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The Effects of Fear and Anger Facial Expressions on Approach- and Avoidance-Related Behaviors

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The facial expressions of fear and anger are universal social signals in humans. Both expressions have been frequently presumed to signify threat to perceivers and therefore are often used in studies investigating responses to threatening stimuli. Here the authors show that the anger expression facilitates avoidance-related behavior in participants, which supports the notion of this expression being a threatening stimulus. The fear expression, on the other hand, facilitates approach behaviors in perceivers. This contradicts the notion of the fear expression as predominantly threatening or aversive and suggests it may represent an affiliative stimulus. Although the fear expression may signal that a threat is present in the environment, the effect of the expression on conspecifics may be in part to elicit approach.

Explanations about the evolution and potential functions of facial expressions date back at least to Darwin (1872/1965). For instance, both fear and anger facial expressions have been hypothesized to be aversive stimuli and for this reason are often used as experimental stimuli to assess responses to threat. The anger expression ostensibly is taken to mean that the expresser is a direct threat to the perceiver. The fear expression, in contrast, is thought to signal the presence of some threat other than the expresser, perhaps alerting the perceiver to danger in the environment (Adolphs, Russell, & Tranel, 1999; Breiter et al., 1996; Morris et al., 1996; Whalen et al., 2001). Though the notion that these two expressions are aversive stimuli has intuitive appeal, to our knowledge this notion has not been directly tested. Nonetheless, neurological and physiological responses to these expressions are generally interpreted in terms of the expressions' presumed aversive significance. In the study reported here, we present data that suggest the anger expression elicits avoidance, supporting the idea that this expression is threatening. The data, however, contradict the notion that the fear expression is primarily perceived as threatening or aversive. Instead, the fear expression appears to facilitate predominantly approach from perceivers.

Approach and avoidance are the basic responses associated, respectively, with aversive and appetitive motivations (Cacioppo & Berntson, 1994; Lang, Bradley, & Cuthbert, 1997). The roots of the word *aversive* are defined by *Webster's Unabridged Dictionary* to mean "to turn away from," whereas the roots of *appetitive* signify "to go to, head for, or strive after." Thus, *aversive* means simply that which elicits avoidance, and *appetitive* does not necessarily mean "appealing" but only that which elicits approach. Appetitive and aversive motivations are thought by some to be the primary motive systems that exist in the brain and to underlie more complex emotional responding (e.g., Lang et al., 1997). From this perspective, the perception of threat is fundamentally linked to the aversive motivational system. Although not all aversive stimuli are threatening (some may be, e.g., disgusting or sad instead), threatening stimuli are, by definition, aversive (Öhman & Mineka, 2001). Therefore, any stimulus signaling potential threat is expected to activate avoidant mechanisms such as withdrawal (Cacioppo & Berntson, 1994; Lang et al., 1997).

The notion that both fear and anger facial expressions are primarily perceived as threatening would entail that both be perceived as more aversive than appetitive, and thus that both would be met with primarily avoidance-related responding. However, animal models provide a mechanism by which a fear expression might instead constitute an appetitive stimulus. Social species, like many canines and primates, use stereotyped nonverbal displays of subordination or fear to keep them from becoming targets of more dominant conspecifics' aggression (Blair, 1995; Preuschoft, 1999; Schenkel, 1967; Smith & Price, 1973). Subordination displays, in contrast to dominance displays, appear nonthreatening and appeasing and may make the organism appear smaller, weaker, more juvenile, or more affiliative (Schenkel, 1967). To *appease* is defined by *Webster's Unabridged Dictionary* as "to bring to a state of ease or content; to conciliate or satisfy." Thus, if fear expres-

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sions are perceived as affiliative and appeasing, these expressions may elicit approach rather than avoidance.

