Perception of Enjoyment and Masking Smiles with Self-Report Measures of Rating on Scales From Happiness to Negative Emotions

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Abstract

Previous studies explored individual's judgment of masking smiles using dichotomous or categorical measures of rating which force individuals to categorize the masking smile into one discrete category. The current study further examined individuals' ability to distinguish between enjoyment and masking smiles (smiles containing trace of negative emotion) with positive-negative dimensional rating scales. Thirty-two undergraduate students participated in the smile judgment study, which consisted an Enjoyment smile and six masking smiles: a smile with a trace of fear, of disgust, of anger in the brow, anger in the mouth, sadness in the brow and sadness in the mouth. Participants had to evaluate each smile with four different scales, which contained a positive and negative dimension (Happiness and either Fear, Sadness, Anger, and Disgust).

Results indicated that participants could distinguish between the masking smiles and enjoyment smiles as they rated the enjoyment smiles more positively than the masking smiles. Participants were most sensitive to masking smiles containing traces of fear as they rated this expression more negatively compared to the other masking smiles. Other than the expression of anger (in the brow), masking smiles were rated more negatively overall than the genuine enjoyment smiles. Finally, response rates were quicker for enjoyment smiles than the masking smiles. Using dimensional measures of rating in the smile judgment task did not change individuals' judgment of the masking smiles but may change the way the smiles are processed.

Key words: Masking smiles, Enjoyment smiles, dimensional ratings

Emotional communication is an important aspect of social interactions and may include the use of both verbal and/or nonverbal means (Keltner and Haidt, 2001). Verbal information may be communicated through the use of words while nonverbal may include the use of different facial expressions, gestures as well as body posture (Keltner and Haidt, 2001). This current thesis focuses on nonverbal communication; more specifically, it will explore facial expressions. The ability to interpret emotional facial expressions in others is a beneficial skill to possess but being able to perceive and extract any meaning from different expressions requires an awareness and attention to the subtle and complex cues that are associated with the expressions (Ekman & Friesen, 1975; Ekman & Friesen, 1986)

Research has previously indicated that most individuals are able to perceive and interpret full face expressions of the basic emotions (macroexpressions of fear, surprise, anger, disgust, happiness, and sadness), doing so at above chance levels even when presented with the expressions for a brief period (e.g. Calvo & Lundqvist, 2008; Dimberg, Thunberg, & Elmehed, 2000; Ekman & Friesen, 1986; Elfenbein & Ambady, 2002). Communication becomes increasingly difficult though when one considers the fact that many emotional facial expressions can be voluntarily controlled.

Individuals may voluntarily control their emotional facial expressions for a number of reasons such as to regulate their emotional states, to protect themselves, or when attempting to manipulate and deceive others (Izzard, 1991; Saarni, 1979; Ekman, 1985; Owren & Bachorowski, 2001). The ability to voluntarily produce facial expressions even when doing so for misleading purposes, most likely contributes to the smoothness and reciprocity of conversations and social communication in general

(DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996; Hancock, 2007). However, in other circumstances the voluntary control of facial expressions may pose as a problem, and accurately assessing the nature of one's facial expressions can become crucial, for instance, in many applied contexts within society such as the courts, parole hearings, politics, and even clinical settings when the ability to distinguish between genuine and deceptive expressions may have high stakes (Porter, tenBrinke, & Wallace, 2012). The current study further examines the differences that may occur in the judgment of different masking smile expressions that contain traces of negative emotions while tracking eye-movements in an effort to gain a better understanding of how individuals differentially perceive and process the emotional facial expressions.

Emotional Facial Expressions

Nonverbal communications, such as facial expressions, are used alongside verbal means of communication to ensure messages are interpreted and received correctly (Keltner & Haidt, 2001). Emotional facial expressions also provide perceivers with an insight into the emotional state of others if interpreted correctly, which in turn provides the perceiver with relevant information such as if an individual should approach or avoid an expresser or something else in the environment, such as a threat (Keltner & Haidt, 2001). For instance infants respond to their parents' nonverbal displays of fear, anger, and happiness to determine whether or not it is safe for them to approach new people or ambiguous situations (Tracy, Randles, & Steckler, 2015). Research has shown that emotional expressions associated with happiness produce approaching behaviour in many different species including humans, while emotional expressions associated with anger do the opposite and produce avoiding tendencies (Marsh, Ambady, & Kleck, 2005).

Apart from signaling approach or avoidance behaviour, emotional facial expressions also communicate complex information such as an expresser's personality and social role (Knutson, 1996; Johnston, Miles & Macrae, 2010). One study done by Knutson (1996) found that different emotional facial expressions change peoples' perceptions of dominance in the expresser, for instance he found that expressers who displayed expressions of anger or disgust were perceived as high in dominance, while people who expressed facial expressions of fear and sadness were perceived as low in dominance. These are only a couple ways in which emotional facial expressions serve important everyday social communicatory functions. Taken together, these studies have revealed how the production and recognition of emotional facial expressions play an important role in everyday social interactions.

Many of the studies that involve nonverbal communication by way of emotions began with an early claim from Charles Darwin that emotional facial expressions have evolved in humans from pre-human nonverbal displays (Darwin, 1872/1998). Darwin's main focus was on the physiological functions that occur alongside emotional expressions, he believed that emotional facial expressions were adaptive for the bearer of an emotion because they allowed an individual to better process and respond to an emotion-inducing situation (ten Brinke, Porter, Baker, 2011). For example it was thought that the expression of fear, which is associated with the widening of the eyes, functions to increase the expresser's peripheral vision in response to any environmental threats, a theory that has recently been supported (Susskind, Lee, & Anderson, 2008).

Darwin's claims that emotional facial expressions had evolved in humans from pre-human nonverbal displays first received empirical support with the claim that there were universal facial expressions (macroexpressions) that could be recognized and produced by individuals from all over the world, these emotions included anger, sadness, disgust, fear, happiness, and surprise. Even individuals from extremely isolated societies in Papua New Guinea could identify these six basic emotions the same way Westerners do when shown images of American emotional facial expressions (Ekman, Sorenson, & Friesen, 1969; Ekman & Friesen, 1975). The finding that members from geographically different societies have the ability to recognize the same nonverbal displays of behaviour and associate them with the same emotions was strong evidence to support Darwin's claim that some emotions and thus emotional facial expressions had evolved in humans. More recently, many cross-cultural studies also support the claim that these six emotional expressions are universal.

From birth, infants are influenced by different emotional facial expressions and begin learning to extract meaning from the expressions at an early age. By the age of 12-to-18 months an infants' behaviour may be influenced positively by a mother's expressions of joy or anger, and the infant is able to interpret adults' emotional reactions as having specific positive or negative consequences (Batty & Taylor, 2006). Thus, even from birth individuals begin learning to express and decode emotional facial expressions and it appears that the ability to decode macroexpressions is a universal phenomenon. Research has indicated though that there are differences in the recognition rates between the macroexpressions of emotions, for instance, happiness is most accurately recognized followed by anger, surprise, sadness, disgust and fear being least often accurately recognized (Beaudry et al., 2005). The ability to decode more complex emotional facial expressions on the other hand may not be a skill individual's so easily acquire as other factors must be taken into account, such as if the smile is felt or false, genuine or posed.

