experiences of negative affect, the general focus of the present studies. Two, from the perspective of our self-regulatory framework, threat-identification skills should be less relevant among those low in temperamental tendencies toward avoidance, as is true of individuals low in neuroticism (Elliot & Thrash, 2002; Zelenski & Larsen, 1999).

Overview of Current Studies

To examine the efficiency of threat-comparator skills, we adopted two different approaches in two separate studies. Study 1 used a paradigm that we expected would be particularly sensitive to comparator speed, but not accuracy. By contrast, Study 2 used a paradigm that we expected would be particularly sensitive to comparator accuracy, but not speed. The tasks differed, as well, in other ways that would be useful in establishing the generalizability of the present findings.

To examine the present predictions, we conducted two experience-sampling studies focused on momentary experiences of negative affect in everyday life. Experience-sampling studies are especially important for establishing the everyday correlates of cognitive processing tendencies and trait × cognition interactions (Robinson, 2004; Robinson & Neighbors, in press). In addition, the specific focus on negative affect was due to the fact that neuroticism is generally regarded as a risk factor for increased negative affect but not

for decreased positive affect (e.g., Carver et al., 2000; Watson et al., 1999).[1]

In both studies, we made the following predictions: One, neuroticism and threat-identification skills would interact with each other in the prediction of daily negative affect. Two, threat-identification skills would predict negative affect at high, but not low, levels of neuroticism. And three, individuals high in neuroticism would benefit, rather than suffer, from efficient threat-identification skills. Findings along these lines would support our self-regulatory predictions as well as clarify the role that threat-identification skills have at low and high levels of neuroticism.

STUDY 1

Study 1 used a threat-identification task involving a degraded font paradigm. This sort of paradigm is often used in the cognitive literature (Dixon, 1981; Vokey, Baker, Hayman, & Jacoby, 1986) but rarely used in the personality literature. In the paradigm, we simply presented threatening and neutral stimuli in a degraded manner and slowly removed such levels of degradation until the words could be identified. Threat-identification skills were operationalized in terms of faster recognition of threatening relative to neutral word stimuli. We predicted that performance in this task would interact with neuroticism such that neurotics fast to identify threatening stimuli would be less vulnerable to negative affect in everyday life.

Methods

Participants

Participants were 81 undergraduates from the University of Illinois (59% female) who received $20 for their participation.

Materials

Threat-identification task. Participants were asked to identify words presented on the screen as quickly and accurately as possible. Each trial

1. Indeed, neuroticism did not predict daily experiences of positive affect in the present studies, and it was also true that neuroticism did not interact with threat-identification skills in the prediction of experiences of positive affect in everyday life, $ps > .05$. Thus, the theoretical focus on daily experiences of negative affect was supported by the lack of relations involving daily experiences of positive affect.

involved a single word, which was degraded by the superimposition of black pixels. These pixels were removed gradually, rendering the word easier to identify over time. Participants were asked to press the space bar as soon as they identified the word on the screen, at which point a dialogue box replaced the word stimulus (i.e., occluding it), and participants had to type in the word in question.

Words were printed in a thick lower-case 24-point font. Words were white on a gray background. The noise level (i.e., % of black pixels) varied as a function of time. At the beginning of each trial, there was 100% noise, meaning that the word could not be seen at all. Twenty-five percent of this noise was removed per second; thus, the word was 50% degraded at 2 seconds. In terms of stimuli, the task included 25 neutral words (e.g., afternoon) and 20 threat words (e.g., danger).[2] These words were chosen based on normed valence ratings (1 = *unpleasant*; 9 = *pleasant*; Bradley & Lang, 1999), such that threat words ($M = 2.72$) were rated as more negative than neutral words ($M = 5.37$), $t(43) = 11.03$, $p < .05$. Threat and neutral words were equated in terms of length and frequency of usage, $Fs < 1$.

Neuroticism scale.   Neuroticism was measured by Goldberg's (1999) Big-Five IPIP scale (short form). The scale involves agreeing or disagreeing with statements indicative of high or low neuroticism (e.g., *worry a lot*). The scale is reliable and valid and correlates highly with the neuroticism scale of the NEO-PI (Costa & McCrae, 1992). For further evidence on the reliability and validity of the scales, see Goldberg (1999). The internal reliability of the scale was .88 here.