On the basis of this line of reasoning, we tested the hypothesis that anger expressions elicit avoidance from perceivers, whereas fear expressions elicit approach. To accomplish this, we used a simple motor task. It has been previously demonstrated that the perception of aversive stimuli is associated with rapid muscle extension, whereas the perception of appetitive stimuli is associated with muscle flexion (Cacioppo, Priester, & Berntson, 1993). Perceivers thus push a lever (extension) in response to aversive stimuli faster than they pull (flexion), but they pull faster than they push to appetitive stimuli (Chen & Bargh, 1999; Da Gloria, Pahlavan, Duda, & Bonnet, 1994; Foerster, Higgins, & Idson, 1998; Solarz, 1960). If both anger and fear expressions are aversive stimuli, behavioral avoidance and muscle extension should be facilitated by both kinds of expressions. If the fear expression is affiliative or appeasing, however, this expression should predominantly facilitate approach and muscle flexion.

Method

Participants

Forty-eight participants (27 women and 21 men) took part in the study. Participants who were recruited via posters placed in the psychology building were paid for their time, whereas others participated in exchange for course credit through the Psychology Department.

Materials

We used a lever (the Microsoft SideWinder) affixed to a desktop PC and the program DirectRT (Jarvis, 2004) to measure motoric approach and avoidance reaction times (RTs) to anger and fear expressions. During the experiment, the lever was positioned on the desktop directly in front of the participants. Participants were instructed not to reposition the base of the lever or hold it in their hands. The base of the lever rested on a rubber pad during the study, preventing it from sliding or moving. The lever can be moved 360°, but participants were instructed only to move it directly forward (away from themselves) or backward (toward themselves) during the experiment.[1] Participants were instructed to move the lever as far forward or backward as they were able to every time they moved it, and to move it as quickly as possible. The time after each stimulus presentation at which the lever reached its maximal point from the baseline position was recorded by the DirectRT software. DirectRT records response latencies with a precision of 10 ms.

Design and Procedure

Participants twice saw a series of the same eight anger and eight fear expressions shown by four men and four women, all showing direct eye gaze. These photographs were drawn from a validated set of photographs used in prior studies (Marsh, Adams, & Kleck, 2005; Matsumoto & Ekman, 1988). All stimulus individuals were adults, although precise age information was not available. The expressions were presented in grayscale in the center of the computer screen. Each photograph was presented at a size of approximately 6″ × 4″. The mean luminosity of the faces was 119.86 cd/m^2, and the mean contrast, computed as the standard deviation of the luminosity, was 58.53.

Each expression appeared for 2 s, during which time participants were asked to push or pull the lever, depending on the expression. The task was thus described to participants as a simple categorization task in which we would be measuring how quickly they could distinguish faces in various categories. The instructions read as follows:

> This study is a test of reaction times. At the desk at which you're sitting, you'll see a video game joystick. We are going to measure how fast you can move the joystick to categorize pictures you see on the screen. You will be categorizing people's faces. You will either push the joystick away from you or pull it toward you to indicate which category each face is in.

In one condition, participants were asked to pull the lever in response to fear expressions and to push in response to anger; in the other condition, participants were asked to push the lever in response to fear and pull in response to anger. Thus, the rate at which each participant pushed the lever to categorize, for example, anger, could be compared with the rate at which the lever was pulled when making the identical categorization in the other condition. Each expression in a series appeared on the screen immediately after the expression prior to it disappeared from the screen.

Two additional sets of photos were used as comparisons to confirm the validity of the lever task. These sets contained photos also selected to be appetitive or aversive and were presented in an identical manner to the facial expressions described above. One set of comparison stimuli included the faces of 16 men confirmed by pretesting to be recognized and admired (e.g., Mahatma Gandhi, Bill Cosby) or hated (e.g., Osama bin Laden, Adolf Hitler). A second set contained faces of 16 women who were either highly attractive (beauty pageant contestants) or disfigured (individuals with craniofacial deformities). Each of these photos was also presented at approximately 4″ × 6″ in size. The average luminosity of the hated and admired faces was 118.66 cd/m^2, and the average contrast was 64.55. For the disfigured and attractive faces, these values were 116.32 cd/m^2 and 57.44. Again, participants saw each set of faces twice; during one presentation, participants were asked to pull in response to one kind of stimulus and push to the other, and in the other condition the response pairings were reversed. The order in which each of the six series of stimulus photos (two experimental and four comparison) was presented to participants was randomized across participants, as was the order in which the individual stimulus photos within each series appeared.

