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Neurotic Contentment: A Self-Regulation View of Neuroticism-Linked Distress

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The present hypotheses were guided by four premises, which were systematically examined in six studies involving 409 undergraduate participants. The first premise, established by prior work, is that trait neuroticism is closely associated with avoidance-related goals. The second premise, however, is that neuroticism may be uncorrelated with cognitive tendencies to recognize threats as they occur, and subsequently to down-regulate them. In support of this point, all six studies found that neuroticism was unrelated to posterror behavioral adjustments in choice reaction time. The third premise is that posterror reactivity would nonetheless predict individual differences in threat-recognition (Studies 1 and 2) and its apparent mitigation (Study 3), independently of trait neuroticism. These predictions were supported. The fourth premise is that individual differences in neuroticism and error-reactivity would interact with each other in predicting everyday experiences of distress. In support of such predictions, Studies 4–6 found that higher levels of error-reactivity were associated with less negative affect at high levels of neuroticism, but more negative affect at low levels of neuroticism. The findings are interpreted in terms of trait-cognition self-regulation principles.

Keywords: neuroticism, avoidance motivation, error, threat, self-regulation, negative affect

The trait perspective on neuroticism emphasizes its associations with numerous adverse outcomes (for reviews, see Watson & Clark, 1984; Widiger, Verheul, & van den Brink, 1999). However, a functional perspective suggests that neuroticism is associated with goals and motives that differ across levels of neuroticism (Carver, Sutton, & Scheier, 2000). More specifically, individuals high in neuroticism are concerned with recognizing, dealing with, and averting possible threats to the self, whether real or imagined (Elliot & Thrash, 2002; Zelenski & Larsen, 1999). Individuals low in neuroticism, by contrast, view themselves as having low levels of avoidance motivation (Elliot & Thrash, 2002). From this action-oriented perspective, explicit and implicit aspects of avoidance motivation could either converge or diverge in their congruence with each other, in turn having potential implications for understanding neuroticism-linked distress.

Such considerations led us to assess individual differences in error-reactivity, which were hypothesized to capture important online tendencies related to self-regulation by avoidance. After three initial studies examining the correlates of this measure, we conducted three additional studies examining the central hypothesis that behavioral tendencies toward error-reactivity would be beneficial at high levels of neuroticism, and costly at low levels of neuroticism, specifically in terms of everyday experiences of negative affect. The introduction presents theoretical background for these literature-informed, but novel, predictions.

Neuroticism and Avoidance Motivation

Neuroticism is a multifaceted trait, but a motivational analysis of this trait suggests that it may be intimately related to avoidance motivation. Along these lines, neuroticism correlates with self-report measures of avoidance motivation (Carver & White, 1994; Zelenski & Larsen, 1999). Neuroticism also predicts reactivity to aversive events, defined in terms of increased negative affect following a negative emotion induction (e.g., Gross, Sutton, & Ketelaar, 1998). Neuroticism is also a strong predictor of the likelihood of developing generalized anxiety disorder (GAD), which is marked by excessive worry and avoidance (Borkovec & Sharpless, 2004; Watson, 2000). In sum, both theory and data link trait neuroticism to avoidance motivation.

However, the having and doing aspects of self-regulation by avoidance are not necessarily convergent with each other. Along these lines, a large number of studies have attempted to relate neuroticism to implicit measures of threat sensitivity and avoidance. In the context of psychophysiological measures of threat sensitivity, such relations are typically meager, difficult to replicate, and more complex than anticipated (for a review, see Matthews & Gilliland, 1999). A similar conclusion characterizes attempts to link neuroticism to cognitive measures of threat

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sensitivity or reactivity (Robinson, Vargas, & Crawford, 2003; Rusting, 1998). One way of summarizing this data is to suggest that self-reported avoidance goals tend to be somewhat independent of threat-related processing tendencies (Tamir, Robinson, & Solberg, 2006). This seeming independence of trait neuroticism and trait-relevant processing tendencies sets the stage for examining their interaction.

Toward a Self-Regulation View of Trait Neuroticism

From one perspective, individuals are victims or benefactors of their traits. From this perspective, neurotic individuals experience higher levels of distress because neuroticism does this to people (McCrae & Costa, 1994). From another perspective, all traits, whether distress-linked or not, capture something important in relation to the general goals of the individual, which can either be enacted well or not so well (Cote & Moskowitz, 1998; Langston & Sykes, 1997). From the latter perspective, all individuals could potentially be successful in instantiating their goals, but the cognitive processing tendencies that would be effective for some individuals are likely to be ineffective for others (Higgins, 1997; Wells & Matthews, 1996).

How, then, could one be a "successful" neurotic? According to the present self-regulation framework, a successful neurotic is likely to be one who possesses threat-processing tendencies that are "matched" to, or in other words facilitative of, the avoidance-related goals characteristic of high levels of neuroticism. Along similar lines, stable individuals (i.e., those low in neuroticism) do not endorse avoidance-related goals to any considerable extent (Elliot & Thrash, 2002). Therefore, in contrast to individuals high in neuroticism, threat-processing tendencies would be "mismatched" to the self-reported goals of such individuals, a mismatch in turn likely to have hedonic consequences. As we see it, then, such match/mismatch principles have equal relevance to low and high levels of neuroticism and threat-related processing tendencies are likely to be beneficial at high levels of neuroticism, but costly at low levels of neuroticism (Robinson & Compton, in press).

It is important to point out that these match/mismatch principles are sound in general terms. Multiple studies in the motivation literature have shown that individuals are more distressed when their implicit motivation is inconsistent with their explicit (i.e., self-reported) motivation (e.g., Brunstein, Schultheiss, & Grässman, 1998; Winter, John, Stewart, Klohnen, & Duncan, 1998). Our lab has extended such match/mismatch principles to interactions between the Big Five traits and cognitive processing measures (e.g., Robinson, Meier, & Solberg, 2005a; Robinson & Wilkowski, 2006). That is, mismatched trait/implicit personality configurations have been linked to higher levels of subjective distress in previous studies.

Nonetheless, few of these prior studies have examined such match/mismatch principles in the context of trait neuroticism, and we contend that this is an important theoretical focus for at least two reasons. First, neuroticism is widely linked to dysfunction and distress. However, we expected to find a subgroup of individuals high in neuroticism who are not particularly distressed in daily life. Second, it is often assumed that neurotic individuals are victims of an overly sensitive threat-monitoring system. However, we expected individuals high in neuroticism to benefit from, rather than suffer from, high levels of threat-reactivity. To examine these trait-cognition self-regulation predictions, we built upon the cognitive control literature.

A Measure of Error-Reactivity

Two primary functions of cognition are to (a) automatically detect potential cognitive failures and (b) implement cognitive control under such conditions (Posner & Raichle, 1994). Both goals appear to be served by the same information processing system responsible for detecting potential (e.g., Carter et al., 1998) or actual (Holroyd & Coles, 2002) errors in information processing. It is well known that people slow down when faced with response conflicts, such as the Stroop task, in order to prevent errors and promote accurate responding (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001). When response errors are made, there is robust tendency for individuals to slow down following such errors, similarly in order to prevent mistakes and errors on subsequent trials (e.g., Rabbitt & Vyas, 1970). In sum, these sorts of error compensation processes are thought to serve the goal of avoiding future mistakes in cognition and behavior (Carter et al., 1998).

