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# Are you Feeling Me?: The Role of Attention in Physiological Empathetic Responses

Gabriela Paganini
*Scripps College*

# ARE YOU FEELING ME?: THE ROLE OF ATTENTION IN PHYSIOLOGICAL EMPATHETIC RESPONSES

**by**

**GABRIELA V. PAGANINI**

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**PROFESSOR HARTLEY**
**PROFESSOR MA**

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## Abstract

This study examined the role of attention and trait empathy within the production of neural facial mimicry responses that have been previously found to be associated with the experience of empathy. More specifically, do people who have high trait empathy levels require less attention to emotional information in order to still exhibit these physiological responses than people who have lower trait empathy levels? It has previously been demonstrated that responses in the zygomaticus and corrugator muscles have been associated with the experience of empathy. College aged participants were shown series of happy, angry, and neutral faces with the amount of attention allocated to the emotional information of the faces manipulated. It was predicted that the level of attention directed at the emotional faces would affect the level of these physiological empathetic responses. Attention directed at the emotional content of the photos was shown to elicit higher activations of these physiological responses than when participants' attention was directed at another characteristic of the stimuli, gender, but trait empathy was not shown to significantly moderate the relationship between these physiological responses and the level of attention directed at the emotional information.

*Keywords*: attention, facial mimicry, empathy

Empathy, the ability to accurately perceive the emotions of others and share those emotions, has evolved as a key aspect of social living. Darwin (1872) discussed the function of emotional displays as signals of important information about an individual's internal state. The ability to accurately interpret those displays is a necessary skill for communal living. Empathy can assist with the development of moral reasoning, as well as motivate prosocial behavior (Cheng, Chen, & Decety, 2014). Moral reasoning and prosocial behavior are also fundamental individual characteristics that allow for prosocial, positive, and productive communal living.

The current research will investigate whether people respond to emotional information in other people's faces even when conscious attention is directed elsewhere. It will explore the question of whether conscious attention is necessary to process emotional information, as well as the relationship between attention and individual trait empathy levels. If attention is required, do highly empathetic people show more response to emotional information when attention is directed elsewhere than less empathetic people? Another possibility is that highly empathetic people may immediately process emotional information in a similar manner to people low in empathy, but may still respond more to emotional stimuli because emotional information is more important to them than people low in empathy.

In order to examine responses to unattended emotional information that may not be conscious, the current research will look at physiological responses that have been previously associated with the processing of emotional information and empathy in past research (Balconi, Brambilla, & Falbo, 2009; Balconi, Bortolotti, & Gonzaga, 2011; Balconi & Mazza, 2010; Li & Han, 2010). Specifically, facial mimicry, which refers to an individual exhibiting changes in their own facial expression in response to seeing an emotional expression in someone else, reflected in activation of facial muscles will be assessed. While these responses have been established as being involved in the processing of emotional stimuli, it does not necessarily imply that the presence of these responses indicates that a person is experiencing empathy. These responses show that the information has been processed in some way. That is a precondition for empathy because if one does not process the emotional information, one cannot empathize. But knowing that information is simply being processed also does not allow it to be established with certainty that empathy resulted.

## Definitions of Empathy

There are many different definitions of empathy within the current research literature. This section will focus on four, widely used definitions for empathy. These definitions highlight the inconsistencies of the conceptualization of empathy. There is no one unified definition of the construct of empathy that is widely accepted.

Some researchers have referred to empathy as the *knowledge* of another person's internal or mental state (Batson, 2009). This definition has been used by Preston & de Waal (2002), Wispe (1986), Eslinger (1998) and Ickes (1993). It has also been labeled various things such as "cognitive empathy" or "empathic accuracy." Put simply, this definition posits that empathy is achieved when an observer knows what another person is feeling.

Another characterization of empathy posits that empathy is *imagining* how someone else is thinking or feeling within a situation, termed the "imagine other" perspective by Batson (1991) and "empathy" or "projection" by Adolphs (1999).

Empathy has also been defined as the experience of *feeling the same emotion* as the person one is interacting with or observing (Damasio, 2003; Decety & Chaminade, 2005). Hoffman (2000) qualified this definition as the person need not necessarily feel the exact emotion or to the exact degree that their counterpart is feeling, but they may simply experience a similar emotion or to some extent.

The fourth definition characterizes empathy as the *adoption* of the posture or expression of the person the subject is observing (Batson, 2009). This has been coined “facial empathy” by Gordon (1996), as well as “motor mimicry” by Dimberg, Thunberg, & Elmehed (2000) or “imitation” by Meltzoff & Moore (1997). This definition of facial mimicry will be explored in depth later on in this paper.

These four different definitions of empathy are similar, but yet diverge in significant ways when trying to operationalize empathy in terms of a research variable. This demonstrates the lack of one definition of empathy widely accepted within the research field, which presents a problem when comparing and building off of other research done on the subject.

## Perception-Action Model

The perception-action model (PAM,) presented by Preston (2007), is based on the tenets of motor behavior. It was built upon research by Preston & de Waal (2002) that provided evidence that a person’s perception of a target’s behavior automatically activates the person’s internal representations for that or similar behavior. The activation of that representation then activates motor areas of the subject’s brain where a response to that activation would have been executed if the behavior were actually carried out (Preston & de Waal, 2002). For example, imagine that someone is watching a baseball player up to bat and the pitcher throws a ball right down the middle, perfect for the batter to hit, but the batter doesn’t swing. If the person observing was invested enough and very intently watching, that person may feel the urge to swing, as well as actually perform the motion of swinging their own hands as though the person had the bat in them.