Posed vs. Genuine Smile Expressions

There are three main ways that emotional facial expressions can be intentionally manipulated (Ekman & Friesen, 1975). An emotional facial expression can be simulated, meaning it is not accompanied by a genuine emotion, the expression can be neutralized, which occurs when the expression of a true emotion is inhibited and the face remains neutral, and the expression can be masked, meaning that the expression corresponding to the felt emotion is replaced by a falsified expression (e.g. a smile) that corresponds to a different emotion, (Porter, & tenBrinke, 2008; Ekman & Friesen, 1975). The ability to voluntarily control one's emotional facial expressions seems to manifest itself at an early age, research indicating as early as three years (Perron & Gosselin, 2004; Gosselin et al, 2002) The ability to control facial expressions adds to the complexity that occurs during social interactions because to extract any meaning the decoder has to pay attention to both the emotion expressed as well as to any details regarding the sincerity of the expressions. The current study will focus on masking expressions, more specifically it will focus on how individuals perceive negative emotional expressions that have been masked with a smile.

The smile is known to be one of the most frequently expressed facial expressions during interactions with others and is often recognized as a sign of happiness or enjoyment (Abel, 2002). Although smiles may be used genuinely during instances of felt happiness, the smile may also be voluntarily expressed in the absence of positive emotions, for example to deceive or manipulate others (Ekman, 2003, 2001; Thibault et al., 2002). Distinctions have been made between genuine enjoyment smile expressions associated with felt positive emotions and posed expressions that are low or absent of positive affect.

Firstly, research has indicated that there are two separate neural pathways for posed and genuine smiles. Voluntary facial expressions have been shown as originating from the brain's cortex, specifically the motor cortex, and are innervated by way of the pyramidal motor system (Katsikitis, 2012; Frank, 2002), while involuntary, spontaneous facial expressions hand have been documented as originating from the older subcortical regions of the brain, the same areas of the brain that have been associated with emotions (Katsikitis, 2012). Secondly, according to functional theorists of emotion such as Paul Ekman (2001), there exist reliable markers within facial expressions that specify when individuals experience positive emotions or when smiling to serve some other communicative function.

Genuine smiles that are associated with subjective positive feelings such as happiness, pleasure, and enjoyment have consistently been documented as comprising the activation of the Zygomatic Major muscle, which pulls the corner of the lips upwards into a smile, as well as the Orbicularis Oculi muscle*,* which causes the lifting of the cheeks, narrows the eye opening and causes wrinkles around the sockets of the eyes (Ekman et al., 1988, 1990; Duchenne, 1990; Ekman, 1992; Frank, Ekman & Friesen, 1993). Most specifically it is the activation of the orbicularis oculi that acts as a marker for genuine smiles that have been associated with positive feeling of happiness. These cues associated with an authentic smile have been collectively referred to as a Duchenne smile as Duchenne (Duchenne, 1990; Ekman & Friesen, 1971) was one of the first researchers to document the importance of the activation of the orbicularis oculi in relation to the emotion of happiness and joy.

While individuals can easily voluntarily contract the zygomatic major, research has shown that voluntary contraction of the orbicularis oculi is a more difficult task. In one study that aimed to observe individuals ability to simulate genuine enjoyment smiles associated with felt happiness, the ability to activate the lateral portion of the orbicularis oculi reached levels of only 20 percent (Ekman, Roper, Hager, 1980; Ekman, Friesen, & O'Sullivan, 1988). Another study done in 1990 induced positive and negative states within participants by having them view different movie clips (Ekman, Davidson, Friesen, 1990). They found that activation of the orbicularis oculi positively correlated with participants self-report of positive affect during the movie clip, while reports of negative affect or neutrality tended to produce smiles with less or no activation of the orbicularis oculi muscle (Ekman, Davidson, Friesen, 1990). Thus the contraction of the lateral portion of the orbicularis oculi is an important characteristic of felt enjoyment smiles as this muscle can only be activated in genuine instances of felt enjoyment, or when individuals are trained to activate such a muscle.

It has been well documented that smiles containing the activation of the orbicularis oculi have been specifically associated with subjective judgments of genuine positive states such as enjoyment and happiness when compared to smiles that do not contain activation of the orbicularis oculi. One study looked at the ability that individuals had in their judgment between genuine smiles associated with enjoyment and non-enjoyment smiles (Perron & Roy-Charland, 2013). Enjoyment smiles included the activation of both the zygomatic major and orbicularis oculi and were symmetrical in their activations. Using three different types of smiles (a symmetric authentic/enjoyment smile, an asymmetric enjoyment smile, and a non-enjoyment smile), they tasked participants with responding with either "really happy" if the participant felt the smile in the image was genuinely happy, or "not really happy" if they felt the smile in the image was only pretending to be happy. The results indicated that individuals responded "really happy" significantly more often for the symmetric enjoyment smile that is associated with true feelings of happiness than for the other two smile types. Thus it would seem that individuals are sensitive to genuine smiles associated with happiness, and the smiles individuals most associate positive states with included the activation of the orbicularis oculi.

Other smile expressions, such as masking smiles, occur when individuals attempt to conceal a negative emotion with a smile. When attempting to conceal or "mask" a hidden negative emotion with a smile the masking strategy is not always perfect and traces of the negative emotion may leak into the smile expression (Ekman, Friesen, & O'Sullivan, 1988). Concealing negative emotions with a smile can be a challenge because the expresser must not only voluntarily activate the muscles associated with the smile but also simultaneously inhibit the involuntary activation of muscles associated with the felt negative emotions. Previous research has indicated that certain facial muscles activated during the true experiences of an emotion are difficult to consciously and voluntarily simulate (Duchenne, 1862/1990; Ekman, Roper & Hager, 1980; Gosselin, et al. 2011; Gosselin, Perron & Beaupre, 2010). Moreover, these same muscles are difficult to inhibit and control when attempting to conceal emotions and could lead to what has previously been referred to as microexpressions (*Inhibition Hypothesis,* Ekman, 2003; Ekman and O'Sullivan, 2006).

Microexpressions have been described as very brief (occurring under a second) as well as very subtle muscular movements of the face or full flashes of a hidden emotion that betray an individuals attempt at concealing or masking an emotion. More recently however, studies done by Porter and colleagues analysed over 400, 000 frames of genuine and deceptive facial expressions and found that microexpressions are actually only manifested in the upper or lower half of the face at one time, suggesting that full flashes of the concealed emotion are actually probably rare (Porter & ten Brinke, 2008; Porter, ten Brinke, & Wallace, 2012). Interestingly, these same researchers found that microexpressions were more likely to be produced when individuals experienced strong emotional reactions as opposed to low emotional reactions, and that the quick activations of facial muscles were actually congruent with the emotions being felt (ten Brinke, Porter, & Baker, 2011).