There are additional sources of data linking error-reactivity to "online" threat detection and correction processes. Both cognitive conflict (Carter et al., 1998; Kerns et al., 2004) and errors made by the self (Dehaene, Posner, & Tucker, 1994; Holroyd & Coles, 2002) activate a structure critical to cognitive control called the anterior cingulate cortex (Carter et al., 1998; Posner & Raichle, 1994). This structure is believed to play a central role in registering threat and error, and recruiting executive control to minimize such threats and errors in the future (Botvinick et al., 2001; Kerns et al., 2004). In support of such mappings, activation of the anterior cingulate has been linked to sensory pain (Rainville, Duncan, Price, Carrier, & Bushnell, 1997), social exclusion (Eisenberger & Lieberman, 2004), and apparent attempts to minimize racial prejudice (Amodio et al., 2004). Thus, there is a large literature suggesting that error-reactivity tendencies are indicative of broader tendencies toward threat-registration and compensation. In the present studies, we sought to build upon this neurocognitive model by examining the individual difference correlates of low and high levels of error-reactivity, as assessed in behavioral terms.

Overview of Present Research

Previous studies in cognitive psychology and cognitive neuroscience have used indices of posterror slowing as an outcome measure of cognitive control in response to a conflict (e.g., Kerns et al., 2004). Accordingly, we operationalized error-reactivity in terms of tendencies to slow down following errors in choice reaction time. However, because past work has not used posterror slowing tendencies as an individual difference measure, at least not in the manner done so here, it was useful to conduct a systematic program of research. Along these lines, we conducted six studies. Studies 1–3 were concerned with issues of convergent and discriminant validity, and Studies 4–6 sought to examine the primary hypothesis that neuroticism and error-reactivity would interact to predict distress in everyday life.

Studies 1–3

Studies 1–3 were designed to examine the zero-order correlates of error-reactivity tendencies. Because the goals of all three studies were similar, we present them together. Error-reactivity processes were examined in choice reaction time tasks, as is common to the literature (e.g., Holroyd & Coles, 2002). Of specific interest was the extent to which individuals slowed down following their errors. To allow such errors to occur naturally, we used unambiguous stimuli associated with low error rates in previous studies (Robinson, Wilkowski, Kirkeby, & Meier, 2006). To ensure that processing was not task-specific, we used a variety of choice reaction time tasks (Robinson, 2007). To ensure that errors were registered, we presented error feedback, as we have done in past studies (Robinson, Meier, Wilkowski, & Ode, in press). Error-reactivity was defined in terms of greater tendencies to slow down following errors in choice reaction time tasks.

The goal of Studies 1 and 2 was to examine potential relations between error-reactivity and a second cognitive–behavioral measure of threat-sensitivity that has been validated in previous studies of ours (Robinson et al., 2005a; Robinson, Meier, & Vargas, 2005b; Tamir, Robinson, & Clore, 2002). In support of the idea that tendencies toward error-reactivity are linked to threat recognition, we predicted that individuals high in error-reactivity would be more accurate in recognizing threatening words (e.g., *cancer*, *knife*) in the second cognitive task. Moreover, we predicted no relations between trait neuroticism and performance in either of the cognitive tasks. Such a differential pattern of correlations would provide both discriminant and convergent validation for error-reactivity as an implicit measure of threat-sensitivity.

Study 3 sought to extend our understanding of individual differences in error-reactivity to levels of avoidance motivation in daily life. Because we view error-reactivity as part of a larger cognitive control system designed to minimize threats and errors when they occur (e.g., Lieberman & Eisenberger, 2005), it was predicted that individuals higher in error-reactivity would report less frequent avoidance motivation in daily life. Such a negative correlation would be consistent with the idea that individuals high in error-reactivity down-regulate threats when they occur rather than letting them linger. Importantly, such results would also begin to make the case for the everyday correlates of error-reactivity, a goal that will be revisited in Studies 4–6.

Method

Participants

The samples from Studies 1–3 all involved undergraduate volunteers from the University of Illinois, Champaign. Sample sizes were 91 (66 female), 102 (57 female), and 35 (19 female) in Studies 1–3, respectively. In Studies 1 and 2, participants were compensated with extra credit for their introductory psychology classes. In Study 3, they were compensated $35 if they completed the multiple aspects of the protocol.

Individual Differences in Error-Reactivity

Categorization tasks. To assess error-reactivity, we used choice reaction time tasks that required the quick and accurate categorization of a centrally presented stimulus (e.g., *mouse*) as belonging to one category (e.g., not animal) or its alternative (e.g., animal). To support the generality of our conclusions, specific categorization tasks were varied within and across studies. All tasks, however, were based on prior assessment protocols of ours (e.g., Robinson, 2007) and are associated with low error rates (e.g., Robinson et al., 2006). Low error rates are desirable in the present context, but effectively preclude task-specific analyses. Instead, the use of multiple tasks, both within and across studies, necessarily means that the findings are not dependent on the use of any particular task or set of tasks.

Participants in Study 1 were asked to complete 7 choice tasks for a total of 408 trials: not animal (e.g., *chair*) versus animal (e.g., *mouse*), unpleasant (e.g., *pimple*) versus pleasant (e.g., *palace*), not blame (e.g., *baldness*) versus blame (e.g., *malpractice*), not threat (e.g., *stench*) versus threat (e.g., *knife*), neutral (e.g., *engine*) versus positive (e.g., *sunset*), not intense (e.g., *whisper*) versus intense (e.g., *shout*), and neutral (e.g., *couch*) versus negative (e.g., *jail*). Participants in Study 2 also completed heterogeneous choice tasks, in this case involving 4 tasks and 224 trials: not me (e.g., *them*) versus me (e.g., *self*), feminine (e.g., *gentle*) versus masculine (e.g., *rational*), vegetable (e.g., *asparagus*) versus fruit (e.g., *banana*), and unpleasant (e.g., *pimple*) versus pleasant (e.g., *palace*). Participants in Study 3 completed a battery identical to Study 1, thus involving 7 choice tasks and 408 trials. Interested readers can contact the first author for a list of stimulus words for the diverse tasks.

Trial procedures. All trials of the choice tasks required pressing the 1 or 9 keys at the top of the keyboard, depending on the particular block and stimulus in question. In all blocks, category labels (e.g., vegetable = 1; fruit = 9) were presented to the left and right of the computer monitor to aid in the response mapping process. Participants were told to be both quick and accurate in their responses. Correct responses were followed by a 150 ms blank delay and incorrect responses were followed by a 1500 ms visual "Error!" message prior to the blank delay. The presentation of error feedback ensured that the participant had registered his or her mistake, which permitted a cleaner assessment of individual differences in error-reactivity.

Scoring reaction time. To score reaction time, we followed several routine procedures. First, we deleted the latencies corresponding to incorrect trials (accuracy Ms = 93.62%, 91.01%, and 94.09% in Studies 1–3, respectively). Second, we log-transformed the remaining latencies in order to reduce the positive skew typical of reaction time data (Robinson, in press). Third, we replaced latencies 2.5 SDs below and above the grand latency mean with these cutoff values in order to reduce the impact of outliers while minimizing data loss (Robinson, in press).

