Emotion

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Online First Publication, January 19, 2015. http://dx.doi.org/10.1037/emo0000054

CITATION

Hammer, J. L., & Marsh, A. A. (2015, January 19). Why Do Fearful Facial Expressions Elicit Behavioral Approach? Evidence From a Combined Approach-Avoidance Implicit Association Test. *Emotion*. Advance online publication. http://dx.doi.org/10.1037/emo0000054

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1528-3542/15/$12.00 http://dx.doi.org/10.1037/emo0000054

Why Do Fearful Facial Expressions Elicit Behavioral Approach? Evidence From a Combined Approach-Avoidance Implicit Association Test

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Despite communicating a "negative" emotion, fearful facial expressions predominantly elicit behavioral approach from perceivers. It has been hypothesized that this seemingly paradoxical effect may occur due to fearful expressions' resemblance to vulnerable, infantile faces. However, this hypothesis has not yet been tested. We used a combined approach-avoidance/implicit association test (IAT) to test this hypothesis. Participants completed an approach-avoidance lever task during which they responded to fearful and angry facial expressions as well as neutral infant and adult faces presented in an IAT format. Results demonstrated an implicit association between fearful facial expressions and infant faces and showed that both fearful expressions and infant faces primarily elicit behavioral approach. The dominance of approach responses to both fearful expressions and infant faces decreased as a function of psychopathic personality traits. Results suggest that the prosocial responses to fearful expressions observed in most individuals may stem from their associations with infantile faces.

Keywords: fear, facial expressions, implicit association test, approach, psychopathy

Although it has long been presumed that emotional facial expressions like fear, anger, and happiness influence perceivers' approach and avoidance tendencies toward the expresser, approach and avoidance responses to fearful and angry expressions were first assessed in 2005 (Marsh, Ambady, & Kleck, 2005). Using a lever task in which avoidance was operationalized as pushing the lever (extension) and approach as pulling (flexion), this study found that perceivers' dominant response to angry expressions is avoidance, whereas their dominant response to fearful facial expressions is approach. These findings were interpreted as signifying that angry expressions are perceived as aversive, whereas fearful expressions are perceived as appetitive. Many experiments have now examined the appetitive and aversive qualities of expressive faces, and have generally found, for example, happiness to be predominantly appetitive and anger to be predominantly aversive (Rotteveel & Phaf, 2004; Seidel, Habel, Kirschner, Gur, & Derntl, 2010; Theodoridou, Penton-Voak, & Rowe, 2013; van Peer et al., 2007; Vrijsen, van Oostrom, Speckens, Becker, & Rinck, 2013), although the degree to which these effects occur may be moderated by personality variables (Heuer, Rinck, & Becker, 2007; von Borries et al., 2012; Roelofs et al., 2010) or affiliation goals (Krieglmeyer & Deutsch, 2013). However, no study has replicated or adequately explained the original, seemingly paradoxical finding that fearful facial expressions elicit behavioral approach in perceivers. In the present study, we sought to replicate and extend this finding by combining the approach-avoidance paradigm with an implicit association task (IAT) to measure associations between fearful expressions and infant faces, in addition to approach and avoidance responses to both types of stimuli, in order to test the hypothesis that fearful expressions elicit approach as a result of their resemblance to vulnerable, infantile faces.

Responses to fearful facial expressions in particular are the target of extensive research in psychology and neuroscience, and these expressions have been used as stimuli in a variety of studies investigating fear-related patterns of behavioral, physiological, and neural responding in healthy and clinical populations across the life span (e.g., Adolphs et al., 2005; Harmer, Rogers, Tunbridge, Cowen, & Goodwin, 2003; Lozier, Cardinale, VanMeter, & Marsh, 2014; Marsh & Blair, 2008; Peltola, Leppanen, Palokangas, & Hietanen, 2008; Springer, Rosas, McGetrick, & Bowers, 2007; Whalen et al., 2001). New information on how these expressions are construed by perceivers may therefore be highly impactful in interpreting past and future research findings. Early research most commonly characterized the social function of fearful facial expressions as conveying the presence of an environmental threat (Anderson, Christoff, Panitz, De Rosa, & Gabrieli, 2003; Springer et al., 2007). Increasingly, however, characterizations of fearful expressions have become more nuanced, often describing these expressions as conveying uncertainty or ambiguity (Whalen, 2007). In contrast to, for example, angry expressions, which convey a direct threat, fearful expressions signal the presence of a threat but do not specify its nature. Both characterizations of fearful expressions are useful and accurate, to an extent. If an individual is seen expressing fear, that individual has undoubtedly perceived a threat somewhere in the environment. However, the simplest interpretation of a fearful expression directed at the per-

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This research was supported in part by a grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (R03 HD064906-01).

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ceiver is that the perceiver *is* the threat—that is, a person who is looking at you in terror is terrified *of you*. Signaling threat or uncertainty would have minimal utility in this case, which suggests the existence of some other social function for the expression. Ideally, an alternate explanation for the social function of fearful facial expressions would clarify why these expressions predominantly elicit approach when other stimuli characterized as threat-related typically elicit avoidance (Rinck & Becker, 2007).