This model posits that a shared emotional representation happens as the person begins to feel the same or a similar emotion to the target as a result of the person's perception of the target's internal state (Preston, 2007). This has also been referred to as a self-other overlap, which is when an observer of an interaction engages in a similar action to that of the target through the activation of the observer's own personal representations of the object's perceived internal state (Preston & Hofelich, 2011).

This model also touches upon the role of a neural mechanism. While there is no "empathy region" of the brain, according to PAM, many brain areas are recruited when the relevant domain is required. These brain areas reflect a pattern of activation that corresponds to a specific internal state. This is what is referred to as a representation. Somatosensory-related brain areas store feeling states so that when a person's perception of another's internal state activates their representation of that internal state, the somatosensory cortex is also activated, hence activating sensations and the experience of emotion to some degree in the person (Preston, 2007).

**Automaticity**

PAM suggests that when a person attends to the emotional state of the target of an interaction, a representation of that emotional state within the person will be automatically activated (Preston, 2007). For example, if you observe someone who is beginning to blush and is exhibiting an embarrassed facial expression, your brain areas that house representations for the feeling of embarrassment would be automatically activated. However, these brain activations are most likely to occur when the target is especially salient. So, if the stimulus is not salient enough, the automatic activation will not take place. In addition, a person is more likely to attend to the state of the target when the target's emotional state is more salient (Colby & Goldberg, 1999). An example of a highly salient emotional state would be a crying baby. Not only is the facial expression pronounced and clear, but this situation also has the advantage of a loud noise to increase its saliency so neural activity is more likely to occur.

To clarify, according to PAM these activations are thought to be automatic, but that does not necessarily mean that one would expect to see a behavioral response whenever a person perceives an internal states of a target. Simply put, these activations are posited to be automatic, but the production of a behavioral response is not. This leads into a discussion of the role of attention in responses to emotional stimuli.

The theory behind the production of automatic responses such as these is based on ideo-motor actions (Preston, 2007). These are brief or attenuated versions of an observed movement that are produced by the observer in situations where the actions of the object are particularly salient (Carpenter, 1884; Prinz, 1987). Ideo-motor actions are presumably only observed when the subject is immersed in the state of the target, is attending to that state, and is not trying to inhibit their own reactions. They are thought to be the result of processes in the cerebellum and frontal lobes, which both inhibit behavior.

## Attention

PAM's matched neural response activations are contingent on attention. The person must attend to the target and its state, but often in social contexts the person does not attend completely or at all. It has been shown that attentional processes are one of the central components to processing emotional facial expressions (Beaudry, Roy-Charland, Perron, Cormier, & Tapp, 2014). There are many factors that could lead to a subject not attending at all or only to some degree in different contexts. Deliberate reallocation of attention also can be used by people to control the extent to which they are consumed or influenced by a target's internal state. This type of control over involvement with a target's state in order to protect oneself from becoming upset can be seen in distressing situations or circumstances. It is obviously distressing to attend to the distress of someone else. An everyday example of this would be changing the channel when a commercial for donations to an animal shelter showing images of emaciated dogs and cats comes on.

Allocating attention is thought to determine whether a matched response will be activated within a subject in the PAM, though this has also been shown in other research. For instance, it has been shown that overt distress can be decreased in infants by distracting them, but hormonal stress levels will remain the same throughout (reviewed in Rothbart, Posner, & Rosicky, 1994). Therefore, even though attention may have an effect on whether an overt response is detected, it may not have the same effect on implicit state levels, such as stress hormone levels.

Another characteristic of attention within the PAM model is the degree of activation associated with responses. Activations of representations within a person may not be robust enough to reach a threshold to attain conscious awareness even though they produce a response from that person. Preston & Stansfield (2008) showed, using reaction time measures, that people process the emotion in images of faces even when their attention is occupied by another cognitive task. What is interesting is that people may or may not show overt responses to the target during tasks like this one. What has not been explored is whether people show neural responses during tasks like this one.

There has also been some criticism of the perception-action model. First and foremost, the criticism is that it is not a unifying a theory of empathy. This has been said due to PAM's emphasis on the neural component and lack of integration of this component with other measures, such as facial mimicry or other physiological measures. Batson (2009) criticized the overemphasis on the role of neural response matching within the model, pointing out that perhaps it should be explored more in step with mimicked motor activity. Second, neural activations or motor mimicry on its own may not always lead to similar internal states within the person and target (Preston, 2007). While PAM lays a foundation for a theory of empathy, it is clear that there is a need for a theory that builds off of PAM's foundation, but encompasses neural, as well as other physiological measures.

## Theories of Emotion Contagion & Facial Mimicry

While the perception-action model places precedence on neural responses on the production of empathetic responses, theories of emotion contagion hypothesize that emotion is transferred from target to observer through the spontaneous mimicry of the target's facial expression (Hatfield, Cacioppo, & Rapson, 1994). Mimickry is defined as a person reproducing facial expressions they perceive in others (Dimberg, Thunberg, & Elmehed, 2000). This mimicry is thought to be what activates a person's own neural representations, which then produce emotional resonance and a subsequent empathetic response. This illustrates a critical distinction between PAM and these theories: whether emotion leads to mimicry or mimicry is what elicits emotion.

Meltzoff & Moore (1997) found that infants exhibit mimicry and that imitation is an active and goal directed process. They reasoned that just because infants are actively engaging in mimicry to attain certain goals, it should not be assumed that mimicry may always be automatic. In line with this, they put forward their own model, the Active Intermodal Mapping Hypothesis (AIM), which was proposed to explain facial imitation. AIM presents a different way of thinking about facial mimicry or imitation than PAM. According to this model, a person perceives a target's facial expression and then compares that expression to their own expression in a supermodal representational space. Differences between and similarities in the expressions are then identified, which then results in facial imitation within the person (Meltzoff & Moore, 1997). This also illustrates a critical distinction between PAM and AIM. PAM emphasizes an automatic component to these responses, whereas a conscious and deliberate component is stressed in AIM.