Momentary affect.   The experience-sampling study asked participants to indicate the extent (0 = *not at all*; 5 = *extremely*) to which they were currently experiencing nine markers of negative affect (*afraid, angry, anxious, ashamed, downhearted, guilty, irritable, nervous, sad*), when paged by the palmtop computer (see below for further details). For each item separately, ratings were averaged across pages. We then averaged across items to form a daily negative affect scale ($\alpha = .95$). The present daily negative affect scale has proven reliable and valid in previous research (e.g., Robinson, Vargas, Tamir, & Solberg, 2004).

2. Threat words were: menace, pain, punishment, criticism, insult, ridicule, conflict, trouble, threat, danger, weapon, enemy, injury, panic, knife, hazard, harm, fatal, deadly, fear. Neutral words were: afternoon, collection, geology, sound, window, situation, definition, cause, custom, theory, moment, method, string, street, couch, bowl, table, pencil, figure, square, plate, computer, cabinet, document, compare.

Procedure

The study included a lab-session portion and an experience-sampling portion. First, participants came into the lab in groups of two to four. After giving informed consent, each participant was seated in front of a personal computer and completed the comparator speed task as well as the neuroticism scale. The experience-sampling portion of the study was completed after the lab session.

Experience sampling.   Participants carried a palmtop computer for 7 days. The computer issued six beeps per day, randomly, between the hours of 10 a.m. and 10 p.m. When paged, participants were asked to complete a survey about their current feelings, which was presented on the palmtop computer. Although participants were instructed to complete the ratings immediately after being signaled, we realized that this might not always be possible (for example, during a shower). For this reason, we allowed participants to make the ratings anytime within a 4-minute window. Of the 35 required pages (5 required per day × 7 days), the average participant completed 28 (80%).

Results

Threat-Identification Speed

The threat-identification task used in Study 1 was designed to measure speed rather than accuracy. Indeed, because the participant had as long as necessary to respond and there was no possibility of identifying stimuli early on in the task, we expected accuracy rates to be quite high. This expectation was borne out by the data in that average accuracy rates were 96% and 97% with respect to threatening and neutral stimuli, respectively.

To compute reaction time scores, we excluded inaccurate trials. We subsequently determined that speed scores were normally distributed, with few outliers, and we therefore simply averaged across trials with reference to threatening ($M = 2177$ ms, $SD = 239$) and neutral ($M = 2155$ ms, $SD = 186$) words considered separately. Given the high accuracy rates, we did not expect trade-offs between speed and accuracy of response. Indeed, speed and accuracy were not significantly related ($rs = .05$ and $.12$, *ns*, in identifying threatening and neutral words, respectively).

As is common in reaction-time tasks, speed at identifying threats was positively correlated with speed at identifying neutral words ($r = .86, p < .05$). Therefore, to control for baseline speed of response

(Fazio, 1990), we entered speed at identifying neutral words as a predictor of speed at identifying threat words (Robinson, in press). We then used the regression equation to calculate a residual score for threat-identification speed. Thus, the residual threat speed score necessarily relates to threat-identification skills independent of those in relation to identifying neutral word stimuli.
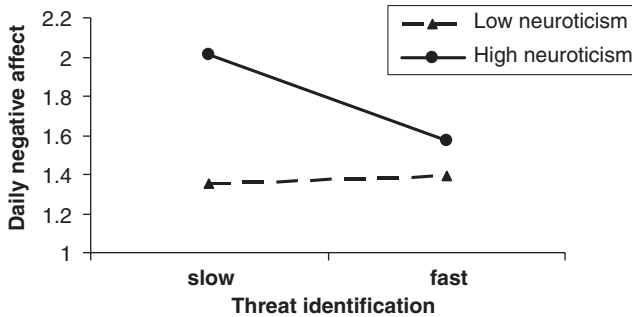
Neuroticism, Threat Identification Speed, and Daily Negative Affect

Trait neuroticism did not correlate with threat-identification speed ($r = -.17$, ns) and threat-identification speed did not correlate with everyday negative affect ($r = .14$, ns). Thus, the present results are not consistent with the idea that tendencies toward negative affect, whether trait-or state-related, are due to tendencies to identify threatening objects quickly. Our predictions, however, related to the interaction of neuroticism and threat speed in the prediction of daily negative affect. To examine whether this interaction was significant, we first centered residual threat speed and neuroticism scores (Aiken & West, 1991). We then conducted a multiple regression predicting levels of daily negative affect from centered neuroticism, centered residual threat speed, and their interaction.