Findings from the comparative psychology literature may help to provide such an explanation. In other group-living, cooperative social species such as the great apes, wolves, and dogs, postural and facial displays of fear tend to communicate submission and appeasement. These cues are often observed in the context of hierarchical interactions in which the weaker individual conveys to the stronger individual that he or she is not threatening through characteristic cues such as, in chimpanzees, crouching and “fear grinning” (Parr & Waller, 2006). Wolves may also crouch and fear grin in addition to rolling over, pinning back their ears, or licking the jowls of a more dominant individual, behaviors that make them appear smaller in size or mimic the behaviors of juveniles (Fox, 1970; Schenkel, 1967). These cues are not used to signal the presence of a threat in the environment. Rather, these fear displays function to inhibit aggression and elicit conciliatory, prosocial behaviors, potentially achieving this effect in part through their similarity to juvenile cues (Lorenz, 1966; Schenkel, 1967).

Fearful facial expressions may serve a similar social function: appeasement through visual similarity to juvenile faces. Several lines of evidence support this possibility. Fearful expressions appear visually babyish, perhaps owing to the widened eyes and high eyebrows that fearful expressions share with infantile faces (Marsh, Adams, & Kleck, 2005). They are also viewed by perceivers as appearing submissive and highly affiliative—nearly as affiliative as happy expressions (Hess, Blairy, & Kleck, 2000)—and they elicit sympathy and a desire to provide help in perceivers even when presented subliminally (Marsh & Ambady, 2007). In addition, individuals who are unusually aggressive or low in empathy, such as psychopaths, are deficient in recognizing and responding appropriately to fearful expressions (Dawel, O’Kearney, McKone, & Palermo, 2012; Marsh & Blair, 2008). Together these findings suggest that fearful facial expressions may elicit approach-related behaviors by conveying vulnerability, affiliation, and babyishness, but that this pattern may be less evident in highly aggressive or unempathic individuals, such as those with psychopathic personalities.

We tested these hypotheses in a task that integrated approach-avoidance responses within an IAT. Fearful and angry expressions and neutral infant and adult faces were presented in the context of an IAT that was designed and analyzed according to guidelines described by Greenwald and colleagues (Greenwald, McGhee, & Schwartz, 1998; Greenwald, Nosek, & Banaji, 2003; Nosek, Greenwald, & Banaji, 2005). The paired response categories in this task were angry/fearful expressions and adult/infant faces. Instead of responding with button presses during the task, participants responded by pulling or pushing a lever. We hypothesized that participants would respond to fearful expressions more quickly when they were paired with neutral infant faces than with neutral adult faces, and that both fearful expressions and infant faces would elicit more rapid approach (pulling) than avoidance (pushing) responses.

Finally, participants completed a measure of psychopathic personality traits, the Psychopathic Personality Inventory—Revised (PPI-R; Lilienfeld & Widows, 2005) at the conclusion of the approach-avoidance IAT. This self-report measure of psychopathy is designed to assess psychopathic personality traits in males and females in the community in keeping with the premise that psychopathic traits are not limited to small subsets of institutionalized or imprisoned adults, but rather represent a personality variable that is continuously distributed in the general population (Skeem, Polaschek, Patrick, & Lilienfeld, 2011). The components captured by the PPI-R (fearless dominance, self-centered impulsivity, and coldheartedness) are consistent with the emerging view of psychopathy as best captured by semidistinct subfactors that arise from impairments in basic emotional and executive processes (Blair, 2007; Patrick, Durbin, & Moser, 2012). We hypothesized that participants with higher levels of psychopathic traits would show reduced approach-based responses to fearful expressions (and perhaps infant faces). Because psychopathy is associated with impaired recognition of fearful expressions (Dawel et al., 2012; Marsh & Blair, 2008) and predatory rather than compassionate responses to vulnerable others, this feature of the task helped to rule out the alternate hypothesis that approach-based responses reflect an attack-based response to vulnerability rather than a prosocial response. The self-centered impulsivity component of the PPI-R is the most reliably robust predictor of a variety of behavioral outcomes related to antisociality (DeLisi et al., 2014; Edens, Poythress, Lilienfeld, Patrick, & Test, 2008); we therefore anticipated that we would observe the strongest relationship between this component of psychopathy and our behavioral task.

Method

Participants

Fifty-three participants, both students and local community members, completed the study. Participants were recruited using flyers hung in public spaces in and around campus and through a departmental study pool that invited interested individuals to participate in a study about the perception of faces. For their participation, participants could receive either $10 or extra credit in a psychology course.

Eight participants’ data were excluded, due to software errors (3), excessively high error rates (≥2 *SD* above the mean; 3), distraction (answering a mobile phone during the procedure; 1), or stated failure to understand task instructions (1). The mean age of the remaining 45 participants (36 females, 9 males) was 20.52 (*SD* = 2.90). Participants reported being free of psychotropic medications during testing except for one who reported recent use of fluoxetine, dextroamphetamine, and bupropion.[1] In addition, psychopathy scores were not available for 3 participants. All participants provided informed written consent prior to testing.

