Optimism and Attentional Bias for Negative and Positive Stimuli

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*Optimism, or positive outcome expectancy, correlates with better psychological and physiological adjustment, in part because of conscious behavior such as coping. However, procedural, automatic, and unconscious processes also may affect adjustment. The emotional Stroop task was used to assess the relationships between optimism and unconscious attentional bias for positively valenced, negatively valenced, neutral current concern, and neutral control stimuli. Undergraduate students (*n = *48) completed personality measures at the beginning of the semester and completed the Stroop task under separate cover. Optimism was associated with a greater attentional bias for positive stimuli relative to negative stimuli. Optimism also was associated with slower skin conductance response rates during negative stimuli. Unconscious attentional biases may contribute to the better adjustment associated with optimism.*

It is generally more adaptive to believe that the future holds positive events than to believe that it holds negative events. Optimism is defined as positive outcome expectancies, either of a generalized, dispositional nature or with regard to a specific situation. Both types of optimism have been associated with better psychological adjustment to stressors such as health and academic role transitions (Aspinwall & Taylor, 1992; Carver et al., 1993; Epping-Jordan et al., 1999; Scheier & Carver, 1992; Segerstrom, Taylor, Kemeny, & Fahey, 1998; Stanton & Snider, 1993) and also might be associated with better physical health via relationships to the cardiovascular and immune systems (Räikkönen, Matthews, Flory, Owens, & Gump, 1999; G. M. Reed, Kemeny, Taylor, Wang, & Visscher, 1994; Scheier et al., 1989; Segerstrom et al., 1998).

An understanding of the processes that lead optimists to better outcomes predominantly relies on self-reports of behavior and cognition in the context of coping with stressors (Aspinwall & Taylor, 1992; Carver et al., 1993; Chang, 1998; Epping-Jordan et al., 1999; Park, Moore, Turner, & Adler, 1997; Scheier, Weintraub, & Carver, 1986; Segerstrom et al., 1998). However, such self-reports may not accurately or entirely capture the processes that lead to better outcomes. First, self-report measures are subject to a number of biases, including memory effects (Stone et al., 1998). In fact, the better outcomes experienced by optimists may color their retrospective reports (Kahneman, 1999). Second, self-report measures capture declarative, volitional, and conscious acts and states. However, procedural, automatic, and unconscious processes also affect behavior and mood (Bargh & Chartrand, 1999; Compas, Connor, Osowiecki, & Welch, 1997). Optimists may be adapting to stressors via processes not available for self-report. For example, optimistic or pessimistic expectations may lead schemas of success or failure to be chronically accessible (i.e., easily and more probably applied to incoming stimuli), leading to differences in attention, interpretation, and emotional and physiological reactions (Carver & Scheier, 1982, 1998; Fiske & Taylor, 1991).

Various assessment methods exist as alternatives to retrospective self-report. Similar to automaticity and awareness themselves, these methods exist on a continuum: Some methods primarily access conscious processes, whereas others primarily access unconscious processes. First, the use of real-time rather than retrospective self-reports minimizes memory biases (Stone et al., 1998), but this method captures only phenomena of which participants are aware and that they can describe (i.e., declarative knowledge). Second, direct observation of behavior (e.g., in a laboratory setting) captures the

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PSPB, Vol. 27 No. 10, October 2001 1334-1343

effects of both conscious and unconscious processes. For example, optimists performed better than pessimists on a vigilance task regardless of negative feedback (Helton, Dember, Warm, & Matthews, 1999). In another study, optimists spent more time reading health risk information than benefit or neutral information (Aspinwall & Brunhart, 1996). Studies such as these avoid the drawbacks of self-report; however, it is impossible to know whether the observed phenomena were the consequence of conscious effort or unconscious processing. For example, optimists may have decided to spend more time reading risk information, had an automatic preference for threatening information, or both (Aspinwall & Brunhart, 1996).

Methods have been developed to study unconscious processes that minimize, although do not eliminate, the influence of conscious processes. The most common method of assessing unconscious attentional bias associated with emotional and motivational states is the emotional Stroop task. The emotional Stroop task requires participants to name the ink colors of a list of words that vary in emotional significance, ignoring the word meaning. When a word has high emotional significance, it becomes more difficult to suppress the word's meaning and name the ink color, creating increased response latency, the technical term for which is "interference." Stroop interference has most often been found in the context of anxiety, in which it has been interpreted as an attentional bias related to threat. Clinical samples show Stroop interference on words relevant to their condition (e.g., *web* for spider phobia; *cancer* for health worry), and trait and state anxiety have been associated with Stroop interference on threat words (see J.M.G. Williams, Mathews, & MacLeod, 1996, for a review of emotional Stroop findings).

The precise mechanism by which emotional words create Stroop interference is not known, but it is likely that they capture attentional resources that would otherwise be directed toward identifying and naming the word's ink color (J.M.G. Williams et al., 1996). Attentional bias for emotional words is likely to be mainly unconscious, because emotional Stroop effects have been demonstrated using subliminal presentation (although see Matthews & Wells, 2000; Wells & Matthews, 1996, for a critique of such studies). Stroop interference is nonetheless influenced by conscious emotional and motivational states. Matthews and Harley (1996) found that a connectionist model that included a threat-monitoring strategy best reproduced emotional Stroop effects for negative stimuli. They concluded that the model supported an interaction between conscious and unconscious processes (cf. Matthews & Wells, 2000; Wells & Matthews, 1996). Consciously experienced and reported optimism could, therefore, affect performance on the emotional Stroop task.