Masking smiles specifically have been documented as comprising the activation of the zygomatic major, also activated during authentic smiles, in addition to the activation of muscles associated with the emotion of fear, sadness, anger, disgust, or contempt (Ekman, Friesen, & O'Sullivan, 1988). An earlier study done by Ekman, Friesen, and O'Sullivan (1988) wanted to test the hypothesis that masking smiles occurred more often when individuals were being deceptive and only feigned happiness, when in fact they felt strong negative emotions. Using nurses as participants, individuals were split into two different groups; one group watched positive emotion inducing films while another group watched films of amputations and burns, which were intended to strongly induce negative emotions. Unknowing to which movie the individual had watched, researchers immediately interviewed the participants and inquired as to which film (positive or negative) the participant had viewed. Participants who watched the negative films had previously been asked to lie during the interview and attempt to deceive the interviewer into believing they had watched the positive film. Results indicated that unlike the group who were truthful during their interviews, participants who were asked to be deceitful during their interviews tended to use many more "masking smiles" during the interviews than the group who were being truthful, means of 1.18 and .80 respectively (Ekman, Friesen, & O'Sullivan, 1988).

Many of these findings discussed provide examples as to how the face may produce different smile expressions through the movement of separate facial muscles, these expressions may occur involuntarily or voluntarily and for many reasons under many circumstances. However, as explained in the next section, research has shown mixed results as to the capabilities that individuals possess in distinguishing between different masking smile expressions that contain traces of negative emotions. Findings concerning microexpressions (e.g. masking smiles) may be important because they provide a basis for the creators of programs that help individuals learn to read emotional facial expressions (e.g. the Paul Ekman Group). Reading facial expressions of emotion, especially microexpressions, can aid individuals with the development of rapport, trust, and collegiality between individual's, and it can also be useful for making credibility assessments, evaluating truthfulness and detecting deception (Matsumoto et al., 2008). This may be a beneficial skill for individuals such as health professionals because it can help them develop better rapport with patients, interact humanely with empathy and compassion, and make the right diagnosis by obtaining complete information (Matsumotoet al., 2008). Since little is still known about the perception and attention of masking smile expressions, the current study will further explore the abilities individuals have in distinguishing enjoyment smiles and masking smiles containing traces of negative emotions to further gain insight into how individuals perceive and judge the different smile expressions.

Sensitivity to Smile Expressions

Tasks involving the judgment of smiles have continuously suggested that individuals are sensitive to enjoyment smiles associated with enjoyment and smiles that serve some other communicatory function (Perron & Roy-Charland, 2013; Miles and Johnston, 2007; Krumhuber & Manstead, 2009; Calvo et al., 2008a, 2008b; Slessor et al., 2010). The ability to distinguish smiles emerges in children as young as the age of six and seven (Thibault et al., 2009; Gosselin et al., 2002, 2010; Frank et al., 1993). When tasked with decoding smiles that contain traces of other emotions, such as anger, individuals seem able to judge the smile as lacking genuineness, but have difficulty actually identifying what the hidden emotion is.

Gosselin and colleagues (2002) looked at the abilities that both children (aged 6-7 and 11-12 years) and adults had in distinguishing between genuine smiles and masking smiles that contained a trace of anger. Genuine smiles contained the activation of both the orbicularis oculi and zygomatic major muscles while the masking smiles contained the simultaneous activation of the zygomatic major, the lip corner puller, and the lip tightener (action units that have been found to be part of anger expressions). All the participants were shown videotapes of different smiles being displayed (all developed according to

FACS) and were tasked with responding “really happy” if they felt the smile was genuine, or with “pretending to be happy” if they felt that the stimulus person was only pretending to be happy. If the participant felt the stimulus person was masking an emotion other than happiness then they were asked to choose the emotion from a list of provided emotions (fear, anger, sadness, surprise, or disgust) which emotion they perceived to be masked by the smile. This task was thought to infer the participants’ explicit knowledge about anger as the hidden emotion.

Results indicated that children had implicit knowledge of the distinction between the enjoyment smiles and smiles that contained traces of anger. Children aged 6-7 years indicated “really happy” significantly more often for enjoyment smiles (M=0.62) that contained the activation of the orbicularis oculi and zygomatic major than for smiles containing the lip tightener (M= 0.33). Children aged 11-12 years indicated, “really happy” significantly more often for the enjoyment smiles (M=0.90) that contained the activation of the orbicularis oculi and zygomatic major than for smiles containing the lip tightener (M= 0.24) - but none of the children (6-12yrs) showed any explicit knowledge regarding anger as the hidden negative emotion. Children aged 6-7 years could only name the hidden emotion as anger 29% of the time while children aged 11-12 could label the hidden emotion as anger 31% of the time. Adults were also able to distinguish between the enjoyment smiles and masking smiles, doing so at significant levels (M=0.83) suggesting they have implicit knowledge about the hidden emotion as well. With regards to explicit knowledge about anger as the hidden emotion, adults labeled the hidden emotion as anger 50% of the time suggesting that explicit knowledge may develop later in an individual’s development.

Perron, et al., (2016) extended on the Gosselin et al. (2002) study by examining individuals' ability to distinguish between enjoyment and masking smiles, but included masking smile expressions that not only contained traces of anger, but also traces of fear, sadness, and disgust. Moreover, this study extended on the previous study by also examining eye-movements during the judgment task to gain a better understanding of the perceptual-attentional mechanisms underlying participant judgment (i.e. what are they attending to and perceiving in the image, and viewing time of each stimulus image). Furthermore, they examined explicit knowledge regarding the masked negative emotion by having participants choose from a list of emotions when they felt the stimulus smile was masking another emotion (Perron, et al., 2016).

Their results indicated that participants accurately responded significantly more often for the enjoyment smiles than the masking smile expressions, indicating they could correctly distinguish between the genuine smiles and the masking smiles. Differences in judgment between the masking smile expressions were also observed. For instance, participants accurately responded "not really happy" significantly more often for smiles containing traces of fear than the other masking smiles. When participants had reported the presence of another emotion they were required to choose from a list to indicate which emotion they felt was present. Accuracy exceeded chance levels for the expressions with anger, sadness and disgust. With respect to viewing time of each stimulus image, a significantly less amount of time was spent viewing smiles that contained traces of fear compared to all the other masking smiles, perhaps suggesting this smile expression was easier to process.

As with the 2002 study, results from the 2016 study were modest, participants were able to make the distinction between genuine enjoyment smiles and the masking smiles, as is inferred from their tendency to respond “really happy” significantly more often for the enjoyment smiles, but they were unable to correctly label the negative emotions hidden within the smile expressions. This study further indicates the difficulties individuals face with such judgment tasks. The characteristics associated with the enjoyment smile in addition to activation of muscles associated with the hidden negative emotion creates a complex task for the decoder when required to identify the concealed negative emotion. Part of the difficulty faced by individuals could be that they are being forced to choose a discrete emotion from a list of emotion categories (e.g. fear, anger, sadness, happiness etc.).