Normative error-reactivity tendencies. We expected that, on average, participants would be slower following errors than following correct responses. To examine this prediction, we compared response latency means following trials associated with a correct or incorrect response. We then performed an ANOVA with "prime" accuracy as a within-subject repeated measure, separately for each study. These analyses were performed on log-transformed latencies, but effects are reported in millisecond values for ease of interpretation. In terms of average trends, participants were slower following their incorrect responses (Ms = 987 ms, 713 ms, and 1078 ms in Studies 1–3, respectively) than following their correct responses (Ms = 702 ms, 607 ms, and 734 ms in Studies 1–3, respectively), all Fs > 95. Thus, our procedures elicited robust normative tendencies related to error-reactivity.

Individual differences in error-reactivity. To score individual differences in error-reactivity, we first computed a difference score by subtracting postcorrect latencies from posterror latencies, separately for each participant and study. Although these scores tended to be positive, such that participants were typically faster following correct responses than following errors, we expected individuals to vary in the size of this difference score. A frequent phenomenon in the cognitive literature is that faster participants tend to have smaller difference scores, a phenomenon that is statistical in nature rather than of primary psychological interest (Faust, Balota, Spieler, & Ferraro, 1999). This was true in the present studies as well (rs $> .5$ across studies). To correct for individual differences in reaction time, we computed residual error reactivity scores that were necessarily uncorrelated with average speed.

The average participant made 26.03, 20.14, and 24.18 errors in Studies 1–3, respectively. These error rates were deemed high enough to perform a split-half reliability analysis of the error-reactivity measure. We therefore repeated the procedures above to create two scores for each participant, one particular to odd trials and one particular to even trials. These independent estimates of error-reactivity were then correlated with each other. Split-half correlations were reasonable, and indeed high for implicit cognitive tasks, $r = .65$, $p < .01$ in Study 1, $r = .71$, $p < .01$ in Study 2, and $r = .54$, $p < .01$ in Study 3.

Correlations with accuracy rates. We view error-reactivity tendencies as part of a general cognitive control system that may facilitate response accuracy (Kerns et al., 2004; Lieberman & Eisenberger, 2005). Thus, it seemed possible to us that higher error-reactivity scores would be associated with fewer errors in the task. To provide sufficient power for this prediction, given the low error rates observed in the studies, we combined data from Studies 1–3. Consistent with the idea that individual differences in error-reactivity facilitate accurate performance, error-reactivity scores predicted higher levels of accuracy following errors, $r = .32$, $p < .01$, and across all trials of the tasks, $r = .28$, $p < .01$.

Neuroticism

Neuroticism is a self-reported trait closely linked to avoidance motivation (e.g., Elliot & Thrash, 2002). However, neuroticism is typically uncorrelated with cognitive–behavioral measures of threat sensitivity or reactivity (Matthews & Gilliland, 1999; Robinson & Compton, in press). Regardless, the present measure of error-reactivity is somewhat novel to the literature and we therefore sought to measure neuroticism in the present studies.

In all studies, neuroticism was measured by Goldberg's (1999) 10-item broad-bandwidth scale. Participants were asked to indicate the extent (1 [*very inaccurate*] to 5 [*very accurate*]) to which statements indicative of low (e.g., *am relaxed most of the time*) and high (e.g., *get upset easily*) levels of neuroticism are generally true of the self. Goldberg (1999) reports that this measure of neuroticism correlates strongly ($r = .82$) with alternative measures of neuroticism such as that from the NEO-PI (Costa & McCrae, 1992). Goldberg (1999; in press) has also reported a good deal of evidence for the reliability and validity of the scale. In Studies 1–3, alphas for the neuroticism measure varied from .87–.90, indicating a highly reliable scale.

Threat Recognition Accuracy (Studies 1 and 2)

Task and trial procedures. To measure threat recognition accuracy, we used a go/no go task that we have used in many prior studies (e.g., Robinson et al., 2005b). The task included two blocks, one in which individuals were asked to press the spacebar only in response to objects "that could kill you" and one in which individuals were asked to press the spacebar only in response to objects "that are relatively neutral—that is, neither positive nor negative." The same 21 stimuli were used in both blocks of the task. Seven of these stimuli constituted substantial threats (*cancer*, *death*, *gun*, *knife*, *murder*, *snake*, and *weapon*), seven of them were neutral in nature (*chair*, *cotton*, *dime*, *engine*, *shoes*, *street*, and *string*), and seven of the stimuli were relatively positive (*candy*, *child*, *flower*, *kiss*, *palace*, *smile*, and *sunset*). Stimuli were drawn from prior word norms (Toglia & Battig, 1978) and have been specifically validated in the go/no task used here (Robinson et al., 2005a).

In tasks of the present type, it is useful to control for the possibility of speed-accuracy trade-offs (Meyer, Irwin, Osman, & Kounois, 1988). This can be done either by allowing individuals a long time to respond, in which case speed is the appropriate unit of analysis, or by time-limiting responses, in which case accuracy is the appropriate unit of analysis (Draine & Greenwald, 1998; Meyer et al., 1988). Because the error-reactivity measure was based on a speed metric, we felt it useful to alter the go/no go task in a manner that would be sensitive to an accuracy metric (Robinson et al., 2005a), specifically for purposes of the generalizability of the findings. In further support of the generalizability of the findings, threat and control blocks involved 63 trials in Study 1 and 126 trials in Study 2. Also, the response-window time limit was 700 ms in Study 1 and 500 ms in Study 2.

Trial procedures were as follows. In both studies and blocks, a stimulus was randomly selected and presented in the center of the computer screen. Participants were instructed to press the spacebar if the stimulus matched the block-defined recognition goal (e.g., the stimulus *murder* in the threat block), but to refrain from pressing the spacebar if the stimulus mismatched the block-defined recognition goal (e.g., the stimulus *flower* in the threat block). In both studies, there were two ways to be accurate, one specific to "go" trials (i.e., hits) and one specific to "no go" trials (i.e., correct rejections). Given our theoretical framework, which emphasized the recognition of threats when they occur, we were more interested in hits than correct rejections. However, we also calculated overall accuracy rates for threat and control blocks as a further way of examining the hypotheses.

Threat recognition skills. Threat block accuracy rates included all trials and averaged across correct hits (e.g., pressing the spacebar to *murder* in the threat block) and correct rejections (e.g., not pressing the spacebar to *flower* in the threat block). Such block-averaged accuracy rates were 81% and 61% in Studies 1 and 2, respectively. A second measure of threat recognition skills was specific to hit rates in the threat block. Such hit rates averaged 87% and 77% in Studies 1 and 2, respectively. Below, we will correlate error-reactivity scores with both types of threat recognition accuracy.

Additionally, because individuals who were more accurate in the threat block also tended to be more accurate in the control block, all ps $< .05$, we computed residual threat recognition scores, and did so separately for each study. In the case of threat block accuracy, such residual scores would necessarily be independent of control block accuracy. Similarly, in the case of threat block hit rates, such residual scores would necessarily be independent of control block hit rates. The purpose of computing the residual scores, then, was to insure that possible relations between error-reactivity tendencies and threat recognition accuracy would be independent of control block performance.

