Facial Expression: The Ability to Distinguish Between Enjoyment and Nonenjoyment Smiles

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ABSTRACT. The smile is a universally recognized facial expression generally associated with happiness. However, this may not always be the case and discerning the difference is surprisingly difficult. Enjoyment smiles involve the involuntary contraction of the orbicularis oculi, which lifts the cheeks and narrows the eyes, and the zygomaticus major, which raises the lip corners. Nonenjoyment smiles only use the zygomaticus major (Frank & Ekman, 1993). In the current study, participants watched Facial Action Coding System (FACS) coded videos of smiles and were asked whether they believed the smiles were real or fake. Tobii X120 eye-tracking software was used to determine the most focused upon facial muscle when interpreting the smiles. It was estimated that the majority of participants would perform at a level slightly above chance, achieve an average of 60% accuracy, and pay most attention to the zygomaticus major (Ekman & Friesen, 1982; Frank, Ekman & Friesen, 1993). Results indicated that the majority of the participants performed significantly above chance, with an average 65% accuracy, and focused on the orbicularis oculi. These findings suggest that the ability to detect smiles is increasing and people tend to look at the eyes rather than the mouth during a smile.

The most frequently used and most easily recognized facial expression is the smile (Ekman, 2009). However, simply because a person is smiling doesn't always mean they are happy. Like other facial expressions, smiling can be produced spontaneously or deliberately. Spontaneous smiles are most commonly referred to as enjoyment smiles and are produced in response to emotional stimuli (Darwin & Ekman, 2009; Duchenne & Cuthbertson, 1990; Ekman 2009; Ekman & Friesen, 1982; Ekman, Hager & Friesen, 1981; Hager & Ekman, 1985). They involve the presence of the orbicularis oculi, the facial muscle surrounding each eye socket (Figure 1), in conjunction with the zygomaticus major, the facial muscle extending from each cheekbone to the corners of the mouth (Figure 2). In an enjoyment smile, the lip corners are pulled upward, the cheeks are lifted, and the eyes are narrowed producing wrinkles commonly referred to as crow's feet (Frank & Ekman, 1993). Deliberate smiles are produced by voluntarily contracting the zygomaticus major muscles, which reach from the cheekbone to the corners of the lips and are called nonenjoyment smiles. The present manuscript focuses on answering the following questions: Can enjoyment and nonenjoyment smiles be interpreted? If so, at what level of accuracy? And what facial feature is the most helpful in making that distinction?

The Human Smile

In the mid 19th century, the French neurologist

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G. B. Duchenne noted that there was more than one way to smile and that only one of these smiles was accompanied by positive emotions (Duchenne & Cuthbertson, 1990). He went on to say that the emotion of frank joy is expressed on the face by the contraction of the zygomaticus major muscle and the orbicularis oculi. In Ekman's reprinted edition of Charles Darwin's book, *The Expression of the Emotions in Man and Animals* (Darwin & Ekman, 2009), Darwin noted that Duchenne's findings seemed to be apparent in both humans and animals, with only one type of smile expressing joy in all species. Due to his extensive research on the topic, Darwin is credited with noting the importance of the presence of the orbicularis oculi in spontaneous smiles and its absence in deliberate smiles.

Landis (1924a; 1924b) showed that across sixteen different situations ranging from listening to popular music, looking at pornography, smelling ammonia, receiving an electrical shock, to watching the decapitation of a live rat, the smile was the most frequent facial expression. He reported that people smile regardless whether they feel anger, disgust, exasperation, revulsion, or sexual excitement and eventually concluded that the smile was a misleading and meaningless indicator of emotion.

Cultural anthropologists found similar results while observing smiles in different cultures. For example, Africans were described as people who not only use the smile to express enjoyment, but surprise, wonder, embarrassment, and discomfort (LaBarre, 1947). Another anthropologist described that early on he was fascinated with human universals. After studying the human smile, he concluded that the search for universals was culture bound and that there are probably no universal facial symbols of emotion (Birdwhistell, 1963; 1990). These anthropologists concluded that the meaning of the smile was culturally determined and that there were no universal facial expressions of emotion and, in particular, facial expressions of enjoyment did not exist. However, because these researchers did not specify which smiles featured only the zygomaticus major muscle and which smiles featured both the zygomaticus major and the orbicularis oculi, they were unable to confirm or disconfirm Duchenne's original observations.