Results

Anger and Fear Expressions

Incorrect responses to the anger–fear task constituted 11.7% of the total number of responses and were analyzed separately, as reported below. This error rate is typical for a recognition task

[1] To ascertain that lateral motion was minimal, we examined data from all fear and anger expression trials and confirmed that in over 99% of all recorded epochs (N = 304,552/307,200) no lateral deviation occurred. In the remaining 0.09%, lateral deviations averaged only 17% of the distance from baseline.

using fear and anger facial expressions (see Fridlund, 1994, p. 204). In addition, missed responses (failures to respond) constituted 3% of all responses. Participants appeared to have closely followed the experimenter's instructions to move the joystick as far as possible. The data showed that only 1% of the correct lever movements did not reach the joystick's apex. We performed a 2 (participant gender) × 2 (stimulus gender) × 2 (expression) × 2 (lever direction) analysis of variance (ANOVA) with repeated measures on the averages of participants' log-transformed RTs for correct responses to each type of stimulus face.

The results of this ANOVA yielded a main effect for emotional expression, $F(1, 45) = 9.21$, $p < .01$, $\gamma = .41$, such that participants responded more quickly to fear than to anger expressions in both conditions. More important, however, the predicted interaction was found for lever direction and facial expression, $F(1, 45) = 7.86$, $p < .01$, $\gamma = .39$, such that participants pushed the lever more quickly than they pulled it in response to anger expressions, $t(47) = 2.30$, $p < .05$, $r = .32$, but pulled more quickly than they pushed in response to fear expressions, $t(47) = 2.81$, $p < .01$, $r = .38$ (see Table 1).

There was also a main effect for stimulus gender, $F(1, 45) = 5.93$, $p < .05$, $\gamma = .34$, such that participants responded faster to female than to male faces. An interaction was found between stimulus gender and emotion, $F(1, 45) = 7.60$, $p < .01$, $\gamma = .38$, such that participants responded (both pushing *and* pulling) to women expressing fear faster than to any other gender–emotion combination (female anger: $t(47) = 3.71$, $p < .01$; male fear: $t(47) = 3.20$, $p < .01$; male anger: $t(47) = 3.21$, $p < .01$), but response times among these three latter types of stimuli did not significantly differ.

No main effect was found for the gender of the participant, $F(1, 45) = 0.02$, *ns*; for the interaction between participant gender and lever direction, $F(1, 45) = 0.13$, *ns*; or for the interaction among participant gender, emotion, and lever direction, $F(1, 45) = 0.01$, *ns*. A marginally significant effect was found between emotion and the gender of the participant, $F(1, 45) = 3.06$, $p = .09$, $\gamma = .25$, such that female participants responded more quickly to fear than anger, $t(26) = 2.91$, $p < .01$, $r = .50$, but male participants did not, $t(20) = 1.07$, $p = .30$, $r = .23$. (See Table 2 for the means and standard deviations of all responses by gender of participant and stimulus.)

No main effect for lever direction was found, $F(1, 47) = 0.46$, *ns*. As can be seen in Table 1, the mean response times across all stimuli for pushing and pulling were nearly identical. This suggests that neither movement was intrinsically easier than the other. No other main effects or interactions were found to be significant. For example, no other interactions with lever direction (all *p*s > .20) or with participant gender (all *p*s > .15) approached significance.

Additionally, an analysis of the error rates, as measured by a 2 (lever direction) × 2 (expression) chi-square analysis, suggests that there was a trend for participants to make more errors when asked to pull in response to anger expressions ($n = 60$) than push ($n = 54$), but to make more errors when asked to push in response to fear expressions ($n = 40$) than pull ($n = 27$), $\chi^2(1, N = 181) = 2.57$, $p = .11$, $\phi = .12$. This pattern is again consistent with the notion that perception of the anger expression facilitates avoidance, whereas perception of the fear expression facilitates approach.