The analysis resulted in a main effect for neuroticism, $t(80) = 11.59$, $p < .05$. Consistent with prior literature, individuals who were higher in neuroticism also tended to experience greater negative affect. However, as we predicted, this main effect was qualified by a significant Neuroticism × Threat Speed interaction, $t(80) = 2.12$, $p < .05$. To determine the nature of the interaction, we computed estimated means for individuals high (+1 SD) and low (−1 SD) in neuroticism, who were relatively fast (−1 SD) or slow (+1 SD) in threat identification (Aiken & West, 1991). The resulting estimated means are shown in Figure 1. As shown in the figure, relations between neuroticism and negative affect were particularly pronounced if the individual was slow to identify threats within the degraded font task.

To further clarify the specific interactive pattern observed in Study 1, we performed simple slopes analyses to examine whether threat-comparator speed predicted negative affect at low (−1 SD) and high (+1 SD) levels of neuroticism. As hypothesized, threat-comparator speed predicted negative affect at high, $t(80) = 2.74$, $p < .05$, but not low, $t < 1$, levels of neuroticism. We also performed

Figure 1
Daily negative affect as a function of neuroticism and threat iden-
tification speed (Study 1).

additional simple slopes analyses by examining whether trait neu-
roticism predicted negative affect at fast (-1 SD) or slow ($+1$ SD)
threat-comparator speed. Neuroticism was a significant predictor of
daily negative affect among individuals slower to identify threats,
$t(80) = 4.12$, $p < .05$, but not among those faster to identify
threats, $t < 1$. It is therefore apparent that the ability to quickly iden-
tify threats was beneficial at higher levels of neuroticism, specifically
with respect to experiences of negative affect in everyday life.

Discussion

The results of Study 1 support several predictions advanced in the
introduction. First, consistent with prior research on personality and
performance measures, neuroticism and threat-identification speed
were largely independent of one another (for a general review, see
Robinson & Neighbors, in press). Second, threat identification speed
was not directly related to negative affect. This is consistent with
research suggesting that processing measures, such as the one ex-
amined here, only rarely have "main effect" implications for affect in
everyday life (Robinson, 2004; Robinson & Neighbors, in press).
Third, the present interactive pattern was consistent with the hy-
pothesis guiding the investigation, namely that neuroticism would
interact with threat-comparator skills in predicting negative affect.
    The present findings are consistent with social-cognitive
frameworks that emphasize the need to examine not only traits,
but also individual differences in social/cognitive processing (Cerv-
one & Shoda, 1999; Mischel & Shoda, 1995). Our results are also

consistent with Robinson et al.'s (2003) suggestion that neuroticism, in combination with a slow recognition of threats as they occur, may be particularly problematic. In this connection, we found that neuroticism was a robust predictor of negative affect among individuals slow to identify threats but not among those fast in doing so. It therefore appears that a comparator system that favors the processing of threats is hedonically beneficial at high, but not low, levels of neuroticism. We sought to extend such conclusions in a second study.

STUDY 2

Cognitive skills can be defined in terms of either speed or accuracy, and Study 1 involved a cognitive task designed to examine the speed of threat identification. To complement the data from Study 1, we designed a different threat-comparator task in Study 2, specifically one designed to measure threat-comparator accuracy rather than speed. Along these lines, we created a version of the go/no-go task (e.g., Nosek & Banaji, 2001) designed to assess the participant's ability to accurately recognize threatening stimuli within a relatively short period of time.

In the task, participants were asked to press the space bar if the word presented on the screen belonged to a certain category (e.g., threatening) but to refrain from pressing the space bar otherwise. Because people were asked to respond when a word matched a pre-defined goal category, the task was particularly suited to assess comparator skills, which are typically defined in terms of the match of a goal (e.g., avoid dangerous objects) to current perceptual input (e.g., a snake) (Carver, 2004; Powers, 2004). To focus the paradigm specifically on accuracy rates, we time-limited responses, as is useful for examining well-learned cognitive responses (e.g., Draine & Greenwald, 1998). In this paradigm, superior threat-comparator skills would be associated with higher go-related accuracy rates in the threat block (Nosek & Banaji, 2001; Robinson et al., 2005).

In Study 1, we focused on the implications of neuroticism and threat-comparator skills for negative affect. However, our predictions should reasonably extend to other variables besides negative affect. Specifically, successful self-regulation is often reflected in greater satisfaction with life (e.g., Diener, Suh, Lucas, & Smith, 1999). In fact, some view successful goal pursuits as essential to life satisfaction (Ryff, 1989). Because we expected threat comparator

skills to contribute to successful self-regulation among neurotic individuals, we predicted that such individuals would experience lower levels of negative affect, as well as greater satisfaction with life domains, if they were skilled at identifying threats.