Most of the literature on the emotional Stroop task has focused on the attentional bias for negative information in relation to negative traits such as neuroticism and trait anxiety and the implications of such an attentional bias for negative mood and avoidance behavior (Mathews & Milroy, 1994; J.M.G. Williams et al., 1996). In contrast with neuroticism and trait anxiety, optimism has a positive pole (Lucas, Diener, & Suh, 1996; Marshall, Wortman, Kusulas, Hervig, & Vickers, 1992) that would be associated with positive mood and approach behavior (Carver & Scheier, 1998; cf. M. A. Reed & Derryberry, 1995). The effect of optimism on attentional bias for positive as well as negative information is therefore of interest. Some emotional Stroop investigations have included positive words, with inconsistent results. Stroop interference on positive words was associated either with positive mood or relaxation induction (Mogg, Kentish, & Bradley, 1993; Richards, French, Johnson, Naparstek, & Williams, 1992) or with high trait anxiety (Dagleish, 1995; Mogg & Marden, 1990). Whereas the former findings are consistent with the hypothesis that positive states create attentional bias for positive stimuli, the latter are inconsistent with that hypothesis. Such findings have led to an alternative hypothesis that the emotional Stroop is sensitive to current concern rather than emotional valence. For example, a high trait-anxious person concerned about his or her level of happiness might have an attentional bias for the word *happy*. However, tests of the correspondence between traits and stimulus valence at the positive pole have been incomplete, because trait anxiety has only a negative pole.

Optimism may, however, interact with current concern. Emotional and motivational states and traits can affect attentional bias by imparting valence or meaning to neutral stimuli. For example, the neutral word *legs* has threatening meaning to a person with a spider phobia and therefore creates Stroop interference. For a pessimistic student, the affectively neutral word *book* may have threatening meaning. A relationship between optimism and reaction to current concern stimuli is likely to be strongest when optimism specific to the concern is assessed (Aspinwall & Brunhart, 1996; Segerstrom et al., 1998).

Finally, it is possible that traits such as optimism create attentional bias only to the degree that they predispose one to more transient affective states. Bower (1994) posited that current affective state affects cognitive processes such as attention and memory, with positive emotions directing cognitive resources toward pleasant stimuli and negative emotions directing cognitive

resources toward unpleasant stimuli. The relationship between optimism and better adjustment raises the possibility that mood could confound optimism effects. However, although anxious mood has affected emotional Stroop performance, it has not consistently mediated effects of trait anxiety or experimentally manipulated stress (e.g., Mogg, Mathews, Bird, & Macgregor-Morris, 1990).

In the present study, the emotional Stroop task was used to investigate the relationship between optimism and unconscious attentional bias for positive, negative, and current-concern stimuli. It was predicted that dispositional, generalized optimism would be positively related to attentional bias for positive emotional stimuli and negatively related to attentional bias for negative emotional stimuli and that these relationships would persist after controlling for trait anxiety and current mood. It was also predicted that academic optimism would be negatively related to attentional bias for academic stimuli because such stimuli would be appraised as less threatening but would not relate to negative and positive emotional stimuli after controlling for dispositional optimism.

Spontaneous skin conductance responses were measured in each condition as a reflection of sympathetic nervous system (SNS) arousal. Cognitive influences on physiological systems and health are often presumed to be mediated by conscious coping, affect, or both; however, not all investigations have found evidence for such mediation (G. M. Reed et al., 1994; Segerstrom et al., 1998). Unconscious processing may have physiological correlates; for example, skin conductance response amplitude was increased by priming discrepancies between actual and ideal or "ought" self-concepts (Higgins, 1989). Skin conductance is a measure of SNS activity and is sensitive to orienting reactions and the psychological qualities of stimuli, including emotional content, threat, and current concern (Barger, Kircher, & Croyle, 1997; Dawson, Schell, & Filion, 1990; Nikula, Klinger, & Larson-Gutman, 1993). Furthermore, SNS activity could help explain optimism's effects on the cardiovascular and immune systems, because the SNS plays an important role in regulating both.

METHOD

Development of Experimental Stimuli

Pretesting was used to identify emotionally positive and negative words as well as words that were rated as emotionally neutral but were identified with college studies, a current concern for the present sample of college students. Nine undergraduate students rated 127 words selected in four a priori categories: positive, negative, academic, and tool. Positive and negative words provided valenced stimuli, academic words provided unvalenced current-concern stimuli, and tool words provided unvalenced control stimuli. The use of the tool category provided a baseline against which to calculate increased latency (interference). The semantic relationships among the tool words controlled for interference resulting from repeated presentation of semantically related words. Positive and negative words were taken from MacLeod and Rutherford (1992) and Dagleish (1995), and additional words were generated from a thesaurus. Academic and tool words were similarly generated from thesaurus entries (*Roget's International Thesaurus*, 1977). Words were presented in either alphabetical or reverse alphabetical order. If the student did not understand the word's meaning, it was to be crossed out and not rated. Students were instructed to rate each word on how positive the word was using a scale that ranged from 1 (*very negative*) to 7 (*very positive*). Students were then asked to indicate if the word was an academic word (i.e., "describes some aspect of studying at a university") or a tool word (i.e., "describes some aspect of tools").

Based on these ratings, words in each category were selected that (a) had 100% comprehension, (b) maximized valence (for positive and negative words) or minimized valence (for academic and tool words), (c) minimized valence range, and (d) maximized correct classification. Word length was matched across categories. Word frequency in English was described by the Standard Frequency Index (SFI) (Carroll, Davies, & Richman, 1971); the four groups were not significantly different from each other in an omnibus test, $F(3, 36) = 2.44$, $p > .05$, or in Tukey's honestly significant difference (HSD) post hoc tests of all pairwise comparisons. Table 1 gives the selected words with the list's average valence rating, standard deviation, average classifications, and mean SFI.

Participants

Personality measures were administered to all 1st-year undergraduates enrolled in an introductory psychology course. Students were then recruited under separate cover for an experiment in "Mental Effort and its Effects." Participation was limited to 1st-year undergraduates to roughly equate academic concerns. Fifty students enrolled and participated in the study. Each was given one 1/2-hour experiment credit toward a class requirement. One participant was dropped from analyses due to outlying values on several Stroop task completion times ($z > 3.0$); another participant was dropped from analyses due to outlying values on several questionnaire measures ($z > 3.0$). Therefore, final analyses were performed on data from 48 participants.

