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Abstract

The present study examined the significance of viewing images of neutral faces versus images of neutral objects on zygomatic muscle activity using facial EMG. Participants (60% women) from a pool of introductory psychology courses had their facial EMG recordings measured in response to images of neutral faces and neutral objects. Participants' valence rating of each image was also recorded using the Self-Assessment Manikin (SAM) in order to rate their emotional response to each image. The primary hypothesis was that participants would have greater activity in the zygomatic muscle region when presented with images of neutral faces as opposed to lessor activity when presented with images of neutral objects. It was also hypothesized that if participants preferred seeing images of faces as compared to objects, their positive feelings would produce higher SAM ratings. Results from the present study indicated images of neutral faces showed no significant difference in EMG activity compared to images of neutral objects. Self-report data also showed no significant difference in pleasantness or emotional valence between ratings of neutral faces and ratings of neutral objects.

Keywords

zygomatic muscle, neutral faces, neutral objects, faces, objects, facial EMG, EMG

Cover Page Footnote

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ABSTRACT

The present study examined the significance of viewing images of neutral faces versus images of neutral objects on zygomatic muscle activity using facial EMG. Participants (60% women) from a pool of introductory psychology courses had their facial EMG recordings measured in response to images of neutral faces and neutral objects. Participants' valence rating of each image was also recorded using the Self-Assessment Manikin (SAM) in order to rate their emotional response to each image. The primary hypothesis was that participants would have greater activity in the zygomatic muscle region when presented with images of neutral faces as opposed to lessor activity when presented with images of neutral objects. It was also hypothesized that if participants preferred seeing images of faces as compared to objects, their positive feelings would produce higher SAM ratings. Results from the present study indicated images of neutral faces showed no significant difference in EMG activity compared to images of neutral objects. Self-report data also showed no significant difference in pleasantness or emotional valence between ratings of neutral faces and ratings of neutral objects.

Imagine if it were possible for researchers to determine whether or not humans prefer seeing facial stimuli as compared to more alternative stimuli throughout our environment (such as objects), and imagine the implications of such findings. Some studies have found that there are specific patterns of brain processing responsible for viewing faces as opposed to objects, which could lead to a difference between how our brains respond to either stimuli (Goffaux & Rossion, 2006; Han, Tijus, & Nadel, 2010; Riddoch et al., 2008; Wegrzyn et al., 2015). Mavratzakis, Herbert, & Walla (2016) believed that facial expressions can be understood as interpersonal, requiring complex neural processing to translate emotional cues into social meaning as compared to objects which are said to be more static and thus require less processing (Han, Tijus, & Nadel, 2010; Riddoch et al., 2008). Given that faces are described as more dynamic and objects more static when processing information, this leads us to believe that recognizing facial expressions and other visual stimuli are important biological processes that affect how we live and function as a species. Some studies have even described recognizing individuals faces as being necessary for survival (Riddoch et al., 2008).

Similarly, Jackson and Arlegui-Prieto (2015) stated: "Normal social functioning depends on the ability to efficiently and accurately detect when someone's facial expression changes to convey positive or negative emotions" (pg. 145). This statement alone suggests support for the importance of recognizing and processing others' emotional facial expressions as it directly impacts how we function socially. Riddoch and colleagues (2008), looked at a patient who had diagnosed prosopagnosia (or the inability to recognize familiar faces) and found that the individual struggled to identify their spouse's face, which resulted in relationship difficulties, a problem that when broadened directly impacted other social relationships. Aside from the broad scope of social functioning, being able to recognize and process facial expressions has been attributed to affecting individuals' patterns of attachment (Sonnby-Borgström & Jönsson, 2004), emotion contagion, and even levels of empathy (Geangu et al., 2016).

In a study that tested whether or not children could elicit rapid facial electromyographic responses to emotional facial expressions and body postures (Geangu et al., 2016), it was found that children as young as three express zygomatic major activity congruent with adults when observing others' happy faces. The very young age at which these children showed selective rapid facial responses to images of humans displaying happy expressions provides evidence to support the idea that recognizing others' facial expressions plays a vital role in human functioning and is part of our innate biological processes.