Materials

The stimulus set consisted of 40 grayscale digital images. Fearful and angry expression images were drawn from the Pictures of

[1] We reanalyzed all data after excluding this participant and found that this exclusion did not change the statistical significance of any of our results.

Facial Affect series (Ekman & Friesen, 1976), and included 10 angry and 10 fearful expressions shown by a single set of 10 Caucasian males and females (each adult was depicted showing both anger and fear). Infant and neutral adult faces were drawn from a previously developed and validated stimulus set (Marsh et al., 2012), and included 10 Caucasian male and female infants and 10 Caucasian male and female adults, all of whom showed neutral facial expressions. All images were presented against a black background and appeared onscreen at a size of approximately 11.5 cm × 16.25 cm. Images were presented using ePrime 2.0 run in a Windows Virtual Machine on an Apple desktop computer. Participants responded using a lever (Microsoft Sidewinder joystick; Marsh et al., 2005) that was affixed to the desktop 12 cm from its edge, directly in front of the participant.

Procedure

During the task, images from each of the 4 categories were presented for 2,000 ms during which time participants categorized them by pulling or pushing the lever. Images were presented in both congruent and incongruent blocks. During congruent blocks, fearful expressions and infant faces were paired, and angry expressions and neutral adult faces were paired, such that participants were instructed to respond to both fearful expressions and infant faces using the same lever movement (either pushing or pulling for both). In incongruent trials, angry expressions and infant faces were paired, and fearful expressions and neutral adult faces were paired, such that participants were instructed to move the lever in the opposite direction for fearful expressions and infant faces (pulling for one and pushing for the other). Participants completed two blocks of 40 congruent trials and two blocks of 40 incongruent trials. In one block of congruent trials, participants were instructed to pull the lever in response to fearful expressions and infant faces (and push in response to angry expressions and neutral adult faces), and in the other block, the instructed response directions were reversed. In one block of incongruent trials, participants were instructed to pull the lever in response to angry expressions and infant faces (and push in response to fearful expressions and neutral adult faces), and in the other block, the instructed response directions were reversed. The order in which these blocks occurred was randomly generated by the computer. Reminder labels, in the form of category names positioned to the left and right of the stimuli, remained on screen throughout each block. Error messages were not displayed following incorrect responses. During these trials, participants saw 20 fearful and angry expressions and 20 neutral infant and adult faces.

Blocks of single-category trials were also provided for practice prior to incongruent and congruent blocks, in keeping with standard IAT procedures, although data from these blocks were not analyzed. So, for example, both double-category blocks (one congruent and one incongruent) that were anchored by instructions to pull the lever in response to infant faces were preceded by two single-category blocks presented in random order. In one, participants pulled the lever in response to infant faces and pushed it in response to adult faces, and in the other they pulled the lever in response to fearful expressions and pushed it in response to angry expressions. This same process was repeated for the two double-category blocks anchored by instructions to push the lever in response to infant faces.

Prior to beginning the task, participants were instructed that they would be sorting faces into categories by pushing the lever away from themselves or pulling it toward themselves in response to the various stimuli that would appear on the screen. They had the opportunity to ask questions and to practice moving the lever before the task began to familiarize themselves with it. Participants were instructed to continue holding the lever between trials to be ready to respond to each image as it appeared. Before each block, participants were reminded to respond as quickly as possible while making as few mistakes as possible.

At the end of the task, participants completed the PPI-R. The PPI-R is a 154-item self-report measure designed to measure psychopathic traits in community samples of males and females, consistent with indications that psychopathy is a dimensional construct that varies continuously throughout the population rather than being confined to a small taxon of “psychopaths” (Skeem et al., 2011). The PPI-R and its predecessor (PPI) show relations with relevant criterion measures that parallel those for other measures of psychopathy (Falkenbach, Poythress, Falki, & Manchak, 2007; Poythress et al., 2010). PPI-R subscales include fearless dominance, which indexes boldness and social potency, self-centered impulsivity, which indexes impulsive and antisocial behaviors, and coldheartedness, which indexes callousness. Of these subscales, self-centered impulsivity is most reliably linked to antisocial behavioral outcomes such as aggression and misconduct in an institutional setting (DeLisi et al., 2014; Edens et al., 2008). Finally, participants provided demographic information and were compensated for participating.

Results

Nonresponses, which constituted trials in which participants failed to move the joystick at least 5% from its baseline coordinates, represented 6.18% of trials and were not included in analyses. Error trials constituted 8.33% of responses, and included error rates of 7.49% for congruent trials and 9.19% for incongruent trials. The error rate for responses to fearful and angry expressions was 12.79%, a rate similar to those previously found in similar tasks (Marsh et al., 2005). The error rate for infant and adult faces was 4.12%. In keeping with the recommendations of Greenwald and colleagues (Greenwald et al., 2003), error trials were included in analyses but were penalized by adding 600 ms to the mean of response times for correct responses within each trial.[2] Means and standard deviations for responses across conditions are presented in Table 1.