Table 1
Mean Response Times Pushing and Pulling a Lever in Response to Three Categories of Face Stimuli

Stimulus type	Push *M*	Push *SD*	Pull *M*	Pull *SD*	Mean difference
Expression					
Anger	1,129	204	1,194	221	−65
Fear	1,149	198	1,065	185	84
Character					
Hated	1,154	199	1,236	209	−82
Admired	1,132	180	1,118	183	14
Attractiveness					
Disfigured	874	269	893	186	−19
Attractive	865	180	820	263	45
Mean all stimuli	1,051		1,054		−3

Note. All values are given in milliseconds. Negative values indicate the dominant response to have been pushing (avoidance); positive values indicate the dominant response to have been pulling (approach).

Comparison Photographs

Correct responses to photographs of hated and liked men and disfigured and attractive women were also analyzed using 2 (participant gender) × 2 (stimulus type) × 2 (lever direction) ANOVAs. For photos of hated and liked men, a significant effect of participant gender was found, such that men responded more quickly than women across all stimuli, $F(1, 46) = 5.38$, $p < .05$, $\gamma = .32$. There were no significant interactions with participant gender, however (all *p*s > .60). The interaction effects between lever direction and stimulus valence for these photos also followed the predicted pattern, $F(1, 46) = 3.32$, $p = .075$, $\gamma = .26$. For photos of disfigured and attractive women, no significant effects of participant gender were found, and so this variable was dropped. The results of the subsequent 2 × 2 ANOVA also showed a weak resemblance to the patterns seen for the other stimuli, $F(1, 45) = 1.84$, $p = .18$, $\gamma = .20$ (see Table 1). The degrees of freedom were reduced from 47 to 45 for this test because 2 participants did not provide any correct responses during these trials.

Analyses of the error rates for hated and liked and disfigured and attractive faces did not reveal significant patterns either for the admired and hated faces $\chi^2(1, N = 80) = 0.62$, *ns*, or for the attractive and disfigured faces $\chi^2(1, N = 36) = 0.21$, *ns*.[2] The results of a manipulation check that participants completed after all of the lever tasks confirmed that the men preselected as hated were perceived to be hated ($M = 1.88$, $SD = 0.71$) more than were the men preselected as admired ($M = 6.36$, $SD = 0.31$), and that the women preselected as attractive were rated to be more attractive ($M = 1.76$, $SD = 0.19$) than the women preselected as disfigured ($M = 6.30$, $SD = 0.44$).

[2] For the analysis of error rates for attractive and disfigured faces, the data for the 2 participants who provided no correct responses in one or more of these series (see ANOVA description) were removed prior to analysis.

Table 2
Mean Response Times and Standard Deviations for Fear and Anger Expression as a Function of Sex of Perceiver and Sex of Stimulus

Variable	Push		Pull		Mean difference
	M	*SD*	*M*	*SD*	
Anger expressions					
Male perceivers					
Male faces	1,154	238	1,205	249	−51
Female faces	1,153	282	1,191	210	−38
Female perceivers					
Male faces	1,164	211	1,183	251	−19
Female faces	1,164	226	1,273	272	−109
Fear expressions					
Male perceivers					
Male faces	1,235	189	1,127	246	108
Female faces	1,161	280	1,096	249	65
Female perceivers					
Male faces	1,205	253	1,137	182	68
Female faces	1,112	245	1,030	202	82

Note. All values are given in milliseconds. Negative values indicate the dominant response to have been pushing (avoidance); positive values indicate the dominant response to have been pulling (approach).

Discussion

The perception of emotional facial expressions affected motoric responses associated with approach and avoidance. More specifically, anger and fear expressions facilitated opposite movement behaviors. Anger expressions facilitated avoidance-related behavior, supporting the notion that this expression appears aversive and perhaps threatening. Fear expressions, however, facilitated approach-related behavior, contradicting the idea that this expression represents a primarily aversive stimulus.