TABLE 1: Stimuli for Stroop Task

	Positive Words	*Negative Words*	*Academic Words*	*Tool Words*
	enjoy	germs	class	knife
	smile	loser	notes	spoon
	adored	deadly	grades	shovel
	achieve	failure	lecture	forceps
	prosper	hateful	seminar	spatula
	triumph	painful	student	stapler
	glorious	downfall	freshman	scissors
	progress	violence	memorize	tweezers
	affection	malicious	professor	corkscrew
	accomplish	infectious	assignment	silverware
Valence rating	6.0	1.9	4.2	4.0
Valence *SD*	0.6	0.8	0.8	0.2
Classification as academic	33.2%	16.5%	98.0%	6.6%
Classification as tool	5.5%	6.6%	13.2%	88.0%
SFI	49.1 (7.0)	43.0 (6.5)	48.7 (10.5)	39.4 (12.5)

NOTE: SFI = Standard Frequency Index. Valence was rated from 1 = *very negative* to 7 = *very positive*.

Measures

Dispositional optimism. Dispositional, generalized optimism was measured with the 10-item Life Orientation Test–Revised (LOT-R) (Scheier, Carver, & Bridges, 1994). The LOT-R is a self-report measure of generalized outcome expectancies (e.g., "In uncertain times, I usually expect the best"). Six items measure expectancies and four are fillers. The LOT-R has acceptable internal consistency (.78) and construct validity with regard to related constructs such as neuroticism, self-esteem, and self-mastery in undergraduate students (Scheier et al., 1994).

Trait anxiety. Trait anxiety was included as a covariate of optimism that also has been related to performance on the emotional Stroop task and therefore was a potential confound. Trait anxiety was measured with the 20-item Trait version of the State-Trait Anxiety Inventory (STAI-Form Y) (Spielberger, 1983). This scale, although designed to measure proneness to state anxiety, also reflects a predisposition to all types of negative mood, that is, negative affectivity (Watson & Clark, 1984). It has acceptable internal consistency (.92) in young adult samples (Spielberger, 1983).

Academic optimism. Academic optimism was measured with a 10-item scale designed to measure expectancies for academic success (e.g., "It's unlikely that I will fail") and keyed to the 1st year of college. The scale demonstrated acceptable internal reliability (.86-.91) and construct validity with regard to dispositional optimism, negative mood, and standardized admission test scores in 1st-year law students (Segerstrom et al., 1998) and in a random sample of 300 1st-year undergraduates from a larger pool who completed screening measures. The experimental sample did not differ from this larger sample in mean academic optimism, $t(345) = 0.70$, $p > .48$.

Mood. State affect was included as a covariate of optimism that also has been related to performance on the emotional Stroop task and therefore was a potential confound. Daily mood was measured with the 20-item Positive and Negative Affectivity Scale (PANAS), a measure of positive and negative mood states that can be administered with different instruction sets for different periods of time. The same-day instruction set was used. Under this set, the scale has acceptable internal consistency (.87-.90) and convergent validity with other mood measures in undergraduate students (Watson, Clark, & Tellegen, 1988).

Emotional Stroop task. In this task, participants were asked to ignore word meanings and name ink colors aloud as quickly as they could. Four cards were used to present positive, negative, academic, and tool stimuli, respectively (see Table 1). There is evidence that Stroop effects are most potent when emotional stimuli are blocked rather than randomized (Richards et al., 1992). On each card, 90 words were printed in sans serif capital letters 2 cm high. Words were presented in random order within blocks of 10, and each word was presented a total of three times in each color (red, green, or blue). Word order and color were restricted so that no word appeared twice in a row and no color appeared three times in a row. Stroop interference, as a measure of attentional bias, is response latency for stimuli of interest (in this case, positive, negative, and academic words) relative to control stimuli (in this case, tool words).

Skin conductance responses. Spontaneous skin conductance responses were measured from two Ag-AgCl electrodes placed on the volar surface of the middle phalanges of the second and third fingers of the nondominant hand. A Biopac psychophysiology system (GSR100B galvanic skin response transducer) with Acknowledge software (Santa Barbara, CA) was used to gather and store skin conductance responses (SCR), which were defined as minimum response amplitude of 0.05 within 1 to 4 seconds (Dawson et al., 1990). SCR frequency was coded as number of responses and SCR amplitude was coded as maximal change within 4 seconds. Two SCR coders showed acceptable agreement on number of responses ($r = .88$) and mean amplitude ($r = .95$) on a subset of data from 12 participants.

Procedure

After arriving at the experiment site, participants were informed as to the procedure and gave informed

consent. Electrodes were attached as described above. They were asked to relax for 1 minute while baseline SCRs were recorded. Following baseline measurements, they were presented with a sample card with the words *who*, *what*, *where*, *when*, and *why* and instructed to name the ink colors of the words as quickly as possible. When it was clear that the participant understood the task, the four cards were administered in counterbalanced order. Time to complete each card was measured with a handheld chronometer and delimited on computerized skin conductance recordings. The chronometer and computer measures correlated > .99 and so were averaged to give a single measure of completion time. Daily mood records were administered in counterbalanced order, with half of the participants completing the mood record before the task and half completing it after.

Data Analysis

The primary analysis examined the effects of generalized and academic optimism on time to color-name three types of stimuli (positive, negative, and academic words) after controlling for the time to color-name the control stimuli (tool words). This analysis employed a general linear model (SAS PROC GLM) with stimulus type as a repeated measure, generalized optimism and academic optimism as continuous independent variables, and time to color-name control stimuli as a covariate. Analyses including academic optimism used generalized optimism as a covariate. The effect size η (eta) is given for all reported effects. η may be interpreted in the same manner as *r*: Effect sizes of .1 are considered small; .3, medium; and .5, large (Cohen, 1987).

Two types of secondary analysis were also performed. First, simple main effects were described with effect size estimates (*r*). In the case of simple main effects of optimism on different stimulus types, partial correlations were used to describe simple main effects. In the case of simple main effects of card type at different levels of optimism, *t* tests comparing stimulus types were performed at three levels of optimism: pessimism (mean item score at or below the response scale midpoint of 3; $n = 6$), moderate optimism (mean item score between 3 and 4, including 4, $n = 27$), and high optimism (mean item score between 4 and 5, $n = 15$). In the interest of presenting all effect sizes in the same metric, *t* values were converted to *r* as a measure of effect size (Rosenthal & Rosnow, 1984). Where appropriate, effect sizes were represented as positive when positive words had higher values than negative words and vice versa.

