TRAIT EMPATHY AND SENSITIVITY TO MORPHED EMOTIONAL FACES

HONORS THESIS

Presented to the Honors Committee of

Texas State University – San Marcos

In Partial Fulfillment of

the Requirements

For Graduation in the Mitte Honors Program

By

Heidi Blocker

San Marcos, Texas

May 2007

Trait Empathy and Sensitivity to Morphed Emotional Faces

Approved:

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Dr. Heather Galloway
Director, Mitte Honors Program

Approved:

____

Dr. Reiko Graham
Department of Psychology
Supervising Professor

____

Dr. Roque Mendez
Department of Psychology
Second Reader

Acknowledgements

I would like to thank Dr. Graham and Dr. Mendez for their guidance and support throughout this process. I would also like to thank Oquidea Morales and other BURPers for help collecting and analyzing data. I am very thankful for all of the motivation and personal support my parents, Erin, Ashley and all my friends have given me.

Abstract

Empathy is a vital component of social intelligence. To understand the construct of empathy, some neurological studies implicate the importance of the frontal lobe, while others propose a shared representations mechanism: viewing emotional facial expressions activates the same brain areas involved in the personal experience of that emotion. We examined the relationship between IRI empathy scores and the interpretation and sensitivity to changes in emotional facial expressions of fear and anger. While there was no relationship between the ability to detect the intensity of fear or anger alone, particular empathy subscales were significant predictors of how individuals interpreted blends of fear and anger. Greater perspective taking and personal distress were associated with an increased likelihood of endorsing a blend as fearful, while greater empathic concern was associated with increased likelihood of endorsing an ambiguous blend as angry. We conclude the IRI measures empathy as a frontal lobe-mediated process, rather than a sensory driven process in deciphering facial expressions. However, the ability to decode facial expressions is just one facet of the complex emotional and cognitive construct of empathy.

Trait Empathy and Sensitivity to Morphed Emotional Faces

Empathy is vital for effective functioning within a social context. Generally when we observe other people in emotional states, we consider the other person's point of view and sometimes feel an emotional response. These processes allow us to feel empathy. Empathy plays a role in moral reasoning and motivates helping behavior (Chlopan, McCain, Carbonell, & Hagen, 1985). Deficits in empathic ability have been linked to antisocial personality disorder, schizophrenia, and autism (Baron-Cohen & Wheelwright, 2004; Cleckley, 1941; Lee, Farrow, Spence, & Woodruff, 2004). Studying the relationship between individual differences in empathic ability and neural models of empathy will lead to a better understanding of this important construct.

Empathy is studied by both social psychologists who use questionnaires to detect self-reported differences in empathy, and neuropsychologists who examine the underlying neural networks important for empathic ability. Social psychologists have generally focused on two aspects of empathy: cognitive and affective components. Hogan (1969) created the Empathy Scale to measure a person's cognitive understanding of another's perspective, while Mehrabian and Epstein (1972) created the Questionnaire Measure of Emotional Empathy to measure emotional arousal in response to the emotions of others. However, neither scale is a pure measure of cognitive or affective aspects of empathy (Cholpan et. al., 1985; Davis, 1996).

Davis' (1980) Interpersonal Reactivity Index (IRI) adopts a multidimensional approach to empathy including both cognitive and affective aspects. The IRI consists of four subscales; each measuring a different aspect of empathy: perspective taking (PT), empathic concern (EC), fantasy (F), and personal distress (PD). Each of these subscales measures a different aspect of empathy. The PT subscale measures the tendency to adopt another's point of view (e.g., "I sometimes try to understand my friends better by imagining how things look from their perspective."). The EC subscale measures feelings of sympathy and concern for others (e.g., "I often have tender, concerned feelings for people less fortunate than me."). The F subscale measures the ability to imagine oneself in the role of a fictitious character in books (e.g., "When I am reading an interesting story or novel, I imagine how *I* would feel if the events in the story were happening to me."). The PD subscale measures personal feelings of anxiety and unease in interpersonal settings (e.g., "Being in a tense emotional situation scares me."). Davis' (1980) IRI is a versatile tool for measuring several different aspects of empathy and their interrelationships.

While social psychologists have focused on describing the cognitive and emotional components of empathy, neuroscientists have focused on elucidating the brain areas that are involved in the experience of empathy. One theory proposes that empathy is achieved through shared representations of emotion; perception of emotion in others activates the same neural systems that are involved in the personal experience of that emotion (Botvinick et al., 2005; Pourtois et al., 2004; Singer et al., 2006). Therefore, an angry face should activate the same neural systems that help to produce the experience of anger within oneself. Some researchers suggest that in addition to brain activations associated with shared-representations, a mechanism has to exist that separates self from other (Decety & Chaminade, 2003). These researchers also emphasize the role of active perspective taking processes in the experience of empathy (Ruby & Decety, 2004).