One of the most important factors leading to our present research was proposed by Wegrzyn and associates (2015), who looked at seminal models of face perception and determined that distinct models in the brain are responsible for carrying out different tasks when observers perceive faces. Most relevant to this study was the information regarding the superior temporal sulcus which is credited with "processing changeable features like gaze or emotion expression" (pg. 132). As a result, it is assumed that superior temporal sulcus activity corresponds to facial motor movement and thus will be more active when perceiving faces as opposed to objects. Specifically, there is an assumption that this facial motor activity will be expressed overtly and could be empirically tested by facial electromyographic activity in the zygomatic muscle.

Previous literature indicates that responses to facial electromyographic (EMG) measures are directly related to emotional activity (Balconi, Giovanni, & Veridana, 2014; Dimberg & Lundquist, 1990; Geangu et al., 2016; Sonnby-Borgström & Jönsson, 2004). Explicitly, our present study focused on the zygomatic facial muscle which is used when smiling (Geangu et al., 2016) and has been found to be active when individuals are presented with pictures of happy faces (Dimberg & Lundquist, 1990). Thus, it is assumed that when an individual responds to visual stimuli which they like or prefer; they may do so with the presentation of a smile and will use their zygomatic muscle to perform this activity. Geangu and colleagues (2016) found that even 3-year-old children possess the same zygomatic muscle responses to happy faces as adults. The result of Geangu et al.'s study implicates and strengthens two important factors leading to the presentation of our current study. For one, the fact that children have been found to show similar facial electromyographic responses in the zygomatic muscle region when shown pictures of happy faces compared to adults provides evidence to support that zygomatic muscle activity (or smiling) is similar in humans regardless of maturation. Second, positive responses to particular stimuli (or the liking of a particular stimulus), would lead to the presentation of a smile and thus the use of the zygomatic muscle.

The previously mentioned studies (Dimberg & Lundquist, 1990; Frank, Vul, & Johnson, 2009; Geangu et al., 2016; Goffaux & Rossion, 2006; Han, Tijus, & Nadel, 2010; Jackson & Arelgui-Prieto, 2015; Mavratzakis, Herbert, & Walla, 2016; Riddoch et al., 2008; Sonnby-Borgström & Jönsson, 2004; Wegrzyn et al., 2015) have studied the value in the processing of facial expression and have found it to be complex and a key factor relating to the overall welfare of the individual. However, these studies have indicated the significance of recognizing facial stimuli without explicitly comparing facial stimuli to any other stimuli (such as objects), illustrating its importance. Only one study has looked at how individuals perceived faces versus objects, yet that study only demonstrated a difference in how we process those stimuli which overlooks the possibility of preferring one stimulus over another (Han, Tijus, & Nadel, 2010). Moreover, the emphasis of the present study was to look at whether or not humans prefer seeing images of neutral faces versus neutral objects and attempts to provide supporting evidence as to the importance of processing another's facial stimuli. Is it possible to illustrate preference of facial versus object stimuli, using facial EMG and differences in zygomatic muscle activity?

The present study examined the significance of viewing images of neutral faces versus images of neutral objects on zygomatic muscle activity using facial EMG, in attempts to provide supporting evidence as to the importance of facial stimuli processing. The independent variable was viewing images of neutral faces or neutral objects. The dependent variable was facial EMG recordings of zygomatic muscle activity when presented with images of either faces or objects. The primary hypothesis was that participants would have greater activity in the zygomatic muscle region when presented with images of neutral faces as opposed to lessor activity when presented with images of neutral objects. The difference in zygomatic muscle activity would thus represent and illustrate the significance of facial processing and would provide empirical evidence to preferences for facial stimuli over other stimuli such as objects. It was also hypothesized that if participants preferred seeing images of faces as compared to objects, their positive feelings would produce higher SAM ratings.

Method

Participants

Researchers recruited participants (60% women, M_{age}= 19, SD = 1.25) from a pool of introductory psychology courses and were told they would receive compensation in the form of 1 SONA credit for their participation.