Methods

Participants

Participants were 37 undergraduates from the University of Illinois (53% female), who received $20 for their participation. The sample size was smaller in Study 2 relative to Study 1, but the comparator task was more explicit in that it required responses related to the threatening nature of the word. The recent literature on affective processing tendencies has concluded that such tendencies are more reliable within the context of more explicit evaluation tasks (e.g., Fazio & Olson, 2003; Klauer & Musch, 2003; Robinson & Neighbors, in press). For this reason, we thought that the paradigm used in Study 2 might be a more sensitive indicator of threat-comparator processes and that a smaller sample size might be sufficient. Such expectations were borne out by the results, as reported below.

Materials

Threat-comparator task.   Participants were asked to press the space bar if a single word presented on the computer screen belonged to a certain category (for example, if the word were neutral). In one block of the task, participants were asked to respond to words representing things that could kill them (*threat* block). In another block, participants were asked to respond to words representing things that are neutral—that is, neither positive or negative (*neutral* block).

Each block in the task included three types of words: threat words (e.g., weapon), neutral words (e.g., street), and positive words (e.g., smile). Each category included seven words that were chosen based on normed valence ratings (Bradley & Lang, 1999).[3] As confirmed by t-tests, threat words were rated more negatively than neutral and positive words (Ms = 2.72, 5.17 and 7.23, for threat, neutral, and positive words, respectively), $t(19)$s > 3, ps < .05. All words were equated for length and frequency of usage, Fs < 1.

Each block included 63 trials, which resulted in three repetitions of each of the 21 words. Words were randomly assigned to trial, separately

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3. Threat words were: knife, gun, snake, cancer, death, weapon, and murder. Positive words were: flower, smile, candy, kiss, sunset, palace, and child. Neutral words were: dime, engine, street, string, chair, cotton, and shoes.

for each participant. In order to alter the go/no-go paradigm in a manner particularly sensitive to accuracy rates, we presented word stimuli for only 700 ms. Thus, to respond to block-relevant stimuli in an accurate manner, participants needed to make their responses within 700 ms. There was a 150 ms blank delay in between trials.

Neuroticism scale. We administered the same neuroticism scale used in Study 1 (Goldberg, 1999). The reliability of the scale was .85 in the present study.

Momentary affect. Individual difference tendencies toward negative affect were examined in the same manner as in Study 1, specifically within a palmtop computer study focused on momentary experiences of negative affect. The response scale and negative affect items were identical to Study 1, and the negative affect scale was similarly reliable ($\alpha = .93$).

Satisfaction with life domains. Participants in Study 2 were also asked to indicate their satisfaction with their lives. The scale, which we have also used before (e.g., Robinson et al., 2004), asks individuals to indicate the extent (1 = *very dissatisfied*; 6 = *very satisfied*) to which they have been satisfied with 10 life domains (appearance, classes, family, finances, friends, grades, health, love life, possessions, and self) over the previous week. To create an overall measure of life satisfaction, we averaged across life domains ($\alpha = .91$).

Procedure

The study included two lab sessions and an experience-sampling portion. First, participants came into the lab in groups of two to four. After giving informed consent, each participant was seated in front of a personal computer and completed the threat-comparator task as well as the neuroticism scale. The experience-sampling portion of the study was identical to the one in Study 1 and was completed several weeks following the initial lab session. Of the 35 required reports (5 required per day × 7 days), the average participant completed 29.60 (85%). Finally, after the experience-sampling portion of the experiment, participants returned to a second lab session. In the second lab session, participants completed the threat-comparator task again and then rated their satisfaction with life domains.

Results

Threat-Identification Scores

Our specific theoretical focus was on threat-comparator skills, defined as the ability to recognize threats as they occur. From the

perspective of the signal-detection literature, such skills would be referred to in terms of "hits." Given the speeded nature of the task, such hits were of utmost interest. By contrast, correct nonresponses on no-go trials were not of interest. First, such nonresponses do not tap skills related to recognizing threats when they occur, the central focus of the study. Second, accuracy rates on such trials are ambiguous as they could reflect either correct decisions or momentary lapses of attention. Consistent with this analysis, no-go accuracy rates (i.e., nonresponses on no-go trials) were in the neighborhood of 90%, and such accuracy rates were not correlated with go accuracy rates, $rs = .19$, ns, and $-.11$, ns, for the threat and control blocks, respectively.