In the second secondary analyses, trait anxiety and same-day mood were added as covariates in the primary model to rule out confounding. The model controlled for main effects of covariates as well as interactions between covariates and stimulus type.

Skin conductance data were modified prior to analysis. SCR number was related to trial number ($r = -.18$), indicating some habituation across the four cards regardless of content. SCR number was therefore residualized by regressing on trial number. Furthermore, to avoid a spurious relationship between Stroop interference and SCR number, the residualized SCR numbers were then divided by trial time to yield residualized SCR rate. SCR magnitude was not related to trial number ($r = -.04$) and, because expressed as a mean, was not susceptible to confounding with trial time. Two individuals were outliers ($z > 3.0$) with regard to SCR magnitude on all trials (although not at baseline), and their outlying values were reduced to the next highest score. Finally, one individual was an outlier ($z > 3.0$) on two trials with regard to SCR rate reactivity (change from the control trial) and was eliminated from SCR analyses.

The first analysis examined the relationship between optimism and SCR rate and mean magnitudes during the three stimulus trials (positive, negative, and academic) after controlling for SCR rate and mean magnitude during baseline and during the control trial (tool). Secondary analyses were performed as described above. Except where indicated, α was set at .05.

RESULTS

Relationships among questionnaire measures. Questionnaire measures correlated as expected. The optimism measures were significantly positively correlated with each other and negatively correlated with trait anxiety. The correlation between dispositional optimism and trait anxiety was identical to that reported in the LOT-R validation sample ($r = -.59$) (Scheier et al., 1994). Negative and positive mood were only modestly correlated with each other; correlations with optimism and trait anxiety were in the expected directions, although modest (see Table 2). Marshall and colleagues (1992) described higher correlations between the LOT and positive and negative affect on the PANAS, ranging between –.17 and .37. However, they assessed mood over a longer time frame. In general, personality will be more highly correlated with measures that are less determined by short-term influences such as recent interactions. Therefore, mood over multiple days will be more highly correlated with personality than is mood on a single day (Epstein, 1979).

Optimism and Stroop interference. In the full multivariate model described above, there was a tendency toward a main effect of stimulus type on Stroop interference, $F(2, 88) = 2.43$, $p < .10$, $\eta = .23$. After applying a Bonferroni correction for multiple comparisons ($\alpha = .008$), all conditions were compared pairwise. Negative words took

TABLE 2: Correlations Among Personality and Mood Measures

	1	*2*	*3*	*4*	*5*
1. Dispositional optimism	—	–.59*	.45*	.04	–.08
2. Trait anxiety		—	–.57*	–.25	.25
3. Academic optimism			—	.09	–.28
4. Positive mood				—	.17
5. Negative mood					—

*$p < .05$.

longest to color-name (567 ms, *SE* = 11 ms) and therefore elicited the greatest degree of Stroop interference relative to control words (539 ms, *SE* = 11 ms); $t(47) = 3.27$, $p < .008$. Positive words also created significant Stroop interference (564 ms, *SE* = 12 ms, vs. 539 ms, *SE* = 11 ms), $t(47) = 2.81$, $p < .008$. Valenced stimuli, therefore, created Stroop interference. Nonvalenced academic stimuli created some Stroop interference but not to the point of statistical significance after Bonferroni correction (553 ms, *SE* = 11 ms, vs. 539 ms, *SE* = 11 ms), $t(47) = 2.10$, $p < .05$.

In the repeated measures regression, there was a significant interaction between generalized optimism and stimulus type, $F(2, 90) = 3.86$, $p < .05$, $\eta = .28$. Optimism was related to more Stroop interference on positive words ($r = .23$) and less Stroop interference on negative words ($r = –.13$); the interaction arose from a significant difference between these correlations ($t = 2.60$, $p < .05$). Optimism was not related to Stroop interference on academic words ($r = .02$), and this relationship was not significantly different from those between optimism and positive or negative words. Figure 1 shows Stroop interference (average response latency per word relative to control words) for negative and positive words, which participated in the interaction; although academic words did not participate, their data are shown for purpose of comparison. Pessimists showed a large difference between negative words and positive words ($r = –.66$), with no evidence of any mean Stroop interference for positive words ($M = –2$ ms/word, $SD = 93$ ms/word).[1] High optimists showed a small to medium difference ($r = .22$) between negative and positive words, and moderate optimists showed no difference ($r = –.04$). The generalized Optimism × Stimulus Type interaction persisted after controlling for trait anxiety, $F(2, 86) = 3.07$, $p = .05$, $\eta = .26$, and same-day mood, $F(2, 84) = 3.62$, $p < .05$, $\eta = .28$.

After controlling for generalized optimism, there was a main effect of academic optimism on Stroop interference, $F(1, 42) = 4.82$, $p < .05$, such that academic optimism was moderately and inversely related to Stroop interference on valenced and current-concern words ($r = –.31$).[2] However, academic optimism was not related to Stroop interference on control words ($r = .04$, $p > .05$).