IAT Effects

We first assessed implicit associations between fearful and angry expressions and, respectively, infant and adult faces. In keeping with recommendations of Greenwald and colleagues (Greenwald et al., 2003), we calculated IAT effect sizes using a *D* statistic. First, all congruent trials and incongruent trials were collapsed, and the incongruent-congruent difference was computed and divided by the pooled standard deviation. This analysis yielded

[2] We also analyzed the data following exclusion rather than penalization of error trials; exclusion of error trials did not change the statistical significance of any of the results.

Table 1
Mean Response Times to Face Stimuli During Congruent and Incongruent Trials

	Congruent *M* (SEM)	Incongruent *M* (SEM)	*M* Difference
Expression			
Angry			
Pull	1,307 (33)	1,409 (40)	−101
Push	1,243 (35)	1,387 (37)	−144
Fearful			
Pull	1,202 (31)	1,286 (33)	−84
Push	1,299 (36)	1,353 (42)	−54
Age			
Adult			
Pull	1,112 (35)	1,120 (35)	−8
Push	1,130 (40)	1,174 (34)	−44
Infant			
Pull	886 (26)	974 (32)	−88
Push	951 (28)	999 (25)	−47

Note. All values are in milliseconds. Negative mean differences indicate that response times were greater in the incongruent condition.

a moderately strong IAT effect for the task, $M_{congruent} = 1{,}138.47$ ms, $M_{incongruent} = 1{,}206.92$ ms, $SD = 175.96$, $D = .39$, indicating that participants were faster to respond when fearful expressions were paired with infant faces and angry expressions were paired with adult faces. The results of a *t* test comparing response times during incongruent and congruent trials indicate this effect to be statistically significant, $t(44) = 4.50$, $p < .001$.

Because we did not predict that the relationship between faces varying in emotional expression and faces varying in age would necessarily be symmetrical, we next calculated IAT effect sizes separately for fearful/angry expressions and infant/adult faces. We observed a moderately strong IAT effect for fearful/angry expressions, $M_{congruent} = 1{,}260.13$ ms, $M_{incongruent} = 1{,}351.20$ ms, $SD = 188.93$, $D = .48$, such that participants responded more quickly during blocks in which fearful faces were paired with infant faces than with adult faces (see Figure 1). The results of a *t* test comparing response times to fearful and angry expressions during incongruent versus congruent trials indicated this effect to be statistically significant, $t(44) = 5.40$, $p < .001$. We observed a small IAT effect for infant/adult faces, $M_{congruent} = 1{,}016.81$ ms, $M_{incongruent} = 1{,}062.64$ ms, $SD = 171.14$, $D = .27$, such that participants responded more quickly during blocks in which infant faces were paired with fearful expressions than with angry expressions (see Figure 2). The results of a *t* test comparing response times to infant and adult expressions during incongruent versus congruent trials also indicated this effect to be statistically significant, $t(44) = 2.69$, $p < .01$.

Approach and Avoidance Responses

Our second question was whether fearful expressions and infant faces elicit similarly approach-based responses whereas angry and neutral adult faces do not. To address this question and analyze only the results pertaining to response direction, we collapsed congruent and incongruent trials and conducted separate 2 (lever direction) × 2 (face type) analyses of variance (ANOVAs) on response times to fearful/angry and infant/adult faces, respectively. When examining responses to fearful/angry faces, ANOVA results yielded a Lever Direction × Expression interaction, $F(1, 44) = 11.56$, $p = .001$, such that participants pulled the lever more quickly than they pushed it in response to fearful expressions, *M* difference = 97 ms, $t(44) = 4.08$, $p < .001$, whereas the reverse was true for angry expressions, *M* difference = 64 ms, $t(44) = 1.72$, $p = .09$, although this effect was only marginally significant (see Figure 3). A main effect of expression was also observed, $F(1, 44) = 7.83$, $p = .008$, such that participants responded more quickly to fearful, $M = 1{,}279.79$ ms, $SD = 199.71$, than angry faces, $M = 1{,}328.30$ ms, $SD = 196.82$. No main effect of lever direction, $F(1, 44) = 2.24$, $p = .15$, was observed.

ANOVA results for infant/adult faces did not yield a significant Lever Direction × Maturity interaction, $F(1, 44) = 0.170$, $p = .68$. Instead, a main effect of response direction was observed, $F(1, 44) = 9.32$, $p = .004$, such that participants responded more quickly when pulling, $M = 1{,}019.98$ ms, $SD = 177.58$, than pushing, $M = 1{,}058.26$ ms, $SD = 175.53$. However, when responses to infant and adult faces were examined separately, an effect of lever direction was found for infant faces, with participants pulling the lever more quickly than they pushed it, $t(44) = 2.75$, $p = .009$, whereas no effect of lever direction was seen for neutral adult faces, $t(44) = 1.40$, $p = .17$ (see Figure 4). A main effect of maturity was also observed, $F(1, 44) = 119.81$, $p < .001$,

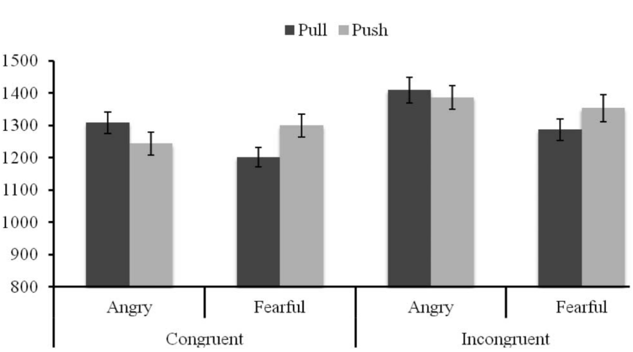

Figure 1. Mean response times (error bars represent standard error of the mean (SEM)) to fearful and angry expressions by response direction and congruence. Response times are presented in ms.