A large body of evidence in support of a shared representations model of empathy stems from pain research. Brain areas normally activated when a person feels a sensation are also activated when observing someone else feeling these sensations (Botvinick et al., 2005; Keysers et al., 2004; Singer et al., 2006). The secondary somatosensory cortex was activated when individuals were touched or when they observed another person or object being touched (Keysers et al., 2004). Botvinick et al. (2005) found similar ACC and insula activation while viewing short videos of facial expressions of pain and during painful thermal skin stimulation. Coactivation of the ACC and insula was also found in individuals both when they were given painful stimulation and when they believed a loved one was receiving a painful stimulation (Singer et al., 2004). Stronger activation of the ACC and insula were correlated with higher scores on the IRI empathy subscale of empathic concern (Singer et al., 2004). Thus, activation of the brain areas involved in shared representations of pain seems to be directly related to empathetic ability as measured by the IRI. In summary, both the ACC and insula seem to be involved in experiencing pain in oneself and observing pain in others.

Another source of evidence in support of a shared representations model of empathy stems from research in the perception of facial expression. Adolphs, Damasio, Tranel, Cooper, and Damasio (2000) suggest that our ability to decode facial expressions may be possible because we internally simulate the emotion with our own somatosensory cortex. This internal simulation may form the neurological basis for understanding what another is feeling (i.e. empathy). Pourtois et al. (2004) propose a similar theory: activation of the somatosensory cortex during the perception of emotions may allow a person to match the visual representation of a facial expression with a somatic record of that emotion based on the body's own experience.

In order for a shared representations model of empathy to be effective, some mechanism has to exist that separates self from other in order to avoid confusion (Jackson, Brunet, Meltzoff, & Decety, 2006). Jackson et al. (2006) had people view painful situations from different perspectives: one representing the self and the other representing another person. When viewed from the self-perspective, painful situations were rated as more painful and activated the ACC, insula, thalamus, and somatosensory cortex more extensively than when viewed from the other perspective. This differential activation may be involved in distinguishing self from other (Jackson et al., 2006). Decety and Chaminade (2003) suggest that the right inferior parietal cortex may also be involved in self-other distinctions, while other research indicates that the posterior cingulate and precuneus may be involved in distinguishing between self and other perspectives (Platek, Mohamed, & Gallup, 2005; Ruby & Decety, 2004). In summary, this research suggests that while overlapping brain areas could be important in creating a mental representation of the physical feelings of another, activation of additional brain areas is necessary in order to attribute these sensations to others.

While the perception and representation of emotion in the brain could be an important component of empathy, additional areas of the brain may be recruited in the empathic process. Like other evaluative judgments, judgments about how another person is feeling should involve both automatic, stimulus-driven components and more deliberate, consciously controlled processes (e.g. Cunningham, Johnson, Gatenby, Gore, & Banaji, 2003). Higher order processes like perspective taking are also important for the ability to understand another's feelings. Once an emotion is detected, additional brain structures may be involved in actively taking another's perspective and regulating the emotional response. These two processes have both been related to frontal lobe activity (Ruby & Decety, 2004; Urry et al., 2006). Therefore, the experience of empathy must also include these frontal lobe-mediated processes.

The frontal lobe appears to play an important role in enabling a general understanding of another's mental state, thoughts, and feelings (Ruby & Decety, 2004; Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003). For example Ruby and Decety (2004) had subjects adopt their mothers' perspective in stories of real-life, emotional situations. This perspective-taking behavior activated the subjects' frontopolar cortex, ventromedial prefrontal cortex, medial prefrontal cortex, right inferior parietal lobe, amygdala and temporal lobes. The ventromedial prefrontal cortex was also activated in individuals listening to emotional stories (Decety & Chaminade, 2003) and damage to this area was related to significantly lower scores on the IRI (Shamay-Tsoory et al., 2003).

The role of the ventromedial prefrontal cortex in both perspective taking and emotion regulation is logical because taking the perspective of others can help individuals regulate their emotions (Urry et al., 2006). The ventromedial prefrontal cortex is thought to play an important role in emotion regulation, especially inhibiting negative emotional responses (Urry et al., 2006) and is also implicated in emotional reappraisal: an emotion regulation strategy that involves cognitively changing the intensity of an emotional experience (Ochsner, Bunge, Gross, & Gabrieli, 2002). The ventromedial prefrontal cortex has an important role in decision making under uncertain conditions (e.g., Fellows & Farah, in press). This decision-making role could be important in feeling empathy, especially when emotional states are ambiguous.