Methods

Eight photographs were obtained from the Chicago Face Database (CFD) and eight were obtained from the International Affective Picture System (IAPS). In addition, one self-report questionnaire was added to determine demographic information relating to the participants. The Chicago Face Database (Ma, Correl, & Wittenbrink, 2015) provides high-resolution, standardized photographs of male and female faces of varying ethnicity between the ages of 17-65. The norming data include both physical attributes (e.g. face size) as well as subjective ratings by independent judges (e.g. attractiveness). For the purpose of this study, eight standardized (4 male and 4 female) and neutrally-rated pictures in respect to attractiveness and expression were chosen from the CFD. The International Affective Picture System (Lang, Bradley, & Cuthbert, 2008) provides normative ratings of emotion (pleasure, arousal, dominance) for a set of color photographs that provide a set of normative emotional stimuli for experimental investigations of emotion and attention. The present study used eight neutrally-rated pictures of objects from the IAPS that were chosen by the researchers: a mushroom, a fan, an umbrella, a book, a clock, a lamp, a building, and a box of tissues. The demographic questionnaire was composed of questions determining varying demographic information to gain further information about the participants.

Valence ratings

Valence was judged on a 9-point scale (1 = *positive valence* or *high arousal* and 9 = *negative valence* or *low arousal*). The Self-Assessment Manikin (SAM) is a computerized scale to indicate how the participant feels after seeing the present image (Bradley & Lang, 1994). The scale presents 9 images ranging from 1-9 with 1 indicating a *positive* response while a 9 indicates a *negative* response. Additionally, SAM allows the participant to describe intermediate feelings of pleasure by pressing buttons for numbers below or between any of the figures. For the purpose of this study, participants were asked to complete a SAM assessment after an initial presentation of all of the images during which EMG was recorded.

Apparatus

Separate from the stimulus materials and self-report questionnaires, participants were hooked up to psychophysiological recording equipment to record physiological responses to images presented before them. Specifically, facial electromyography (EMG) recordings were obtained through the placement of reusable recording electrodes (filled with standard electrode gel) over the zygomatic muscle, and were amplified using a BIOPAC MP36 recording unit. The BIOPAC MP36 recording unit was attached to a laptop separate from the participant's computer. In order to interpret the raw EMG signals into usable data, the laptop hooked up to the BIOPAC unit ran E-Prime stimulus presentation software to amplify low frequency waves to approximately 20 to 200 Hz.

The participant's computer consisted of a 17-inch LCD monitor that was separate from the laptop recording EMG data. Yet, a BIOPAC program was used on both computers in order to see the time in which the images were presented and the corresponding EMG activity. Participants were also asked to sit three feet away from the monitor to deter any feelings of discomfort.

Procedure

Participants were asked to come in, at which point they were greeted by the researcher and were then asked to sit in front of their computer. Following a simple researcher introduction, the participant was given a brief insight as to the purposes of the study (to look at physiological responses to images) and then asked to complete the informed consent form and demographic questionnaire. Subsequently, after informed consent had been given, the experimenter prepared the skin for EMG recording and attached the necessary electrodes. The participant was given instructions on how to complete the experiment. Participants then watched a computer screen with the presentation of neutral faces and neutral objects. Each image was shown for 8 seconds, with a 5-second interval between each. Once the presentation was complete, the researcher removed the sensors. Participants were then shown the same presentation without the EMG sensors and were asked to fill out an electronic SAM report, rating their pleasantness about the pictures. Before completing the SAM, a screen was presented with instructions regarding the purpose of the SAM and how they were to go about rating each individual image. After the SAM was complete, participants were given a debriefing form and were asked if they had any more questions regarding the experiment, at which point the researcher would oblige. If the participant had no more questions they were thanked and dismissed.

Results

The present experiment looked at participants' zygomatic muscle activity when presented with images of neutral faces and neutral objects, as well as self-report data asking how the participants felt about each image. Our first hypothesis was that participants would show greater zygomatic muscle activity when presented with images of neutral faces than when shown images of neutral objects. Our second hypothesis was that participants would rate images of neutral faces with greater SAM ratings than images of neutral objects. Results from the present study found no significant evidence supporting either of our hypotheses. Four participants' EMG data were omitted due to messy signals.

A dependent samples t-test was used to determine differences in EMG recordings (between neutral faces and neutral objects), as well as self-reporting results from the Self-Assessment Manikin. In regards to EMG, images of neutral faces (M = .002, SD = .002) showed no significant difference in EMG activity compared to images of neutral objects (M = .002, SD = .002), $t(15) = -.006$, p = .995. Self-report data also showed no significant difference in pleasantness or emotional valence between ratings of neutral faces (M = 5.15, SD = .69) compared to ratings of neutral objects (M = 5.27, SD = .89), $t(19) = -.491$, p = .629. The present data shows no significant differences when participants were viewing images of neutral objects when compared to neutral faces, showing that one does not elicit more zygomatic activity than the other.