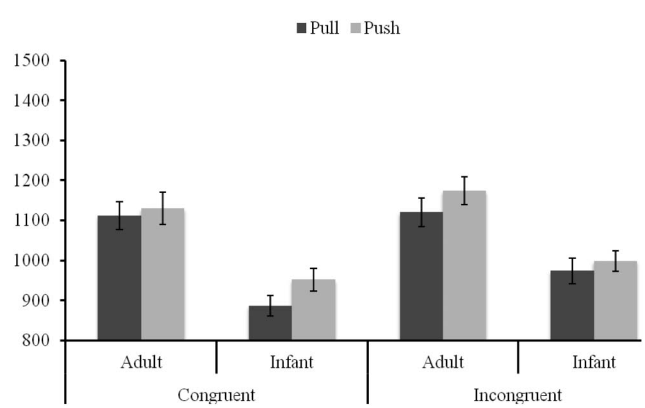

Figure 2. Mean response times (error bars represent standard error of the mean (SEM)) to adult and infant faces by response direction and congruence. Response times are presented in ms.

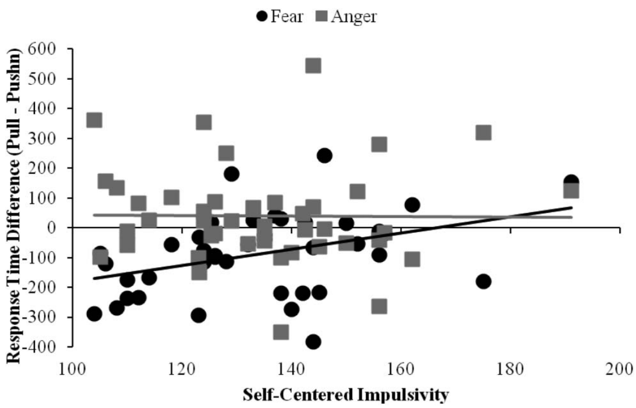

Figure 3. Response time (ms) difference scores to fearful and angry expressions as a function of self-centered impulsivity. Negative values indicate a dominant pull (approach) response, whereas positive values indicate a dominant push (avoidance) response.

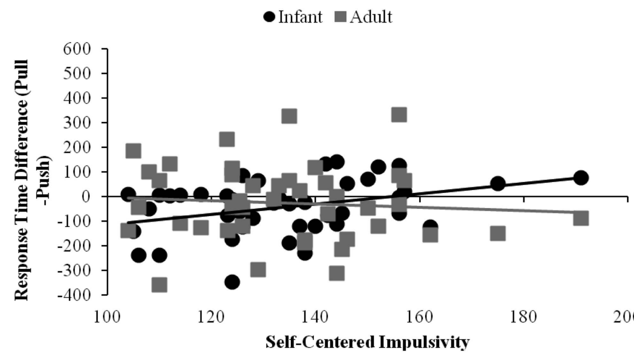

Figure 4. Response time (ms) difference scores to infant and adult faces as a function of self-centered impulsivity. Negative values indicate a dominant pull (approach) response, whereas positive values indicate a dominant push (avoidance) response.

such that participants responded more quickly to infant faces, $M =$ 951.20 ms, $SD = 159.32$, than adult faces, $M = 1{,}131.56$ ms, $SD = 205.84$.

No interactions between congruence and lever directions were hypothesized or observed. An omnibus 2 (congruence) × 2 (lever direction) × 4 (face type: angry, fearful, adult, or infant faces) ANOVA did not yield a significant 3-way interaction, $F(3, 42) = 1.73$, $p = .175$, nor did 2 (congruence) × 2 (lever direction) ANOVAs conducted separately for each face type, p values > 0.10.

Response Times and Psychopathy

Our third question concerned whether approach and avoidance responses to fearful expressions and infant faces are moderated by psychopathy. To address this question, we assessed the relationship between psychopathy and responses to the four stimulus categories. PPI-R scores were calculated according to standard guidelines (Lilienfeld & Widows, 2005). We also calculated outlier scores on the PPI-R validity scales and identified 6 participants who were virtuous responding outliers, $T > 65$, and one who was a deviant responding outlier, $T > 65$. In keeping with standard scoring guidelines, these participants were retained in all analyses (Lilienfeld & Widows, 2005).

