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Perceptual Negativity Predicts Greater Reactivity to Negative Events in Daily Life

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Abstract

Reinforcement sensitivity theory includes the idea that people differ in their sensitivity to negative events, but relevant process-based assessments have not been developed. The present studies assessed sensitivity to negative events in terms of the extent to which negative word stimuli were perceived to be larger than neutral word stimuli. There was a general tendency to overestimate the size of negative relative to neutral words, but individuals differed substantially in this form of what is termed *perceptual negativity*. Of more importance, two studies (total $N = 151$) found systematic relationships between individual differences in perceptual negativity and reactivity to negative events in daily diary protocols. Study 1 found that within-person variations in the occurrence of daily negative events undermined goal-related optimism to a greater extent at higher, relative to lower, levels of perceptual negativity. Study 2 conceptually replicated this interaction in the context of within-person associations between the occurrence of daily negative events and antisocial behavior. These findings are important in advancing reinforcement sensitivity theory, in operationalizing a particular component of it, and in extending it to reactivity processes in daily life.

Keywords

Reinforcement Sensitivity; Behavioral Inhibition; Perception; Reactivity; Daily

1. Introduction

Gray (1981; 1982; 1987) sought to understand the motivational and affective dynamics underlying propensities toward impulsive behavior and anxiety. In doing so, he proposed reinforcement sensitivity theory (RST). Of most importance in the present context, he suggested that individuals are likely to be differentially sensitive to threatening events in the environment and reactive to them for this reason, functions ascribed to a Behavioral Inhibition System (BIS). This system is activated by threats or negative events and orchestrates a possible defense by generating arousal, anxiety, and preparing for the organism for potential avoidance (Gray, 1987). It is worth noting that such functions might be ascribed to the fight-flight-freeze system (FFFS) rather than to the BIS in a revised version of RST; in revised RST, BIS plays a more internal monitoring function related to conflict management (Gray & McNaughton, 2000).

Reinforcement sensitivity theory has proven generative in thinking about variations in personality and clinical outcomes (Corr, 2008). Much of this work has involved self-reports of personality that have uncertain relations to the neurocognitive sorts of processes that Gray (1982; 1987) emphasized as well as to how an individual might react to negative events

when they are actually encountered (Robinson, Boyd, & Liu, in press). In this connection, given that BIS is activated by negative events, a good portion of the system is likely related to “front-end” processes such as how negative events are attended to and perceived. Indeed, the term “sensitivity” in RST would seem to emphasize perceptual processes and particularly those that would enhance or boost the signal of negative stimuli when they occur. This perceptual component of the BIS has not been directly modeled, at least in the context of Gray’s (1987) original RST framework.

There are, however, reasons for focusing on perceptual processes in assessing the impact of negative stimuli and, by extension, operations of the BIS of the original RST. Bruner and Postman (1948) found that tokens inscribed with negative affective symbols (e.g., a swastika) were perceived to be larger than those inscribed with neutral symbols. Cole, Balceris, and Dunning (2013) found that people perceived a lesser distance between the self and an apparently dangerous person relative to two control conditions. Fessler, Holbrook, and Snyder (2012) found that others with weapons were perceived to be more muscular and taller than those without weapons. It is further evident that the brain prioritizes negative stimuli over neutral ones at an early level of processing (150–300 ms subsequent to exposure), a time course consistent with processing within the visual cortex (Bublitzky, Fleisch, Stockburger, Schmälzle, & Schupp, 2010). These results have not involved individual differences, but there are suggestions that at least certain forms of anxiety, such as simple phobias, may be characterized by what is termed “loomingness” – perceptions that negative stimuli are more dynamic and quickly approaching the self (Riskind, Rector, & Taylor, 2012). Further, it has been established that anxious people tend to selectively attend to threatening information (Frewen, Dozois, Joanisse, & Neufeld, 2008). What is yet to be determined is whether: (a) some people are more sensitive to negative over neutral events in strictly perceptual terms, (b) using non-phobic stimuli, and whether (c) such perceptions can allow us to understand individual differences in the sort of negative reactivity processes ascribed to BIS sensitivity (Corr, 2008).