On average, "hits" occurred on 79% of the threat trials and 57% of the control block trials. These responses were necessarily made quickly because of the 700 ms response window ($Ms = 494$ and 525 in threat and control blocks, respectively). Additionally, there was no hint of a speed–accuracy trade-off in this task as accuracy and speed in recognizing go stimuli were uncorrelated with each other, $rs = -.02$, ns, and $-.13$, ns, in threat and control blocks, respectively.

We could, therefore, proceed by examining go accuracy rates, the intended focus of the assessment instrument. As could be expected, go accuracy rates were correlated across blocks such that participants who tended to be more accurate in one block also tended to be more accurate in the other, $r = .38$, $p < .05$. We calculated residual threat scores that were uncorrelated with go accuracy rates in the control block.

Given that participants completed the threat-accuracy task twice, we used the same procedure described above to score threat-identification accuracy within the second assessment of it. Threat-identification accuracy at Time 1 was highly correlated with threat-identification accuracy at Time 2, $r = .62$, $p < .05$. This stability coefficient compares favorably to most implicit measures of affective processing (Robinson, 2004; Robinson & Neighbors, in press).[4]

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4. Participants in Study 2 completed the threat identification task at two times, separated by at least 2 weeks. The data reported in the manuscript pertain to Time 1 threat accuracy scores. However, analyses involving Time 2 threat accuracy scores also resulted in Neuroticism × Threat Accuracy interactions and the pattern of estimated means was the same as those reported. Time 2 threat

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Table 1

**Correlations Between Threat Comparator Accuracy (Residualized),
Neuroticism, Daily Negative Affect, and Life Satisfaction (Study 2)**

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	1	2	3
1. Threat comparator accuracy			
2. Neuroticism	− .03		
3. Daily negative affect	.01	.24	
4. Life satisfaction	.17	− .34*	− .36*

*Note:* $*p < .05$.

Neuroticism, Threat Identification Accuracy, and Daily Negative Affect

Table 1 presents the correlations between neuroticism, daily negative affect, and residual threat accuracy. As shown in the table, threat accuracy scores were not significantly correlated with either neuroticism or negative affect. More important to the present hypotheses, we predicted that participants who were high in neuroticism would experience less daily negative affect if they were more accurate in the threat-comparator task. To examine this prediction, we first centered residual threat and neuroticism scores (Aiken & West, 1991). We then conducted a regression analysis in which we predicted daily negative affect from threat-comparator accuracy, neuroticism, and their interaction.

We predicted that individuals high in neuroticism would benefit from accurate threat-comparator processing. Consistent with our hypothesis, there was a significant Neuroticism × Comparator Accuracy interaction, $t(36) = -2.05$, $p < .05$. To determine the nature of this interaction, we used the regression equation to generate estimated means for those low (−1 SD) and high (+1 SD) in neuroticism who were less (−1 SD) and more (+1 SD) accurate in identifying threats. These estimated means are displayed in Figure 2. As shown there, individuals high in neuroticism experienced less negative affect over a weeklong period if they were more accurate at identifying threats.

accuracy data thus provide additional support for the present self-regulatory predictions.
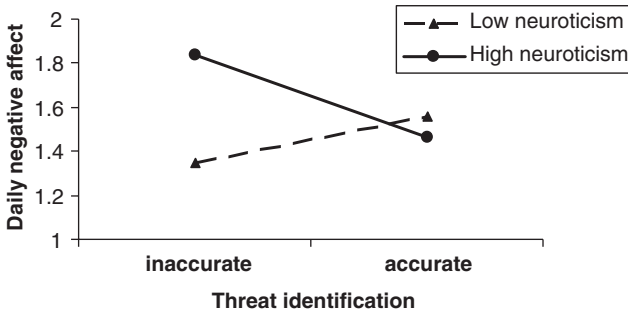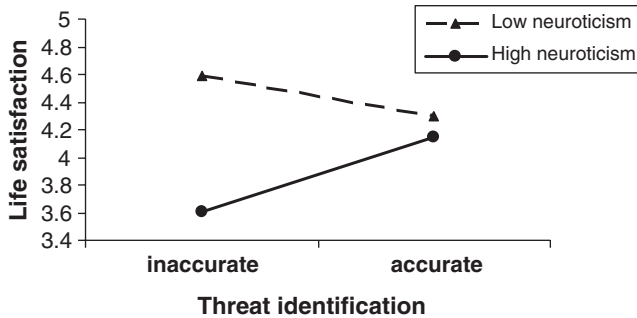
Figure 2
Daily negative affect as a function of neuroticism and threat iden-
tification accuracy (Study 2).