Experience Sampling Measure of Daily Avoidance Motivation (Study 3)

A goal of Study 3 was to understand the potential role of error-reactivity in predicting everyday tendencies toward avoidance motivation. To investigate this question, we conducted a small-scale experience-sampling study using palm pilot computers. Participants were asked to carry the palm pilots with them in daily life and to respond to a brief survey when paged by the computer. They carried the computers for 7 days, during which time we paged them 42 times, 6 times per day. To accommodate variations in sleep-wake cycles, all pages occurred between 10 a.m. and 10 p.m. However, to obtain a representative view of avoidance motivation in daily life, pages occurred at random times of the day. Participants had 4 minutes to respond to a particular page, with a reminder set of beeps at 2 minutes after the initial ones.

We recognize that there are inopportune times to fill out a survey (e.g., while taking a shower or in a small class). Accordingly, although 42 pages were delivered, participants were instructed that we expected them to respond to 35 of the 42 pages. For purposes of documenting compliance, participants who responded to more than 35 pages were recoded as having responded to 35 (although all of their responses were used for data-analysis purposes). Of the 35 required responses, the average participant responded to 29.57, for a response-rate of 84.48%. This is a reasonably high compliance rate for studies of this type (Conner, Barrett, Bliss-Moreau, Lebo, & Kaschub, 2003).

To assess the frequency of avoidance-motivated states in everyday life, participants were asked the following question: “To what extent are you trying to AVOID something that you don’t want?” Responses were “NO” or “YES.” The average participant responded “YES” 24.75% of the time. We should also note that there was a parallel approach-motivation question, but that error-reactivity scores did not predict responses to this question. Thus, the error-reactivity measure had specific relevance to predicting avoidance motivation in daily life.

Procedures

Participants in Study 1 completed the neuroticism, error-reactivity, and threat recognition tasks in a single session. The behavioral measures of error-reactivity and threat recognition skills were measured first and second, respectively, and self-reported neuroticism was measured last. This implicit to explicit order has been recommended in general terms (Robinson & Neighbors, 2006). In Study 2, the same variables were assessed. Here, error-reactivity and neuroticism were assessed in an initial assessment session. A week later, participants returned to complete the threat recognition task. Study 3 also separated the measurement of the independent and dependent variables. The error-reactivity and neuroticism measures were completed in an initial assessment session, followed by the experience-sampling portion of the study, which was completed during the subsequent week. The important point here is that the assessment protocols varied across studies, again in support of more general conclusions.

Results

Relations Between Neuroticism and Error-Reactivity

Neuroticism has been shown to be somewhat independent of behavioral or neural measures of error-reactivity. On the basis of these prior findings, we predicted that neuroticism would be independent of error-reactivity scores. In fact, neuroticism did not predict error-reactivity scores in any of the studies, $|rs| < .17$, ps $> .10$.

Relations Between Neuroticism and the Dependent Measures

The dependent measures were either behavioral in nature (Studies 1–2) or designed to capture in vivo tendencies toward avoidance motivation in daily life (Study 3). We did not expect neuroticism to correlate with these dependent measures, with the possible exception of Study 3, which used a self-reported outcome measure. In Studies 1 and 2, neuroticism did not significantly correlate with threat-recognition accuracy, regardless of the manner in which such accuracy scores were computed, $|rs| < .18$, ps $> .05$. In Study 3, there was a marginal correlation between neuroticism and self-reported avoidance motivation in daily life, $r = .32$, $p < .10$.

Relations Between Error-Reactivity and the Dependent Measures

We hypothesized that error-reactivity scores would be positively correlated with threat recognition accuracy in the go/no go task. Indeed, this was the case. Error reactivity scores were correlated with threat block accuracy, whether based on raw ($r = .46$, $p < .01$ in Study 1 and $r = .31$, $p < .01$ in Study 2) or residual ($r = .28$, $p < .01$ in Study 1 and $r = .26$, $p < .01$ in Study 2) block accuracy scores. Error reactivity tendencies also predicted hit rates involving threatening stimuli, and this was again true for both raw ($r = .43$, $p < .01$ in Study 1 and in Study 2, $r = .34$, $p < .01$) and residual ($r = .41$, $p < .01$ in Study 1 and $r = .28$, $p < .01$ in Study 2) accuracy scores. Thus, there was robust support for a systematic relation between error-reactivity tendencies and the accuracy of threat recognition.

Turning to Study 3, we pursued the possibility that error-reactivity scores would predict the frequency of self-reported avoidance motivation in daily life. Of further importance to our self-regulation framework, we predicted that this correlation would be a negative one, in that higher levels of error-reactivity would be associated with less frequent avoidance-motivated states. Indeed, this was the case, $r = -.36$, $p < .05$. The direction of this correlation, in combination with the results of Studies 1 and 2, suggests that error-reactivity tendencies are associated with the recognition of, but subsequent remediation of, potential threats as they occur.

Controlling for Neuroticism

Neuroticism was uncorrelated with error-reactivity in all three studies. Therefore, it was not surprising that when we controlled for neuroticism, error-reactivity scores continued to predict the dependent measures in all studies, *p*s $< .05$. Thus, tendencies toward error-reactivity displayed discriminant validity with respect to the dependent measures of Studies 1–3.

Discussion

Studies 1–3 sought to examine the construct validity of error-reactivity, measured in behavioral terms. With respect to discriminant validity, we did not observe any systematic relations between trait neuroticism and error-reactivity. The independence of these measures is not surprising given the prior literature that informed our predictions, at least in general terms (e.g., Matthews & Gilliland, 1999; Rusting, 1998). Although we do not preclude the possibility that neuroticism may predict some components of online threat processing (e.g., Eisenberger, Lieberman, & Satpute, 2005), we do nevertheless conclude that neuroticism appears to be independent of the error-reactivity and compensation processes examined here.

The second empirical focus of Studies 1–3 pertained to convergent validity. Our sense was that error-reactivity captures something important concerning the avoidance-related tendencies of individuals. However, to appreciate the nuances of the present findings, it is important to recognize that avoidance motivation is a multicomponent system (Carver & Scheier, 1998; McClelland, 1987). In particular, to avoid a threat means both to recognize it when it occurs and to adjust one's processing and behavior such that the threat is averted (Lieberman & Eisenberger, 2005).

We believe that individual differences in error-reactivity capture both of these reactive and proactive components of online avoidance tendencies. In support of the reactive component, error-reactivity scores were associated with higher levels of threat-recognition accuracy (Studies 1–2). In support of the proactive component, error-reactivity scores were associated with less frequent tendencies toward avoidance-motivated states in daily life (Study 3). The latter correlation is quite consistent with the idea that individuals high in error-reactivity compensate for online threats as they occur, in turn minimizing prolonged states of avoidance motivation. We suggest that such tendencies toward threat-recognition and compensation are likely to be functional at high levels of neuroticism, and this was the systematic focus of Studies 4–6.

Studies 4–6

Error-reactivity tendencies, although not correlated with neuroticism, may nevertheless support avoidance goals, in that they appear to be associated with threat-recognition and compensation processes (Studies 1–3). Such considerations led us to the interactive predictions of Studies 4–6. It was predicted that high levels of error-reactivity would be hedonically beneficial among neurotic individuals, who are frequently concerned about possible threats to the self (Elliot & Thrash, 2002). On the other hand, it was predicted that high levels of error-reactivity would be hedonically costly among individuals low in neuroticism, precisely because such implicit tendencies would mismatch the low levels of avoidance motivation reported by such individuals (Elliot & Thrash, 2002). In other words, we hypothesized that neuroticism and error-reactivity would interact to predict distress in daily life and that the interactive pattern would support the match/mismatch trait-cognition principles that guided our work.