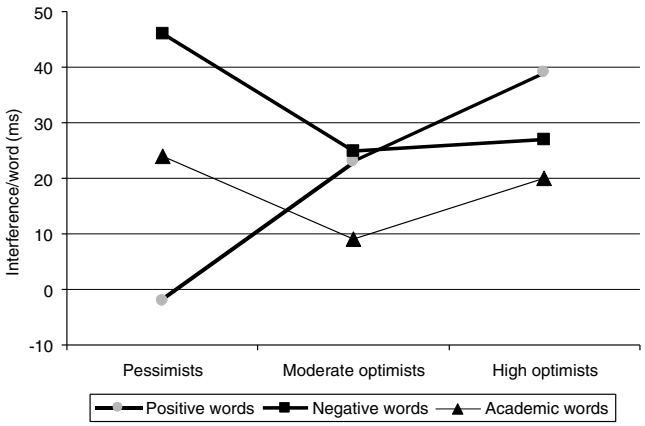

Figure 1 **Stroop interference (ms/word) on negative, positive, and academic words for pessimists (mean item score < 3), moderate optimists (mean item score between 3 and 4), and high optimists (mean item score between 4 and 5).**

There was no interaction between academic optimism and stimulus type, $F(2, 88) = .01$, $\eta = .02$. The main effect of academic optimism persisted after controlling for trait anxiety, $F(1, 43) = 4.10$, $p < .05$, $\eta = .30$, and was only slightly reduced after controlling for same-day mood, $F(1, 42) = 3.50$, $p < .10$, $\eta = .28$.

Effects on SCRs. The SCR rate was significantly elevated in all trials compared with baseline (after Bonferroni correction, $\alpha = .013$, $p < .01$). In the full multivariate model, there was a tendency toward a significant effect of stimulus type on SCR rate, $F(2, 41) = 2.59$, $p < .10$, $\eta = .33$. Although valenced stimuli tended to elicit faster rates than unvalenced stimuli, there were no significant pairwise differences. Unlike SCR rate, SCR magnitude did not significantly increase above baseline during any trial.

There was a significant interaction between generalized optimism and stimulus type in predicting SCR rate, $F(2, 84) = 3.99$, $p < .05$, $\eta = .29$. Generalized optimism was related to small increments in SCR rates during positive ($r = .10$) and academic ($r = .11$) stimuli and to a moderate decrement in SCR rate during negative stimuli ($r = –.31$). The latter correlation was significantly different from both of the former: from positive, $t(43) = 2.39$, $p < .05$, and from academic, $t(43) = 2.58$, $p < .05$. Figure 2 shows change in SCR rate during negative, positive, and academic words relative to control words. There was a large difference between pessimists' high SCR rate during negative words and lower rates during positive ($r = –.61$) and academic ($r = –.74$) stimuli. High optimists had small differences between their low SCR rate during negative words and their higher rates during positive ($r = .20$) and academic ($r = .10$) stimuli. SCR rate during negative stimuli did not differ substantially from positive

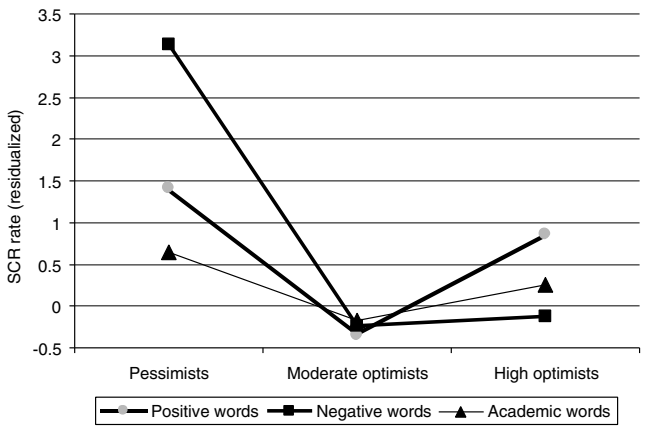

Figure 2 **Change in nonspecific skin conductance response rate during negative, positive, and academic words relative to control words for pessimists (mean item score < 3), moderate optimists (mean item score between 3 and 4), and high optimists (mean item score between 4 and 5).**

stimuli ($r = -.09$) or academic stimuli ($r = .02$) for moderate optimists. The generalized Optimism × Stimulus Type interaction was reduced somewhat after controlling for trait anxiety, $F(2, 82) = 2.12$, $p > .05$, $\eta = .22$ (although note that the Trait Anxiety × Stimulus Type interaction did not itself reach significance even without controlling for generalized optimism, $F[2, 84] = 1.92$, $p > .05$, $\eta = .21$). The generalized Optimism × Stimulus Type interaction persisted after controlling for same-day mood, $F(2, 80) = 3.70$, $p < .05$, $\eta = .29$. Generalized optimism did not predict SCR magnitude, and academic optimism was not related to SCR rate or magnitude after controlling for generalized optimism.

DISCUSSION

Bruner (1957) noted, "Some people are readier to expect and therefore quicker to perceive the least desirable event among an array of expected events, and others the most desired" (p. 144). The present study examined the role of generalized positive expectations about the future—optimism—in attentional bias for positive and negative stimuli. Consistent with Bruner's observation, as optimism increased, attentional bias for positive stimuli increased and attentional bias for negative stimuli decreased. These differences were observed using the emotional Stroop task, a paradigm that is interpreted to primarily measure unconscious, automatic attentional bias.

The effect of optimism is most obvious in the relative attentional bias for positive versus negative stimuli. Among the pessimistic participants, there was an attentional bias for negative stimuli (47 msec interference compared with usual emotional Stroop effects of 30 to 40 msec) (Matthews & Harley, 1996) but no attentional bias for positive stimuli. Among the moderately optimistic, attentional biases for negative and positive stimuli were approximately equal, and among the highly optimistic, attentional bias for positive stimuli slightly exceeded that for negative stimuli. However, even among the highly optimistic, there was an attentional bias for negative stimuli that probably has adaptive value. Attending to threats in the environment allows one to fight, flee, or activate coping resources early, before threats become more severe. It has been proposed that optimists, by virtue of positive expectancies, do not adequately attend to threats, predisposing them to disappointment when things go wrong and, perhaps more seriously, a failure to take precautions or prevent negative outcomes (Tennen & Affleck, 1987). The present results suggest that optimists have attentional biases for both negative and positive stimuli. Although optimists had a much greater bias for positive material than did pessimists (by about 40 msec), and their bias for negative stimuli was somewhat less than that of pessimists (by about 20 msec), the consequence was more balance in attentional bias compared with pessimists. The group with the most balanced responses was, in fact, moderately optimistic.