In the context of limitations to current knowledge, we introduce an assessment intended to model a perceptual component of the (original) BIS (Gray, 1987) that we term *perceptual negativity*. It is defined and operationalized as a tendency to perceive negative stimuli to be larger than neutral stimuli. This operationalization is consistent with several studies in which size estimates have been shown to vary by motivational and affective factors (Bruner & Postman, 1948; Veltkamp, Aarts, & Custers, 2008). It is also consistent with biological models in which higher levels of motivation are thought to boost the “salience” of motivation-consistent stimuli (Berridge, 2007). Words were used as stimuli because they do not elicit strong arousal (Fazio, 2001), generate consensual ratings of valence (Osgood, Suci, & Tannenbaum, 1957), typically result in larger effect sizes (relative to pictures) in the anxiety and threat-selective attention literature (Frewen et al., 2008), and because the size of such stimuli can be precisely controlled (Ode, Winters, & Robinson, 2012). We predicted that, on average, negative words would be perceived to be larger in font size than neutral words.¹

Individual differences in perceptual negativity were of more interest. We expected to be able to contrast individuals who exhibit this negativity bias versus those who do not. One might determine whether traits predict the magnitude of this bias, but in fact self-reported personality traits do not often predict the processing tendencies that they might reasonably be expected to predict (Robinson & Neighbors, 2006). Accordingly, we have advocated

¹Previous studies have shown that size estimates can also vary by other psychological dimensions such as value (Bruner & Postman, 1948), perceived power (Schubert, Walz, & Giessner, 2009), and motivational salience (Veltkamp et al., 2008). In addition, van Ulzen, Semin, Oudejans, and Beek (2008) found that negative pictures were estimated to be larger than neutral or positive pictures.

research in which implicit measures are treated as predictors of reactions to daily life events because such designs can examine ecologically valid reactions in which the issue is not what people believe to be generally true of the self (Robinson & Wilkowski, in press). If perceptual negativity is a component of the BIS system, as we contend, it should predict greater reactivity to negative events in daily life. Findings of this type would illustrate the value of adopting a process-oriented experimental approach to assessing a motivational system whose operations are theoretically important but empirically underdetermined. Both studies assessed the extent to which negative events occurred on a particular day. The daily outcome measures, however, were varied across studies in order to support a more general set of conclusions.

2. Study 1

In Study 1, we focused on the extent to which within-person (across-day) variations in the occurrence of negative events undermined goal-related optimism. There is considerable evidence for inverse relations of this type (Carver & Scheier, 1998), but we hypothesized that this inverse relationship would be stronger at higher levels of perceptual negativity.

2.1. Method

2.1.1. Participants and Procedures—Undergraduate participants signed up for a two-part daily diary study. The perception task was completed in the laboratory in groups of 6 or less on 17 inch CRT monitors at a viewing distance of approximately 60 cm. At the end of this week, an 18-day reporting protocol commenced. Reports were to be completed after 8 p.m. and before 3 a.m. Participants completing less than half of the daily reports were deleted, leaving 90 people (53% female; 87% Caucasian; M age = 19.7; M number of reports = 12.9).

2.1.2. Perceptual Negativity—A font-size matching task was created. Each of 80 trials began by presenting a vertical array of letter “Z”s along the left side of the computer screen. They varied in size from 8-point font to 24-point font in either an ascending or descending order, with array order counterbalanced across participants. A word was then presented toward the middle right side of the screen, vertically centered. To encourage effort in the task, its size was varied from 12-point font to 22-point font in a randomized trial-to-trial manner. Both fonts (for the word and the Z array) were presented in Courier-New, which preserves equal spacing for all letters. Participants categorized the word as “bad” or “neutral” by voicekey. This procedure was used to draw attention to the evaluative nature of the stimuli. When a vocal response was registered, a mouse cursor appeared at center screen and participants were given 6 seconds to make a mouse click on the “Z” matching the font size of the word. A small minority of trials (1.31%) was deleted because participants were too slow. The task involved 20 neutral words (e.g., SEAT, DOOR) and 20 negative words (e.g., HARM, PAIN) that were matched in terms of their number of letters ($M = 6.68$), $F(1, 38) = 1.54$, $p > .20$. Stimuli were rated by 8 graduate students along a 1 (very negative) to 9 (very positive) scale. With word as the unit of analysis, the negative words were decidedly more negative ($M = 2.02$) than the neutral words ($M = 5.21$), $F > 500$, $p < .01$.²

For each participant and trial, we subtracted the actual font size from the font size chosen, with higher numbers reflecting size overestimations. People generally overestimated the size of negative words ($M = 1.05$; $SD = 0.99$; $\alpha = .93$) more than neutral words ($M = 0.83$;

²Positive words were also presented and generally seen to be larger than neutral words (also see Ode et al., 2012), $ps < .05$, but the present theoretical and empirical focus was on perceptual negativity and reactions to negative events. A positive minus neutral difference score did not interact with negative events in either study, $ps > .10$, and the cross-level interactions reported remained significant when controlling for this other difference score, $ps < .05$.