That the anger expression might generate avoidance responses is unsurprising. Why, however, might the fear expression elicit predominantly approach-related responding? Rather than serving as a threat signal, the fear expression may serve as an appeasement cue, intended to ameliorate conflict or elicit conciliatory or affiliative behavior, much like the submission cues of other species (e.g., Blair, 1995; Schenkel, 1967). Fear expressions have been rated to appear highly submissive and also highly affiliative—approximately equally as affiliative as happy expressions (Hess, Blairy, & Kleck, 2000). In addition, perceivers view fear expressions as appearing rounder, kinder, warmer, more submissive, and more babyish than anger expressions (Marsh et al., 2005). Such perceptions would be difficult to explain if fear were predominantly threat inducing. But if fear serves to elicit approach, then perceivers might perhaps construe it as affiliative in that it encourages the formation of social bonds. Indeed, evidence exists to suggest that fear and other distress-related emotions like sadness and anxiety elicit not only the desire for affiliation but also caregiving from members of the social group (e.g., Batson, Duncan, Ackerman, Buckley, & Birch, 1981; Radke-Yarrow, Zahn-Waxler, Richardson, & Susman, 1994; Schachter, 1959).

It is unclear why participants responded more quickly to fear expressions than to anger expressions and to female faces more quickly than to male faces. There are several possible explanations. First, the perception of anger expressions appears to activate neural circuits involved in behavioral suppression and inhibition (Blair, Morris, Frith, Perrett, & Dolan, 1999). Perhaps because of this, participants' responses to anger expressions were slowed relative to fear expressions. In terms of effects for stimulus gender, the women's facial expressions may have been easier to identify—and thus respond to—than were men's expressions (Wagner, Buck, & Winterbotham, 1993). The data indicated that participants responded more quickly to women's fear expressions than to any other expressions. If women's fear expressions were the easiest to identify, this could potentially account for the main effect for response times to both fear expressions and female faces.

Alternative explanations for the main findings in the present study must also be considered. In showing weakness or submission, fear expressions could actually serve the maladaptive purpose of inviting attack, which is also a form of approach. In general, however, the evidence would seem to contradict this possibility. As discussed above, appeasing or submissive gestures serve the symbolic purpose of "raising the white flag" in most social species and typically reduce the chances of attack from conspecifics. Stereotyped gestures that can prevent aggressive encounters serve members of a social group by reducing the likelihood of injuries. Moreover, evidence from cross-cultural, cross-species, and infant research suggests that facial expressions are innate and evolved. An expression that invited others to attack the expresser would seem an unlikely candidate for preservation by natural selection.

Another potential interpretation of these data is that they provide support for the possibility that pushing and pulling responses to aversive and appetitive stimuli are not automatic. Specifically, a paradox might be seen in the fact that, although fear-related words such as *death* and *hell* elicit avoidance in perceivers, fear expressions appear to elicit approach. The meaning of emotional expressions appears to be processed automatically (Whalen et al., 1998). Moreover, approach and avoidance responses can be emitted by even very simple organisms and, in humans, can be reflected by even involuntary activities such as a potentiated startle. This suggests that approach or avoidance motivations can be elicited automatically (Cacioppo & Berntson, 1994). However, it need not follow that the meaning of expressions would automatically affect approach- and avoidance-related behaviors like pushing and pulling under all circumstances. Perhaps whether fear-related stimuli elicit either approach- or avoidance-related behavior depends on the context or attentional set of the perceiver. For example, Rotteveel and Phaf (2004) have shown that when participants are asked to make button-pressing movements similar to pushing and pulling a lever to categorize faces by gender, the effects of the target faces' emotional expressions disappear. This would suggest that the behavioral responses to affectively valenced stimuli can be mediated by conscious processes.

The present article, however, was not aimed at testing the automaticity of the approach and avoidance response. Instead, the aim was to assess the extent to which the fear expression could be construed as appetitive and approach-related. Essentially without exception, muscle flexion is a behavior associated with appetitive stimuli and approach (see Rotteveel & Phaf, 2004). Although appetitive stimuli need not always elicit flexion, when flexion does occur in response to a stimulus, it implies that the stimulus is appetitive. Thus, although directing perceivers' attention away from the emotional aspect of a fear expression might result in a

reduction or an elimination of the approach response, that the approach response would be the dominant response to the perception of a fear expression remains noteworthy.