## An Extension on Attention

Theories of facial mimicry, as well as PAM, make the assumption that responses are produced when a person's attention is directed at the emotional information expressed by a target. Thus, they touch on the vital role of attention in the production of these responses, but do not explain what occurs when attention is not specifically directed at emotional information. This begs the question, is emotional information still processed to some extent, even when a person is not attending to a target, or specifically, the emotional information being conveyed by that target?

It is very possible that emotional information is still being processed even when a person is not directing specific attention to it. Emotional information has been shown to be extremely important evolutionarily (Darwin, 1872). Thus, it could be possible that the brain may have an attentional reserve that registers emotional information automatically even when conscious attention is directed elsewhere. This might not register in consciousness of the person, unless the emotional information were of extreme importance, in which case it would then capture attention. This goes along with past research that has shown that more salient expressions of emotion increase the probability of a person directing their attention to them (Colby & Goldberg, 1999).

Even if the brain is processing emotional information perceived from a stimulus, that does not mean that an overt conscious response, such as comforting the target, will be produced by the person. That being said, it may still be possible to detect if a person is processing this type of information with neural and physiological measures. Responses may be seen even when attention is engaged or focused elsewhere, although it is expected, within the current proposed study, that the more attention is directed to from the target, the stronger the responses will be.

## Trait Empathy

Trait empathy has been defined as the recognition of an object's feelings, as well as sharing those feelings (Mehrabian & Epstein, 1972). As opposed to state empathy, which refers to a level of experienced empathy that is situational, trait empathy is considered to be more like a stable personality characteristic that is dispositional. It is widely accepted that increased trait empathy is associated with greater ability to accurately assess and recognize emotions as conveyed through facial cues and expressions (Balconi & Canavesio 2013; Besel 2007). This ability is commonly referred to as empathic accuracy. In a previous study, Adolphs, Damasio, Tranel, Cooper, & Damasio (2000) showed that motor, sensory, and somatosensory actions, which could be demonstrating that a person shared the feelings of a target, play a role in empathic accuracy. It has also been demonstrated that participants with an increased tendency to reciprocate facial expressions score higher on trait empathy questionnaires (Balconi & Canavesio, 2013; Lee, Dolan, & Critchley, 2007). Looking at it from the opposite perspective, participants with lower trait empathy levels have been found to be less facially expressive (Andréasson & Dimberg, 2008).

Past research suggests that it is easier and takes less cognitive energy to recognize facial expressions of others for those with higher trait empathy levels (Balconi & Bortolotti 2012, 2014; Goldman & Sripada, 2005). Participants with higher levels of trait empathy have been shown to process and recognize the emotional content of faces at faster speeds than those with lower levels of trait empathy.

Nevertheless, not all research has shown people high in trait empathy to be more responsive or accurate. Ickes, Stinson, Bissonnette, & Garcia (1990) conducted a study that went beyond simply using images of facial expressions, as a majority of past research has utilized. The study tried to replicate a more naturalistic setting, using mixed sex dyads in in-person interactions. Participants were asked to review videotapes of their interactions and fill out both a self-report measure to report how they were feeling at various points in the conversation, as well as a measure to report how they perceived their conversation partner felt at various points. The results showed that participants who scored higher on a trait empathy scale were no more accurate at assessing their partner's states during the conversation than those who scored lower on the empathy scale. These results may have been due to a problem with the validity of the scale used to assess trait empathy or the freedom which the participants had within their conversations. They were not directed to have conversations about emotional situations, therefore the content may not have been emotional enough to elicit empathy and thus, not indicative of empathic accuracy.

While the past research reviewed above provides evidence for a relationship between trait empathy and level of ability to understand emotional information, there has been no research that has explored the relationship between trait empathy and attention needed to process emotional information. It may be that people with higher trait empathy levels will be more likely to respond when attention is directed elsewhere than will those lower in trait empathy. If they do, there are multiple possible explanations. It has already been shown that higher trait empathy levels are associated with the ability to process and recognize the emotional content of faces at faster speeds than those with lower levels of trait empathy (Balconi & Bortolotti 2012, 2014; Goldman & Sripada, 2005), one possible explanation may be that they also have a greater reserve for processing emotional content, even when attention is not directed at the target. Another possible explanation could be that people with high trait empathy in fact do not have any greater reserve than those who have low trait empathy for tracking stimuli out of the focus of consciousness. Instead, both those high and low in trait empathy may process emotional information even when conscious attention is elsewhere, but because emotional information is much more important to those high in empathy, they may still respond more to emotional stimuli. The current study will attempt to tease apart which of these patterns is occurring by using manipulations of participants' attention during a task where they are presented emotional stimuli.

## Physiological Measures

Past research has demonstrated the presence of physiological responses when a person experiences emotional stimuli, specifically electromyographic responses, which were used in the current study.

### Electromyography

Gallese & Goldman (1998) proposed that as a person perceives the facial expression of an object, the person automatically retrieves somatic and visual information, which is used to understand the state of the object, as well as to create a somatosensory representation in order to match the emotional or internal state of the target. Electromyography (EMG) has been used as a physiological measure of those matching somatosensory responses. EMG is the measurement of electrical activity of motor responses from specific muscles, in this case facial muscles that express emotion. EMG of facial muscles has been previously associated with emotional responses and also hypothesized to reflect trait empathy and empathic responses (Balconi, Bortolotti, & Gonzaga, 2011).