In appreciating the interactive predictions and findings, it should be noted that neuroticism is a robust predictor of negative affect, so much so that it has sometimes been labeled as dispositional negative affect (e.g., Watson & Clark, 1984). Moreover, there are multiple routes through which neuroticism appears to predispose one to negative affect, including processes related to exposure and reactivity to stressors, as well as temperament (Bolger & Schilling, 1991; Gross et al., 1998; McCrae & Costa, 1991). Some of these processes would be quite independent of the trait-cognition self-regulation principles examined here, and we therefore expected "main effects" of neuroticism in predicting everyday negative affect. However, such main effect findings would not contradict our match/mismatch predictions, but rather would be independent of them.

Method

Participants

Participants in Study 4 were 73 (45 female) undergraduate students from the University of Illinois. Study 5 consisted of a different sample of 50 (32 female) undergraduates from the same population. Participants in Study 6 were 58 (39 female) undergraduates from North Dakota State University. All participants completed the protocols in return for extra credit for their psychology classes.

Error-Reactivity Tendencies

Categorization tasks. Participants in Study 4 were asked to complete the following choice tasks: not blame (e.g., *baldness*) versus blame (e.g., *malpractice*), unpleasant (e.g., *trash*) versus pleasant (e.g., *smile*), not threat (e.g., *stench*) versus threat (e.g., *knife*), neutral (e.g., *engine*) versus positive (e.g., *sunset*), not animal (e.g., *chair*) versus animal (e.g., *mouse*), and neutral (e.g., *couch*) versus negative (e.g., *jail*). There were six blocks, each specific to one of the six choice tasks, and a total of 264 trials.

Participants in Study 5 were asked to complete the following choice tasks: neutral (e.g., *couch*) versus negative (e.g., *jail*), not blame (e.g., *baldness*) versus blame (e.g., *malpractice*), not threat (e.g., *stench*) versus threat (e.g., *knife*), not animal (e.g., *chair*) versus animal (e.g., *mouse*), neutral (e.g., *engine*) versus positive (e.g., *sunset*), not symptom (e.g., *mildew*) versus symptom (e.g., *nausea*), and not self-doubt (e.g., *thirsty*) versus self-doubt (e.g., *insecure*). There were seven blocks, each involving 44 trials, for a total of 308 trials.

To make a case for the generalizability of our findings, we asked participants in Study 6 to complete a very different task, namely the Stroop task. Stimuli consisted of three letter strings (green, red, and xxx) presented in either a green or red font color. There were 252 trials. Participants in Study 6 completed the same Stroop task twice, with several weeks in between. This also allowed us to examine the test-retest stability of error-reactivity tendencies.

Trial procedures. In all studies, participants were asked to make a 1 or 9 key response depending on the particular block and stimulus in question. In all cases, category labels (e.g., green = 1; red = 9 in Study 6) were presented to the left and right of the computer screen to aid in the response-mapping process. Such labels varied from block to block in Studies 4 and 5, but remained the same in Study 6.

Participants in all studies were instructed to be both quick and accurate in their responses. If the trial stimulus better matched the left (right) category, they should press the "1" ("9") key at the top of the keyboard. If participants made a correct response on a given trial, there was a brief blank delay before the next stimulus (which was 150 ms in Studies 4 and 5, and 500 ms in Study 6). On the other hand, following an error, we presented a visual "Error!" message before presenting this blank delay. The presentation of error feedback ensured that the participant had registered his or her mistake. The error message was presented for 1500 ms in Studies 4 and 5, and for 2000 ms in Study 6.

Scoring reaction time. Reaction times were scored as in Studies 1–3.

Normative error-reactivity tendencies. We expected that, normatively, participants would be slower following errors than following correct responses. To examine this prediction, we averaged latencies separately depending on whether the previous (*n - 1*) trial involved an error or a correct response. We then performed an ANOVA with accuracy as a within-subject repeated measure, separately for each study. These analyses were performed on log-transformed latencies, but effects are reported in millisecond values for ease of interpretation. Participants were faster following correct responses (*M*s = 852 ms and 808 ms for Studies 4 and 5, and 533 ms and 455 ms for Times 1 and 2 of Study 6) than following errors (*M*s = 1492 ms and 1333 ms in Studies 4 and 6, and 854 ms and 651 ms at Times 1 and 2 of Study 6), all Fs > 200.

Individual differences in error-reactivity. Individual differences in error-reactivity were scored as in Studies 1–3. We then sought to examine the internal reliability of error-reactivity scores through the use of split-half correlations. Although the average number of errors in Studies 4 ($M = 10.61$) and 6 (*M*s = 5.74 and 8.48 at Times 1 and 2, respectively) was sufficient for assessing error-reactivity processes, these average error rates did not permit a split-half analysis. However, the number of errors in Study 5 was higher ($M = 24.24$), and we therefore performed such an analysis. Separate residual error-reactivity scores were calculated for odd and even trials considered separately. Consistent with Studies 1–3, the split-half reliability was reasonably high, $r = .66$, $p < .01$.

Correlations with accuracy rates. Recall that higher levels of error-reactivity were associated with more accurate performance in Studies 1–3. We sought to examine whether this pattern was apparent in Studies 4–6 as well. As in Studies 1–3, error rates were fairly low and we therefore combined data across studies for sufficient power. Consistent with Studies 1–3, higher error-reactivity scores were associated with higher accuracy rates, both following errors, $r = .45$, $p < .01$, and over the course of all of the trials, $r = .30$, $p < .01$.

Neuroticism. Trait neuroticism was assessed in a manner identical to Studies 1–3 using Goldberg's (1999) broad-bandwidth scale (alphas varied from .84 to .86).

Negative affect. Participants in Study 4 were asked to report on the extent (1 [very slightly or not at all] to 5 [extremely]) to which they had experienced 18 markers characteristic of high levels of negative affect (items: afraid, angry, angry at self, ashamed, blameworthy, disgusted, disgusted with self, dissatisfied with self, distressed, guilty, hostile, irritable, jittery, loathing, nervous, scared, scornful, and upset) during the past few weeks. The markers were taken from the PANAS-X (Watson & Clark, 1994). To score negative affect, we averaged across items ($\alpha = .84$).

Participants in Study 5 completed a daily mood-reporting protocol. For each of seven days in a row, they were asked to report on the extent (1 [*not at all*] to 9 [*extremely*]) to which they had experienced six markers of negative affect (angry, ashamed, downhearted, guilty, irritable, & sad) during that particular day. We calculated a negative affect score for each participant by averaging across days and items ($\alpha = .91$). Participants in Study 6 were asked to report on the extent (1 [*very slightly or not at all*] to 5 [*extremely*]) to which they had experienced five markers characteristic of high levels of daily negative affect (items: afraid, distressed, irritable, nervous, and upset) for 15 days in a row. To score negative affect, we averaged across days and emotion items ($\alpha = .92$).