Beginning in the early 1980's, Ekman and Friesen began to rediscover and validate Duchenne's theories. They abandoned their Facial Affect Scoring Technique (FAST; Ekman, Friesen & Tomkins, 1971) and decided to use the Facial Action Coding System (FACS; Ekman & Friesen, 1984), invented in 1978, to evaluate and assess universal facial expressions in emotions. They did so by photographing and recording the facial muscles and noting how these muscles could be manipulated during the different states of emotion.

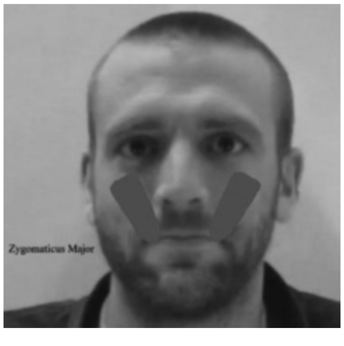
In an effort to make learning and discussing the structures in the face less difficult, Ekman and Friesen categorized all of the facial nerves and muscles into 44 Action Units (AU) in the FACS. Any facial movement can be described in terms of the particular action unit, or units, that it activates. For example, the zygomaticus major muscle (musculus zygomaticus major) is coded as AU 12 and the orbicularis oculi (pars orbitalis) is coded as AU 6. Thus an enjoyment smile is coded as AU 12 + AU 6. There is one more action unit that goes into an enjoyment smile and that is the separation of the lips (AU 25, depressor labii inferioris). However, due to the fact that this action is also present in nonenjoyment smiles it is not considered to be a distinguishing feature of smiling (Ekman & Rosenberg, 2005). Henceforth, in this paper, all smile features will be referred to in terms

FIGURE 1

Orbicularis Oculi

FIGURE 2

Zygomaticus Major



of their Action Units instead of their Latin names.

Smile Types

Spontaneous smiles were originally called *felt smiles* until 1982 when Ekman and Friesen changed the term to the *enjoyment smile* because of the controversy over whether people were actually aware of the smile when it occurred. Later on, Ekman suggested that the enjoyment smile be called the *Duchenne smile* in honor of Duchenne's work (Ekman, 1989; 1990). To avoid any unnecessary confusion the term enjoyment smile will henceforth be used in this paper when referring to a smile elicited by positive emotion that uses both the orbicularis oculi and the zygomaticus major muscle, with the term nonenjoyment smile referring to all other types of smiles.

In his book on human emotions and behaviors, Ekman (2009) defined 18 different types of smiles with only one of these, the enjoyment smile, accompanying positive emotions. Some of the more popular nonenjoyment smiles include the *phony smile*, in which the person pretends to show positive emotions when in reality no emotion is felt. The *masking smile* is an attempt to cover the person's negative emotions. The *dampened smile* occurs when the person feels positive emotions but attempts to appear as if those feelings are less intense. Finally, the *gestural* or *polite smile*, is a smile that might be seen when someone receives an unappreciated gift and does not want the giver to feel bad (Ekman & Friesen, 1982; Ekman, 2009).

People smile when they are happy or when they like a certain individual (Ekman, 1992; 1994). People also smile when they feel embarrassed (Kraut & Johnston, 1979), uncertain (LaBarre, 1947), and sad (Klineberg, 1962). Regardless of intent, individuals who smile are perceived as being happier (Otta, Abrosio & Hoshino, 1996; Otta, Lira, Delevanti, Cesar & Pires, 1994), more attractive, kind, honest, and competent (Hess, Beaupre & Cheung, 2002; Reis et al., 1990), and are better liked (Palmer & Simmons, 1995; Young & Beier, 1977) than people who do not smile.

Enjoyment smiles have been found to have a number of distinctive features apart from AU 12 and AU 6. Some these features include the *onset*, which is the time it takes the face to move from a neutral expression to the highest peak of a smile. The *apexis* the amount of time a smile is held at its peak. The *offset* is the time it takes the face to move from the highest peak of a smile back to a neutral expression. The *duration* is the total time it takes the face to move from onset to offset.