Previous studies have shown that participants shown pictures of emotional facial expressions automatically activate the emotion appropriate facial muscles (Dimberg 1982, 1990). Two specific facial muscles have been studied in past research on empathic responses to emotional stimuli, the *corrugator supercilii* and the *zygomaticus major* muscles, which are muscles in the face involved with furrowing one's brow and with smiling, respectively (Westbury & Neumann, 2008). Electrical activity within the corrugator muscle has been a response generally associated with negatively-valenced stimuli, while a response to positivelyvalenced stimuli has been associated with electrical activity in the zygomatic muscle (Bradley, Codispoti, Cuthbert, & Lang 2001).

As referenced earlier, the salience of the emotions displayed by facial expression stimuli has a significant influence on a person's empathic response. The intensity, the degree of arousal of the stimuli, and valence, positive or negative stimuli, have also been shown to have influence on a person's electromyography responses (de Vignemont & Singer, 2006).

In a study conducted by Balconi, Bortolotti, & Gonzaga (2011) using EMG, students were shown emotional faces and asked to respond as to whether the image showed emotion or no emotion. The researchers found that the accurate detection of facial expression and automatic facial muscle mimicry reactions to the emotional face images were related. Results were interpreted to support the notion that automatic reactions, such as facial muscle mimicry, contribute to empathy by mirroring the emotional state of a target. As theorized by PAM, the activation of similar emotional states and production of automatic responses permits a person's understanding of a target's internal state. A similar study done by Balconi & Canavesio (2016) also supported this conclusion.

**Is Attention Needed?**

The Emotional Stroop task, also referred to as Emostroop, was developed by Preston & Stansfield (2008) as a behavioral measure to investigate the role of attention within the PAM model. The Emostroop's primary goal is to explore the assumption that when a person observes the emotional state of another, even if the emotional state is not attended to, long-term representations on the semantic level are activated spontaneously. It is thought that this effect must require conscious awareness, but without requiring directed attention.

The task asks participants to respond non-verbally to emotional words, which are superimposed over task-irrelevant images of faces. The faces are either displaying emotional expressions that are congruent or incongruent with the words. In a series of studies, Preston & Stansfield (2008) found that participants responded more slowly when the background face images were incongruent with the overlaid word than when the word was congruent with the background face images. They took this to suggest that activation of semantic-level representations for emotions from facial expressions are spontaneous or, at least, do not require directed attention. In their second study, they explicitly told participants that there was no benefit to attending to the background faces. They still found slower performance on incongruent trials, which suggests that participants were still processing the faces spontaneously.

In a study done by Hofelich & Preston (2012), the researchers tried to interrelate, within participants, the conceptual encoding of facial affect, facial mimicry, and trait empathy. The results showed that trait empathy and facial mimicry were interrelated. Participants were shown to mimic the emotion of the word overlaid onto pictures, which was consistent with previous research showing that mimicry can be predicted by the degree of attention. Word mimicry was also stronger in high empathy participants. The Emostroop, however, has only been used with reaction time as a measure and has yet to be used in conjunction with any neural measures of empathetic responses.

## Study Overview

The current research aimed to explore the function of attention in the production of physiological responses that have been associated with the processing of emotional information, which may be related to the production of empathetic responses. It investigated whether physiological responses still appear when attention is directed to other, non emotional, characteristics of stimuli. Further, it investigated whether trait empathy levels moderated the effect of attention on the presence of physiological responses.

Participants were shown a series of facial expressions conveying different emotions (happy, angry, and neutral). In the first part of this task, participants were asked to simply watch the images presented to them on a computer screen. This served a condition in which attention was not directed (termed the Non-directed condition). In the second block of the task, participants were asked to make a judgment about what gender they believed the actor in each of the picture was (termed the Gender condition) Attention was engaged, but not on the emotional content of the facial images. In the third block, participants were asked to make a judgment as to what emotional expression the images are conveying (termed the Emotion condition). Electromyography was used as the measure of a physiological response, looking specifically at the zygomaticus supercilii major and corrugator muscles' motor electrical activity. The zygomaticus supercilii major muscle region was expected to respond to positive emotions and the corrugator muscle to negative emotions. At the end of the study, participants were asked to complete three trait empathy measures.

A fixed order of conditions was used due to worries that anyone who received the Emotion condition first would then have their attention for the following conditions still oriented towards the emotion conveyed, which could have had an effect on the manipulation of attention.

It was hypothesized that facial muscle electrical activities would decrease for all participants during the Gender condition as compared to the Emotion condition. It was also predicted that all participant's physiological responses would increase from the first block task to the third block of the task. Responses were predicted to be at lowest levels in the Non-directed condition, with an increase in the Gender condition, but not as high as in the Emotion condition.

Participants with higher trait empathy, relative to those with lower trait empathy, were hypothesized to have increased electrical activity in their zygomaticus supercilii in response to the images showing happy expressions and in their corrugator muscle in response to images showing angry expressions.

Trait empathy levels were expected to moderate the relationship between amount of attention directed to the faces and the extent of physiological responses. Participants with higher trait empathy levels were expected to exhibit increased physiological matched responses to the emotional facial images even when attention is not directed to the emotional expression of the facial images, in comparison to participants with lower trait empathy.

# Method

## Participants

Thirty undergraduate college students (mean age: 19.83, range: 18-22) from a group of small liberal arts colleges in Southern California participated in the study. Of the 30 participants (29 women), 63.3% were Caucasian, 16.7% Asian, 13.3% Latina, 3.3% Filipina, and 3.3% Indian. They were recruited by using a convenience sample and were recruited through psychology courses and social media. Participation was completely voluntary and in accordance with the Scripps College Institutional Review Board guidelines and all participants received 10 dollars or class extra credit as compensation for their time and participation.