What is the effect of unconscious attentional biases on the conscious lives of optimists and pessimists? In the realm of psychopathology, attentional bias for threat is thought to lead to cognitive preoccupation with threatening stimuli, so that spider phobia might be associated with inability to disengage attention from a web on one's office ceiling or to dismiss thoughts about the current location of the spider (Wells & Matthews, 1996; J.M.G. Williams et al., 1996). Given the same set of environmental stimuli, therefore, a more pessimistic individual might be preoccupied only with the negative or threatening aspects of the environment and overlook the positive or encouraging aspects. On the other hand, a more optimistic individual would be more likely to attend to and process both positive and negative aspects of the environment. Optimists are more likely than pessimists to reinterpret negative events in a positive way and to find meaning or growth in stressful experiences (Davis, Nolen-Hoeksema, & Larson, 1998; Park, 1998; Scheier et al., 1986). Presumably, attention to positive aspects of a stressful situation is a necessary condition for these processes. Attending to positive aspects increases the probability that they will be incorporated into an understanding of the situation, and such incorporation seems the essence of positive reinterpretation. Furthermore, attending to signs of progress toward goals is likely to enhance active pursuit of those goals and decrease disengagement and avoidance (Carver & Scheier, 1982, 1998).

Consequences of attentional bias can also result from the conscious ways in which individuals subsequently attempt to think about their environment. For example, Mathews and Milroy (1994) hypothesized that automatic detection of threatening stimuli is followed by intentional attempts to avoid further processing. Therefore, increased automatic attention to negative stimuli increases intentional avoidance of those stimuli. This paradox also may apply to optimism and pessimism: Whereas pessimists in this study had greater attentional bias for negative stimuli than did optimists, Aspinwall and Brunhart (1996) found that pessimism predicted decreased reading time for risk-related information. These results are consistent with pessimists' greater endorsement of cognitive avoidance as a conscious coping strategy compared with optimists (e.g., Scheier et al., 1986). Unfortunately for pessimists, conscious avoidance is ineffective and likely leads to intrusions of the avoided thoughts (Wegner, 1989). One could hypothesize the following cognitive concomitants of optimism and pessimism: Pessimists' attention is drawn to negative information, whereas optimists' attention is drawn to both negative and positive information. Consequently, the pessimist tries to avoid negative thoughts but finds that such thoughts intrude in consciousness and trigger rumination (Freeston & Ladouceur, 1993; Freeston, Ladouceur, Thibodeau, & Gagnon, 1991). The optimist, on the other hand, processes both negative and positive information and may even deliberately pay attention to negative information that is relevant to future well-being (Aspinwall & Brunhart, 1996).

Optimism was also related to physiological responses during the emotional Stroop task. Pessimism was associated with faster SCR rates during negative stimuli, suggesting that pessimists' SNS activity was greater than that of optimists while processing negative information. This may be a function of increased orienting to the stimuli, more threat perception, or more activated emotions, any of which could influence SCR rate (Dawson et al., 1990). Unlike attentional bias, the relationship between optimism and SNS activity seemed to be limited primarily to negative stimuli. One possibility is that SNS activity in this case primarily reflected threat appraisal that would have more likely been applied to negative stimuli and would have been more likely to be employed by pessimists. The relationship between optimism and lower SNS activation during processing suggests a mechanism for links between cognitive constructs such as optimism and physiological outcomes related to the cardiovascular and immune systems. It should be noted that this effect was strongest among the most pessimistic participants, who constituted only 13% of the sample, and so it will be important to replicate this effect. It is possible that physiological effects will be observed only in the tail(s) of the optimism distribution (cf. the relationship between inhibited temperament and physiology; Kagan, 1994).

With regard to the Stroop task itself, there was stronger support for the valence hypothesis than the current concern hypothesis. Unvalenced academic stimuli did not create emotional Stroop interference and were not related to generalized or academic optimism. Academic optimism was associated with less Stroop interference for all types of stimuli, but this may be an effect of intelligence, with more intelligent individuals both more academically optimistic and less cognitively susceptible to Stroop interference effects. There are at least two potential explanations for failure of the academic optimism scale to predict emotional Stroop interference. First, because the academic optimism scale was administered weeks to months before the Stroop testing, participants' expectancies might have changed in the interim. However, this scale has shown reasonable test-retest reliability in professional students over a 2-month period ($r = .66$) (Segerstrom et al., 1998). Second, optimism may only predict emotional Stroop interference for affectively valenced stimuli. Furthermore, the relationship between optimism and attentional bias due to valence may be different for general and current-concern stimuli. Because all current-concern stimuli were neutral in the present study, such a possibility could not be tested. Future research should cross-stimulus current concern and valence in the Stroop paradigm while examining optimism relevant to the current concern (cf. Aspinwall & Brunhart, 1996).

The differences between trait anxiety and dispositional, generalized optimism have been the focus of several investigations, with some authors concluding that the LOT is a reverse-scored measure of neuroticism or trait anxiety (Smith, Pope, Rhodewalt, & Poulton, 1989; D. G. Williams, 1992) and others concluding that it measures a distinct construct (Lucas et al., 1996; Marshall et al., 1992; Scheier et al., 1994). The present results tend to support the latter view, because controlling for trait anxiety did not account for the effect of optimism on attentional bias and only partially accounted for the effect on SCR rate. Furthermore, the relationship between optimism and attentional bias did not appear to be mediated by same-day mood. It is possible that attentional biases are developed over long periods of time and, therefore, daily fluctuations in mood affect this process less than long-term schemas, expectancies, affective tendencies, or some combination thereof.

Finally, the relationship between optimism and attentional bias is likely to be dynamic, and causality will likely run in both directions. This dynamic process suggests the possibility of intervention to change the nature or direction of the spiral. Changing involuntary cognition is the basis of Beck's cognitive therapy for depres-

sion, which focuses on accessing and remodeling automatic negative thoughts (Beck, Rush, Shaw, & Emery, 1979), and Riskind and colleagues (Riskind, Sarampote, & Mercier, 1996) reported using cognitive therapy to increase the frequency of positive cognitions and optimistic beliefs. Involuntary cognition is not thought to be entirely inaccessible—it may be affected by rehearsal and other voluntary strategies—and so may form another point of intervention in efforts to promote optimistic expectancies and their positive concomitants (Cameron & Nicholls, 1998; Riskind et al., 1996).