Intrapsychic conflict has long been viewed as a robust predictor of anxiety states (Horney, 1945; Miller, 1944), and empirical research has supported this principle (e.g., Emmons & King, 1988). Thus, the hypotheses of Studies 4–6 were specific to negative affect. However, we also note that we measured positive affect in these studies and that neuroticism and error-reactivity did not interact to predict positive affect in these studies. Thus, the findings below are consistent with the idea that trait-cognition mismatches have particular relevance to predicting experiences of distress (Robinson & Compton, in press).

Procedures

The protocol of Study 4 was completed in a single assessment session. The categorization task, used to measure error-reactivity, was completed first. Subsequent to this, participants reported on their recent experiences of negative affect and then on their levels of neuroticism.

Study 5, by contrast, involved two assessment phases. In an initial assessment session, participants completed the measure of error-reactivity and then the measure of neuroticism, in that order. Two weeks later, they began a 7-day mood reporting study. They were asked, at the end of each of the seven days, to characterize their mood states during that particular day. After completing the seven daily forms, they returned the completed packet to the psychology department. For data analysis purposes, we retained only participants who completed all seven of the reports, which was the vast majority (> 85%) of the participants. We note that similar results occurred when including the participants who failed to complete all seven reports.

Participants in Study 6 completed the protocol in three separate phases. In a first assessment session, we measured Time 1 error-reactivity and then neuroticism. In a second assessment session completed three weeks later, we measured Time 2 error-reactivity. In between these two assessment sessions, participants completed a 15-day mood-reporting protocol. Participants in Study 6 were instructed to log into a website for each of the 15 days sometime in the evening (i.e., after 7 p.m.). They completed the short daily report, which required characterizing their mood states during the day in question. Owing to the Internet-based procedures of the protocol, we could ensure daily compliance. The average participant completed 14.55 of the 15 daily reports for a mean compliance rate of 96.99%.

Results

Test-Retest Stability

Because participants in Study 6 completed the error-reactivity measure twice, we could examine the test-retest stability of the measure. The correlation was moderately high, $r = .57$, $p < .01$, meaning that participants who slowed down following their errors at Time 1 also did so at Time 2. We therefore averaged across the two estimates.

Correlations Among Measures

As is common in the literature, the measures of neuroticism and negative affect were positively correlated, rs = .43–.54, ps < .01. On the other hand, error-reactivity tendencies were not correlated with trait neuroticism, ps >.15, or experiences of daily negative affect, ps > .35.

Primary Analyses

To examine the hypothesized interactions between neuroticism and error-reactivity, we z scored both predictors and then computed an interaction term by multiplying these z scores. Such procedures were performed separately for each study. We then performed multiple regressions predicting negative affect from individual differences in Neuroticism, Error-reactivity, and the Neuroticism × Error-reactivity interaction.

In Study 4, there was a main effect for Neuroticism, $t(1, 69) = 5.06$, $p < .01$, $\beta = .50$, no main effect for Error-reactivity, $t(1, 69) = -0.15$, $p > .85$, $\beta = -.01$, and a significant Neuroticism × Error-reactivity interaction, $t(1, 69) = -2.47$, $p < .05$, $\beta = -.24$. In Study 5, there was a main effect for Neuroticism, $t(1, 46) = 4.50$, $p < .01$, $\beta = .60$, no main effect for Error-reactivity, $t(1, 46) = -0.90$, $p > .35$, $\beta = -.11$, and a significant Neuroticism × Error-reactivity interaction, $t(1, 46) = -2.06$, $p < .05$, $\beta = -.28$. Similarly, in Study 6, there was a main effect for Neuroticism, $t(1, 54) = 4.18$, $p < .01$, $\beta = .43$, no main effect for Error-reactivity, $t(1, 54) = 1.24$, $p > .20$, $\beta = .13$, and a significant Neuroticism × Error-reactivity interaction, $t(1, 54) = -2.58$, $p < .05$, $\beta = -.27$. Thus, interactions were found in all three studies.

To understand the nature of the significant interactions, we computed estimated means for those low (−1 *SD*) and high (+1 *SD*) in each of the components of the interaction term, based on the relevant regression equation (Aiken & West, 1991). Such analyses were conducted separately within each study. The resulting estimated means are reported in Figure 1. In all cases, the pattern was the same such that the relation between neuroticism and distress was reduced among individuals high in error-reactivity.

Combined Analyses of Studies 4–6

It seemed useful to combine the data from Studies 4–6 prior to examining simple slopes. Within each study separately, we z scored neuroticism, error-reactivity, and negative affect. We then combined the data into one larger data set ($N = 181$) and performed simple slopes analyses as outlined by Aiken and West (1991).

The simple slope for error-reactivity was positive at low levels of neuroticism, $t(1, 177) = 2.46$, $p < .05$, $\beta = .20$, and negative at high levels of neuroticism, $t(1, 177) = -2.72$, $p < .01$, $\beta = -.24$. This means that higher error-reactivity contributed to more negative affect among those low in neuroticism, but to less negative affect among those high in neuroticism, a striking confirmation of our match/mismatch predictions.

We next turned to analyses focused on the effects of neuroticism. The relationship between neuroticism and negative affect was more pronounced among those low in error-reactivity, $t(1, 177) = 8.28$, $p < .01$, $\beta = .71$, relative to those high in error-reactivity, $t(1, 177) = 3.05$, $p < .01$, $\beta = .26$. These results again underscore the fact that higher error-reactivity tendencies were beneficial at high levels of neuroticism.

Discussion

Neuroticism was not associated with error-reactivity tendencies in any of the studies. However, error-reactivity scores were again reasonably high in internal reliability, particularly given that we used a behavioral measure of personality rather than a self-reported one (Robinson & Neighbors, 2006). Study 6 also showed that the test-retest stability for error-reactivity scores ($r = .57$) was quite respectable for a behavioral measure (Fazio & Olson, 2003). We therefore conclude that error-reactivity is a reliable individual difference dimension.

More important, Studies 4–6 supported our interactive predictions and did so in each study. Among individuals high in neuroticism, higher error-reactivity scores were associated with less negative affect in everyday life. On the other hand, among individuals low in neuroticism, higher error-reactivity scores were associated more negative affect. It was also true that neuroticism was more predictive of negative affect among individuals low in error-reactivity, and these results too supported our match-mismatch derived hypotheses.

In support of decades of research, it was also found that neuroticism was correlated with negative affect regardless of the error-reactivity tendencies of the individual. Such main effects were independent of our interactive predictions, but do suggest an important caveat to our interactive conclusions. Matched neuroticism-cognition configurations may be beneficial, but not sufficient to eliminate trait-linked vulnerabilities, which are substantial in the case of neuroticism and tendencies toward negative affect (Bolger & Schilling, 1991; Gross et al., 1998; McCrae & Costa, 1991).