**Materials**

**Trait Empathy.** Three separate measures, all of which have good reliability and validity, were used to assess trait empathy within participants. Multiple measures were used in order to get a true sense of participant's trait empathy levels, potentially stripping away any noise that may have been produced individually by any of the measures.

***The Interpersonal Reactivity Index (IRI).*** The IRI (Davis, 1980) is a self-report index with 28 items divided into four subscales aimed at assessing empathy. The subscales include Perspective Taking, Empathic Concern, Personal Distress, and Fantasy. In this measure, the subscale of Fantasy refers to a person's use of their imagination in order to put themselves into the emotional states of fictitious characters. Participants rated the extent to which each item described them using a 5-point response scale (1= *does not describe me very well* to 5= *describes me very well*). Scores were determined by summing responses in each subscale. Good internal consistency has been demonstrated for the scale with a range of Cronbach's α coefficient from .68 to .79 (Davis, 1980).

***Emotional Empathic Tendency Scale (MEES).*** The MEES (Mehrabian & Epstein, 1972) is a self-report measure that focuses on seven aspects of emotional empathy: susceptibility to emotional contagion, appreciation of the feelings of unfamiliar and distant other, extreme emotional responsiveness, tendency to be moved by others' positive emotional experiences, tendency to be moved by others' negative emotional experiences, sympathetic tendency, and willingness to be in contact with other who have problems. The scale consists of 33 items, with an 8-point response scale (-4= *very strong disagreement* to +4= *very strong agreement).* For this study, it was modified to a 5 point response scale (-2= *very strong disagreement* to +2= *very* *strong agreement*). This scale has shown good reliability. (Cronbach's α = .84, Mehrabian & Epstein, 1972).

***Emotional Contagion Scale (EC).*** The EC (Doherty, 1977) is an unidimensional self-report measure that assesses one's susceptibility to others' emotions as a result of internal feedback caused by mimicry. It is a 15 item scale for which each item is rated on a 5-point likert type scale (*Never* to *Always*). The scale assesses mimicking tendencies for love, happiness, fear, anger, and sadness. It has demonstrated good construct validity, as well as good reliability (Cronbach's α = .90, Doherty, 1977).

**Computer Task.** The experimental procedures were controlled by programs written in E Prime (Version 2.0, Schneider, Eschman, & Zuccolotto, 2002) running on a PC computer. The task that participants were asked to perform included a total of three blocks, each containing 90 trials.

The images used within the computer task were selected from Pictures of Facial Affect (PFA; Ekman & Friesen, 1976). These images have been previously tested for homogeneity of expressions, as well as intensity of each expression. For this task, the images chosen were pictures of faces of male and female actors displaying happy, angry, or neutral facial expressions. There were 10 images conveying happy expressions, 10 images conveying neutral expressions, and 10 images conveying angry expressions chosen. All photos were shown a total of 3 times in each of the blocks. Each image was 11 x 15 cm and in black and white.

In the first block of trials (Non-directed), participants were asked to observe the stimuli and "just watch" the images as they appeared. In the second block of trials (Gender), participants were asked to observe the images and make a forced choice response about the actor's gender. They made this judgment ("male" or "female") by pressing either '1' or '2' key on a keyboard.

All participants were told that the actors in all photos were cisgender, which refers to a person whose identity and gender corresponds with their birth sex. This block was used as the condition in which participant's attention was specifically directed at the images, but to something other than the emotional information of the images. In the third block of trials (Emotion), participants were asked to determine the emotion conveyed in each image ("happy", "angry", or "neutral") by pressing either '1', '2', or '3' key on the same keyboard.

Within each block, the order of the 30 images was randomized, with all three emotions appearing equally often. Before each image, a black fixation cross appeared at the center of a white display for 1,000 ms. The image then was displayed for 500 ms. A screen was then displayed prompting a response from the participant in the second and third blocks until a response from the participant, correct or incorrect, was detected via the response box. Once a response was detected, the picture was replaced with a black display. The inter-trial interval for the second and third blocks was 2,000 ms. For the first block, where there was no response required from the participant, the inter-trial interval was 4,000 ms.

**Physiological Measure.** Electromyography (EMG) was used to measure physiological responses from participants during the computer task. Facial activity was recorded through a physiological recording device (Biopac M36R) using AcqKnowledge software (Version 4.2) with a sampling rate of 500 Hz and a bandpass 5-1000 Hz filter. Specifically, the zygomaticus major and supercilii muscle regions were examined during exposure to emotional facial image stimuli during the computer task. The electrodes were positioned over the corrugator and zygomatic muscles in accordance with guidelines for psycho-physiological recording (Fridlund & Cacioppo, 1986). Frequencies between 20 to 400 Hz were of interest and the EMG responses were scored as the difference between the mean rectified corrugator/zygomatic signals observed during the presentation of the stimuli, split into two time segments (0-500 ms, 500-1000 ms after stimulus presentation) and the mean rectified signals in the 200 ms prior to stimulus presentation (baseline). Positive values indicated that the muscle activity was greater during the stimuli presentation than during the baseline phase.

**Procedure**

Participants were asked to come to a laboratory for a single session lasting approximately one hour. Upon arrival, participants were asked to read an informed consent form providing information on the study. Once participants provided written consent, they were asked to provide basic demographic information, such as age, gender, and ethnicity. Then they were prepared for EMG recording. After the application of the EMG electrodes, participants were given the initial instructions for the tasks. They then went through the Non- directed block, the Gender block, and finally the Emotion block of the task. After completing the computer task, participants were asked to complete the three trait empathy questionnaires. Participants were debriefed, compensated, and thanked for their participation.