Compared to nonenjoyment smiles, enjoyment smiles tend to be shorter in total duration, generally lasting between two-thirds of a second to four seconds (Hager & Ekman, 1985; Hess & Kleck, 1990), and have longer onset and offset times which range from one-half to three-quarters of a second (Hess & Kleck, 1990; Schmidt, Bhattacharya & Denlinger, 2009; Schmidt, Cohn & Tian, 2003). Smiles are perceived as being more genuine when they have longer onset and offset times and shorter apex times (Ekman & Friesen, 1982; Krumhuber & Kappas, 2005). Conversely, nonenjoyment smiles have been found to have total durations generally longer than 4 s (Hager & Ekman, 1985) and shorter onset and offset times (Hess & Kleck, 1990; Schmidt, Ambadar, Cohn & Reed, 2006; Weiss, Blum & Gleberman, 1987).

Enjoyment smiles are significantly more symmetrical than the multiple nonenjoyment smiles (Lynn & Lynn, 1938, 1943). This asymmetry of nonenjoyment smiles is more prominently displayed on the left side of the face compared to the right, which suggests greater involvement of the right cerebral hemisphere in false emotions (Ekman, Hager, & Friesen, 1981; Hager & Ekman, 1985). Fox and Davidson (1987; 1988) examined this relationship using 10-month-old infants. Using electroencephalography (EEG) to measure brain activity, they found that enjoyment smiles were associated with more anterior (frontal) activation of the left cerebral hemisphere compared to other types of smiles, which were associated with anterior activation of the right cerebral hemisphere. This confirms the notion that the right cerebral hemisphere is greatly involved with false emotions, especially smiles. Ekman, Davidson, and Friesen (1990) were the first to examine this relationship in adults. They found that, when participants portrayed enjoyment smiles, there was slightly greater activity in the left parietal lobe than any other lobe of the brain. Conversely, when participants portrayed nonenjoyment smiles, there was significantly greater activity in the right anterior temporal and parietal lobes.

In general, the functions of each hemisphere of the brain are contralaterally related to the body (Ekman et al., 1990). In other words, the right side of the brain controls the left side of the body and the left side of the brain controls the right side of the body. Nonenjoyment smiles are associated with the right cerebral hemisphere (Ekman et al., 1981; Hager & Ekman, 1985). This explains why they are asymmetrical on the left side of the face. Enjoyment smiles activate the left cerebral hemisphere (Fox & Davidson, 1987, 1988; Ekman et al., 1990), thus moving the right side of the face and equalizing the facial muscles used in smiling thereby producing a symmetrical enjoyment smile.

Detecting Smiles

Frank and colleagues (1993) were the first to test whether enjoyment smiles could be distinguished from nonenjoyment smiles. Previous studies involving smiles examined how well observers could detect deception and noted that smiles were present whether the confederates told the truth or lied. They combined all forms of smiling into one category and did not determine whether enjoyment smiles could be distinguished from the many types of nonenjoyment smiles. Instead, they concluded that the presence of a smile is not a telltale cue for whether or not someone is being deceptive (DePaulo, Stone & Lassiter, 1985; Zuckerman, DePaulo & Rosenthal, 1981; Zukerman & Driver, 1985).

When detecting deception, people are correct at an average of 50% of the time with very few performing at an above chance level (Ekman & Friesen, 1974, 1982; Ekman, Friesen & O'Sullivan, 1988; Ekman & O'Sullivan, 1991; Hess & Kleck, 1994). A recent meta-analysis of over 250 studies explained that the average person is only correct 53% of the time when attempting to determine whether or not someone is telling the truth (Bond & DePaulo, 2006). However, when distinguishing between enjoyment and nonenjoyment smiles, individuals perform at a slightly above chance level with an average of 60% accuracy (Ekman & Friesen, 1982; Frank et al., 1993). These results are similar in both men and women.

There are developmental considerations in detecting emotion. Frank et al. (1993) found that adults were sensitive to AU 12 when detecting smiles. In addition, 9- and 10-year-old children were sensitive to AU 12 when detecting enjoyment smiles, but 6- and 7-year-old children were not (Gosselin, Beaupre & Boissonneault, 2002; Gosselin, Perron, Legault & Campanella; 2002; Saarni, Mumme & Campos, 1998). Josephs (1994) found that 4- and 5-year-old children were able to correctly match a character's face with the expressed emotion. Banerjee (1997) tested 3-year-old children and found similar results. This supports earlier findings that the ability to distinguish emotions increases with age, which holds true until age 40, when performance begins to decrease (Ekman & O'Sullivan, 1991; O'Sullivan, 2005; O'Sullivan & Ekman, 2004). It is important to note that these studies relied on self-report or experimenter observation instead of an eye-tracking device when determining the action unit to which participants were most sensitive.