Discussion

The purpose of this study was to measure zygomatic muscle activity while presenting participants with images of neutral faces and neutral objects. The first hypothesis was that participants would show greater zygomatic activity when presented with images of neutral faces compared to images of neutral objects. The second hypothesis looked at participants' SAMs ratings and predicted that participants would rate images of neutral faces more positively than images of neutral objects. The data did not support either of our hypotheses. Participants' EMG recordings when viewing images of neutral faces showed no significant difference compared to when participants viewed images of neutral objects. In addition, SAMs ratings showed no significant differences among participants' ratings of neutral faces compared to neutral objects.

Our results did not support our prediction that humans prefer facial stimuli.. Although our study attempted to mirror other studies (Dimberg & Lundquist, 1990; Geangu et al., 2016; Mavratzakis, Herbert, & Walla, 2016; Sonnby-Borgström & Jönsson, 2004), which have found greater zygomatic responses when presented images of smiling faces, our study used neutrally-rated materials. The lack in significant EMG activity for our study compared to others could be due to a phenomenon known as facial mimicry (Dimberg & Lundquist, 1990; Geangu et al., 2016; Mavratzakis, Herbert, & Walla, 2016; Sonnby-Borgström & Jönsson, 2004), which involves copying a person's facial expressions below a level of awareness. In the prior studies that looked at zygomatic muscle activity in response to viewing images of faces, images of smiling faces successfully caused an increase in zygomatic activity; however, no studies have looked at the differences in EMG recordings between viewing objects compared to faces. It is possible that our results were found to be insignificant due to the use of neutrally rated-images of faces and objects compared to other studies that used images showing facial expressions. It is also possible that some of the neutrally-rated pictures of faces could have been viewed as slightly negative. However, it was important for the present researcher to control for facial mimicry by using neutrally-rated images.

In addition to using neutrally-rated images of faces/objects, the present study had other limitations that could account for the lack of significant differences between viewing neutral faces and neutral objects. The first involved eliminating a significant portion of our data due to insufficient recordings. In total, four participants' data was omitted due to the researcher's error in attaching the electrodes which resulted in messy EMG recordings. This led to an even smaller sample size, which could have affected the overall results of the present study. The lack of a large sample size, and the lack of diversity within the participant pool, are other factors that should be considered when interpreting our results. A replication of this study, with a sample encompassing a larger region or multiple regions, could lead to developing actual significant effects as compared to the present study which found zero.

Other weaknesses of the present study involve the lack of previous research on this particular field as well as the research environment. Prior to conducting our study, research was found that supported the relationship between seeing images of smiling faces and greater zygomatic muscle activity. Yet, these studies involved seeing images of faces that were smiling compared to our study which involved images without facial expressions. It is also possible that during the EMG task, the presentation of neutral objects primed the participants to show little emotional reaction to the images of neutral faces presented after. The research environment may have also played a strong role in the lack of supporting evidence of our hypothesis. For example, the participants before conducting the experiment were asked to keep movement reduced to a minimum which may have kept them from reacting in any way. Additionally, the participants were asked to conduct the experiment in a room which contained more than one researcher. Future research looking to replicate the present study may seek to control these possible confounding variables.

Despite our study's weaknesses, it does draw attention to the void in research which only supports the importance of facial stimuli generally, but not in comparison to other stimuli. It is also possible, given our results, that humans do not prefer facial stimuli as opposed to object stimuli as previously hypothesized. Replications of this study would be recommended in order to better conclude human preference for seeing facial stimuli when compared to object stimuli. Various limitations of the present study such as sample size, sample type, lack of previous research and the research environment, suggest other methods be used to determine the relationship between the effects of viewing various stimuli. Taking a more representative sample from the population and investigating a larger sample are suggestions for future studies to further test these hypotheses. Future studies could also evaluate the relationship between zygomatic EMG recordings and self-report ratings of images to better understand how we categorize stimuli on the basis of importance.

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