## Ethics

Studying the phenomena of empathy within a college aged population was aimed at adding to the research literature. One of the primary benefits of this study was to expand the knowledge on the topic of empathy, in particular how it is activated. This study aimed to add to the already existing research within the field in order to give greater understanding of this phenomenon. Specifically, the study aimed to provide evidence for a potential relationship between individual's trait empathy level and the amount of attention needed to direct at a stimulus in order to experience empathy.

Another benefit to participants and society at large was the prompting of participants to think about empathy and the role of empathy in their own lives. It has been shown that key aspects of empathy are decreasing in the current college age population (Konrath et al., 2010), so to prompt participants to start thinking about it by participating in the study may have brought about a benefit within itself. This decrease in empathy levels within this population is concerning due to the fact that it may be predictive of a continuing decrease in empathy in future generations. At the end of the study, participants were prompted to begin thinking about their own empathetic tendencies.

Participants were asked for information that reasonably could be asked of them in their everyday lives. The risk of harm or discomfort in the research was no greater than in daily life. They were simply asked to complete a brief computer task while wearing EMG electrodes, followed by filling out survey questions. The participants were not from a protected population. There was also no direct deception involved within the study. Therefore, there were no foreseeable risks associated with participation in the study, suggesting that study participation should be designated below the level of minimal risk.

Moreover, participation within the study was completely voluntary. Participants were instructed that they may stop participation at any point during the study for any reason, without any penalty and still receive compensation for their time. Participants also were not asked to provide any information that was sensitive in nature or consider sensitive issues or topics that could have caused them discomfort.

All data collected from participants were anonymous. Participants names were not attached to any of the surveys that they filled out, the results of their performance on the computer task, or to any of the physiological measurements taken during the computer task. Participant id numbers were attached to the information, but names of participants were not connected to those identification numbers. Only the principal investigator was able to look at the data collected throughout the study and no individual data was shared with any outside sources. Data was only shared on the aggregate level for purposes of reporting results.

There were no potential risks to participants that would be more than going through their daily lives, therefore the benefits of the study clearly outweigh the potential risks, or lack thereof, to participants.

## Results

For all analyses performed, significance was set at $\alpha = 0.05$. Before any statistical analyses were performed, some transformations of the data were necessary. Missing data for the corrugator muscle from two participants due to signal issues were replaced by the condition mean. Using Tukey's Hinges, outliers were identified for variables of EMG responses and the values were Winsorized.

Participants were asked to fill out three separate trait empathy measures. In order to obtain a purer measure of the latent factor, empathy, a Principal Components Analysis was carried out on these three measures. Results showed that a single component accounted for 79.78% of the variance. Loadings of the three measures on the component were as follows: IRI, .92; EC, .87; MEES, .88. Factor scores on the component were obtained for each participant using the regression method. In order to divide participants into high and low empathy categories, two groups were created using the factor scores. These two groups were created using a median split on the factor scores (Mdn = -.0043).

Facial muscle responses were measured in two time segments; 0-500 ms after stimulus presentation and 500-1,000 ms after stimulation presentation and scored as the difference between the mean rectified corrugator/zygomatic signals during those time segments and 200 ms before stimulus presentation. There was a significant main effect of time, such that motor activations in both of the muscles measured were higher 500-1,000ms post stimulus ($M$ = 1.36 μV, $SD$ = .00 μV) than 0-500ms post stimulus presentation ($M$ = -8.62 μV, $SD$ = .00 μV), $F$(1, 28) = 11.035, $MSe$ = 1.283E-6 $p$ = .002, η2 = .283. Therefore, the rest of the analyses were performed on the 500-1,000ms time segment.

A 3 (Attention) x 2 (Muscle) x 3 (Emotion) x 2 (Trait Empathy) Factorial ANOVA was performed on the level of muscle motor activations of the zygomaticus major and supercilli muscles. Though the four factor interaction was nonsignificant, $F$(4, 112) = .67, $MSe$ = 5.267E-8 $p$ = .614, η2 = .023, follow up tests were performed in order to look at the conditions that were of interest to this study. Because of the complexity of the design, effects not related to the hypotheses will not be reported. First, there was a significant main effect of attention between the three different attentional condition blocks of the computer task, $F$(2, 56) = 11.459, $MSe$ = 4.171E-9, $p$ < .001, η2 = .290. Post hoc tests using the Bonferroni procedure showed that the first condition, Non-directed, ($M$ = .36 μV, $SD$ = .00 μV) had significantly higher motor activations than the third condition, Emotion ($M$ = 2.65 μV, $SD$ = .00 μV), which had marginally significantly higher activations than the second condition, Gender ($M$ = .-32 μV, $SD$ = .00 μV).

The level of activation of the corrugator towards images that conveyed angry expressions was examined as a function of the three attention conditions, as well as the high and low empathy groups. Participants within the high trait empathy group showed higher increases in motor activation within the corrugator muscle ($M$ = 6.62 μV, $SD$ = .00 μV) than participants within the low trait empathy group ($M$ = 1.33 μV, $SD$ = .00 μV), which was a marginally significant difference, $F(1, 28) = 3.280$, $MSe$ = 6.295E-10, $p = .081$, η2 = .105. The trend of the attention conditions, contrary to hypothesis, showed that the greatest increases in motor activations in the corrugator to angry faces were during the first condition, Non-directed ($M$ = 11.79 μV, $SD$ = .00 μV), followed by Emotion ($M$ = 5.68 μV, $SD$ = .00 μV), and Gender with the lowest activation ($M$ = -5.53 μV, $SD$ = .00 μV), actually showing a negative activation level, meaning that there was less motor activation during when the image was shown than during baseline (200ms pre stimulus presentation) (see Figure 1). The interaction between empathy level and attention condition was however nonsignificant, $F(2, 28) = .462$, $MSe$ = 1.681E-10, $p$ = .632, η2 = .016.

