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FACING FEAR: EXPRESSION OF FEAR FACILITATES PROCESSING OF EMOTIONAL INFORMATION

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Evidence shows that manipulating the expressive component of fear can influence the processing of emotional information. Participants unobtrusively produced the expressive behaviors typical of fear, anger or happiness. Participants producing the expression of fear were faster at classifying verbal material with emotional content than participants producing the expressions of happiness or anger. These effects were especially pronounced for participants who were generally sensitive to their own bodily cues, as indicated by their degree of field-dependence measured by the Rod-and-Frame Task (Witkin & Asch, 1948). The results suggest that one way of eliciting the cognitive consequences of fear is by inducing the embodied expressive behavior.

Keywords: facial expression, fear, field-dependence, embodiment, metaphor.

Emotional processes are fundamentally "embodied." Bodily processes such as expressive behaviors and physiological changes are central components of the subjective experience of emotion. Following William James (1890), many modern theories of emotion go further and propose that bodily activities are the causes of emotional feelings. Many studies (see Cappella, 1993, for a review)

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indeed support the notion that feeling states can be induced by changes in people's bodily activities. For example, people who adopt facial expressions of emotions often report feeling the corresponding emotion (e.g., Duclos et al., 1989; Laird, 1974), and these effects can persist over extended periods of time (Schnall & Laird, 2003). Similarly, adopting a posture can result in emotional feelings, such as fear, anger, or sadness (Duclos et al., 1989).

However, some of this work has been criticized for relying on self-reports, and for being confounded by experimental demand characteristics (Tourangeau & Ellsworth, 1979). Furthermore, although effects of emotional expressions on subjective feelings have been documented extensively, it is unclear as to what extent specific emotional expressions influence the cognitive processing of emotional content.

The cognitive consequences of fear and anxiety have been well documented (Mathews & MacLeod, 1994). Chronic states of anxiety are associated with heightened sensitivity to fear-relevant information, including threatening information (MacLeod & Mathews, 1988; Richards & French, 1992), and generally emotional information (Fox, Russo, & Dutton, 2002; Martin, Williams, & Clark, 1991). Whereas this cognitive bias has been repeatedly demonstrated for clinically anxious samples, the findings have been less conclusive when inducing temporary states of fear in nonclinical samples. For example, Riemann and McNally (1995) induced elation and anxiety using a film, and presented an attentional task with words varying in emotionality and personal concern. Contrary to prediction, no effects of the mood induction were found, presumably because the mood change was not maintained throughout the experiment.

Rather than using films or other ways of inducing mood, in this study we used a different way of accessing the cognitive consequences of fear, manipulating the embodied component of fear. Recent theories of embodiment (e.g., Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005) have suggested that simulating certain aspects of an experience (e.g., the expressive behavior of an emotion) can invoke the cognitive concept of that experience. Thus, we tested whether or not a fearful expression can produce some of the cognitive consequences of fear.

Reaction time tasks requiring fast responses are often used to assess aspects of cognitive processing that are not accessible to self-reports. For example, modifications of the classic Stroop task have demonstrated that people exhibit attentional biases towards noncolor words that are personally meaningful. Specifically, patients with emotional disorders show greater response latencies for naming the ink color of words relevant to their clinical condition (see Williams, Mathews, & MacLeod, 1996, for a review). The Implicit Associations Test (IAT) also measures a person's automatic associations with certain groups of stimuli, therefore indicating implicit cognitive preferences (Greenwald, McGhee,

& Schwartz, 1998). Furthermore, lexical decision tasks have been used in classic psycholinguistic studies to capture attentional biases toward certain types of information (e.g., Meyer & Schvaneveldt, 1971).

In the current study, performance on a sentence classification task was compared for participants producing expressions of fear, happiness, and anger. The stimuli were word-strings forming emotional sentences (related to fear, happiness, and anger) and neutral sentences, and the participants' task was to indicate whether a word-string formed an English sentence or not.

We predicted that participants with a fear expression would be faster to classify stimuli that were of relevance to the primed embodied state of fear. This effect could manifest itself in one of two ways: The fear expression might produce an effect for fearful material, but not for other (e.g., happy) emotional material. In contrast, the fearful expression might enhance vigilance toward *all* emotional sentences, similar to the findings in the literature on clinical anxiety (Fox et al., 2002; Martin et al., 1991).