We used a two-alternative forced-choice task to measure sensitivity to subtle differences in emotional facial expression. This task was chosen because it has been demonstrated to be sensitive to emotion processing deficits associated with bilateral amygdale damage (Graham, Devinsky, & LaBar, 2007) and has also been shown to be sensitive to maturational processes in childhood and adolescence (Thomas, De Bellis, Graham, & LaBar, in press). We examined morphs of fear and angry facial expressions. Blends of fear or anger with neutral expressions were utilized to examine an individual's sensitivity to changes in emotional intensity, while blends of fear and anger were employed to investigate an individual's interpretation of emotion blends.

We investigated whether the IRI empathy scale measures empathy as a sensory perception process or a cognitively driven, decision making process. If the IRI is sensitive to shared representations processes then subscale scores should be related to d' measures of sensitivity. Individuals scoring highly on the IRI scale might need less emotion displayed in order to detect an emotion and may be more sensitive to changes in emotional intensity (i.e., the IRI should be significantly related to d' measures and PSE values especially in the neutral to anger and neutral to fear morph types). If the IRI is sensitive to cognitively-mediated processes, then subscale scores should not be related to sensitivity, rather reaction times should be affected and there should be evidence of a decision bias in the absence of sensitivity differences (i.e., the IRI should be significantly related to PSE differences and not sensitivity differences especially in the fear and anger blends). This decision bias would reflect a decision-making process mediated by the frontal lobes.

Method

Participants

Participants were 146 students (102 female, 34 male) age 18-45 years, recruited from undergraduate psychology classes at Texas State University. Participants were offered extra course credit in exchange for participation in the study. Volunteers gave written informed consent for participation in the study. Procedures for human subjects were approved by the Institutional Review Board at Texas State University.

Stimulus Development

Emotional facial expressions of fear and anger were taken from the Ekman pictures of facial affect (Ekman &Friesen, 1976; Matsumoto & Ekman, 1998). All facial expressions were from the same ten actors who were posed in full frontal orientations. The faces were cropped with an ovoid mask to eliminate extraneous clues such as hair, ears, and neckline. Images were normalized for contrast and luminance and presented against a gray background. Prototypical expressions of fear and neutral, anger and neutral, and fear and anger were morphed together to create three different morph progressions. The morphs were created using the methods described in LaBar, Crupain, Voyvodic, & McCarthy (2003) and Graham et al. (2007) using MorphMan 2000 software (STOIK, Moscow, Russia).

Ten images were created for each morph progression, but the endpoints of each morph increment were removed from the stimulus to display only the more ambiguous emotional facial expressions. For example, for the neutral to anger continuum, morph increment 1 was 77.77% neutral and 22.22% angry, increment 2 was 66.66% neutral and 33.33% angry, increment 3 was 55.55% neutral and 44.44% angry, and so on. A total of 180 images were used in this experiment (3 emotion morph types x 10 models x 6 morph increments) and are shown in Figure 1.

--------- Insert Figure 1 about here ---------

Questionnaire

The Interpersonal Reactivity Index (Davis, 1980) is composed of four seven-item subscales: perspective taking (PT), empathic concern (EC), fantasy (F), and personal distress (PD) (see Appendix). The alpha coefficients for internal reliability range from .70 to .78 and for test-retest reliability ranges from .61 to .81 for the scale (Davis, 1996). A number of questions were reversed so that participants were not led to answer in one particular direction. Participants answered on a five point Likert scale (one indicating “not like me” and five indicating “very much like me”).

Design and Procedure

The 180 morphed faces were used in three, two-alternative forced-choice identification tasks, one for each morph type. In each task, faces were presented one at a time and participants were asked to make one of two possible responses as quickly and accurately as possible. Each trial consisted of a fixation for 1000ms, followed by an individual emotion morph for 505ms. A response selection screen then appeared which was displayed until the participant made a response (Figure 2). The fixation screen consisted of a scrambled face superimposed onto a centrally-positioned crosshair. The response selection screen consisted of two alternative emotion descriptors that differed for each of the three tasks. For example in the neutral to anger morph task, participants chose between a response of neutral or a response of anger. Each of the three tasks was administered three times to each participant for a total of nine runs. The task order was counterbalanced across all participants. Participants completed each morph type three times in a row, with a pause between each completed task, before moving on to the next morph type. After the participants were finished with the three trials for all three morph types they filled out the questionnaire.