The same follow up examination was conducted in order to determine the pattern of responding of the zygomaticus muscle when images showing happy faces were shown during the three conditions. Surprisingly, it was participants who were in the low trait empathy group that showed a marginally significantly higher level of activation ($M$ = .48 μV, $SD$ = .00 μV) than those in the high trait empathy group ($M$ = -1.98 μV, $SD$ = .00 μV), who actually demonstrated a decrease in activity from baseline, $F(1, 28) = 3.355$, $MSe$ = 1.376E-10, $p = .078$, η2 = .107. Participants showed a motor activation increase in the zygomaticus in response to images of happy faces during the Non-directed condition ($M$ = 2.59 μV, $SD$ = .00 μV) and a negative activation level in the Emotion condition ($M$ = -2.31 μV, $SD$ = .00 μV) and the Gender condition ($M$ = -2.53 μV, $SD$ = .00 μV) (see Figure 2).

It was also hypothesized that the corrugator muscle would not show increases in activation in response to images showing happy emotional expressions in any of the three attention conditions. Contrary to this, participants showed an increase in motor activity in the corrugator to happy faces in the Non-directed condition ($M$ = 11.35 μV, $SD$ = .00 μV), followed by a negative level of motor activity in the Gender condition ($M$ = -5.72 μV, $SD$ = .00 μV) and a very small level of motor activity in the Emotion condition ($M$ = 1.92 μV, $SD$ = .00 μV), which was effectively equal to the level of activation in the Gender condition.

The level of response in the zygomaticus muscle to angry faces was examined because there was predicted to be no effect. However, there was an effect that approached significance for attention condition for the level of response from the zygomaticus muscle to images of angry faces, $F(2, 58) = 3.099$, $MSe$ = 6.135E-11, $p = .053$, $\eta 2 = .097$, but follow up pairwise comparisons showed no significant effects.

## Discussion

In terms of the attentional component within this study, it was predicted that participants overall would show higher levels of facial mimicry within the Emotion and Gender attention conditions than in the Non-directed condition. Overall both muscles responded highest when participants were asked to simply watch the images go by, followed by a decrease in responding for the second task, where they were asked to categorize the people in the photos as male or female, and then ending with an increase, not as high as in the first condition, when participants were asked to categorize the emotions the people within the images were displaying.

Though this was not the hypothesized pattern, it is worth noting that when participants were asked to direct their attention to the emotion within the stimuli versus a characteristic of the stimuli that was emotionally irrelevant, there was an increase in facial mimicry. This is a solid indicator that attention does make a difference in the level of emotional processing that takes place not just people high in trait empathy, but those who are low in trait empathy as well.

It is possible that the decrease in motor activation levels from the first task could be partly due to an order effect. There were only 10 images per emotion that were shown three times in each task, repeated over the three tasks. It is very likely that some of the facial mimicry responses may have been blunted due to the fact that the stimuli were repeated over again, and therefore may not have been as salient in later conditions as when participants first saw them in the first attention condition of the task due to a sort of desensitization to the stimuli. Since this study was conducted with a fixed order of conditions to avoid arousing expectations that emotion was the focus, there is no way to tease apart whether the order of the conditions is responsible for the trend that was demonstrated. However, even if this was the case, it could mean that directing participants' attention to emotion, even after they have seen the same set of images multiple times, still elicits an increase in facial mimicry as compared to when attention was directed at gender, even though the emotional condition within this study was always last. However, this trend was only shown to be true for the corrugator muscle in response to images of angry faces and not for the zygomaticus muscle in response to images of happy faces.

It was also predicted that participants with high trait empathy levels would show a significantly higher level of facial mimicry within all attention conditions, as compared to participants within the low trait empathy group. Surprisingly, participants within the high trait empathy group did not show these effects. Curiously, many previous studies have demonstrated this effect. Balconi & Canavesio (2013) demonstrated that participants with an increased tendency to reciprocate facial expressions score higher on trait empathy questionnaires. Hofelich

& Preston (2012) also found facial muscle responsiveness to be correlated with trait empathy levels.

Trait empathy levels also did not significantly moderate the relationship between facial mimicry levels and the amount of attention directed at the emotional content of the stimuli presented to participants. It was predicted that participants with high trait empathy would respond with greater facial mimicry with the appropriate muscle in response to the appropriate emotion than participants with low trait empathy. This trend was only shown with the corrugator muscle in response to images of angry facial expressions. This pattern though was not demonstrated in the zygomaticus muscle in response to images of happy facial expressions.

One possible explanation for this could be that negative emotions are more salient and potentially require more of a response from those who witness them. People who are higher in trait empathy may be more responsive to negative emotions simply because a negative emotion may be a more important cue to process the emotion presented in order to empathize and help someone who is experiencing a negative emotion compared to someone who is happy and experiencing a positive emotion, who most likely does not necessarily need help or an immediate reciprocated emotional response.

What is perplexing was that participants both with high and low trait empathy levels actually showed a negative activation level in the zygomaticus muscle in response to images of happy faces, meaning that they showed less of a response to those faces in this muscle than during baseline when there was no face being shown. Participants with high trait empathy, strangely enough, showed a greater negative activation than participants with low trait empathy. This could have a type of active suppression effect due to the fact that participants were asked to perform a cognitive task. However, if this were this case, one would have expected to see negative activation levels within the corrugator as well. It may have been that the angry expressions were more salient and realistic than the happy expressions, possible coupling with a suppression effect to result in these negative activations.