To test whether the effect of threat-comparator accuracy was specific to low (-1 SD) or high ($+1$ SD) levels of neuroticism, we ran simple slopes analyses. Such analyses did not yield significant results at either low or high levels of neuroticism, $ts < 1.5$. We also performed additional simple slopes analyses by examining whether trait neuroticism predicted daily negative affect at low (-1 SD) and high ($+1$ SD) levels of threat comparator accuracy. These analyses demonstrated that neuroticism was a significant predictor of daily negative affect among individuals inaccurate at identifying threats, $t(36) = 2.53$, $p < .05$. By contrast, neuroticism did not predict daily negative affect among individuals who were accurate at identifying threats, $t < 1$. Overall, the results are consistent with the idea that the ability to accurately identify threats is beneficial for individuals high in neuroticism.

Neuroticism, Threat-Identification Accuracy, and Life Satisfaction

As shown in Table 1, threat accuracy scores were largely unrelated to life satisfaction. Nevertheless, we expected participants who were high in neuroticism to experience greater life satisfaction if they were more accurate at identifying threats. To examine this prediction, we repeated the analyses described above, using satisfaction with life domains as the predicted outcome. Consistent with our hypothesis, we found a significant Neuroticism × Threat Accuracy interaction, $t(36) = 2.30$, $p < .05$. We used the same procedure described earlier to plot this interaction, with the resulting estimated

Figure 3
Life satisfaction as a function of neuroticism and threat identification
accuracy (Study 2).

means depicted in Figure 3. As the figure shows, individuals high in neuroticism were more satisfied with their lives when they were more accurate in identifying threats within the comparator task.

To test whether the effect of threat-comparator accuracy was specific to low (-1 SD) or high ($+1$ SD) levels of neuroticism, we ran simple slopes analyses. The analyses demonstrated that threat-comparator accuracy was a significant predictor of life satisfaction at high levels of neuroticism, $t(36) = 2.62$, $p < .05$, but not at low levels of neuroticism, $t < 1.2$. Additional analyses indicated that neuroticism was a significant predictor of life satisfaction among individuals who were less accurate at identifying threats, $t(36) = 3.82$, $p < .05$, but not among individuals who were more accurate at identifying threats, $t < 1$. Such analyses support our hypothesis that the ability to accurately identify threats is beneficial for individuals high in neuroticism.

Discussion

Study 2 replicates Study 1 within the context of a comparator-processing task that emphasized threat categorizations and response accuracy. As in Study 1, threat-comparator skills interacted with neuroticism to predict daily negative affect, and the pattern was quite comparable to that in Study 1. In addition, Study 2 extended the present analysis by showing that neuroticism and threat-comparator processing also interacted to predict recent experiences of life satisfaction and did so in a manner parallel to daily negative affect. Such findings again suggest that threat-comparator skills are

hedonically beneficial at high, but not low, levels of neuroticism, an interactive pattern consistent with our self-regulatory predictions.

GENERAL DISCUSSION

Neuroticism is a self-reported trait associated with a broad tendency to endorse avoidance-focused goals (Elliot & Thrash, 2002; Zelenski & Larsen, 1999). However, as recognized by multiple authors (e.g., Mischel & Shoda, 1995; Robinson et al., 2003), traits in themselves cannot define a self-regulation system. Rather, the person needs to have the skills required to efficiently link relatively abstract goals to concrete objects in the environment (Gollwitzer, 1999; Powers, 2004). Together, broad motivation-related tendencies, in combination with more specific cognitive/affective ones, *can* define a self-regulation system (Carver & Scheier, 1999; Cervone, 2004).

We sought to build on these insights by examining potential interactions between neuroticism and comparator skills related to the efficient identification of threats in affective-processing tasks. Because individuals high in neuroticism are motivated to avoid threats (e.g., Zelenski & Larsen, 1999), we predicted that such individuals would benefit from faster threat-identification skills, which should be associated with more successful self-regulation by avoidance (e.g., Öhman, 1997). On the other hand, individuals low in neuroticism do not tend to self-regulate by avoidance (e.g., Zelenski & Larsen, 1999). We therefore predicted that threat-comparator skills would be relatively less consequential at low levels of neuroticism.