We first computed difference scores for responses to each face type by subtracting all push trials (collapsed across congruence) from all pull trials (collapsed across congruence). We then assessed the relationship between these difference scores and overall psychopathy scores, as well as fearless dominance, self-centered impulsivity, and coldheartedness subscale scores using Pearson's correlations (see Table 2). Total psychopathy scores were not correlated with differences in response times for any stimulus category, nor were fearless dominance scores. Self-centered impulsivity scores were positively correlated with difference scores for both fearful expressions, $r(40) = .40$, $p = .009$ (see Figure 3), and infant faces, $r(40) = .36$, $p = .020$ (see Figure 4), such that as self-centered impulsivity increased, participants tended to push the lever more quickly than they pulled it in response to fearful and infant faces. Self-centered impulsivity scores were not correlated with responses to angry expressions or neutral adult faces, p values $> .50$. Coldheartedness scores were not associated with responses to fearful expressions or infant or adult neutral faces. However, coldheartedness scores were positively correlated with responses to angry expressions, $r(40) = .37$, $p = .016$, such that as coldheartedness scores increased, participants pushed the lever more quickly than they pulled it in response to these expressions.

To compare the relative strength of the associations between PPI-R subscales and responses to fearful expressions and infant faces, we next conducted two simultaneous multiple regression analyses in which the relative strength of approach responses to these stimulus categories were the dependent variables and the three major subscales of the PPI-R were the predictor variables. Results showed that, consistent with the results of our correlational analyses, self-centered impulsivity predicted reduced approach-based responding to fearful expressions, $\beta = .43$, $t = 2.77$, $p =$ .009, whereas neither fearless dominance, $\beta = -.02$, $t = -0.12$, $p = .90$, nor coldheartedness, $\beta = -.13$, $t = -0.81$, $p = .42$, scores did. Likewise, self-centered impulsivity predicted reduced approach-based responding to infant faces, $\beta = .35$, $t = 2.19$, $p =$ .035, but neither fearless dominance, $\beta = -.07$, $t = -0.46$, $p =$ .65, nor coldheartedness, $\beta = .14$, $t = 0.87$, $p = .39$, scores did.

We also decomposed self-centered impulsivity scores into subfactor scores and examined correlations for each of these subfactors separately (see Table 2). Results showed that both Machiavellian egocentricity and rebellious nonconformity were positively correlated with approach responses to fearful expressions, and (marginally) infant faces. The remaining subscales (blame externalization and carefree nonplanfulness) were not significantly correlated with response times to these stimuli or to angry expressions or neutral adult faces.

Finally, in consideration of the potential role of gender effects, we recalculated our primary correlations after standardizing psychopathy scores within genders. The standardized scores were highly correlated with the raw scores, $r(40) = .98$, $p < .001$ for composite PPI, $r(40) = .99$, $p < .001$ for fearless dominance, $r(40) = .96$, $p < .001$ for self-centered impulsivity, and $r(40) =$ .99, $p < .001$ for coldheartedness. Standardized self-centered impulsivity scores were associated with responses to fearful expressions, $r(40) = .50$, $p = .001$, and (marginally) with responses to infant faces, $r(40) = .29$, $p = .066$. Standardized coldhearted-

Table 2
Correlations Among Response Time Differences and Psychopathy Scores

	Pull–Push Response Time Difference			
	Expression		Age	
	Angry	Fearful	Adult	Infant
	r (*p*)	*r* (*p*)	*r* (*p*)	*r* (*p*)
Total PPI-R	.10 (.528)	.25 (.114)	.07 (.646)	.27 (.090)$^{+}$
Fearless Dominance	.05 (.773)	.06 (.708)	.12 (.443)	.04 (.783)
Self-Centered Impulsivity	−.01 (.963)	.40 (.009)**	−.08 (.604)	.36 (.020)*
Machiavellian Egocentricity	−.01 (.940)	.34 (.032)*	.02 (.915)	.31 (.052)$^{+}$
Rebellious Nonconformity	−.01 (.956)	.42 (.006)**	−.29 (.067)$^{+}$	.30 (.056)$^{+}$
Carefree Nonplanfulness	.04 (.795)	.11 (.479)	−.14 (.368)	.09 (.580)
Blame Externalization	−.03 (.859)	.19 (.235)	.13 (.411)	.28 (.072)$^{+}$
Coldheartedness	.37 (.016)*	−.03 (.856)	.10 (.312)	.20 (.203)

Note. Positive correlations indicate that increases in the psychopathy score correspond to decreases in the relative dominance of the pull response.
$^{+}$ $p < .10$. * $p < .05$. ** $p < .01$.

ness scores were associated with responses to angry expressions, $r(40) = .36$, $p = .018$. No other significant correlations were observed.