Individual Differences: Field-Dependence

Previous research has demonstrated individual differences in the degree to which people's emotions are "embodied." For example, some people report feeling happy when they are induced to put on a smile, whereas others do not (Laird & Crosby, 1974). This difference in response to bodily cues is stable over time and consistent across a wide variety of behaviors and feelings (e.g., Schnall, Abrahamson, & Laird, 2002; Schnall & Laird, 2003). To provide a measure of individual differences in bodily sensitivity that was independent of facial expressions, we assessed field-dependence. In general, individuals who are field-dependent rely on contextual cues from the situation, outside their bodies, whereas individuals who are field-independent rely more on internal, bodily cues. Earlier research has shown that field-independent individuals are more responsive to manipulations of their facial expressions (Duncan & Laird, 1977). The Rod-and-Frame Task (Witkin & Asch, 1948) is one of the most common measures of field-dependence. For this task, the participant sits in a completely dark room and is presented with a luminous rod surrounded by a luminous frame tilted to the left or to the right. The rod can be moved independently from the frame, and the participant's task is to adjust the rod to make it appear completely vertical. Field-dependence is measured as the extent to which the participant either relies on external cues from the contextual frame, rather than from cues of her own body, as indicated by the number of degrees that the participants' perception deviates from the true vertical. Our prediction was that the experimental manipulation of producing "embodied" facial expressions and postures should be more effective for participants who are field-independent, and thus sensitive to internal bodily cues.

Overall, the objective was to investigate the influence of the expressive behavior of fear on emotional information processing, which could result in either a specific effect for fear-relevant information, or a general effect for any emotional information. Individual differences in field-dependence were hypothesized to moderate the effect of fearful expressions on the processing of emotion-related material.

METHOD

Overview

Participants were randomly assigned to one of three experimental conditions in which they adopted the expressive behavior of fear, happiness, or anger. An elaborate cover story was administered to ensure that participants were not aware that producing an emotional expression was the focus of the experiment. While producing the expressions, participants completed a sentence classification task involving emotion metaphors. Participants producing a fear expression were expected to show greater facilitation, and thus faster response times, when making sentence classifications of stimuli relevant to fear. Individuals who were, in the Rod-and-Frame Task, identified to be relatively responsive to bodily cues were expected to show more pronounced effects of the experimental manipulation.

Participants

Sixty-two undergraduate students (41 females) identifying themselves as native speakers of English participated for $7 in compensation. The age of the participants ranged between 18 and 22, with a mean of 19.45 years. Equipment failure occurred for one male, whose data were excluded from analyses.

Stimuli

The stimuli consisted of 12 metaphors each describing fear (e.g., “she was frozen in her tracks”), happiness (e.g., “she was flying high”) and anger (e.g., “he flew off the handle”), selected from linguistic studies of metaphor (Kövecses, 2000; Lakoff & Johnson, 1980). Emotion metaphors were used because they do not contain explicit emotion words, and were less likely to direct participants’ attention to the real purpose of the study. Also, emotion metaphors are hypothesized to have a bodily basis (Lakoff & Johnson, 1980): Phrases such as “getting cold feet” when feeling afraid, or “getting hot under the collar” when feeling angry, are hypothesized to reflect physiological changes during those feelings, such as a decrease in skin temperature for fear, and an increase for anger. Because we manipulated bodily cues, it seemed especially appropriate to use “embodied” emotion metaphors.

All metaphors were pretested to ensure comprehensibility, and matched for number of letters, sentence length and word frequencies. For standardization purposes, all expressions were transformed into third-person, past tense statements. Sentences had the basic form of "pronoun (he/she) + verb + object." Twelve neutral nonmetaphorical sentences were constructed by replacing one word of an emotion metaphor with a word of equal or higher word frequency. For instance, "she snapped at him" (anger metaphor) was transformed into "she glanced at him" (control sentence). Thus, there were 48 different stimuli: 36 emotion metaphors (12 for each emotion category) and 12 control sentences. Word frequencies did not differ across word types, $F(3, 47) = .25$, $p < .86$.

Forty-eight nonsentences were constructed by pseudorandomly combining the words that formed the target stimuli (e.g. "she him snapped at"), and were used as filler items.

Procedure

Participants came into the laboratory individually for a study on the "influence of cranial nerve activity on cognition." Instructions indicated that contracting certain muscles would activate the cranial nerve system, and as a consequence, might improve cognitive functioning.