General Discussion

The Correlates of Error-Reactivity Tendencies

Tendencies to slow down following errors in choice RT reflect the operation of a neurocognitive system that engages controlled responses when potential threats are detected (Lieberman & Eisenberger, 2005). We also recognize, however, that the present measure of error-reactivity was behavioral in nature, and thus novel to

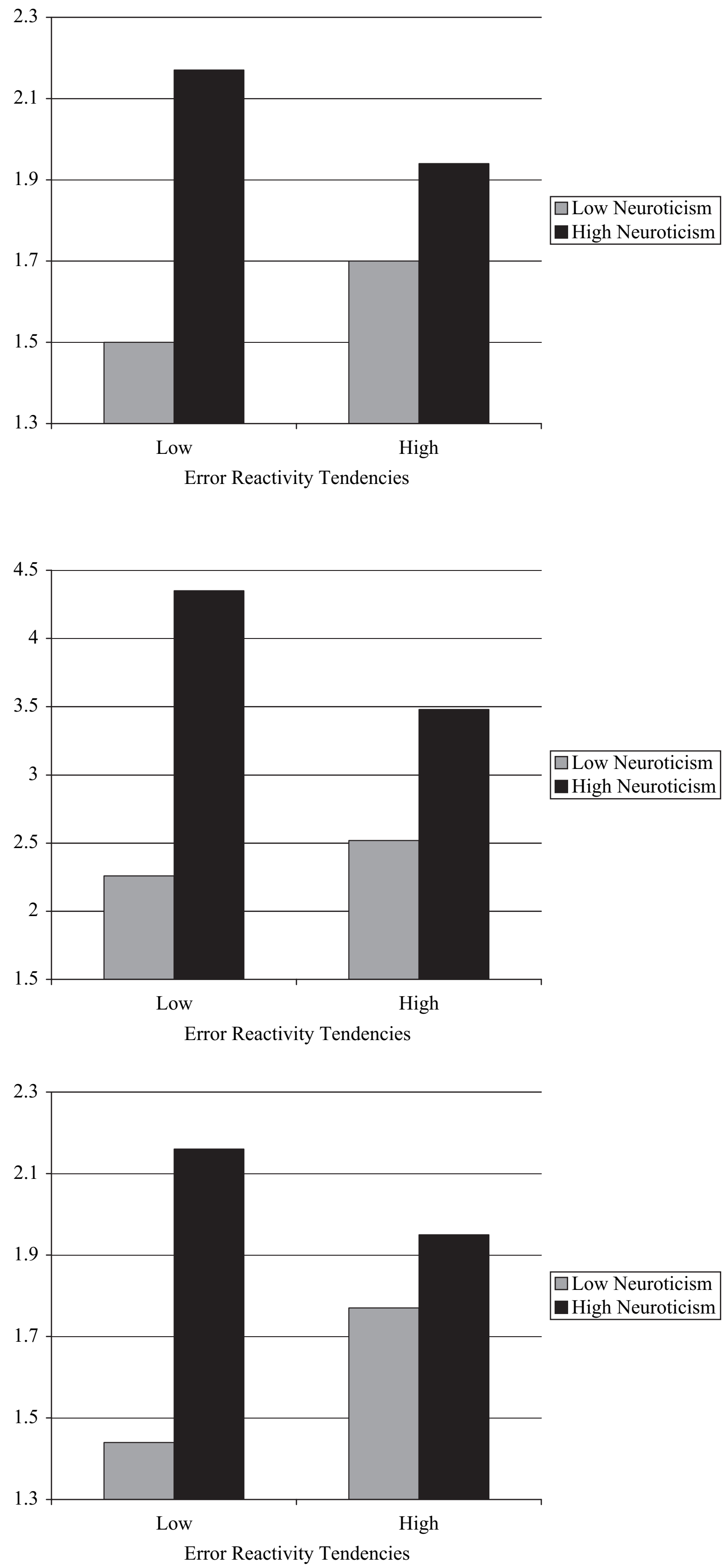

Figure 1. Neuroticism and error-reactivity as predictors of negative affect, studies 4 (top panel), 5 (middle panel), and 6 (bottom panel).

the literature on individual differences. Therefore, we conducted an extensive series of studies examining the reliability and validity of this individual difference measure.

In support of the idea that error-reactivity tendencies reflect the engagement of cognitive control following the perception of threat, higher error-reactivity scores were associated with the more accurate recognition of threats in a go/no go task with extensive history in our lab (e.g., Robinson et al., 2005b; Tamir et al., 2002), specifically in Studies 1–2. Because this go/no go task taps threat-recognition tendencies in a face-valid manner, we conclude that error-reactivity tendencies are systematically related to threat-recognition tendencies. The purpose of Study 3 was to better understand potential relations between error-reactivity and avoidance motivation in everyday life. We found that individuals higher in error-reactivity reported a lesser frequency of avoidance-motivated goals, consistent with the idea that individuals high in error-reactivity down-regulate threats as they occur rather than letting them linger. The combined results of Studies 1–3 therefore indicate that error-reactivity tendencies are related to both threat-recognition (Studies 1–2) and its apparent down-regulation (Study 3).

This dual set of correlates is quite consistent with the cognitive control literature, which has shown that reactivity to threats and errors, defined in neural terms, is often a prelude to successfully down-regulating them (Kerns et al., 2004; Lieberman & Eisenberger, 2005). The present measure should not be equated with such neural activity, but it is nevertheless comforting that the present results seem consistent, in broad terms, with neural theories of cognitive control. A benefit of the present assessment technique is that it permits the inclusion of larger sample sizes and more studies than is typical of personality investigations of cognitive control using fMRI or ERP techniques.

Interactive Predictions and Conclusions

Neuroticism predicts self-reported avoidance motivation, which in turn predicts negative affect (e.g., Elliot & Thrash, 2002). Based on such self-report relations, it is common to view neurotic individuals as victims of their avoidance tendencies. This could potentially be true with reference to self-reported avoidance motivation. However, a very different picture emerges when we examine implicit processes.

In this connection, consider that neurotic individuals are trying to "do" something—namely, avoid potential threats to the self. Second, consider that threat-recognition and error-reactivity skills would support, or be consistent with, the avoidance-related goals of such individuals. This led us to predict that neuroticism and error-reactivity tendencies would interact with each other and would do so in a manner to suggest that high levels of error reactivity would be beneficial at high levels of neuroticism.

By measuring neuroticism, error-reactivity, and negative affect in everyday life, we were able to provide support for these predictions. Far from being victims of tendencies toward error-reactivity, individuals high in neuroticism actually benefited from such tendencies, as high neuroticism combined with higher error-reactivity was associated with lower levels of negative affect in Studies 4–6. By contrast, individuals low in neuroticism were not benefited by cognitive tendencies toward error-reactivity, as they reported higher levels of negative affect.

In the following discussion sections, we expand on our findings in several ways. First, we consider implications of null correlations between neuroticism and error-reactivity. Second, we consider implications of null correlations between error-reactivity and negative affect in daily life. Third, we revisit the interactive hypotheses that guided our predictions. In all cases, we link the present findings to the larger literature on neuroticism, threat-processing, and neuroticism-related self-regulation.

Neuroticism and Threat-Processing Tendencies

In the literature on neuroticism and threat-related processes, there has been a considerable tendency to assume a straightforward relationship along these lines. In fact, it is often the case that neuroticism does not predict threat-related cognitive processes (Robinson et al., 2005b; Robinson et al., 2003; Tamir et al., 2006). This general sort of conclusion also emerges from a literature that has sought to test the personality theories of Eysenck and Gray in cognitive terms (Matthews & Gilliland, 1999). Similar null relations emerged in the present studies. That is, trait neuroticism was not correlated with error-reactivity despite the fact that error-reactivity predicted threat recognition accuracy in Studies 1–2.