--------- Insert Figure 2 about here ---------

Questionnaire Data Analysis

The reversed items on the questionnaire were corrected. For each subscale (PT, EC, F, PD), the responses were added up to give a total subscale score. Correlations were conducted between each of the subscales.

Behavioral Data Analysis

Corrected d’ scores for two-alternative forced-choice tasks (MacMillan & Creelman, 1991) were computed for each morph increment and then were summed according to morph increment to create five different cumulative d’ scores. The d’ gives an estimate of each person's sensitivity to subtle changes in facial expressions. The average d' and d' slope of the cumulative functions were computed for each participant across all three morph types. The average d' represented the average sensitivity of participants over the 6 morph increments. The d' slope was the slope of the d' values over the 6 morph increments, and represented the sensitivity of the participant to small changes in facial expression across the morph increments.

The point of subjective equality (PSE) was calculated for each of the three morph types for each person. As the emotion on the face progresses from neutral to fear (or neutral to anger or fear to anger) participants shift from endorsing the facial expression of neutral to endorsing the depiction of fear. The PSE gives an estimate of the categorical boundary and represents the morph increment at which the subjects are most likely to be guessing (i.e., the expression is most ambiguous to them). Also, means of median reaction times were calculated for each individual for each morph type to determine average response latency for each morph type.

We simultaneously entered the four subscales (PT, EC, F, PD): as independent variables in a multiple regression analysis predicting the points of subjective equality (PSE), average d' values, d' slope, and median reaction times, for each of the three morph types: neutral to anger, neutral to fear, and fear to anger. Only significant subscales with significant relationships to criterion variables were included in the results and discussion below.

Results

Correlations between the IRI subscales are summarized in Table 1. Empathic Concern was significantly correlated with Fantasy ($r = .293$, $p < .01$), Perspective

Taking ($r = .523$, $p < .01$), and Personal Distress ($r = .270$, $p < .01$). Personal distress and Fantasy were also significantly correlated ($r = .221$, $p < .05$). These positive correlations indicate that individuals with high scores on one subscale have high scores on the other correlated subscale as well.

For the neutral to anger morph type, none of the subscales were significantly related to average d', d' slope, PSE, or reaction times. None of the IRI subscales were able to predict differences in subjects' sensitivity to the intensity of anger in a face.

For the neutral to fear morph type, the main effects of perspective taking, $\beta(146) = .154$, $p = .076$, and personal distress, $\beta(146) = .158$, $p = .068$ were marginally significantly predictive of median reaction times (see Table 2). This indicates that individuals scoring higher on perspective taking and personal distress had a tendency to take longer to decide if the face presented expressed a neutral or fearful expression. The IRI empathy subscales were unrelated to the subjects' PSE or sensitivity to the intensity of fear in a face.

--------- Insert Table 2 about here ---------

For the fear to anger morph type, perspective taking, $\beta(146) = .223$, $p < .05$, personal distress, $\beta(146) = .200$, $p < .05$ and empathic concern, $\beta(146) = -.348$, $p < .01$ were all significantly related to PSE (see Table 3). Higher the scores on the PT and PD subscales were related to higher PSE values, signifying these individuals are more likely to endorse a face portraying a blend of fear and anger as fearful. Conversely, the higher empathic concern scores were related to lower PSE values, signifying these individuals are more likely to endorse an ambiguous face as angry rather than fearful. Also in the fear to anger morph type, personal distress was significantly related to median reaction times, $\beta(146) = .211$, $p < .05$. Individuals with higher personal distress scores took longer to decide the emotion expressed. The IRI subscales were not related to the subjects' sensitivity to small changes in the facial expression from fear to anger (i.e., d' measures); the subscales were only related to the morph increment at which the faces appeared most ambiguous to the subjects (i.e., PSE).

--------- Insert Table 3 about here ---------

Discussion

Our ability to understand and identify with the emotions of others is a critical aspect of adaptive social function. Empathy consists of both emotional and cognitive components and is thought to involve brain areas associated with shared emotional representations and emotional decision making processes. One aspect of the empathic process is the shared representation of emotion in the brain (i.e., we understand what others are feeling because perceiving an emotion activates the same neural network as feeling it ourselves) (Botvinick et al., 2005; Pourtois et al., 2004; Singer et al., 2004). Another aspect of this process relies on frontal lobe areas that are important for perspective-taking and emotion regulation (Ruby & Decety, 2004; Urry et al., 2006) that are associated with a cognitively-mediated decision process (Fellows & Farah, in press). The objective of this study was to determine the relationship between empathy scores (as indexed by the IRI) and sensitivity to facial expression. We were interested in determining the degree to which IRI scores were related to shared representations empathic processes and cognitively-mediated decision processes.