After providing informed consent and some demographic information, participants filled out a list of emotion rating scales for a baseline measurement of emotional feelings. Items on the scale were *relaxed, angry, happy, sad, afraid, depressed, upset,* and *confused,* and each had a 4¼-inch-long line next to it, labeled *don't feel at all* and *feel very strongly* at either end. Participants were asked to describe their feelings at the moment by marking an "X" on the part of the line that best described how strongly each emotion was felt.

Participants were then presented with word-strings on the computer and indicated whether or not they formed an English sentence by pressing one of two keys. It was emphasized to work as quickly as possible, but to not sacrifice accuracy for speed. Stimuli were presented at the center of a computer screen, in lower-case letters in Verdana font, point-size 30, on a light gray background, and remained on the screen until the response was made. The Inter-Stimulus-Interval was 2 seconds. After having pressed the key, the participant rested his/her index finger on a black button directly below the "yes" and "no" keys while waiting for the next stimulus to appear on the screen. Each participant received a different random order of the experimental stimuli. Response latencies were measured by the computer beginning with the onset of each phrase, and measurement was terminated once the participant pressed the correct button.

Each participant first received 12 practice sentences to get familiar with the procedure. After this practice trial block, the participant was informed that in order to improve performance on the task, certain cranial nerve exercises would be performed. The experimenter read the instructions to the participant and pointed out specific muscles on an anatomical chart while monitoring whether the correct muscle contractions were produced. Instructions for the contractions were based on previous studies (e.g., Duclos et al., 1989; Schnall & Laird, 2003), and were given until the participant succeeded at producing the desired expressions.

For the “Fear” expression, instructions were to raise the eyebrows while moving the head back, and letting the mouth relax and hang open a little. To accomplish a fearful posture, participants were asked to sit at the edge of the chair, draw the feet underneath the chair, and lean the upper body slightly backwards.

For the “Happiness” expression, instructions were to push the corners of the mouth up and back while opening the mouth a little. Participants were also asked to sit up straight in the chair and place the nondominant hand on the armrest, while the legs were straight in front, with knees bent, and feet right below the knees.

For the “Anger” expression, instructions were to push the eyebrows down and together while pressing the lips together. At the same time, participants placed the feet flat on the floor directly below the knees, leaned slightly forward, and clenched their nondominant hand to make a tight fist.

The participant was asked to maintain the muscle contractions while working on the sentence classification task. It was pointed out that if the contractions felt uncomfortable at any point, they should be released a little, and should never feel painful in any way. The 96 stimuli (48 sentences and 48 filler items) were presented in 6 blocks of 16 trials each, and in between blocks, the participant was asked to relax the muscles and to stretch a little, to avoid the muscle contractions from becoming too strenuous.

To obtain a measurement of emotional feelings before and after producing expressions, a second set of rating scales (the same as for the baseline rating) was given after participants completed the sentence classification task.

Subsequently, to account for individual differences regarding a person’s focus on internal vs. external cues, field-dependence was assessed using the Rod-and-Frame Task. The participant was escorted to a different room that was completely darkened. While blind-folded, the participant was seated in a chair placed eight feet away from an illuminated frame with a rod in the middle. The experimenter tilted the frame 28° to either the right or the left, and also independently tilted the rod 28° to either the right or the left. Then the participant was asked to remove the blind-fold, and the experimenter slowly rotated the rod until the participant judged its position to be completely vertical. Twelve counterbalanced trials were administered, and deviations (measured in degrees) from the vertical were recorded. Finally, in a postexperimental questionnaire participants were asked about their difficulty in producing the muscle contractions, on a rating scale ranging from 1 (*very easy*) to 5 (*very difficult*). Then participants were debriefed and dismissed.

RESULTS

FIELD-DEPENDENCE

The individual difference variable of field-dependence was computed by adding the Rod-and-Frame Task error scores for each participant, and computing absolute mean errors. Boxplots of Rod-and-Frame measurements were examined for each participant, and errors beyond 3 box lengths from the upper or lower edge of the box were excluded. Because the resulting scores were roughly normally distributed and no natural break point was identified by inspecting the histogram, a median split was performed to categorize participants into those that were field-dependent and field-independent.

SENTENCE CLASSIFICATION TASK

Errors on the sentence classification task were excluded and replaced by the mean for that stimulus. In order to reduce the impact of outliers, and because the data were positively skewed, all reaction times were log-transformed. Mean response latencies were computed for each sentence type (fear, happiness, anger, control). In order to account for individual differences in overall speed, control sentences were used as a covariate in the analysis. To justify this, an ANOVA with Expression Condition (Fear, Happiness, Anger) as independent variable and control sentences as dependent variable confirmed that the three expression conditions did not differ in their response to the control sentences, $F(2, 56) = .71$, $p < .49$.