Some emotion theorists, such as Russell (1993) feel that there are problems posed with the forced-choice response formats used within the study of emotional facial expressions. For example, if the emotion that was spontaneously first thought of by the participant was not on the list, then they are forced to choose the label that most closely relates to their first thought but may not accurately fit with their first perception of the emotion portrayed within the expression, as has been shown to be the case in some studies of facial expressions (see Russell, 1993 and 1989). Indeed, recognition rates in judgment tasks of emotional facial expressions have been shown to falter when non-forced-choice response measures are used (Tracy, Randles, & Steckler, 2015), indicating that it may be an easier task when forced-choice methods are employed or that the tasks entail different forms of processing.

Moreover, while discrete full-face expressions of emotion (macroexpressions) may easily be perceived in discrete categories such as *Happiness, Anger, Disgust, Fear*, masking smiles contain characteristics of both happiness as well as the negative emotion making the perception of the physical parameters of each separate emotional expression unclear. Past research indicates that the perception of emotions categorically is a critical process used to effectively decode emotional facial expressions, but in everyday social situations facial expressions occurring naturally might vary along a number of continua (e.g. from happy to sad, from sad to angry, from angry to afraid etc.) (Mehu & Scherer, 2015). Thus it might not be appropriate to force participants to choose one emotion over the other in judgment tasks of masking smiles when the expression in fact has characteristics of two separate emotional expressions.

Goals of Current Study

To gain a better idea of how individuals perceive the emotional expression as a function of the hidden negative emotions, it may be a better measure to have participants respond on scales that more accurately reflect the two different dimensions of the smile (happiness and the negative emotion)(Russell, 1989; 1993). While there exist studies which use dimensional rating measures in judgment tasks of emotional facial expressions, these studies mainly focus on the emotional valence and arousal of the expression (see Mehu and Scherer, 2015) as opposed to the perceptions of the two emotional dimensions within the masking smile expressions (e.g. is the expression perceived as corresponding to the negative or positive emotion). The current study will further examine individuals' ability to distinguish enjoyment smiles from masking smiles that contain traces of negative emotions, but instead of using forced-choice formats, this study used continua between happiness and the negative emotions of fear, sadness, anger, and disgust. Since a masking smile contains characteristics of a genuine smile as well as characteristics of the hidden negative emotion, there are no clear lines dividing the two expressions making the task extremely complex (Ekman & Friesen, 1975; D'Hondt, Timary, Bruneau, & Maurage, 2015). The continua/scales used within the present study extend positively from happiness at one end and extend negatively towards the negative emotion at the other end of the scale, while the middle of the continua represents a response of equal perception between happiness and the negative emotion allowing for a more accurate reflection of the masking smiles.

These scales might allow participants more freedom in their judgment of the masking smiles and allow for a better understanding of how individuals differentially perceive smile expressions with respect to the hidden negative emotions (e.g. is a smile with a trace of anger rated more negatively than one containing disgust?) because they do not force participants to choose a discrete emotion but instead allow the participant to respond on scales that reflect the two dimensions of the smile. Furthermore, eye-movements of participants will be recorded throughout the judgment tasks to observe any differences that may occur in viewing times of the different smile expressions. Differences in viewing time may be indicative of other factors for instance gazing time, which has been defined as the rate of gazing (e.g. fixations) across the total viewing period, has been negatively related to the difficulty of the task (Nakayama et al., 2002). Also, saccade occurrence rate – saccades being a movement of the gaze from one side of the face to the other side of the face – has been found to decrease as task difficulty or mental load increases (Nakayama et al., 2002).

If results are similar to previous studies then it might be expected that images of enjoyment smiles – characterized by activation of both the zygomatic major and orbicularis oculi - might be rated more positively on the scales than the masking smile expressions. We might also expect there to be variations in rating between the different masking smile expressions that contain the traces of negative emotions. For example, if results are similar to the Perron's (2016) study we might expect expressions containing traces of fear to be rated more negatively. Differences may also be observed in viewing time of the different smile expressions; in the previous study expressions containing traces of fear were judged in the least amount of time than the other expressions.

Either of these results would be in line with psycho-evolutionary theories which posit that the ability to decode emotional expressions associated with negative emotions of anger and fear would have immense adaptive value (Hess & Thibault, 2009), for instance you may become more alert and prepare to react if you observed an expression of fear on the face of the individual next to you. Moreover, if participants are not only sensitive to the masking smiles but also exhibit knowledge as to the correct emotion being masked it might be expected that patterns of higher ratings will be observed on the continua containing the correct negative emotion for that specific image since participants randomly rated each of the images on each of the four different scales (happiness-anger, happiness-sadness, happiness-fear, and happiness-disgust).

Methods

Participants

32 undergraduate students studying at Laurentian University, 2 males and 30 females (M=22.13yrs, Min.=18yrs, Max. = 40yrs) with normal or corrected-to-normal

vision participated in this study. Participants all filled out a demographic questionnaire where they indicated their age, gender, and visual acuity.

Independent Variables

1. Smile Prototypes

Seven different smile prototypes were used for the purpose of this study; Enjoyment, Angry Brow, Angry Mouth, Disgust, Sad Brow, Sad Mouth and Fear (see Appendix A). The Enjoyment smile is characterized by both the activation of the orbicularis oculi (AU6) and zygomatic major (AU12) muscles. The other six smiles used were created to represent masking smiles and contained characteristics of the enjoyment smile as well as traces of fear, anger, sadness or disgust. The smile containing the microexpressions of fear used additional activations of the "Brow Lower" (AU 4), the "Inner Brow Raiser" (AU 1), as well as the "Outer Brow Raiser" (AU 2). To depict anger two different smiles were used, one that contained anger in the brows and the other contained anger in the mouth. The smile containing anger in the brows required the additional activation of the "Brow Lower" (AU 4) while the smile containing anger in the mouth required the additional activation of the "Lip Presser" (AU 24). Two types of smiles containing traces of sadness were used. The first smile had the trace of sadness in the eyebrow area and contained the activation of both the "Brow Lower" (AU 4) and the "Inner Brow Raiser" (AU 1). The second smile contained the trace of sadness in the mouth area requiring activation of the "Lip Corner Depressor" (AU 15). Finally, the last smile with the trace of disgust contained the "Nose Wrinkler" (AU 9).

2. Scales

Four different continua were used within the study and each contained a positive and negative dimension (Happiness and either Fear, Sadness, Anger, and Disgust). Patterns of rating on each of the four scales were observed as a function of the seven smile prototypes. The negative emotion (fear, sadness, anger, and disgust) is represented on the continua in negative numbers (-1, -2, and -3) while the positive emotion (happiness) is represented in positive numbers (+1, +2, and +3). Each increase on the continua (either negatively or positively) represents an even increase in perceived intensity towards that dimension of the facial expression (happiness or the negative emotion). For example, a rating of +3 on the scale means that the smile was perceived as complete happiness while an answer of +2 means that the participant perceived the smile as a little less than a complete smile of happiness, while a response of +1 meant that the smile was perceived as exhibiting more happiness than 0 which represented equal perception of happiness and the negative emotion. The same process is represented on the negative dimension of the continua so a rating of -3 on the scale means that the smile was perceived as complete expression of the negative emotion, an answer of -2 means that the participant perceived the smile as a little less than a complete expression of the negative emotion, and a response of -1 means that the expression was perceived as exhibiting more of the expression associated with the negative emotion than an expression of happiness but not so much that the expression is perceived as both equally an expression of happiness and the negative emotion (represented by 0 on the scale).