In light of such data, it may be useful to free ourselves from the restrictive assumption that cognitive processing tendencies must be correlated with self-reported traits in order to predict state-related outcomes (Robinson, 2004, 2007, in press). For example, McClelland, Koestner, and Weinberger (1989) report a number of studies in which implicit behavioral measures of motivation predicted everyday experience and behavior despite being uncorrelated with trait-related measures of motivation. Similar findings have emerged from the more recent literature focusing on individual differences in implicit cognition (Greenwald & Nosek, 2001; Robinson & Compton, in press). Thus, we suggest that cognitive–behavioral measures of personality provide information about the person that simply cannot be derived from self-report. However, the present studies also illustrate the benefits of theory and assessment focused on the interaction of traits and basic cognitive processes.

Insights Concerning Error-Reactivity Tendencies

Individuals who pause following their mistakes display a greater degree of sensitivity to them, and this sort of behavioral inhibition is clearly part of a larger cognitive control system designed to interrupt problematic routines in favor of behaviors better suited to the situational context (Banfield, Wyland, Macrae, Münte, & Heatherton, 2004; Lieberman & Eisenberger, 2005). Yet, both insufficient and chronic error sensitivity can be associated with problems. On the one hand, insufficient error-reactivity may be theoretically linked to behaviors associated with impulsivity and aggression (MacCoon, Wallace, & Newman, 2004). On the other hand, chronic activation of the cognitive-conflict circuit has been linked to problems related to excessive vigilance (Gehring, Himle, & Nisenson, 2000).

A point worth making is that the personality-related correlates of cognitive control are likely to depend on the wider goals of the individual. This point was made here in terms of the systematic interactions between neuroticism and error-reactivity. These interactions are important because we were able to show that the same measure of error-reactivity tendencies was associated with both higher and lower levels of distress, depending on levels of neuroticism. Neural manifestations of cognitive control could function similarly. For example, higher levels of anterior cingulate activation following errors could be functional among individuals who have self-control issues (e.g., depressed persons), but dysfunctional among individuals who are already too vigilant for errors (e.g., obsessive–compulsive persons). Such observations are admittedly speculative, but consistent with some recent directions in the literature (e.g., Eisenberger et al., 2005; Pizzagalli et al., 2001).

Regardless of such points, the zero-order correlates of the present error-reactivity measure warrant further investigation, and we offer some potentially useful directions in this regard. First, we suggest that error-reactivity may be related to other cognitive processes favoring threatening information such as those related to selective attention (see Mogg & Bradley, 1998, for a review). Second, we suggest that such tendencies may predict a preference for caution over risk in studies of decision-making (for a review, see Loewenstein, Weber, Hsee, & Welch, 2001). Third, and most general, we suggest that such tendencies may be closely related to individual differences in "prevention-focus" (as highlighted by Higgins, 1997). In short, it is possible that error-reactivity taps an important individual difference dimension related to threat sensitivity in online processing, but more data are needed.

Implications Related to Neurotic Self-Regulation

Frequent concerns related to potential threats, combined with low levels of online threat monitoring, may be especially problematic. Along these lines, Borkovec and Sharpless (2004) contend that individuals suffering from GAD have high levels of avoidance motivation along with insufficient monitoring of actual threats as they occur. Because of this mismatch of avoidance motivation and cognitive tendencies related to it, GAD patients are thought to worry about nearly every situation, whether it constitutes a potential threat or not.

We (e.g., Robinson et al., 2003) have made a similar suggestion in relation to trait neuroticism. Neurotics worry about potential threats, and it would be useful for them to possess tendencies served to that worry. From this perspective, threat recognition tendencies would support more effective self-regulation at high, but not low, levels of neuroticism. Robinson et al. (2003) reported preliminary data in support of this interactive prediction using a choice RT measure of threat processing and dependent measures related to daily negative affect. The present studies report parallel interactions involving a very different threat processing measure. However, the present results were replicated across studies, whereas this was not true of the preliminary data reported by Robinson et al. (2003). In both investigations, though, the same picture emerges. Neuroticism, these data suggest, can be associated with effective self-regulation, but only among neurotic individuals sensitive to threats as they occur in real-time transactions with the environment. Among these individuals, at least, neuroticism need not be associated with very high levels of negative affect.

Also important is the observation that although high levels of error-reactivity were hedonically beneficial at high levels of neuroticism, they were hedonically costly at low levels of neuroticism. Clearly such data indicate that the same processing tendencies can either support or undermine emotional well-being, depending on their match or mismatch to the trait-related goals of the individual (Robinson & Compton, in press). In the case of individuals low in neuroticism, we view it likely that high tendencies toward error-reactivity induce vigilance and caution among individuals who view such tendencies as unwanted much of the time. This type of mismatch, too, would induce distress according to our match/mismatch framework.

From the interactive nature of the results, then, the following picture emerges. High levels of error-reactivity are independent of the conscious avoidance-related goals of the individual, as assessed by trait neuroticism. Nevertheless, high levels of error-reactivity commit the individual to certain courses of action related to threat recognition and compensation, regardless of the conscious goals of the individual. Such threat-compensation processes, if they coincide with conscious goals related to avoidance motivation (as in the case of individuals high in neuroticism), benefit self-regulation and contribute to lesser distress. On the other hand, such threat-compensation processes, if they are inconsistent with conscious goals related to avoidance motivation (as in the case of individuals low in neuroticism), lead to courses of action inconsistent with conscious goals and therefore contribute to greater distress. In sum, the cross-over nature of the interactions observed here is clearly consistent with a larger body of match/mismatch findings in which crossover interactions of the present type have been observed (Robinson & Compton, in press).

Future Directions

We assessed error-reactivity in categorization tasks associated with a low tendency toward error. This seemed desirable in that errors here, as in everyday life, would be an infrequent occurrence (Shallice & Burgess, 1993). However, we also admit that a more difficult task might produce an even more reliable measure.

We informed participants that they had made errors on particular trials. Therefore, it is difficult to know whether similar results would occur with no overt feedback. However, from another perspective, we sought to measure posterror slowing tendencies, and it may be that the best way to examine such tendencies is to provide error feedback. Regardless, it is important to better understand the role of error feedback in relation to the present results.

The present measure of error-reactivity is essentially a difference score. This renders it somewhat unclear whether the important variance related to slow-down tendencies following errors or to speed-up tendencies following correct responses. However, in relation to this concern, it must be mentioned that it is crucial to have some control over individual differences in speed, which are very pronounced in choice RT tasks (Robinson & Oishi, 2006). To purify RT-related measures, then, a difference score approach is necessary (Robinson, in press).

Conclusions

The present six studies had two purposes. The first purpose of the studies was to validate a new behavioral measure of error-reactivity. Although this measure was not correlated with neuroticism, it did predict threat-recognition accuracy and lower avoidance motivation in daily life (Studies 1–3). The second purpose of the studies was to examine an interactive self-regulation model in which it was hypothesized that individuals high, but not low, in neuroticism, would subjectively benefit from higher levels of error-reactivity. Support for such predictions was provided in Studies 4–6 in terms of daily experiences of negative affect. In sum, the six studies both validate a behavioral measure of error-reactivity and support the idea that individuals high in neuroticism subjectively benefit from cognitive tendencies related to error-reactivity and its control.

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