To examine if the IRI is sensitive to sensory perception processes or a frontal lobe-mediated processes, the present study administered the IRI and measured subjects' sensitivity to and interpretation of emotional faces using a two-alternative forced-choice task of morphed facial expressions. We predicted that if empathy scores on the IRI are related to sensory perception processes, then individuals who score higher on the IRI subscales should be more sensitive to subtle changes in facial expressions (i.e., d' measures should be higher). Alternatively, if empathy scores on the IRI are related to more cognitive, decision-making driven processes, then individuals who score higher on the IRI subscales might not necessarily be more sensitive to subtle changes in facial emotion, but might be biased in their interpretation of emotion blends (i.e., PSE values should be different with no corresponding changes in sensitivity measures).

The shared representations model theorizes that the perception of emotion in others will activate the same brain areas in an individual as the personal experience of that emotion. A person must be able to perceive emotion in order to activate the shared representation of the emotion in the brain, a mechanism that allows for the feeling of empathy. If the IRI is sensitive to shared representations processes, then higher empathy scores should be associated with greater sensitivity. In other words the individual should be able to detect lower levels of emotion in a face and should be more sensitive to changes in intensity. Analyses of the relationship between the IRI subscale scores and sensitivity measures for both the neutral to anger and neutral to fear morph types revealed no significant relationships. None of the IRI subscales were related to sensitivity (i.e. the ability to detect emotion) suggesting that the IRI subscale scores are not sensitive to stimulus-driven, shared representation processes.

Analyses of the fear to anger morph type indicated the IRI subscales of empathic concern, perspective taking, and personal distress were all significantly related to the points of subjective equality (PSE). The PSE is an estimate of the point at which a person switches from identifying the face as expressing one emotion (e.g. fear) to identifying the expression as the other emotion (e.g. anger). In other words, the PSE reflects the emotion morph that appears most ambiguous to a person. Since the IRI subscales were predictive of different PSE values, but not of d’ sensitivity values, we reason that the IRI subscales are related to an individual’s decision making process in interpreting ambiguous emotion blends. The ventromedial prefrontal cortex is important in decision making (Fellows & Farah, in press). Therefore, the fact that the IRI empathy subscale scores were predictive of different interpretations of fear/anger emotion blends suggests that the IRI is sensitive to frontal lobe-mediated, top-down empathic processes.

Higher PD and PT scores predicted higher PSE values for the fear to anger morph (i.e. the likelihood to identify an ambiguous face as fearful), while higher EC scores predicted lower PSE values (i.e. the likelihood to identify a face as angry). This means for the same ambiguous face, those high in PD or PT are more likely to judge the face as fearful, while those high in EC are more likely to judge the same exact face as angry. These findings are considered in detail below.

Individuals who scored highly on the PD subscale were more likely to identify an ambiguous emotion blend of fear and anger as fearful. Higher PD scores are associated with high levels of anxiety and chronic fearfulness (Davis, 1983). Studies have demonstrated that anxious individuals orient more rapidly to fearful faces (Holmes, Richards, & Green, 2006; Mathews, Fox, Calder, & Yiend, 2003; Putman, Hermans, & van Honk, 2006; Tipples, 2006). Therefore, an anxious individual should score higher in PD, and may be biased to respond to the fear present in the ambiguous face, rather than anger. Individuals with high PD scores also had greater median reaction times, when looking at neutral to fear and fear to anger morphs (i.e. they took longer to make a response after viewing the face). This finding is congruent with studies that suggest that highly anxious individuals are slower to disengage attention from fearful faces (Fox, Russo, & Dutton, 2002; Georgiou et al., 2005). Individuals with high anxiety may experience distress at seeing fear and therefore take longer to free their attention from the face to make a response. Therefore, it is likely that the bias to respond to fear in ambiguous blends and the tendency to look longer at fearful faces in individuals scoring higher in PD is mediated by anxiety. Future studies should examine this possibility.

High PT scores were related to an increased likelihood of interpreting blends of fear and anger as fearful. PT scores have been shown to be predictive of the degree of fear felt while viewing scary movies, while EC scores were unrelated, although the mechanism is unclear (Hoekstra et al., 1999). This bias towards fear exhibited by individuals high in perspective-taking in Hoekstra et al. (1999) may be related to the finding in the present study that individuals high in PT are more likely to judge a blend of fear and anger as fearful. It is interesting to note that although both PT and PD scores were predictive of a bias towards fear interpretation, there was no correlation between PT and PD scores. Therefore, although individuals high in PD and PT show the same tendency toward fearful interpretations, it is likely that different mechanisms underlie these interpretations. Future research is necessary to further examine PT, PD, and biases toward fearful interpretations in ambiguous contexts.