Discussion

The results of this study demonstrated that the dominant response to fearful facial expressions is motoric approach, replicating the findings of Marsh and colleagues (Marsh et al., 2005), and that responses to neutral infant faces elicit parallel approach-based responses, whereas neutral adult faces do not. IAT results also confirmed an implicit association between fearful facial expressions and infant faces, such that participants responded most quickly—both when pushing and pulling the lever—to these types of faces when they were paired. This indicates that fearful expressions cause adults' faces to become more closely associated with infants' neutral faces than with other adults' neutral faces. Finally, we demonstrated for the first time that psychopathic personality traits, in particular self-centered impulsivity, mute or even reverse approach-based responses to both fearful expressions and infant faces. Although many studies have found that psychopathy impairs recognition of fearful facial expressions (Dawel et al., 2012; Marsh & Blair, 2008), this is the first demonstration of aberrant behavioral responses to fearful expressions in connection with psychopathy. These results provide evidence for the conclusion that fearful facial expressions may elicit behavioral approach because of their associations with infantile faces, which also elicit approach. They also suggest the possibility that a failure to respond in this characteristic way to fearful expressions and infant faces may be associated with a predilection for aggressive and antisocial behavior.

These findings may help clarify seemingly counterintuitive findings regarding the perception of fearful facial expressions. First, the original finding that fearful facial expressions elicit approach may seem paradoxical, given that other fear-related stimuli like images of spiders or negative words like "death" or "hell" typically elicit avoidance (Chen & Bargh, 1999; Rinck & Becker, 2007). That fearful facial expressions instead elicit approach suggests that fearful facial expressions are not merely "fear-related" stimuli and that the primary signal value of these expressions may not be to generate fear in perceivers. But why would these expressions elicit approach? Plausible explanations include the possibility that the vulnerability conveyed by these expressions elicits attack-based approach, or that the uncertainty conveyed by these expressions elicits curiosity-based approach. However, the findings of the present study contradict these possibilities because psychopathy, which is associated with increased predation of vulnerable targets (Book, Costello, & Camilleri, 2013; Wilson, Demetrioff, & Porter, 2008) as well as high levels of novelty- and stimulation-seeking (Lilienfeld & Widows, 2005), was associated with *reduced* approach to both fearful expressions and infant faces. If approach responses to fear were attack-based or curiosity-based, one would instead anticipate a heightened approach toward these stimuli in individuals with higher levels of psychopathic traits. That psychopathy was instead associated with reduced approach responses toward fear and infants suggests that the approach response may reflect something specifically lacking in individuals with psychopathic traits, namely compassionate, nonaggressive responses toward vulnerable, infantile individuals. The fact that psychopathy impairs recognition of fearful facial expressions cannot explain the observed pattern of results, as this impairment would in theory affect approach- and avoidance-based responses equally, and therefore no relationship between psychopathy and approach-avoidance difference scores would be expected.

That the strongest association was observed between our behavioral findings and scores on the self-centered impulsivity component of the PPI-R is consistent with previous findings that this component tends to be the most reliable and robust predictor of behavioral outcomes related to antisociality (DeLisi et al., 2014; Edens et al., 2008). Because this component is most closely linked to aggressive behavior, our findings are also consistent with the notion that approach-based responding to fearful facial expressions is associated with the inhibition of aggression in response to distressed and vulnerable others. It could be considered surprising that our behavioral responses were not predicted by scores on the coldheartedness component of psychopathy, which indexes callousness and therefore should theoretically be associated with the constructs being measured in our behavioral task. However, the fact that this component typically is not a strong predictor of aggression, or other clearly callous behaviors, suggests that its associations with behavioral outcomes are weaker. By contrast, the Machiavellian egocentricity subfactor of self-centered impulsivity was associated with behavioral responses in our task; this scale is also thought to be associated with callousness and may be a more robust predictor of behavioral outcomes related to low empathy (DeLisi et al., 2014; Edens et al., 2008).

The present findings may also clarify previous results showing fearful facial expressions to be perceived as strongly affiliative, nearly as affiliative as happy expressions, and more strongly affiliative than other "negative" expressions like anger, disgust, and sadness (Hess et al., 2000). This pattern becomes more interpretable if fearful expressions are viewed as social signals that convey vulnerability and a need for assistance via their implicit associations with infantile faces. This interpretation is compatible with recent findings linking the perception of both fearful expressions and infant faces to the neuropeptide oxytocin (Fischer-Shofty, Shamay-Tsoory, Harari, & Levkovitz, 2010; Marsh et al., 2012). In mammals, the oxytocin system is thought to have evolved to promote nurturing and affiliative behaviors toward infants (Carter, Williams, Witt, & Insel, 1992). Administering oxytocin to healthy adults causes them to perceive neutral infant, but not adult, faces as more appealing (Marsh et al., 2012) and increases sensitivity to both fearful facial expressions (Fischer-Shofty et al., 2010) and happy facial expressions (Marsh, Yu, Pine, & Blair, 2010). This suggests that the neurochemical processes that underlie responses to fearful facial expressions may overlap with those that underlie responses to infantile faces and other affiliative, appetitive social stimuli.