The current study was focused exclusively on the ability to distinguish between enjoyment and nonenjoyment smiles rather than whether or not someone was telling the truth. Participants were tested to determine their accuracy in this interpretation and the use of an eye-tracker was incorporated, in addition to self-report, so that the action unit to which participants' were the most sensitive could be accurately determined. As based on previous research, the current hypothesis stated that the majority of participants would perform at a slightly above chance level, with the average accuracy rating being 60%, that men and women would achieve about the same level of accuracy, and that they would be most sensitive to AU 12.

Method

Participants

Participants consisted of 66 students and faculty members at a Midwestern university (21 men and 45 women) ranging from 18 to 65 years of age ($M = 24.5$, $SD = 9.8$). Ethnicity of the participants was as follows: 56 White, 4 Black, 4 Asian, 1 Native American, and 1 Middle Eastern. The original sample recruited was 87, however, 21 participants were not included in the analysis, because 4 were not tracked properly when watching the videos, and 17 could not be calibrated at all. The majority of the participants reported majors in the social and natural sciences with some of them in the arts and humanities, business and industry, and education and human services. The study was reviewed and approved by the Institutional Review Board (IRB) and no compensation other than the possibility of extra credit was given for participating in the study.

Materials

The materials used in this study were 20 FACS coded videos, each of which depicted a person smiling (13 men and 7 women) for an average of 4 s each. Ten of the videos showed enjoyment smiles (8 men and 2 women) and 10 showed nonenjoyment (5 men and 5 women). Eighteen of the videos depicted White actors (12 men and 6 women), one depicted a Black actor (man), and one depicted an Asian actor (woman). The videos showed each of the different phases in the smile (onset, apex, and offset) and were obtained from the BBC Science and Nature Web site (BBC, n.d.). Each video was uploaded into Tobii X120 infrared eye-tracking software so that the area of the smile participants spent the most time looking at could be recorded. The videos were presented in randomized order for each participant to help eliminate the possibility of order effects or confounding variables.

Procedure

Once informed consent was obtained, participants' eyes were calibrated with Tobii eye-tracking software, so that it could accurately follow their movements. This procedure took about two minutes to complete after which, participants were given instructions using the following script:

> You will now watch a series of video clips each depicting a smile. The first video is a practice video that does not affect the study, so you may answer in any way you like. After that please choose the answer that best represents the question. Be sure to watch each video carefully, because it will only be played one time. Are you ready to begin?

The independent variable was smile type and had two levels: enjoyment (real) and nonenjoyment (fake). The dependent variable was the percentage of the videos that each participant identified correctly. Each participant was individually tested. When they finished watching the videos, they were given a short demographics questionnaire that asked them their age, sex, ethnicity, area of study or their career as well as an open ended question that asked where they looked while interpreting smiles. All questions were multiple-choice with the exception of age, ethnicity, and career, which were open responses. After this was completed, they were thanked for their participation and given a debriefing form.

Results

A nonparametric binomial sign test showed that the amount of participants (80%) who performed at an accuracy level above chance (50%) was significant ($p < .001$). To expand upon this finding, a second nonparametric binomial test was conducted setting a cutoff at 60% accuracy, or slightly above chance. Results indicated that the amount of participants (67%) who performed at an accuracy level slightly above chance (60%) was significant ($p = .009$). Descriptive statistics on the average percent correct for each participant showed that, overall, participants were correct 65% of the time in distinguishing between enjoyment and nonenjoyment smiles.

A 2 (participant sex) x 2 (actor sex) x 2 (smile type) analysis of variance (ANOVA) was conducted on the percent correct for each video. Results showed no significant effect of participant sex, $F(1, 40) = 0.07$, $p = .79$, $\eta^2 = .002$, with nearly equal performance between men and women, 64.1% vs. 65.0%. Enjoyment smiles and nonenjoyment smiles were equally readable, $F(1, 40) = 0.89$, $p = .35$, $\eta^2 = .027$ with participants achieving a 65.9% accuracy rating on enjoyment smiles and 63.2% on nonenjoyment smiles. There was no significant effect of the sex of the actor in the video, $F(1, 40) = 1.39$, $p = .25$, $\eta^2 = .042$. However, participants gave slightly more accurate responses to the videos that depicted the face of a woman ($M = 67.6\%$) compared to that of a man ($M = 62.9\%$).