Dependent Variables

1. Ratings

Each of the seven smile prototypes (Enjoyment, Angry Brow, Angry Mouth, Disgust, Fear, Sad Brow, and Sad Mouth) were rated on each of the four scales (Anger-Happiness, Sadness-Happiness, Fear-Happiness, and Disgust-Happiness); 20 participants rated the images on the continua that began with the positive dimension and 20 participants rated the images on the continua that began with the negative dimensions. It is the differences in rating between the seven smile prototypes and the four different scales that we were interested in observing.

2. Eye-Movements

Recoding the eye-movements of participants while they view the different stimulus images gives some insight into how the individual processed the smile expression (e.g. task difficulty). For the purpose of this study, viewing time and fixations made for each of the trial images were recorded and observed.

Materials:

Facial Action Coding System (FACS) - The seven types of smiles used within this study were all coded in accordance with the FACS. FACS is a research tool useful for measuring any facial expression a human being can make. More specifically, FACS is an anatomically based, comprehensive, and objective technique used for the measurement of all observable facial movement. Each observable component of a facial movement is called an Action Unit or AU. According to this system, all facial expressions can be broken down into their constituent AU's. The FACS manual describes the criteria for observing and coding each AU and describes how AU's appear in combinations. The images for this study were previously produced within a laboratory setting. The encoders consisted of 3 men and three women. For each type of smile four different encoders were used producing a total of 28 pictures. Only smiles that exacted 100% inter-rater agreeability following an evaluation by two qualified FACS coders were chosen for the previous study, and thus also this study.

Apparatus:

To record eye movements within this study the EyeLink II system was used. This system has an average accuracy of 0.5°, with a high sampling rate of 500Hz. Eye movements are tracked by two cameras which are located beneath the eyes and an infrared sensor which is located on the forehead tracks head movement. Only one pupil is tracked for this study, that which yields the most accurate calibration. To ensure a maximum deviation of 1° in visual acuity a nine-point calibration procedure was used.

Procedure

Once participants felt comfortable with the EyeLink II system upon their head, the calibration process began. After a nine-point calibration was met, participants were then exposed to the stimuli on a computer screen in front of them. The gaze position of the pupil being tracked is also displayed at the same time on the experimenters monitor to allow for examination of the participants gaze position. Prior to beginning the experimental trials, the participants first completed five practice trials to ensure that they understood exactly what their task entailed.

Participants were tested in sessions lasting approximately 30 minutes. The entire experiment consisted of a total of 28 images (7 smile prototypes x 4 encoders of each prototype), with 192 trials per session; 96 of the trials consisted of images that were characteristic of an Enjoyment smile (4 encoders X 6 repetitions of each image X 4 continua) while the remaining 96 trials consisted of images that were characteristic of masking smiles (6 types of smiles X 4 encoders of each X 1 repetition of each X 4 continua) containing traces of the negative emotions of either fear, anger, sadness, or disgust. Each of the 192 stimulus images was presented separately with only one of the four scales presented beneath the image to be rated on (see Appendix A. for an example). Upon completion of the task, each of the 28 images had been rated separately on each of the four scales (Fear-Happiness, Sadness-Happiness, Anger-Happiness, and Disgust-Happiness) (see Appendix B). For instance, the Disgust smile prototypes were not only rated on the Disgust-Happiness scales but also on the Angry-Happiness, Sadness-Happiness, and Fear-Happiness scales at separate times throughout the experimental session.

Participants were asked to evaluate the image and rate on the scale where they perceived the smile expression belonged with respect to happiness and the negative emotion presented on the continuum. The participants themselves entered the responses by pressing a button on the keyboard in front of them that corresponded to their response on the scale. 20 of the participants judged the smile expressions on scales that began with the positive dimension (happiness-to-sadness, happiness-to-anger, happiness-to-fear, or happiness-to-disgust). Another 20 participants judged the smile expressions on scales that began with the negative dimensions (sadness-to-happiness, anger-to-happiness, fear-to-happiness, and disgust-to-happiness). Once the participant gave their response, the next image appeared on the computer screen and the process is repeated until the 192nd trial when the experiment ended automatically with the given final rating.

Data Analysis

An alpha of .05 was used for all of the analyses, except for when Dunn's correction was applied for simple main effects tests. The mean ratings on the positive-negative continua were computed for each of the seven smile prototypes (Enjoyment, Anger Eyes, Anger Mouth, Disgust, Fear, Sadness Eyes, and Sadness Mouth). Ratings were also examined as a function of the scale type (anger to happiness, fear to happiness, sadness to happiness, disgust to happiness) for the seven prototypes.

All of the eye-movements were scored via the EyeLink Dataviewer. The mean response time was measured as a function of the smile prototype (Enjoyment, Anger Eyes, Anger Mouth, Disgust, Fear, Sadness Eyes, and Sadness Mouth). Moreover, this program allows for participants fixations to be viewed superimposed on the stimulus image, therefore the proportion of gazing time at the eyes, nose, and mouth regions were computed for each of the smile prototypes. Proportion of gazing time for each zone was computed by dividing the amount of time spent in a particular zone by the total time spent on the stimulus (see Perron, et al., 2016).

Results

Since the order of the scales from negative emotions to happiness and happiness to negative emotions was counterbalanced to ensure that no order bias occurred, an analysis was done to compare the ratings on the negative-positive continua with ratings on the negative-positive continua. A between-subjects analysis of variance (ANOVA) revealed no significant effect of order, $F_{(1, 30)} = 0.11$, $p = .74$, $\eta^2_p = .004$.

Ratings on the Continua

An analysis was done to compare the mean ratings on the scales as a function of the seven smile prototypes (Angry Brow, Angry Mouth, Disgust, Enjoyment, Fear, Sad

Brow, and Sad Mouth). A repeated-measures analysis of variance (ANOVA) revealed a significant effect for smile type, $F_{(6,186)} = 72.84$, $p< .001$, $\eta^2_p = .70$ (see Figure 1). Post-hoc tests (LSD) revealed that participants rated Enjoyment smiles significantly more positively than any of the masking smiles (Fear, Angry Mouth, Angry Brow, Sad Brow, Sad Mouth, and Disgust). Fear smiles were rated significantly more negatively than the other masking smiles (Angry Mouth, Angry Brow, Sad Brow, Sad Mouth, and Disgust). The Angry Brow smile was rated significantly more positively than the masking smiles (Fear, Sad Brow, Sad Mouth, Disgust, and Anger Mouth). The Sad Mouth, Sad Brow, Disgust, and Angry Mouth smiles were rated significantly more negatively than the Enjoyment smiles and the Angry Brow smiles but significantly more positively than the Fear smiles.