High scores on the EC subscale predicted an increased likelihood of interpreting an ambiguous facial blend of fear and anger as angry. Individuals with high EC scores do not seem to be particularly sensitive to fear (Hoekstra et al., 1999); perhaps by default those individuals are inclined to interpret the ambiguous face as angry. Alternatively, individuals high in EC seem to be more sensitive to the violation of social norms (Blair & Curran, 1999; Parkinson, 2001). For example, individuals who scored highly on the EC subscale, but not any of the other IRI subscales, were more likely to be angered by the reckless behaviors of others (Parkinson, 2001). Because angry facial expressions are a potential signal of norm violation (Blair & Curran, 1999), individuals with higher EC scores (who are concerned about social conformity) may be more likely to focus on and identify the anger in an ambiguous blend of fear and anger.

Finally, intercorrelations between the different IRI subscales in conjunction with the regression results outlined above are both relevant and informative. As mentioned previously, scores on both the PT and PD subscales were predictive of similar interpretations of fear and anger blends; however, there was no correlation between the two subscales. As mentioned previously, this lack of relationship seems to suggest that perspective taking and personal distress are predictive of similar interpretations of expression blends; it is likely that different mechanisms underlie these interpretations. Another interesting finding was that the regression analysis for PSE for the fear to anger morph revealed that PT and EC were predictive of different interpretations of the emotion blends. In contrast, there was a significant correlation between these two subscales, a relationship that has been reported in previous studies (e.g., Davis, 1983). It is curious that while PT and EC are highly correlated, they predict different interpretations of ambiguous blends. One study suggests an important factor in differentiating between PT and EC is fear; PT and EC are not related when predicting levels of fear (Hoekstra et al., 1999). Future research is necessary to examine the interrelationship of PT and EC and interpretation biases in ambiguous contexts.

This study examined the relationships between scores on the IRI and sensitivity to changes in fearful and angry facial expressions and their blend. We found that IRI scores were not related to stimulus-driven sensory processes, but were related to more cognitively-mediated decision-making processes. We conclude that the IRI is sensitive to processes that are under more deliberate cognitive control. However, there are other empathy scales that measure empathy in slightly different ways (e.g., Hogan, 1969; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Mehrabian & Epstein, 1972). It would be interesting to determine if these other scales have different relationships with the sensitivity or interpretation of morphed facial expressions of emotion.

One limitation of this study was that it only examined two negative emotions: fear, anger, and their blend. Therefore it is difficult to generalize across all positive and negative emotional expressions; perhaps different results would have been obtained with other emotions. Future studies should examine other facial expressions or expression blends. Another limitation of the current study is the lack of context for the facial expressions used in the behavioral task of the experiment. Additional contextual cues such as body language, gaze direction, or narrative events are all components present in real life experiences that could influence the interpretation of emotion and the empathic response. Finally, the behavioral task used in this study may not be sensitive to sensory representation processes, but other methods such as event related potentials and fMRI might be more sensitive to individual differences in sensory representation processes associated with empathy (e.g. Shamay-Tsoory et al., 2003).

A body of evidence exists that the perception of facial expression may be modulated by gaze direction (e.g. Adams & Kleck, 2003, 2005). Future studies could manipulate the gaze direction of morphed emotional faces to determine if gaze direction affects the interpretation of the blend of fear and anger. The present study used faces with direct gaze, but if the gaze direction were averted, the emotion blends may be interpreted differently. For example, Adams & Kleck (2003, 2005) found people were faster and more accurate at identifying angry faces when the gaze was direct, while they were faster and more accurate at identifying fearful faces when the gaze was averted. Perhaps the use of faces with direct and indirect gaze can help to clarify the results of the present study.

One of the main findings of this study was that the IRI subscales are associated with cognitive, frontal-lobe processing of empathy, in which the ventromedial prefrontal cortex has been implicated. Future studies could focus on how individuals with socioaffective disorders that show deficits in empathic processing and frontal lobe function, such as autism, schizophrenia, anti-social personality disorder (Baron-Cohen & Wheelwright, 2004; Cleckley, 1941; Lee et al., 2004) perform on the our task. We would expect these individuals to have lower IRI scores and abnormalities in facial expression processing relative to controls. This might allow us to gain more insight into the relationship between empathy and sensitivity to facial expressions.