Tobii eye-tracker analyses and the participants' self-report of where they looked while watching the videos showed that the 33 participants who were correct in distinguishing enjoyment and nonenjoyment smiles at an accuracy rate of over 70% spent the majority of their time focused on AU 6 (Figure 3). Conversely, the 13 participants who performed at an accuracy rate of 50%, or lower, spent the majority of their time focused on AU 12 (Figure 4). This was true across participant and actor sex.

In order to find a more general statistic, an independent samples t test was conducted to compare the total amount of time, in seconds, that participants spent looking at AU 6 and AU 12. When both smile types were examined together results indicated that participants spent significantly more time looking at AU 6 ($M = 1.29$, $SD = 0.08$), compared to AU 12 ($M = 0.89$, $SD = 0.38$), $t(38) = 4.62$, $p < .001$ (Table 1). When examined separately, data showed that this significance was more prominent in enjoyment smiles, during which participants looked at AU 6 ($M = 1.29$, $SD = 0.08$) significantly more than AU 12 ($M = 0.92$, $SD = 0.17$), $t(18) = 4.04$, $p = .001$ (Table 1), than in nonenjoyment smiles during which participants spent significantly more time looking at AU 6 ($M = 1.29$, $SD = 0.14$) compared to AU 12 ($M = 0.85$, $SD = 0.05$), $t(18) = 2.85$, $p = .01$ (Table 1). These findings suggest that when observing either enjoyment or nonenjoyment smiles, both men and women look at AU 6 more than AU 12.

According to the self-report data, 75% of the participants in the current study reported looking at the eyes (AU 6), 10% reported looking at the mouth, (AU 12) and 5% reported the face in general terms. However, according to the eye-tracking data, some of the participants who reported looking at the eyes focused on the mouth and other parts of the face. In addition, about one-fourth of these participants performed around the level of 50%, suggesting that they did not really know what they were looking for. This suggests that self-report of where the participants' believed they looked when interpreting smiles is not a very reliable measure.

A multiple regression analysis was conducted to evaluate how well each of the selected independent variables predicted participants' ability to accurately detect smiles. The predictors were the selected variables of age, participant sex, ethnicity, area of study (arts and humanities, business and industry, education and human services, social and natural sciences), and career (undergraduate student, graduate student, professor, lawyer, social worker) and the indicator variable was the percentage of smiles that were correctly identified.

The linear combination of selected variables was not significantly related to the percent correct, $F(5, 60) = 1.88$, $p = .111$. The sample multiple correlation coefficient was 0.14, indicating that approximately 7% of the correctly identified smiles could be accounted for by the linear combination of selected variables. The coefficients showed that ethnicity was significant ($p = .005$) and the more participants in an ethnic group, the better the group performed. Thus, White participants performed significantly better than others. However, this is most likely due to the unbalanced sample, and as a result, further analysis was not conducted. Age ($p = .258$), participant sex ($p = .576$), area of study ($p = .476$), and career ($p = .493$) were not significant predictors of a person's ability to distinguish enjoyment from nonenjoyment smiles.

Discussion

This study was conducted under the hypotheses that the majority of the participants would perform at slightly above chance level in their ability to distinguish enjoyment and nonenjoyment smiles. Specifically, it was hypothesized that the average accuracy rating across participants would be 60% with no significant difference in performance between men and women, and that participants would be most sensitive to the Facial Action Coding System action unit 12, the zygomaticus major muscle (Ekman & Friesen, 1982; Frank et al., 1993).

The significant finding that 80% of the participants performed at an accuracy level above chance is a new finding that supports previous research and the current hypothesis. Previous studies showed that the majority of participants performed at an above chance level, but they did not statistically specify this majority. The significant finding that 67% of the participants performed at a level above 60% accuracy is also a new finding. This significance extends upon previous work in that 60% was the overall accuracy rating found in previous studies. Therefore, the 65% average accuracy rating achieved by participants in the current study is contradictory to previous research and the current hypothesis (Ekman & Friesen, 1982; Frank et al., 1993).