A second analysis was computed to examine the mean ratings on the four scales as a function of the seven smile prototypes. A 4 x 7 (scales x prototypes) repeated-measures ANOVA revealed a significant main effect for prototype, which was discussed in the section previously, and a main effect for scale type, $F_{(3, 93)} = 4.38$, $p< .001$, $\eta^2_p = .12$. An interaction between scale type and smile prototype was also revealed, $F_{(18, 558)} = 2.52$, $p= .001$, $\eta^2_p = .08$.

For the scale types (Anger, Sadness, Fear, and Disgust), post-hoc tests (LSD) revealed that for the Enjoyment smile prototypes, regardless of the scales, participants judged them more positively than all the other smile prototypes, and for Angry Brow they judged them more positively than all but the Enjoyment smile prototypes. For the Fear smile prototypes, on the happiness to fear scale, participants judged this smile as more negative than all the other smile prototypes. For the happiness to sadness scales, Fear was judged more negatively than all but Angry Mouth. For the happiness to disgust scales, Fear smile prototypes were judged more negatively than the Sad Brow smile prototypes (in addition to the Enjoyment and Angry Brow prototypes). No other difference was observed on that scale. On the happiness to anger scale, the Fear prototype was judged more negatively than all but the Angry Mouth and Sad Mouth smile prototypes. Angry Mouth was also judged more negatively than all but Fear and Sad Mouth. Finally, Sad Mouth was judged more negatively than Sad Brow on the happiness to sadness scale.

Simple main effects tests were computed to explore the interaction between smile prototype and scales. Dunn's correction was applied to alpha and to be considered significant the *p* value needed to be smaller that .014. A difference between scales was only observed for Sad Brow prototypes, $F_{(3, 93)} = 6.83$, $p < .001$, $\eta^2_p = .18$. Post-hoc tests (LSD) revealed that participants judged the Sad Brow smiles more positively when the scale is between happiness and anger than any of the other scales. For all the other smile prototypes, the differences between scales were not significant, Anger Brow, $F_{(3, 93)} = 2.79$, $p = .045$ $\eta^2_p = .08$; Angry Mouth, $F_{(3, 93)} = 1.64$, $p = .19$ $\eta^2_p = .05$; Disgust, $F_{(3, 93)} = 3.51$, $p = .018$ $\eta^2_p = .10$; Enjoyment, $F_{(3, 93)} = .53$, $p = .66$ $\eta^2_p = .02$; Fear, $F_{(3, 93)} = 1.93$, $p = .13$ $\eta^2_p = .06$; and Sad Mouth, $F_{(3, 93)} = 1.69$, $p = .17$ $\eta^2_p = .05$.

Eye Movement Measures

Response Time. An analysis was also done to compare the mean response time between the seven prototypes. A repeated-measures ANOVA revealed a significant effect of smile type, $F_{(6, 186)} = 3.12$, $p <.05$, $\eta^2_p = .09$. Post-hoc tests (LSD) revealed that participants responded significantly faster for Enjoyment smiles than any of the masking smiles except Disgust smiles, which did not significantly differ from any of the smile expressions (see Figure 2).

Proportion of time in interest Areas. An analysis was computed to compare the mean proportion of time in three different zones of the face (Eyes, Mouth and Nose) for the seven smile prototypes. A 3 x 7 (zone x smile prototype) repeated-measures ANOVA revealed a main effect of the zone, $F_{(2, 62)} = 3.57$, $p < .05$, $\eta^2_p = .16$, and a main effect of smile prototype, $F_{(6, 186)} = 5.91$, $p < .05$, $\eta^2_p = .10$. An interaction between zone and smile prototype also reached significance, $F_{(12, 372)} = 4.57$, $p < .001$, $\eta^2_p = .13$.

Simple main effects tests were computed to explore the interaction between smile prototype and zones. Dunn's correction was applied to alpha and to be considered significant p value needed to be smaller that .015. For Anger Brow, Disgust, Happiness, and Sad mouth prototypes, respectively, there was no effect of zone, $F_{(2, 62)} = 2.28$, $p = .11$, $\eta^2_p = .07$; $F_{(2, 62)} = 4.04$, $p = .02$, $\eta^2_p = .12$; $F_{(2, 62)} = 4.12$, $p = .02$, $\eta^2_p = .12$; $F_{(2, 62)} = 3.21$, $p = .05$, $\eta^2_p = .09$. For Anger Mouth prototypes, there was an effect of zone, $F_{(2, 62)} = 5.58$, $p < .015$, $\eta^2_p = .15$. Post-hoc tests (LSD) revealed that participants spent less time in the mouth than in the eyes or nose. The latter two did not differ significantly. For Fear prototypes, there was an effect of zone, $F_{(2, 62)} = 14.55$, $p < .015$, $\eta^2_p = .32$. Post-hoc tests (LSD) revealed that participants spent more time in the eyes than the nose and more time in the mouth than the nose. For Sad Brow prototypes, there was an effect of zone, $F_{(2, 62)} = 6.75$, $p < .015$, $\eta^2_p = .18$. Post-hoc tests (LSD) revealed that participants spent more time in the eyes and the nose than the mouth.

For the Eyes zone, there was a significant difference between prototypes, $F_{(6, 186)} = 4.13$, $p < .015$, $\eta^2_p = .12$. Post-hoc tests (LSD) revealed that participants spent more time in the eyes for Fear smile prototypes than all the other smile prototypes, except Sad Brow. For Sad Brow smile prototypes, participants spent more time in the eyes than for Disgust and Sad Mouth smile prototypes. For the Mouth zone, there was a significant difference between prototypes, $F_{(6, 186)} = 9.27$, $p < .015$, $\eta^2_p = .23$. Post hoc (LSD) revealed that participants spent less time in the mouth for Fear smile prototypes than all the other smile prototypes. For Angry Brow and Enjoyment smile prototypes, participants spent more time fixating the mouth than the Angry Mouth and Sad Brow smile prototypes. For the Nose zone, there were no significant differences between prototypes, $F_{(6, 186)} = 1.35$, $p = .24$, $\eta^2_p = .04$.

Discussion

The current study investigated individuals' ability to distinguish enjoyment smile expressions and masking smile expressions that contained traces of negative emotions through the use of rating scales that contained both positive and negative dimensions. Furthermore, eye-movements were recorded to further investigate the perceptual and attentional mechanisms associated with the processing and decoding of the different smile expressions. Consistent with the Perron et al. (2016) and Gosselin et al. (2002) studies, participants could accurately distinguish the enjoyment smiles from the masking smile expressions as they rated this smile significantly more positively than any of the masking smile expressions, regardless of what scale it was rated on.