Results of two studies were in accord with these predictions. In Study 1, neuroticism interacted with threat-comparator skills such that the faster identification of threats was associated with less negative affect at high, but not low, levels of neuroticism. A parallel pattern was found in a second study using a different measure of threat comparator skills. Study 2 also extended such interactive results to the domain of life satisfaction. The results of both studies offer broad support for the idea that threat-identification skills are hedonically beneficial at high levels of neuroticism. These results have a number of implications related to self-regulation and neuroticism.

The Comparator Function of Self-Regulation

Gollwitzer (1999) suggested that the implementation of goals depends largely on the ability to link them to objects in the

environment. Similarly, Carver and Scheier (1999; Carver, 2004) proposed a comparator function that links relatively abstract goals to relatively concrete environmental objects. Comparator skills are viewed as necessary to ensure that goals are translated into specific self-regulatory actions (Lewin, 1935; Powers, 2004). Despite the obvious importance of such comparator functions, precious little assessment-related research, especially of a cognitive nature, has focused directly on the measurement of such skills (Robinson et al., 2003). The present research is particularly important from this assessment-related perspective.

From the cognitive viewpoint, we note that cybernetic models have done an excellent job in theoretically elucidating the component operations likely involved. However, it also has to be recognized that such models often emphasize theory over data (as recognized by a central theoretician in this literature: Powers, 2004). Therefore, from a pragmatic empirical perspective, it is crucial to develop assessment-related strategies for measuring comparator functioning (Powers, 2004). The present assessment tools—related to perceptual identifications of threat (Study 1) and abilities to categorize threats when they occur (Study 2)—should be helpful in further exploring the cognitive underpinnings of the comparator stage of self-regulation.

Along these lines, it seems to us that the present measures tap what might be viewed as a "sentinel" or "advance scout" of other, more conscious appraisals and coping efforts (see also Robinson et al., 2005; Tamir, Robinson, & Clore, 2002). A sentinel neither avoids nor approaches, but rather gathers information that should be useful in deciding whether to retreat or advance (e.g., in military battles). In short, we view our measure as tapping early aspects of self-regulation involved in identifying stimuli to avoid (e.g., a snake). Such early categorizations should contribute to, but not strictly determine, the course of later processes involved in self-regulation.

Indeed, we point out the obvious, namely, that research on appraisal tendencies comes almost exclusively from self-report studies (see Scherer, 1988, for a review). Among researchers who have compared self-reported and in vivo appraisal tendencies, it is quite clear that they are rarely related to each other (Bassili, 1996; Fazio, 1995; MacLeod, 1993; McClelland, 1987; Robinson, 2004). Recent theoretical frameworks have attempted to incorporate this fact within extant models of appraisal. For example, Smith and Kirby (2001)

distinguish associative appraisal processes, which are typically unconscious, from appraisal judgments, which are slower and more reason based. The important point here is that the present data reaffirm the benefits of a cognitive analysis of appraisal and self-regulation (Robinson, 2004, in press).

Personality, Appraisal, and Self-Regulation

From one perspective, the potential independence of self-reported personality traits and in vivo processing tendencies could produce a significant bifurcation of the field (Cervone, 1997, 2004). From another perspective, however, it may be useful to embrace both levels of analysis and even integrate them, if possible. Fortunately, such an integration appears to be possible, and its outlines are beginning to take form (e.g., Brunstein & Maier, 2005; Winter, John, Stewart, Klohnen, & Duncan, 1998).

Specifically, the personality system is one consisting of traits, motives, and specific processing tendencies (Cervone, 2004; Mischel & Shoda, 1995; Robinson, in press; Winter et al., 1998). These multiple components of personality may or may not be consistent with each other. In general, when such components are consistent, the personality system is likely integrated, efficient, nonconflicted, and associated with higher levels of subjective well-being (Carver, 2004; Rogers, Kirschenbaum, & Henderson, 1989; Westen, 1998). By contrast, when such components of personality are not consistent, the personality system is likely fragmented, inefficient, conflicted, and associated with lower levels of subjective well-being (Brunstein & Maier, 2005; Sheldon & Kasser, 2001; Robinson & Wilkowski, in press; for an exception, see Elliot & Church, 1997).