According to eye-tracking data and the independent samples t test, both men and women in the sample spent significantly more time focusing on AU 6 compared to AU 12 when looking at both enjoyment and nonenjoyment smiles (Figures 3 and 4). This difference was more marked for the enjoyment smiles and was contradictory to previous research, which stated that participants focused on AU 12 significantly more than AU 6 (Ekman & Friesen, 1982; Frank et al., 1993; Krumhuber & Manstead, 2009). This could be explained by the fact that AU 6 is active in enjoyment smiles and in absent in nonenjoyment smiles. In addition, the eye-tracking data of the 33 participants who performed above 70% showed that they spent the majority of their time focused on AU 6 in both enjoyment and nonenjoyment smiles (Figure 3). The eye-tracking data was opposite for the 13 participants who performed at, or below, 50% (Figure 4), which suggests that the participants who achieved 70% or higher were noting the absence

FIGURE 3

Tobii Heat Map

Participants with 70% or greater accuracy correctly answered enjoyment smile (left) correctly; correctly answered nonenjoyment smile (right).

AU 6 in nonenjoyment smiles, and those who performed at or below 50% were not.

A number of different explanations could be given as to why this contradiction occurred. The first one is that previous studies did not incorporate the use of an eye-tracking device and relied solely on the participants' self-report and experimenter observation. As the analysis of self-report showed, even though most of the participants in the current study reported looking at the eyes some of them focused on other parts of the face. In addition, about one-fourth of the participants who reported looking at the eyes performed around the level of chance, suggesting that they did not really know what they were looking for. Nevertheless, data showed that the overall focus was on AU 6 rather than AU 12, which is contradictory to previous studies. This suggests that self-report is not a very reliable measure and that the use of an eye-tracking device is essential in determining the area of the face that is most focused upon when detecting emotion.

The hypothesis was confirmed when a repeated measures analysis of variance (ANOVA) was conducted on participant sex. As previous research suggested, the results revealed no significant differences in performance ability among men and women (Ekman & Friesen, 1982; Ekman & O'Sullivan 1991; Ekman & Friesen, 1993). Additional findings showed that both enjoyment and nonenjoyment smiles were equally readable by participants. This finding contradicts previous research, which said that enjoyment smiles are easier to read based on the fact that there is only one type of enjoyment smile and many different nonenjoyment smiles (Duchenne & Cuthbertson, 1990; Ekman, 2009; Ekman & Friesen, 1982; Gosselin, Beaupre, et al., 2002; Gosselin, Perron et al. 2002). However, current research showed that both types of smiles were interpreted with about the same level of accuracy.

In addition, the sex of the actor in the video had no significant effect on the participants' responses. However, the faces of female actors were slightly easier to read than those of male actors. This could potentially be explained by the finding that women are better at physically expressing their emotions than men (Ekman, Roper & Hager, 1980).

FIGURE 4

Tobii Heat Map

Participants with 50% or lower accuracy incorrectly answered enjoyment smile (left) correctly; incorrectly answered nonenjoyment smile (right).

Limitations

Although the multiple regression analysis showed a significant effect among the ethnicity of the participant, that was most likely because there were unequal numbers of participants across ethnic groups, with minimal representation across groups. Thus, if the ethnic groups were balanced, the results may have turned out differently. In addition, the sample sizes of men and women were not ideally balanced. There were roughly twice as many women as there were men (45 to 21). Due to the nearly equal performance between men and women, it is likely that a balanced sample would yield similar results.

One of the major limitations in this study was that the stimuli were not balanced. Across 20 videos, 65% (n = 13) depicted a male actor and 35% (n = 7) depicted a female actor. However, the faces of women were more accurately rated than those of men. Therefore, this imbalance may have suppressed potentially significant findings. Another complication with the stimuli was that there were more male enjoyment (n = 8) smiles than female (n = 2) enjoyment smiles. Once again, the faces of women were more accurately rated than those of men. Due to the fact that there were one-fourth as many female enjoyment smiles, this finding could remain or become significant if a balanced sample were used.

Perhaps the most important limitation to note is that the videos in this study might not have been perfect representations of enjoyment and nonenjoyment smiles. Specifically, the onsets and offsets of these smiles may no longer be an accurate representation of emotion. New research is being conducted specifically on the durations of smiles, and the findings indicate that the duration of onset and offset times, specifically in enjoyment smiles, may be different than those depicted in the videos used in the current study. However, until the significance of this research is made known, the onset and offset times in the videos used in the current study are assumed to be accurate (C. Freshman, personal communication, January 8, 2012).