With respect to the current study, participants were sensitive to the traces of negative emotions as they rated the masking smiles significantly more negatively in general than the enjoyment smiles. It also seems that the masking smiles containing traces of negative emotions are not all equally perceived and judged. Variations were observed not only between the smile expressions as a function of the ratings on the negative-positive scales but also with respect to the area in which the trace of negative emotion was displayed (e.g. angry mouth vs. angry brow). Moreover, participants did not seem to have any knowledge regarding the masked negative emotions, as no meaningful patterns were observed for smile prototype as a function of the scale it was being rated on. As with the previous studies, participants are sensitive to the enjoyment and masking smile expressions, but they lack knowledge regarding the dissimulated emotions. Finally, patterns of rating in the judgment task from this study reproduced the results from Perron et al. (2016), indicating that with respect to the judgment of masking smile expressions, the smiles are perceived similarly regardless of dichotomous, categorical, or dimensional measures of rating. The following discussion will elaborate on these main points further.

Explanations for Variations in Ratings

Results from the current study indicate that individuals are sensitive to enjoyment smiles as they rated enjoyment smiles significantly more positively than any of the masking smiles across all four of the scales they were rated on. These results are not too surprising considering the depth of studies that involve the judgment of enjoyment smiles and the results they purport regarding these smiles. First off, studies have shown that enjoyment smiles containing the activation of the orbicularis oculi and zygomatic major have been associated with significantly greater subjective reports of happiness, pleasure, and enjoyment when compared to other emotional expressions (Ekman & Rosenberg, 2005). Moreover, research also indicates that individuals can accurately distinguish enjoyment smiles from non-enjoyment smiles as a function of the activation of both the zygomatic major and orbicularis oculi. Like previous studies, results of the current study further indicate that individuals perceive smiles associated with the activation of the orbicularis oculi and zygomatic major as being happier expressions associated with the emotion of happiness, as is inferred from their tendency to rate these smile expressions more positively, and thus more closely associated with the expression of happiness. Moreover, they responded to the enjoyment smile significantly faster than any of the other smile expressions, suggesting this expression was easier to process and decode.

One reason that the enjoyment smile was rated more positively and thus correctly distinguished from the masking smiles could be because this expression was the only expression used within the study that contained all of the same characteristics activated during the full-expression (i.e. no addition of characteristics associated with another emotion). This could also be the reason that the smile was processed and decoded in a significantly faster rate; contrary to the finding from the Perron et al. (2016) study whereby smiles containing traces of fear were more quickly responded to. The masking smiles on the other hand contain characteristics from two separate emotions and thus it is a more complex task. Holistic accounts of emotional facial expressions suggest that individuals require the whole face (eyes, nose, mouth) in order to make accurate judgments regarding the displayed emotional expression (Beaudry, et al., 2014). While the masking smiles within this study were also presented as a whole image, the characteristics associated with the masked negative emotion were presented in either the brow area or the mouth area for all the masking smiles with the addition of the characteristics from the enjoyment smile. Perhaps macroexpressions are easier to correctly judge because they contain activation of muscles associated with the one whole expression and emotion as opposed to expressed characteristics associated with two separate unrelated emotions.

Like the results from both the Perron et al. (2016) and Gosselin et al. (2002) studies, masking smiles were distinguishable from the enjoyment smiles. With respect to this study, the masking smiles were all rated significantly more negatively when compared to the enjoyment smiles. These results infer that individuals perceived the expressions as being associated with negative emotional expressions as opposed to genuine expressions of enjoyment. The ability to distinguish genuine smiles from smiles that are masking negative emotions would have significant adaptive value. Psycho-evolutionary theorists of emotion such as Darwin (1872) and Plutchik (2001), propose that expressive behaviours associated with emotions, such as facial expressions, communicate information from one individual to another about future events and therefore act to affect an individual's chance of survival. The face is a visible signal of others' social intentions and motivations, thus the ability to decode facial expressions to gather this valuable information may serve to be adaptive and may increase one's chances of survival. For instance, understanding or even sensing that the individual one is interacting with has become angry would allow the individual to adapt his or her behaviour accordingly to the situation perhaps avoiding or approaching the situation. Thus, information acquired from facial expressions, such as perceived authenticity of a smile expression, promotes efficient interpersonal behaviour that can aid to maximize social outcomes which is adaptive and beneficial for an individual.

Variations between the masking smile expressions were also observed as a function of the positive-negative ratings on the scales. Expressions containing traces of sadness, disgust, and anger (in the mouth) were all rated more negatively than enjoyment smiles and masking smiles with a trace of anger (in the brow), but not rated significantly more negatively than masking smiles containing traces of fear. Thus, these masking smiles were perceived as negative emotional expressions, but smiles containing traces of fear were the expressions most perceived as negative by participants. Just as participants tended to judge masking smiles with traces of fear as "not really happy" significantly more often than the other masking smiles in the Perron et al. (2016) study, masking smiles with traces of fear were rated significantly more negatively than any of the other masking smile expressions within this study. These results indicate that individuals are particularly sensitive to the masking smiles when traces of fear are presented in the expression. These results are interesting when one considers that emotional expressions of fear are usually the least recognized in judgment tasks of discrete emotional expressions (macroexpressions) (Beaudry et al., 2014; Calvo & Lundqvist, 2008; Gosselin, Kirouac & Dore, 1995).

One theory that could explains individuals' sensitivity to emotional expressions that contain traces of fear would be the Fear Module Theory proposed by Ohman and Mineka (2001). Characteristics of this proposed module are that the module is preferentially activated by stimuli that are fear relevant in our evolutionary perspective, and that its activation to fear associated stimuli is automatic in nature thus requiring little effort from the individual. With respect to results from the current study, it could be that individual's process the masking smiles associated with fear automatically and that while they cannot identify the expression as containing characteristics of fear, they may implicitly understand that the fear smile is not authentic and is associated with a negative emotion or negative emotion characteristics. Future studies should further investigate the implicit processes individuals may use when decoding masking smile expressions that contain traces of fear, as it appears to be the masking smile individuals are most accurately able to perceive as not associated with happiness but least able to label (see Perron et al., 2016).

While not rated more positively than the enjoyment smiles, smile expressions containing traces of anger when presented in the brows, were rated significantly more positively when compared to the other masking smile expressions. These results also replicate the finding from the Perron et al. (2016) study whereby individual's produced the unexpected response of "really happy" significantly more often for masking smiles containing traces of anger (in the brows) than for the other masking smile expressions, indicating they had difficulties distinguishing the anger smile (in the brows) from the genuine enjoyment smiles. Like the masking smiles containing traces of fear, these results are opposite to those found in judgment tasks of discrete emotional expressions (macroexpressions) whereby anger is typically the most accurately identified negative emotion (Beaudry et al., 2014; Calvo & Lundqvist, 2008).