Conclusions

Facial expressions are powerful social signals that allow us to make inferences about the internal states of others, which essential to the empathic process. The purpose of this study was to determine the relationship between IRI empathy scores and the interpretation and sensitivity to changes in fearful and angry facial expressions and their blend. This study found that IRI scores were not related to d' measures of sensitivity, but were related to different interpretations of fear and anger blends. Our results suggests that empathy, as indexed by the IRI, is not related to stimulus-driven sensory processes, but is related to more cognitively-mediated decision-making processes. In conclusion, the IRI empathy scale is sensitive to processes under more deliberate cognitive control.

Table 1

Intercorrelations Between IRI Subscales

Subscale	Perspective Taking	Empathic Concern	Fantasy	Personal Distress
Perspective Taking	--	.523**	.140	-.043
Empathic Concern		--	.293**	.270**
Fantasy			--	.221*
Personal Distress				--

Note. * $p < .05$. ** $p < .01$.

Table 2

Regression analysis (Betas) predicting sensitivity measures based on empathy subscales for neutral to fear morph type

Subscale	PSE	Average d’	d’ slope	Median rt
Perspective Taking	--	--	--	.154[a]
Empathic Concern	--	--	--	--
Fantasy	--	--	--	--
Personal Distress	--	--	--	.158[a]

Note: [a] .05 < p < .01

Table 3

Regression analysis (Betas) predicting sensitivity measures based on empathy subscales for fear to anger morph type

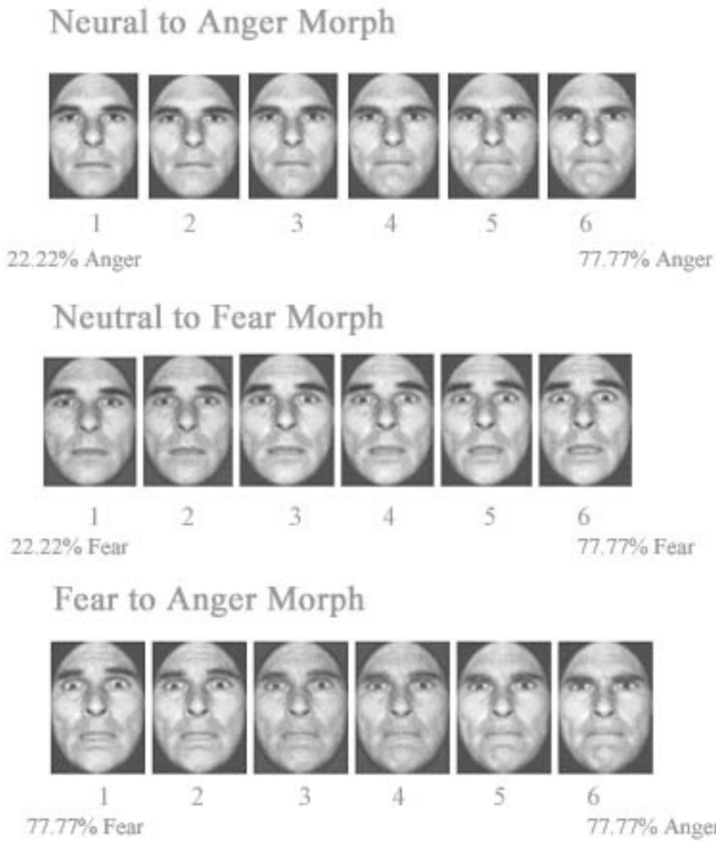
Subscale	PSE	Average d’	d’ slope	Median rt
Perspective Taking	.223*	--	--	--
Empathic Concern	-.348**	--	--	--
Fantasy	--	--	--	--
Personal Distress	.200*	--	--	.211*

Note. * $p < .05$. ** $p < .01$.

Figure Captions

Figure 1. Examples of the three emotion morph continua used in this experiment: A) neutral to anger, B) neutral to fear and C) fear to anger.

Figure 2. Example of the stimulus sequence in a trial of the two-alternative forced-choice task.