In sum, we suggest that successful personality functioning depends, in part, on the congruence of multiple aspects of personality, both explicit and implicit. Although this general suggestion is not novel (e.g., McClelland, Koestner, & Weinberger, 1989; Robinson & Wilkowski, in press; Westen, 1998), our specific instantiation of this general principle is entirely so. However, we believe that the trait × skill comparator interactions demonstrated here should not be exclusive to neuroticism and threat-identification skills. Perhaps most obviously, it would seem that extraversion and reward-identification skills should also interact in the prediction of subjective well-being.

Fortunately, it is apparent that such interactions do occur, both within the context of extraversion and implicit affiliation motivation (Winter et al., 1998) and in the context of interactions related to reward comparator skills of the present type (Tamir, Robinson, & Solberg, 2005). For example, skilled comparator functions related to recognizing rewarding stimuli are beneficial in the context of high, but not low, levels of extraversion (Tamir et al., 2005). Although the latter data are still preliminary, such data converge with the present data in indicating that reward-comparator skills are beneficial at high levels of extraversion (Tamir et al., 2005), whereas threat-comparator skills are beneficial at high levels of neuroticism (present studies).

Neuroticism, Threat-Identification Skills, and Negative Affect

It is common to assume that individuals high in neuroticism must be victimized by their sensitivity to threatening stimuli in the environment. At a certain level, this framework must be valid in that data clearly suggest that individuals high in neuroticism, relative to those low in neuroticism, are more reactive to negative events and stimuli (Bolger & Schilling, 1991; Gross, Sutton, & Ketelaar, 1998; Zelenski & Larsen, 1999). However, sensitivity and reactivity are likely different sorts of processes, and there is mixed evidence for the idea that individuals high in neuroticism are more skilled at encoding or categorizing negative stimuli (Robinson et al., 2003; Rusting, 1998). For example, the present studies *do not* support the idea that neuroticism correlates with threat-identification skills.

Moreover, we have advanced a self-regulatory framework that makes predictions somewhat opposite to conventional views of neuroticism and threat-identification skills. Whereas conventional views posit that individuals high in neuroticism are victims of their threat-sensitivity processes, we are suggesting that individuals high in neuroticism actually benefit from skills related to the efficient identification of threats. The present data are in accord with these predictions. Also, our results are compatible with theory and data reported by Higgins (2000). He proposed that prevention-focused (i.e., avoidant) individuals experience a greater degree of performance satisfaction when they attend to possible negative and threatening outcomes. Swann and colleagues, too, have shown that individuals with negative self-concepts seem to benefit from, and

even prefer, negative (relative to positive) social feedback (for a review, see Swann & Schroeder, 1995).

Why would neurotic individuals benefit from, rather than suffer from, threat-identification skills? We suggest that neurotic individuals habitually self-regulate by avoidance and that a focus on threatening events is consistent, or compatible with, this trait-related disposition. Such compatibility leads to a smooth and orderly self-regulation system in which trait dispositions and cognitive processing tendencies support each other in relation to the goals at hand (Carver, 2004; Powers, 2004). Goal-consistent processing tendencies, in turn, promote adaptation to the immediate environment (Powers, 2004; Robinson, in press).

Indeed, theory and research in clinical psychology is also consistent with our results. In the clinical literature, data are compelling in suggesting that phobias are potentiated rather than mitigated by cognitive avoidance of the phobic object (Foa & Kozak, 1986; Rachman, 1980). Of equal importance, it has been suggested that individuals suffering from habitual worry (Borkovec et al., 1998; Borkovec & Sharpless, 2004) or depression (Segal, Williams, & Teasdale, 2004) gain hedonic benefits rather than costs when they focus on the present threats in the environment. All of this discussion leads to the general point that the worry linked to neuroticism is often more problematic when it is not tied to threatening events as they occur in real time (Borkovec et al., 1998; Robinson, Wilkowski, & Meier, in press). The present studies make this point in relation to trait neuroticism and threat-identification skills.

Conclusions

Whereas some traditional accounts of neuroticism have depicted neurotic individuals as victims of their maladaptive appraisal tendencies, the present research makes the novel suggestion that threat-comparator skills should be beneficial, rather than costly, at high levels of neuroticism. We developed two cognitive paradigms designed to examine threat-comparator skills. Neuroticism did not correlate with threat comparator skills. However, neuroticism did interact with such skills in predicting daily negative affect. The nature of the interaction supported our self-regulatory predictions that threat-comparator skills would reduce, rather than increase, levels of daily negative affect among neurotic individuals. Thus, the present

results have significant implications for the role of threat-identification processes in neurotic self-regulation and well-being.

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