Finally, even though the use of the Tobii eye-tracking system was very beneficial to this study, there were some drawbacks that caused the data of 21 participants to be discarded. This could have happened for any number of reasons such as the lighting in the room, the participant's vision level, or the distance from the eye-tracker. In any case, it was clearly more beneficial to use the eye-tracker and cope with its limitation than to avoid using it at all.

Future Research

Some other interesting possibilities would be to examine the smile recognition ability of children and infants using eye-tracking software and using them as actors in the stimuli. The comparison between children, infant, and adult faces could be made to find out if certain age groups are better at reading people, or are easier to read than others. It would be interesting to find out if the sex of the children and infant actors would have an effect on the interpretation of their smile similar to the finding in this study.

In addition to inherent traits, life experiences may also determine peoples' ability to detect emotion. Several studies have mentioned that socially excluded individuals tend to notice emotion faster than nonsocially excluded individuals (Bernstein, Sacco, Brown, Young & Claypool, 2010; Bernstein, Young, Brown, Sacco & Claypool, 2008; DeWall, Maner & Rouby, 2009; Maner, DeWall, Baumeister & Schaller, 2007). In addition, children from abusive families averted their eyes when seeing nonenjoyment smiles and elevated their gaze when seeing enjoyment smiles, whereas children from nonabusive families displayed no significant gaze difference (Bugental, Kopeikin & Lazowski 1991). However, research has not yet determined whether socially excluded or abused individuals are more accurate at distinguishing smiles.

Given the fact that AU 6 and AU 12 are the two primary features in a smile, it would be interesting to find out if participants would still be able to distinguish between enjoyment and nonenjoyment smiles if one portion of the face was covered, and at what level. Often, individuals are only able to see parts of the face through masks, bad camera angles, restricted views, et cetera. If the most expressive part of the face could be determined it may be of considerable importance to criminal investigators and law enforcement officials. For example, would participants continue to perform significantly higher than chance if they only observed AU 6? Based on the findings in this study, it would seem that, if one were to focus exclusively on AU 6, then they would have much greater accuracy. Conversely, would they perform significantly lower than chance if they only observed AU 12? Again, the findings in the current study indicated that focusing on AU 12 was associated with lower accuracy in distinguishing enjoyment and nonenjoyment smiles.

In conclusion, the main findings in this study were contradictory to previous work and the current hypothesis. The finding that significantly more participants achieved an accuracy rating of over 60% is contradictory to previous work and the current hypothesis, neither of which foresaw this significance. It can also be considered a new finding in that previous studies have not tested for this significance. In addition, participants in the current study had an overall accuracy rating of 65%, which is not only higher than chance, but also higher than the average accuracy rate of 60% found in previous research. The most surprising finding was that most people focused on AU 6 rather than AU 12, which was contrary to previous research and the current hypothesis. The reason behind this finding could be that previous studies did not incorporate the use of an eye-tracker. It is very possible that people have always looked at the eyes and have simply reported looking at the mouth due to the fact that the mouth displays smiles. One last finding that was not incorporated in the current hypothesis was that enjoyment and nonenjoyment smiles were equally readable. This contradicts previous research, which said that enjoyment smiles are easier to read than nonenjoyment smiles. In the end there are many questions that have yet to be answered, and continued research should be conducted incorporating

TABLE 1

Average Time (in Seconds) Spent Looking at Action Units in 10 Enjoyment and 10 Nonenjoyment Smiles

Muscle & Smile Type	Time										Mean
AU6 Enjoyment	1.43	1.31	1.03	1.65	1.62	1.07	1.10	1.29	1.01	1.43	1.29
AU6 Nonenjoyment	1.22	0.91	1.90	1.46	1.04	0.61	1.71	1.00	1.99	1.09	1.29
AU12 Enjoyment	1.10	1.05	0.96	1.14	0.85	1.08	0.71	0.88	0.76	0.71	0.92
AU12 Nonenjoyment	0.81	0.76	1.02	0.76	1.07	0.57	0.81	0.74	0.14	0.86	0.85

the use of eye-tracking software instead of, or in addition to, self-report to determine the most helpful feature in distinguishing enjoyment and nonenjoyment smiles.

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