Another possible explanation for no significant difference between the high and low trait empathy groups would be that those effects could have been polluted within the Gender and Emotion conditions due to desensitization or expectancy effects referenced earlier. If that was the case, the only condition where a clean comparison between high and low trait empathy participants' facial mimicry responses could be made would be within the Non-directed condition. While the difference within this particular attention condition is still not significant, looking at the means shows that within the matched muscle and emotion pairings of interest, corrugator to angry faces and zygomaticus to happy faces, participants within the high trait empathy group are showing effects almost twice the size as those in the low trait empathy group. This doesn't completely explain why this study did not show a significant effect of trait empathy that has been shown to be in a reliable effect in many previous studies, part of the reason may have been the desensitization or expectancy effects that might have occurred due to the within subjects, fixed order design of this study.

One direction that would be very beneficial for this research to go in, is to use a between subjects design, where there would be no chance of order effects in terms of the stimulus presentation and it would be much clearer as to the effects of directing people's attention to different aspects, emotional and not, of emotional stimuli are. Another direction would be to use more realistic form of emotional stimuli. Even though the images used within this study have very high validity ratings, they may have been outdated for use with college aged participants and may have been hard to relate to and believe the emotions expressed in them. In the future, it would also be beneficial to move away from simply using images of emotional facial expressions and move toward more interactive forms of emotional stimuli, such as possibly videos.

This study provided foundational evidence for a role of attention in the processing of emotional information. It demonstrated that the direction of attention makes a difference in how much facial mimicry, as an example of physiological responding, which could serve to further research on how these physiological responses come about and in what circumstances. This could add to our understanding of what situations may be conducive to an empathetic response being made by a person versus those which may not be.

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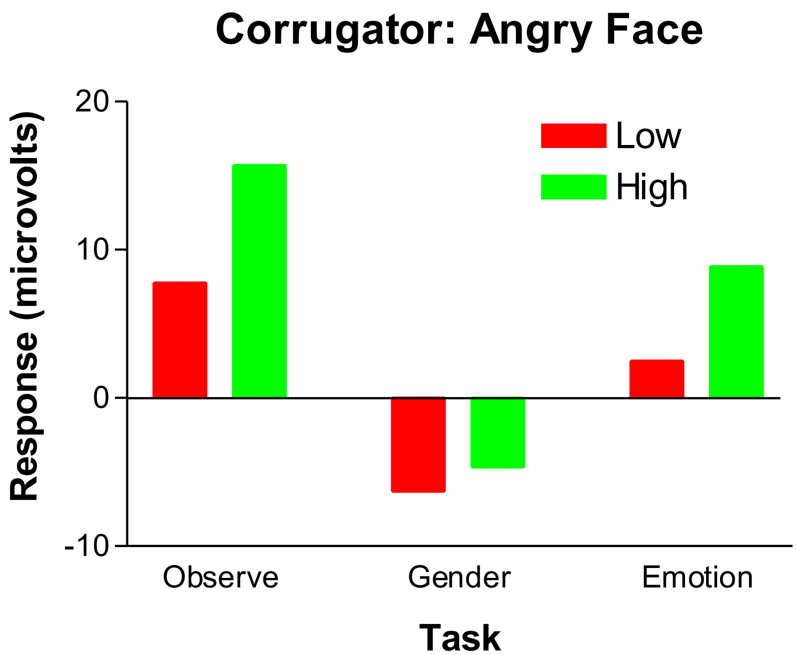


*Figure 1*. Mean difference values (μV) representing the EMG response to angry faces within the corrugator muscle. Significant difference found between the tasks, but no significant difference shown between the high and low trait empathy groups.

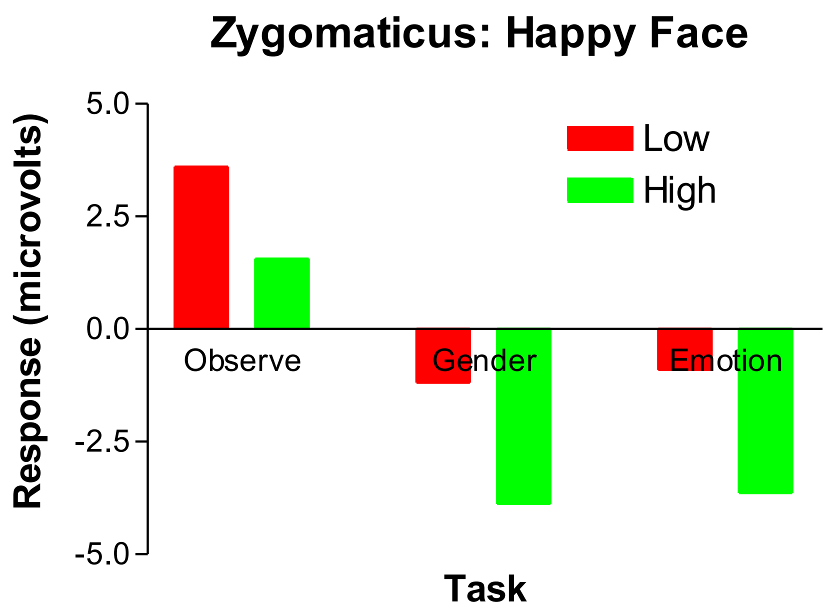


*Figure 2*. Mean difference values (μV) representing the EMG response to happy faces within the zygomaticus muscle. Significant difference found between the tasks, but no significant difference shown between the high and low trait empathy groups.