People who are higher in dispositional, generalized optimism are more likely to characterize themselves as effective copers and happy and healthy people (Scheier & Carver, 1992). These same people may have unconscious or automatic cognitive processes on which they are unable to report but that may still have important affective and behavioral correlates (Bargh & Chartrand, 1999; Compas et al., 1997). One such process is attentional bias: These data suggest that pessimists are much more likely to attend to negative than positive aspects of their environment, whereas optimists attend to both equally or favor positive aspects. Because such differences potentially contribute to affect, behavior, conscious cognition, and physiology, it will be important to continue to include unconscious and automatic processing in the optimism constellation.

NOTES

1. For purposes of comparison, moderate optimists did show interference on positive words: $M = 23$ ms/word, $SD = 57$ ms/word, which was significantly different from 0, $t(26) = 2.12$, $p < .05$.

2. Note that in the case of this main effect, η and r yield the same result.

REFERENCES

Aspinwall, L. G., & Brunhart, S. M. (1996). Distinguishing optimism from denial: Optimistic beliefs predict attention to health threats. *Personality and Social Psychology Bulletin, 22*, 993-1003.

Aspinwall, L. G., & Taylor, S. E. (1992). Modeling cognitive adaptation: A longitudinal investigation of the impact of individual differences and coping on college adjustment and performance. *Journal of Personality and Social Psychology, 63*, 989-1003.

Barger, S. D., Kircher, J. C., & Croyle, R. T. (1997). The effects of social context and defensiveness on the physiological responses of repressive copers. *Journal of Personality and Social Psychology, 73*, 1118-1128.

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54*, 462-479.

Beck, A. T., Rush, A. J., Shaw, B. F., & Emery, G. (1979). *Cognitive therapy of depression*. New York: Guilford.

Bower, G. H. (1994). Some relations between emotion and memory. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions*. New York: Oxford University Press.

Bruner, J. S. (1957). On perceptual readiness. *Psychological Bulletin, 64*, 123-152.

Cameron, L. D., & Nicholls, G. (1998). Expression of stressful experiences through writing: Effects of a self-regulation manipulation for pessimists and optimists. *Health Psychology, 17*, 84-92.

Carroll, J. B., Davies, P., & Richman, B. (1971). *The American heritage word frequency book*. Boston: Houghton Mifflin.

Carver, C. S., Pozo, C., Harris, S. D., Noriega, V., Scheier, M. F., Robinson, D. S., Ketcham, A. S., Moffat, F. L., & Clark, K. C. (1993). How coping mediates the effect of optimism on distress: A study of women with early stage breast cancer. *Journal of Personality and Social Psychology, 65*, 375-390.

Carver, C. S., & Scheier, M. F. (1982). Control theory: A conceptual framework for personality-social, clinical, and health psychology. *Psychological Bulletin, 92*, 111-135.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York: Cambridge University Press.

Chang, E. C. (1998). Dispositional optimism and primary and secondary appraisal of a stressor: Controlling for confounding influences and relations to coping and psychological and physical adjustment. *Journal of Personality and Social Psychology, 74*, 1109-1120.

Cohen, J. (1987). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum.

Compas, B. E., Connor, J., Osowiecki, D., & Welch, A. (1997). Effortful and involuntary responses to stress: Implications for coping with chronic stress. In B. H. Gottlieb (Ed.), *Coping with chronic stress*. New York: Plenum.

Dagleish, T. (1995). Performance on the emotional Stroop task in groups of anxious, expert, and control subjects: A comparison of computer and card presentation formats. *Cognition and Emotion, 9*, 341-362.

Davis, C. G., Nolen-Hoeksema, S., & Larson, J. (1998). Making sense of loss and benefiting from the experience: Two construals of meaning. *Journal of Personality and Social Psychology, 75*, 561-574.

Dawson, M. E., Schell, A. M., & Filion, D. L. (1990). The electrodermal system. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of psychophysiology: Physical, social, and inferential elements*. New York: Cambridge University Press.

Epping-Jordan, J. E., Compas, B. E., Osowiecki, D. M., Oppedisano, G., Gerhardt, C., Primo, K., & Krag, D. N. (1999). Psychological adjustment in breast cancer: Processes of emotional distress. *Health Psychology, 18*, 315-326.

Epstein, S. (1979). The stability of behavior: I. On predicting most of the people much of the time. *Journal of Personality and Social Psychology, 37*, 1097-1126.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition* (2nd ed.). New York: McGraw-Hill.

Freeston, M. H., & Ladouceur, R. (1993). Appraisal of cognitive intrusions and response style: Replication and extension. *Behaviour Research and Therapy, 31*, 185-191.

Freeston, M. H., Ladouceur, R., Thibodeau, N., & Gagnon, F. (1991). Cognitive intrusions in a non-clinical population: I. Response style, subjective experience, and appraisal. *Behaviour Research and Therapy, 29*, 585-597.

Helton, W. S., Dember, W. N., Warm, J. S., & Matthews, G. (1999). Optimism, pessimism, and false failure feedback: Effects on vigilance performance. *Current Psychology: Developmental, Learning, Personality, Social, 18*, 311-325.

Higgins, E. T. (1989). Knowledge accessibility and activation: Subjectivity and suffering from unconscious sources. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thought* (pp. 75-123). New York: Guilford.

Kagan, J. (1994). *Galen's prophecy: Temperament in human nature*. New York: Basic Books.

Kahneman, D. (1999). Objective happiness. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology*. New York: Russell Sage.

Lucas, R. E., Diener, E., & Suh, E. (1996). Discriminant validity of well-being measures. *Journal of Personality and Social Psychology, 71*, 616-628.

MacLeod, C., & Rutherford, E. M. (1992). Anxiety and the selective processing of emotional information: Mediating roles of awareness, trait and state variables, and personal relevance of stimulus materials. *Behaviour Research and Therapy, 30*, 479-491.