The specific nature of the task that participants were asked to perform needs to be kept in mind, however. In this paradigm, participants explicitly categorized the anger and fear expressions as they manipulated the lever. It is plausible that the need to explicitly evaluate the stimuli changed the nature of these stimuli, although the results of a study by Chen and Bargh (1999) contradict this possibility. Using a lever paradigm and categorization task similar to the ones used here, Chen and Bargh found that explicit evaluation did not appear to affect approach and avoidance responses. In the first of their two studies, participants evaluated words as good or bad, and pushed or pulled a lever depending on each word's perceived valence. In a second study, participants pushed or pulled in response to all words, regardless of perceived valence. The effects were the same across the two studies—participants pushed the lever faster to negative words and pulled faster to positive words. Thus, the results of the lever task appear to be independent of the occurrence of explicit evaluation.

Other elements of the experimental context should still be taken into account when interpreting the results of this study, however. Here, the fear expression was presented in a relatively neutral context. It is possible that the meaning of and responses to the fear expression would change were the perceiver to encounter it in a potentially dangerous environment. If the study contained a potential threat, perhaps an impending shock or aversive noise, a fear expression might be perceived as a threat signal and thus an aversive stimulus rather than an appetitive one. This does not exclude the possibility that, even though fear appears to elicit approach in a relatively neutral environment, this expression may still represent a negative stimulus. Examples can be conceived in which negative stimuli would elicit behaviors associated with approach. For example, paramedics would be expected to respond to the sight of an injury or blood with approach-related behavior, although the sight would probably still be unpleasant to them rather than (or in addition to) being strictly appetitive. In this sense, one might see a distinction between the valence of a stimulus and the behavior it elicits.

Some questions as to how to interpret the behaviors measured in this study will be difficult to fully address before behavioral responses to other types of facial stimuli, for example, smiles, are assessed. It may be that although the predominant response to a fear expression in some contexts is to approach, this tendency would be small relative to the tendency to approach a smiling expression. Along these lines, it would also be beneficial to look at responses to smiling because some see a relationship between the expressions of happiness and fear. Preuschoft (1995) suggests that the origins of the human smile may lie in the fear grimace, or "silent bared-teeth display," seen in some primates. The silent bared-teeth display is thought to signal submission and appeasement. Perhaps approach responses to fear expressions in the present study occurred in part because features of fear expressions (e.g., bared teeth and raised eyebrows) are perceptually similar to features of smiling expressions. For example, the expressers' teeth were visible in seven of the eight fear expressions used in this study but in only one of the eight anger expressions. It is worth noting, however, that in facial expression judgment tasks, perceivers seldom explicitly confuse fear and happiness (Fridlund, 1994). That fear and smiling expressions may share common features should not come as a surprise, as both expressions are thought to share similar signal values, namely, indicating appeasement or affiliation. It would also not come as a surprise, then, were both expressions to elicit approach from those who perceive them.

Future research should also address the mechanisms linking the perception of emotional expressions to approach and avoidance. In general, the neural mechanisms underlying the perception of facial expressions of emotion, and underlying the approach and avoidance mechanisms, are still not well understood. However the two processes likely would be linked by the generation of emotion in the perceiver. Emotional expressions are thought to elicit emotional responses in perceivers. Sometimes these responses are analogous to the emotion perceived. Sometimes, however, the perceiver's emotional responses are instead complementary to the emotion perceived. For example, when people see an anger expression, they may have a desire to escape rather than feeling angry (Blairy, Herrera, & Hess, 1999). Such reactions to the perception of anger could motivate withdrawal. Perhaps emotions associated with concern or sympathy might be elicited by the perception of a fear expression and lead to approach. Measuring emotional responses to the perception of emotional expressions—either via self-report or via psychophysiological techniques—and assessing the relationship between these emotional responses and approach and avoidance might shed light on the mechanisms underlying these responses.

Conclusions

We have presented data that suggest that the fear expression facilitates approach-related behavior in perceivers, indicating that this expression could be a social cue that serves the function of making the expresser appear approachable to perceivers. Anger expressions instead may make the expresser more aversive. Potentially adaptive social functions such as these may help to explain why facial expressions have been selected by evolution as a part of the behavioral repertoire of humans. In future investigations of responses to emotional expressions, researchers may wish to consider the potential social implications of these expressions.

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