$SD = 0.99$; $\alpha = .87$), $F(1, 89) = 15.77$, $p < .01$. That both bias scores were positive might reflect a tendency for task-relevant stimuli to be generally salient, thereby seeming larger than they are in actuality (Ode et al., 2012). In any case, perceptual negativity was quantified in a way such that this general tendency toward size overestimations was not an issue. Specifically, perceptual negativity was quantified by subtracting the participant's overestimation for neutral words from his/her overestimation for negative words ($M = 0.22$; $SD = 0.52$). For descriptive purposes, we performed a median split along this perceptual negativity dimension. Above the median, there was a pronounced tendency toward perceptual negativity (M difference = 0.63 font units), $F(1, 44) = 226.67$, $p < .01$. Below the median, there was a reversal such that negative stimuli were perceived to be smaller than neutral stimuli (M difference = -0.20), $F(1, 44) = 18.24$, $p < .01$. In other words, perceptual negativity is somewhat particular to certain people relative to others and therefore a pronounced individual difference. In the results section, perceptual negativity will be treated as a continuous rather than dichotomous predictor.

2.1.3. Daily Protocol—Individuals higher in perceptual negativity were hypothesized to be more reactive to negative events in daily life. On each day, participants reported on the extent (1 = not at all true today; 4 = very much true today) to which two negative events (“experienced a lot of unpleasant events” & “something bad happened today”) occurred. We averaged across the two items ($M = 1.68$; $SD = 0.45$; $\alpha = .93$). The daily outcome examined in Study 1 was whether participants were “pessimistic” versus “optimistic” (along a 1–5 pessimism to optimism scale) while pursuing their goals ($M = 3.46$; $SD = 0.66$).³

3. Results

Multilevel modeling (MLM) procedures were used to examine a possible moderating role for perceptual negativity in reactivity to daily negative events. Such MLM procedures are ideal for analyzing nested data like daily diary reports (Fleeson, 2007) and we followed recommendations in conducting the analysis. This included person-centering negative event scores (Enders & Tofighi, 2007), z-scoring continuous, rather than dichotomized, variations in perceptual negativity (Aiken & West, 1991), and the use of the SAS PROC MIXED analysis platform (Singer, 1998). A “cross-level” interaction was predicted such that negative events should undermine optimism to a greater extent at higher levels of perceptual negativity. In this analysis, there was a main effect for Negative Events, $b = -.35$, $t = -6.93$, $p < .01$, no main effect for Perceptual Negativity, $b = .02$, $t = 0.26$, $p > .75$, but a significant cross-level interaction, $b = -.14$, $t = -2.43$, $p < .05$. Estimated means for this interaction (rather than actual means, as perceptual negativity was a continuous variable), as a function of low (-1 SD) versus high ($+1$ SD) levels of each of the predictors (Aiken & West, 1991), are reported in the top panel of Figure 1. As shown there, negative events were a more consequential predictor of daily goal-related optimism at the high ($+1$ SD), $b = -.48$, $t = -6.68$, $p < .01$, relative to low (-1 SD), level of perceptual negativity, $b = -.21$, $t = -2.73$, $p < .01$.⁴

4. Discussion and Study 2

Study 1 found that people higher in perceptual negativity displayed greater reactivity to daily negative events, an interactive pattern that deserves conceptual replication. Another way in which people often react to negative events is by engaging in antisocial behavior, a

³In both studies, conceptual replication of the cross-level interactions occurred with another measure of negative events more particular to social feedback (e.g., “was criticized”). Interested readers can contact the authors for relevant statistics.

⁴In a precursor to the present studies, the trait of neuroticism was found to be unrelated to perceptual negativity as we have assessed it, $p > .95$.

phenomenon termed reactive or emotional aggression (Berkowitz, 1993). Such negative events need not involve direct provocation; instead, nearly any negative event that makes people feel bad (e.g., disappointing outcomes, physical discomfort, etc.) renders it more likely that they will engage in antisocial behavior (Anderson & Bushman, 2002). Accordingly, we ran a second study in which the focus was on the extent to which daily negative events triggered such behaviors. We hypothesized that this relationship would be stronger at higher levels of perceptual negativity, much as there are positive relations between self-reports of BIS and reactive aggression that are consistent with original RST (Smits & Kuppens, 2005).