Mean response latencies of the three emotional sentence types (fearful, angry, happy sentences) were submitted to an ANCOVA with sentence type as within-subjects factor, control sentences as covariate, and expression condition (fear, happiness, anger) and field-dependence as between-subjects factors.

A significant main effect of condition showed that the expression groups indeed differed when correctly classifying emotional sentences, $F(2, 55) = 3.20$, $p < .05$ (see Figure 1 for means).

Planned comparisons further showed that the fear condition was significantly faster than the happiness condition, $F(1, 55) = 4.69$, $p < .03$, and the anger condition, $F(1, 55) = 4.95$, $p < .03$, whereas the reaction times in the latter two conditions did not differ ($p > .95$).

There was also a significant effect of metaphor type, $F(2, 112) = 31.68$, $p < .0001$, with fastest reaction times for fear metaphors, relative to happiness metaphors, $F(1, 56) = 23.01$, $p < .0001$, and anger metaphors, $F(1, 56) = 72.39$,

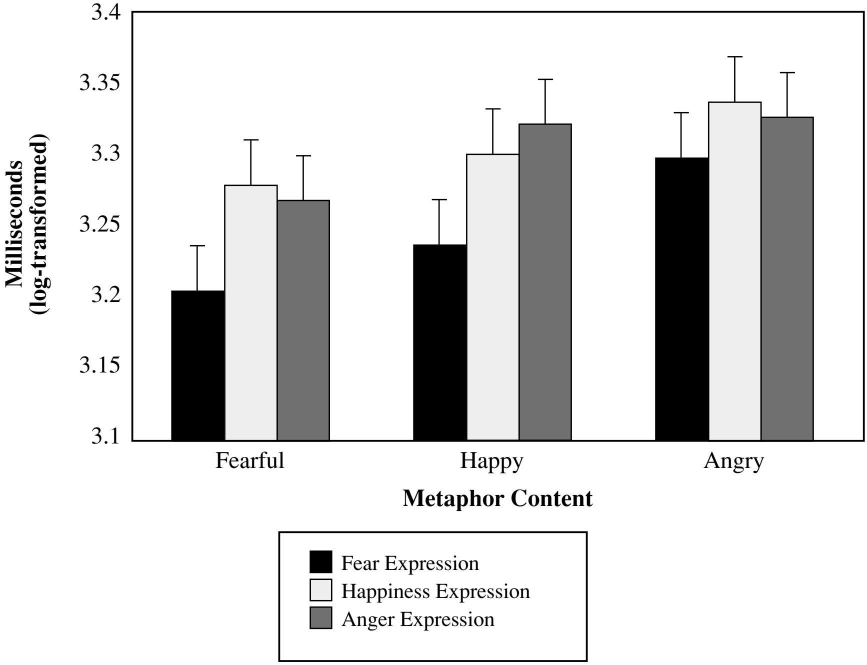

Figure 1. Mean reaction times for all participants. Error bars show standard errors of the mean.

$p < .0001$. Finally, there was a significant interaction for Field-Dependence and Metaphor Type, $F(2, 112) = 3.00$, $p < .05$, and a marginal interaction of Condition and Metaphor Type, $F(4, 112) = 2.28$, $p < .07$. There was no three-way interaction for Field-Dependence, Condition and Metaphor Type.

The prediction that field-independent individuals show more pronounced effects of the experimental manipulation was then tested using simple effects analyses, as recommended by Keppel (1991, p. 112). Indeed, field-independent participants in the fear expression condition ($M = 3.18$, $SD = .14$ log ms) were significantly faster than field-dependent participants in the fear expression condition ($M = 3.29$, $SD = .08$ log ms), $F(1, 55) = 5.44$, $p < .02$. In addition, field-independent individuals in the fear condition were faster than field-independent individuals in both the happiness expression condition ($M = 3.26$, $SD = .08$ log ms), $F(1, 55) = 7.13$, $p < .01$, and the anger expression condition ($M = 3.32$, $SD = .11$ log ms), $F(1, 55) = 7.31$, $p < .01$.

Thus, we found that producing the bodily expressions associated with fear led to a more rapid processing of sentences not only related to fear, but also sentences with other emotional content. Consistent with previous work (e.g., Schnall & Laird, 2003), the effect was especially pronounced for individuals who generally rely on bodily cues, namely field-independent participants.