Marshall, G. N., Wortman, C. B., Kusulas, J. W., Hervig, L. K., & Vickers, R. R. (1992). Distinguishing optimism from pessimism:

Relations to fundamental dimensions of mood and personality. *Journal of Personality and Social Psychology, 62*, 1067-1074.
Mathews, A., & Milroy, R. (1994). Processing of emotional meaning in anxiety. *Cognition and Emotion, 8*, 535-553.
Matthews, G., & Harley, T. A. (1996). Connectionist models of emotional distress and attentional bias. *Cognition and Emotion, 10*, 561-600.
Matthews, G., & Wells, A. (2000). Attention, automaticity, and affective disorder. *Behavior Modification, 24*, 69-93.
Mogg, K., Kentish, J., & Bradley, B. P. (1993). Effects of anxiety and awareness on color identification latencies for emotional words. *Behaviour Research and Therapy, 31*, 559-567.
Mogg, K., & Marden, B. (1990). Processing of emotional information in anxious participants. *British Journal of Clinical Psychology, 29*, 227-229.
Mogg, K., Mathews, A., Bird, C., & Macgregor-Morris, R. (1990). Effects of stress and anxiety on the processing of threat stimuli. *Journal of Personality and Social Psychology, 59*, 1230-1237.
Nikula, R., Klinger, E., & Larson-Gutman, M. K. (1993). Current concerns and electrodermal reactivity: Responses to words and thoughts. *Journal of Personality, 61*, 63-84.
Park, C. L. (1998). Stress-related growth and thriving through coping: The roles of personality and cognitive processes. *Journal of Social Issues, 54*, 267-277.
Park, C. L., Moore, P. J., Turner, R. A., & Adler, N. E. (1997). The roles of constructive thinking and optimism in psychological and behavioral adjustment during pregnancy. *Journal of Personality and Social Psychology, 73*, 584-592.
Räikkönen, D., Matthews, K. A., Flory, J. D., Owens, J. F., & Gump, B. B. (1999). Effects of optimism, pessimism, and trait anxiety on ambulatory blood pressure and mood during everyday life. *Journal of Personality and Social Psychology, 76*, 104-113.
Reed, G. M., Kemeny, M. E., Taylor, S. E., Wang, H.-Y. J., & Visscher, B. R. (1994). Realistic acceptance as a predictor of decreased survival time in gay men with AIDS. *Health Psychology, 13*, 299-307.
Reed, M. A., & Derryberry, D. (1995). Temperament and attention to positive and negative trait information. *Personality and Individual Differences, 18*, 135-147.
Richards, A., French, C. C., Johnson, W., Naparstek, J., & Williams, J. (1992). Effects of emotion manipulation and anxiety on performance of an emotional Stroop task. *British Journal of Clinical Psychology, 83*, 479-491.
Riskind, J. H., Sarampote, C. S., & Mercier, M. A. (1996). For every malady a sovereign cure: Optimism training. *Journal of Cognitive Psychotherapy: An International Quarterly, 10*, 105-117.
Roget's International Thesaurus. (4th ed.). (1977). New York: Harper & Row.
Rosenthal, R., & Rosnow, R. L. (1984). *Essentials of behavioral research: Methods and data analysis.* New York: McGraw-Hill.
Scheier, M. F., & Carver, C. S. (1992). Effects of optimism on psychological and physical well-being: Theoretical overview and empirical update. *Cognitive Therapy and Research, 16*, 201-228.
Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology, 67*, 1063-1078.
Scheier, M. F., Matthews, K. A., Owens, J. F., Magovern, G. J., Lefebvre, R. C., Abbott, R. A., & Carver, C. S. (1989). Dispositional optimism and recovery from coronary artery bypass surgery: The beneficial effects on physical and psychological well-being. *Journal of Personality and Social Psychology, 57*, 1024-1040.
Scheier, M. F., Weintraub, J. K., & Carver, C. S. (1986). Coping with stress: Divergent strategies of optimists and pessimists. *Journal of Personality and Social Psychology, 51*, 1257-1264.
Segerstrom, S. C., Taylor, S. E., Kemeny, M. E., & Fahey, J. L. (1998). Optimism is associated with mood, coping, and immune change in response to stress. *Journal of Personality and Social Psychology, 74*, 1646-1655.
Smith, T. W., Pope, M. K., Rhodewalt, F., & Poulton, J. L. (1989). Optimism, neuroticism, coping, and symptom reports: An alternative interpretation of the Life Orientation Test. *Journal of Personality and Social Psychology, 56*, 640-648.
Spielberger, C. D. (1983). *State-Trait Anxiety Inventory (Form Y).* Palo Alto, CA: Mind Garden.
Stanton, A. L., & Snider, P. R. (1993). Coping with a breast cancer diagnosis: A prospective study. *Health Psychology, 12*, 16-23.
Stone, A. A., Schwartz, J. E., Neale, J. M., Shiffman, S., Marco, C. A., Hickcox, M., Paty, J., Porter, L. S., & Cruise, L. J. (1998). A comparison of coping assessed by ecological momentary assessment and retrospective recall. *Journal of Personality and Social Psychology, 74*, 1670-1680.
Tennen, H., & Affleck, G. (1987). The costs and benefits of optimistic explanations and dispositional optimism. *Journal of Personality, 55*, 377-393.
Watson, D., & Clark, L. A. (1984). Negative affectivity: The disposition to experience aversive emotional states. *Psychological Bulletin, 96*, 465-490.
Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.
Wegner, D. M. (1989). *White bears and other unwanted thoughts.* New York: Guilford.
Wells, A., & Matthews, G. (1996). Modeling cognition in emotional disorder: The S-REF model. *Behaviour Research and Therapy, 34*, 881-888.
Williams, D. G. (1992). Dispositional optimism, neuroticism, and extraversion. *Personality and Individual Differences, 13*, 475-477.
Williams, J.M.G., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin, 120*, 3-24.

Received March 20, 2000
Revision accepted November 7, 2000