4.1. Method

4.1.1. Participants and Procedures—Unless otherwise noted, procedures for Study 2 were identical to those of Study 1. A difference was that 14 daily reports were obtained rather than 18. Another difference was that participants in Study 2 were sent daily email reminders to complete their daily reports. This boosted compliance rates and we could therefore set a higher criterion for inclusion. On the basis of compliance rates, and before an inspection or analysis of any of the data points, we deleted responses from participants who completed less than 9 of the 14 daily reports. This left 61 participants (41% female; 72% Caucasian; M age = 19.7; M number of reports = 11.7).

4.1.2. Perceptual Negativity—The stimuli and number of trials were identical to Study 1. However, the task was changed slightly for the sake of generalizability. A capitalized word was presented 1/3 toward the bottom of the computer screen in a 14, 15, 17, or 18-point font size. It was vocally categorized as “bad” or “neutral”. Subsequently, the letter “Z” was presented toward the top 1/3 of the computer screen in a 16-point font. Participants were told that the size of the “Z” letter would not match the size of the word shown and that they should change its size upwards (up arrow) or downwards (down arrow) to match the word’s size, with each arrow press changing the “Z”’s size by 1 unit. When the size was perceived to match, the enter key was pressed.

For each trial, we subtracted the actual font size of a word from its perceived font size, the latter as reflected in the size of the letter “Z” perceived to match. As in Study 1, people again generally overestimated the size of negative words ($M = 1.84$; $SD = 1.15$; $\alpha = .96$) more than neutral words ($M = 1.71$; $SD = 1.03$; $\alpha = .94$), $F(1, 60) = 5.32$, $p < .05$. Individual differences in perceptual negativity were calculated by subtracting a participant’s mean for neutral words from his/her mean for negative words ($M = .13$; $SD = .43$). Perceptual negativity was pronounced above the median (M difference = 0.46), $F(1, 80) = 65.09$, $p < .01$, and reversed below the median (M difference = -0.22), $F(1, 29) = 31.19$, $p < .01$, along this perceptual negativity dimension, descriptive results that are comparable to Study 1.

4.1.3. Daily Protocol—The occurrence of daily negative events was assessed in the same manner as Study 1 ($M = 1.57$; $SD = 0.40$; $\alpha = .90$). The outcome measure asked people how many times (0 = not a single time; 3 = more than 2 times) they engaged in three common antisocial behaviors (“argued with someone”, “criticized someone”, & “insulted someone”). The behaviors had to be common because less common ones (e.g., stealing, vandalism) would not occur with sufficient frequency for day-to-day analyses. The three ratings were averaged for each day for each participant ($M = 0.59$; $SD = 0.40$; $\alpha = .86$).

5. Results and Discussion

Negative event scores were person-centered and perceptual negativity was z-scored. Subsequently, we ran an MLM analysis in examining antisocial behavior as a function of

these two predictors. In this analysis, there was a main effect for Negative Events, $b = .23$, $t = 5.50$, $p < .01$, no main effect for Perceptual Negativity, $b = .01$, $t = 0.14$, $p > .85$, and a cross-level interaction, $b = .08$, $t = 2.13$, $p < .05$. Estimated means for this interaction ($-1/+1$ SD for each of the predictors) are shown in the bottom panel of Figure 1 and they are conceptually parallel to Study 1's results. The relationship between daily negative events and antisocial behavior was stronger at the high ($+1$ SD), $b = .31$, $t = 5.46$, $p < .01$, relative to low (-1 SD), $b = .16$, $t = 2.82$, $p < .01$, level of perceptual negativity. In sum, the findings of Study 2 are highly parallel to those of Study 1 in the context of a set of behaviors that should become more frequent as daily negative events also become more frequent (Berkowitz, 1993).

6. General Discussion

From a self-regulation perspective, people might generally be expected to be more sensitive to negative events than neutral ones (Carver & Scheier, 1998). Normative results were consistent with this idea in that people generally overestimated the size of negative words more than neutral words in both studies. Consistent with Gray's (1982; 1987) RST theory of BIS sensitivity, however, substantial heterogeneity was found across people. Some people displayed *perceptual negativity* and others did not. Further, it was found that higher levels of perceptual negativity were associated with greater reactivity to negative events in two overlapping yet distinct daily process studies. The findings support the value of modeling a sensitivity component of the BIS in cognitive-perceptual terms.