Difficulty of Producing the Expressions

A potential confounding factor was differences in the difficulty of the muscle contractions across the expression conditions. To test this possibility, the rating for reported difficulty of producing the expression was analyzed in a one-way ANOVA with expression condition as factor. The three conditions did not differ, $F(2, 58) = .64$, $p < .53$. Thus, reported difficulty of producing the expressions is unlikely to account for the reported findings.

Self-Reports of Emotional Feelings

Pre- and posttest ratings of emotional feelings were examined for changes in reported feelings with repeated-measures ANOVAs with pre- and posttest rating for each emotion adjective, and Expression Condition and Field-Dependence as factors. Contrary to expectation, there was no significant interaction effect for reported changes in ratings of feeling afraid and Expression Condition, $F(2, 55) = .43$, $p < .66$, nor a three-way interaction of Feeling, Expression and Field-Dependence, $F(2, 55) = .15$, $p < .86$. No other emotion ratings showed significant changes dependent on Expression Condition, nor any other three-way interactions, all *p*s > .12.

DISCUSSION

Overall, the results from this experiment support the notion that the mere facial expression of fear can be sufficient to influence the processing of emotional information. These effects were obtained on *all* emotional material independent of specific emotional content, not only on fear-specific stimuli, consistent with previous reports on the clinical literature of anxiety (Fox et al., 2002; Martin et al., 1991). Perhaps when a person is in the vigilant state that accompanies fear, any emotional material is potentially relevant, such that negative cues signal the possibility of danger, whereas positive cues signal the absence thereof.

Several additional aspects of the findings are noteworthy. First, the effects were specific to the fear expression condition, and did not extend to the anger expression condition. Thus, it was not the case that any kind of negative bodily expression resulted in a cognitive bias. Second, no changes in participants' emotional feelings as reported before and after the experimental manipulation were found, suggesting the possibility that the results were produced by the bodily cues directly, rather than being mediated by feelings. And third, as predicted, the effects depended on whether or not a person was relatively sensitive to bodily states. Field-independent individuals showed a more pronounced facilitation effect of the fearful expression than did field-dependent individuals. Thus, consistent with previous studies, it seems some people pay more attention to their own bodily cues and are more influenced by experimental manipulations of those bodily cues (Schnall & Laird, 2003).

The Role of Feelings

At a first glance it seems surprising that there was no evidence for a mediating role of subjective feelings on effects of information processing. Participants' self-reports before and after the experimental manipulation did not differ. More specifically, participants in the fear expression condition did not report feeling more afraid, nor did participants in the happiness expression condition report feeling happier. These results seem at odds with previous studies that did find effects of producing expressive behaviors on self-reported feelings (e.g., Duclos et al., 1989; Laird, 1974).

How can this apparent discrepancy be explained? Perhaps the effects were not due to induced feelings, but instead were caused directly by the bodily expressions. Indeed, some authors argue that affective expressions, as one instantiation of affect, can have similar cognitive consequences as other affective cues (Clore & Colcombe, 2003). Supportive evidence comes from demonstrations that the smiles and frowns of politicians (Ottati et al., 1997) and colors perceived as happy and sad (Soldat & Sinclair, 2001) can have the same effects as moods. Like affective feelings, embodied expressions are representations of value, that is, of goodness and badness. Although bodily cues can induce mood under certain circumstances, they may also be considered within a broader view, recognizing that multiple representations of affective meaning can each have similar effects (cf. Clore & Schnall, 2005).

"Embodied" Emotions

As noted earlier, we used "embodied" metaphors with the objective of investigating whether or not manipulating embodied emotional expressions would have an effect on cognitive processes. The present study is, to our knowledge, one of the first studies to use embodied metaphors, while at the same time experimentally manipulating aspects of embodiment. Theories of *embodied cognition* have at their core the assumption that a great deal of abstract thought is structured and constrained by bodily concepts (e.g., Gibbs, 1994; Kövecses, 2000; Lakoff & Johnson, 1980). The current research was designed within the framework of this embodied perspective and borrowed the assumptions of an embodied approach to cognition and its metaphorical expressions. We found experimental evidence that online emotional processing, objectively measured by reaction times rather than self-reports, can be influenced by a person's bodily expression of an emotion. Our results suggest that cognitive consequences of fear are elicited when the particular instantiations of the emotion are embodied expressions rather than feelings.

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