Finally, our findings help to clarify the links between the socioperceptual deficits and aggression that characterize individuals with psychopathic traits. It is fairly well established that psychopathy impairs the recognition of fearful facial expressions (Dawel et al., 2012; Marsh & Blair, 2008). These deficits may stem from impairments in eye gaze toward fearful faces (Dadds, El Masry, Wimalaweera, & Guastella, 2008) or from difficulty simulating the emotion conveyed by these faces (Marsh, 2013). It is also well established that psychopathy represents a significant risk factor for antisocial behavior, in particularly proactive, or instrumental, aggression (Blair, 2001; Glenn & Raine, 2009). But the link between these two essential characteristics of psychopathy remains unclear. The present study suggests that psychopathic traits, in particular self-centered impulsivity, reduce the approach-based response typically observed in response to vulnerable others, such as those who are frightened or very young. If such approach-based responses indeed reflect compassion rooted in atavistic mammalian urges to help vulnerable others, the absence of these responses among individuals with psychopathic traits may help to explain their relatively callous disregard for engaging or persisting in aggressive behaviors that harm vulnerable individuals.

Limitations

Some limitations of the current findings must also be considered in interpreting these results. First, the sample size of the present study, although comparable to the sample sizes used in previous similar studies that obtained similar results (Marsh et al., 2005; Roelofs et al., 2010; Rotteveel & Phaf, 2004; Theodoridou et al., 2013), was not large. It is possible that with larger sample sizes, additional interesting theoretical associations, such as between the fearless dominance or coldheartedness subscale of the PPI-R and approach responses to fearful or infant faces, could be detected. The sample also included more females than males. However, standardizing psychopathy scores within gender had minimal effects on the magnitude of observed associations between psychopathy and behavioral responses during the task. This is consistent with the findings of previous investigations, which have failed to find any interaction between gender and approach and avoidance responses to anger and fear (Marsh et al., 2005; Wilkowski & Meier, 2010) or responses to the infant faces used in this study (Marsh et al., 2012). And although males usually score higher in psychopathy than females, the neurocognitive mechanisms that underlie psychopathic traits are not believed to differ across sexes (Skeem et al., 2011; Viding & McCrory, 2012). That said, future studies explicitly aimed at investigating potential gender effects might be better able to determine whether it is significant that standardizing psychopathy scores within gender slightly increased the magnitude of effects relevant to fearful expressions while slightly decreasing the magnitude of the effects relevant to infant faces.

It should also be noted that when and whether approach and avoidance tendencies automatically result in engagement of the flexor and extensor muscles has been subject to debate (Chen & Bargh, 1999; Rotteveel & Phaf, 2004; Wilkowski & Meier, 2010). Some studies have shown that motoric approach and avoidance responses may not be automatic (Rotteveel & Phaf, 2004) and are sensitive to construal, such that when arm extension is framed as moving toward an object, this movement may reflect approach instead of avoidance (Seibt, Neumann, Nussinson, & Strack, 2008). Factors such as these, plus the known sensitivity of this task to salient goals (Krieglmeyer & Deutsch, 2013) may help to explain why Wilkowski and Meier, who used a different approach/avoidance paradigm than that used in the present study, found results that were interpreted as demonstrating the dominant response to anger to be approach (no significant difference was obtained in response to fear; Wilkowski & Meier, 2010). This may reflect some feature of their task having primed goals or construals that were not primed in the present task. It may also be relevant that in our task, the joystick movements were simply described as a means of categorizing faces (rendering the approach/avoidance link to the signal values of the stimulus faces implicit) whereas in Wilkowski and Meier's task the relevance of the approach-avoidance component of the task to the faces was made explicit. These discrepancies reinforce the importance of incorporating additional stimuli for which appetitive and aversive qualities are well delineated—for example, the infant faces used in the present study, and the attractive and disfigured women and beloved and hated public figures used by Marsh and colleagues (Marsh et al., 2005)—into approach/avoidance paradigms to aid in interpretation of findings.

Finally, it cannot be determined with certainty from this study that the implicit association between fearful expressions and infant faces in this study was due to similarities in the appearance of these faces rather than to some more conceptual similarities. However, we posit that appearance similarities are the most likely basis for this implicit association because similarities in the appearance of fearful expressions and infant faces are established (Marsh et al., 2005; Sacco & Hugenberg, 2009; Zebrowitz, Kikuchi, & Fellous, 2007), and there is no clear alternative hypothesis. In particular, it is unlikely that the observed associations occurred due to fearful expressions being more common or more intense in infants than angry expressions, as the progenitors of these expressions have been found to emerge roughly concurrently in infancy (Camras & Fatani, 2008) and are, along with other emotions, all expressed more intensely by children than adults as a rule (Izard, 1994).

Conclusions

Emotional facial expressions like fear and anger are universal means of communication and social regulation with powerful effects on social interactions (Elfenbein & Ambady, 2002). The present research extends prior findings on how fearful and angry expressions influence fundamental behavioral expressions of emotion, approach, and avoidance (Berntson, Boysen, & Cacioppo, 1993), and for the first time demonstrates similarities in behavioral responses to fearful expressions and infant faces, both of which preferentially elicit approach. Findings support the possibility that approach responses to fear may reflect these expressions' similarities to vulnerable, infantile faces, and suggest that highly antisocial individuals may lack the tendency to respond to vulnerable faces with approach. These findings have implications for understanding basic mechanisms of social perception as well as understanding the roots of empathy, psychopathy, and aggression.

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Received April 16, 2014
Revision received August 8, 2014
Accepted December 4, 2014 ■