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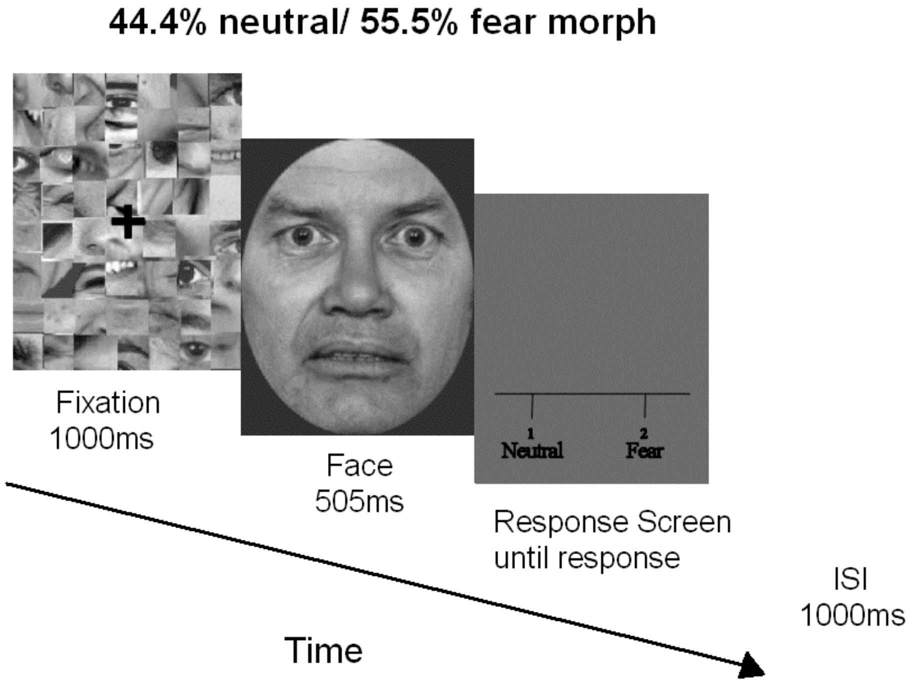

Figure 2. Example of the stimulus sequence in a trial of the two-alternative forced-choice task.

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APPENDIX

Interpersonal Reactivity Index

Items 4 to 40. The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you on a scale of A (not at all like you) to E (very much like you).

1. I daydream and fantasize, with some regularity about things that might happen to me.

   A B C D E

   Not like me Very much like me

2. I often have tender, concerned feelings for people less fortunate than me.

   A B C D E

   Not like me Very much like me

3. I sometimes find it difficult to see things from the "other guy's" point of view.

   A B C D E

   Not like me Very much like me

4. Sometimes I don't feel very sorry for other people when they are having problems.

   A B C D E

   Not like me Very much like me

5. I really get involved with the feelings of the characters in a novel.

   A B C D E

   Not like me Very much like me

6. In emergency situations, I feel apprehensive and ill-at-ease.

   A B C D E

   Not like me Very much like me

7. I am usually objective when I watch a movie or a play, and I don't often get completely caught up in it.

   A B C D E

   Not like me Very much like me

8. I try to look at everybody's side of a disagreement before I make a decision.

A B C D E

Not like me Very much like me

9. When I see someone being taken advantage of, I feel kind of protective towards them.

A B C D E

Not like me Very much like me

10. I sometimes feel helpless when I am in the middle of a very emotional situation.

A B C D E

Not like me Very much like me

11. I sometimes try to understand my friends better by imagining how things look from their perspective.

A B C D E

Not like me Very much like me

12. Becoming extremely involved in a good book or movie is somewhat rare for me.

A B C D E

Not like me Very much like me

13. When I see someone get hurt, I tend to remain calm.

A B C D E

Not like me Very much like me

14. Other people's misfortunes do not usually disturb me a great deal.

A B C D E

Not like me Very much like me

15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

A B C D E

Not like me Very much like me

16. After seeing a play or a movie, I have felt as though I were one of the characters.

A B C D E

Not like me Very much like me

17. Being in a tense emotional situation scares me.

A B C D E

Not like me Very much like me

18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.

A B C D E

Not like me Very much like me

19. I am usually pretty effective at dealing with emergencies.

A B C D E

Not like me Very much like me

20. I am often quite touched by things that I see happen.

A B C D E

Not like me Very much like me

21. I believe that there are two sides to every question and try to look at them both.

A B C D E

Not like me Very much like me

22. I would describe myself as a pretty soft-hearted person.

A B C D E

Not like me Very much like me

23. When I watch a good movie, I can very easily put myself in the place of a leading actor.

A B C D E

Not like me Very much like me

24. I tend to lose control during emergencies.

A B C D E

Not like me Very much like me

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while.

A B C D E

Not like me Very much like me

26. When I am reading an interesting story, I imagine how *I* would feel if the events in the story were happening to me.

A B C D E

Not like me Very much like me

27. When I see someone who badly needs help in an emergency, I go to pieces.

A B C D E

Not like me Very much like me

28. Before criticizing somebody, I try to imagine how I would feel if *I* were in their place.

A B C D E

Not like me Very much like me