Relation to Other Constructs and Measures

It is useful to consider what perceptual negativity assesses in relation to other constructs. Perceptual negativity is not a measure of perceptual augmenting versus reducing (Petrie, 1967) in general terms. Rather, neutral object size estimates were subtracted from negative object size estimates to assess tendencies to see negative stimuli, *in particular*, as larger. It is not a measure of repression-sensitization in that repression-sensitization correlates very highly with trait anxiety (Golin, Herron, & Lakota, 1967), yet perceptual negativity does not correlate with neuroticism, a closely related trait (see footnote 4). Perceptual negativity should correlate with measures of a looming perceptual style (Riskind et al., 2012), at least those that assess looming perceptions in an implicit, process-based manner. Note, though, that we operationalize perceptual negativity in terms of stimuli that are not especially evocative in emotional terms and in terms of stimuli that are broadly negative in connotation rather than phobia-specific. The findings should therefore be interpreted in such general and basic terms.

Perceptual negativity may be a good measure of sensitivity to negative stimuli, a theoretical component of the BIS (Gray, 1987), but not other posited components of the BIS. Our measure does not assess selective attention processes as only one stimulus was presented at a time. It does not assess physiological arousal in potentially threatening conditions. It does not assess behavioral caution. To assess these other BIS-related processes, distinct and targeted cognitive-behavioral probes would be desirable (Robinson et al., in press). Even so, it is at least possible that sensitivity to negative events, as assessed, might predict more downstream manifestations thought to occur with BIS sensitivity (Gray, 1987). Our results support this point in that perceptual negativity predicted reactivity to negative events in daily life.

In assessing perceptual negativity, we built on the original RST of Gray (1987) rather than a later version in which the operations of the BIS were revised considerably (Gray & McNaughton, 2000). In the revised RST, the BIS is proposed to monitor conflicts between approach and avoidance systems, engendering caution under such circumstances (Corr,

2008). This is certainly not what is assessed by perceptual negativity. Rather, what is assessed is a tendency to perceive negative events, considered in isolation, as salient and therefore potentially more influential or important (Berridge, 2007; Higgins, 1996). The results are consistent with this interpretation of perceptual negativity and its daily life manifestations. Such points aside, the revised RST entertains similar sensitivity functions, but ascribes them to the FFFS instead (Corr, 2008). Ultimately, then, perceptual sensitivity is an important component to both the original (Gray, 1987) and revised (Gray & McNaughton, 2000) versions of RST and our perceptual negativity measure was designed to assess such processes.

Additional Questions

It is useful to consider several questions in understanding the findings. Might higher levels of (originally-conceptualized) BIS predict smaller rather than larger size estimates for negative stimuli? In terms of perceptual processes, the answer is no, in that people more motivated to avoid negative stimuli seem to perceive them to be more prominent rather than less prominent, perceptions that should engender subsequent avoidant actions (Cole et al., 2013; Riskind et al., 2012).

Why were there not main effects for perceptual negativity in predicting the daily outcomes? In answer to this question, we suggest that our results are quite consistent with RST, which emphasizes reactions to negative events or stimuli rather than processes that are always operative (Gray, 1987). In other words, the primary question of the RST framework is how people *react* to motivation-relevant stimuli, an emphasis that is consistent with the present findings. We might further emphasize that daily diary protocols are particularly suited to examine reactivity processes, including those of an RST type (Robinson et al., in press).

Should lower levels of perceptual negativity be characterized in terms of problematically low levels of BIS? Our findings argue against this idea. Some reactivity to daily negative events was observed at both lower and higher levels of perceptual negativity. For example, negative events undermined goal-related optimism at both low and high levels of perceptual negativity, but such reactions were more extreme at higher levels (Study 1). More extreme reactions to negative events are problematic from a well-being perspective (Watson, 2000) and arguably problematic from a self-regulation perspective as well (Carver & Scheier, 1998). Overall, then, we regard higher levels of perceptual negativity as more problematic than useful, a suggestion that is compatible with our findings.

Conclusions

We sought to assess a component of Gray's (1987) theory of BIS motivation in terms of the perceptual salience of negative stimuli. A general tendency was found in which negative words appeared to be larger than neutral words. People differed quite a bit in such tendencies, however. Those who exhibited perceptual negativity to a greater extent were more reactive to negative events in daily life. Our perceptual negativity measures should be of value in predicting other outcomes consistent with a sensitivity interpretation of the BIS.

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Figure 1. Estimated Means for Goal-Related Optimism (Study 1, Top Panel) and Antisocial Behavior (Study 2, Bottom Panel) as a function of Daily Negative Events and Perceptual Negativity