Beaudry and colleagues (2014) found that the removal of the brow area in macroexpressions of anger significantly impaired the recognition of anger expressions. Thus, one reason that the masking smile containing traces of anger were rated positively could be that the characteristics associated with the emotion of anger must be fully displayed in both the brow and mouth regions to be accurately perceived as the expression associated with the negative emotion of anger. The anger expressions may require holistic processing of the expression whereby the characteristics presented are only representative of the one emotion of anger as a whole (both brow and mouth areas) as opposed to only having the characteristics of anger presented only in the brow area with the addition of the characteristics associated with the enjoyment smile. Moreover, studies have shown that the contraction of the zygomatic major has been linked to pleasant stimuli and emotions (Smith, 1989), thus its activation in addition to the characteristic of anger in the brow could have served to significantly confuse its perception.

Some studies have also found that attributions such as “puzzlement” and “concentration” are given when participants judge emotional expressions whereby muscular contractions are in the brow area (Pope & Smith, 2004). Attributions such as these would most likely be rated more positively as they would not be associated with a negative emotion or emotional expression. Future studies should use neutral-happiness scales to better examine how the smile expression with traces of anger (in the brow) is actually perceived when compared to the enjoyment smile expression. Is the smile regarded as being associated with happiness, or is it just not perceived negatively?

If participants had knowledge as to the correct emotion being masked by the smile expression, then patterns of rating should be most negatively on the scale that was represented with the correct emotion label since participants rated each image on all four of the scales (sadness-happiness, anger-happiness, fear-happiness, and disgust-happiness). For instance, if participants had knowledge as to the expression of disgust then you might expect it to be rated more negatively on the disgust-happiness scale than the sadness-happiness, anger-happiness, or fear-happiness scales. An analysis was done to compare prototypes and scale types on the positive-negative ratings, the only significant finding was that the masking smile containing traces of sadness (in the brow) were rated significantly more positively on the scale between happiness-anger. No meaningful interpretation can be made from this other than the fact that participants seem to have no knowledge regarding the emotions being masked. This assumption would be consistent with the previous studies where it was found that participants had no explicit knowledge regarding the masked emotions, being unable to accurately label them even when given a list of emotions to choose from (Perron et al., 2016; Gosselin et al., 2002).

Interpretation of masking smiles in the natural world would most likely occur in a specific context and the accurate interpretation of the smile may require the addition of other factors such as posture and non-facial gestures. Moreover, some studies have proposed that the recognition of emotional expressions may also depend on the dynamics of the emotional expression, which allow for more accurate differentiation of the emotional expressions. Scherer's component process model of emotion suggests that changes in facial expressions occur in a sequential and cumulative manner, and that each change in muscular activation of the face (action units) adds to the effect of the previous change and is an important process that allows individuals to more accurately distinguish between the basic emotional expressions (Wehrle, Kaiser, Schmidt, & Scherer, 2000).

In one study it was indeed found that the dynamic presentation of facial expressions overall increased the recognition accuracy rates of the emotion, and it reduced the confusion between any unrelated emotions (e.g. fear and surprise) when compared to the use of static emotional expressions (Sherer, 1992). The previous study mentioned observed judgments of macroexpressions, but because masking smiles contain characteristics of both happiness and a negative emotion, decoding of the hidden emotion in this current task is made more difficult. Nevertheless, future research should consider using dynamic masking smile expressions to better understand individual's ability to accurately decode the masking smile expression. It could be that the dynamics behind the masking smile expression, such as timing and temporal structure, allow for an individual to better differentiate between the two unrelated emotions.

Variations in Fixations of Smile Types and Zones

The current study also examined the differences in dwell time (amount of fixations) as a function of three separate zones (eyes, nose, mouth) and as a function of the seven smile prototypes. This was done to examine individual's perceptual and attentional mechanisms used throughout the task. I.e. what region of the expression are individuals most perceiving and attending to? If individuals perceive the distinct cues that differentiate the negative emotions present in the expressions then one might expect that they would be attending to this region of the expression more often. For instance, one might expect that for the angry brow smile expression, attention would be mostly given to the brow area of the expression than the mouth or nose because this is where the cue to the negative emotion is displayed. This was not the case as no differences between the zones were found, with the exception of angry mouth and fear prototypes. Results revealed that for the smiles masking fear, participants spent a significantly greater proportion of time fixating the eyes than any of the other smile expressions, except for sadness (in brow). In studies that examine the holistic vs. featural processing of emotional expressions, the removal of the brow area in expressions of fear significantly impaired the accurate recognition of the expression (see Beaudry et al., 2014). That masking smiles containing traces of fear were fixated longer in the eyes may be suggestive that participants use this cue to guide their judgments of this smile expression.

Enjoyment smiles and masking smiles containing traces of anger (in brow) were fixated significantly more often in the mouth area than the eyes or nose than any of the other smile expressions. This may create a significant disadvantage for accurately distinguishing the anger (in brow) smile expression as the cues associated with the negative emotion are presented in the brow region. This may be another explanation as to why this smile expression was rated significantly more positively than any of the other masking smiles expressions. They may have fixated longer on the mouth region because they were confused by the opposing characteristics in the expressions (happiness in the mouth and anger in the brows). For the nose region no significant differences were observed as a function of prototypes. The only smile expression where one may have assumed fixations to the nose would have been greater than the fixations made to the eyes or mouth regions would be the smiles masking disgust because disgust is the only expression where its unique cue is presented in the nose region (the nose wrinkler). This was not the case in this current study. Further research is needed to understand what strategies individual's employ when decoding the various smile expressions because the results of the current study suggest that individuals are not attending to the regions of the face where the cues are present, a strategy that may be beneficial for the decoding of masking smile expressions.

Dimensional Measures vs. Forced-Choice Measures

Although dimensional measures of rating were used within this study, results remained similar to those from the Perron et al. (2016) study that used dichotomous and categorical rating measures in the judgment tasks of masking smile expressions. While in the 2016 study participants accurately judged enjoyment smiles as “really happy”, results from this current study indicate that enjoyment smiles were rated positively compared to the masking smile expressions. Moreover, results from the 2016 study indicated that participants were more likely to accurately respond with “not really happy” more often for the masking smiles containing traces of fear, indicating their sensitivity to the smiles masking fear. Like the previous study, participants from this study also seem more sensitive to the masking smile expressions containing traces of fear as this smile expression was rated significantly more negatively than the other smile expressions.

Also like the 2016 study, masking smiles containing traces of anger (in brow) were more often confused with the enjoyment smiles as this smile expression was rated more positively than any of the masking smile expressions. Although previous studies suggest that results of emotional expression judgment tasks falter when forced-choice response formats are used, the results of the current study suggest that the smiles are perceived similarly whether the response measures are dichotomous, categorical, or dimensional. The difference between the tasks may be observed in how the smiles are processed as opposed to perceived; in this study the enjoyment smiles were responded to significantly more quicker than any of the smile expressions while in the 2016 study the smiles containing traces of fear were responded to significantly more quicker.

Future studies should compare the response time from judgment tasks that use dimensional, categorical, and dichotomous rating measures to accurately identify any processing speed differences between these tasks to gain further knowledge as to processing difficulty between these different tasks. For instance, it has been shown that there are different areas activated in the brain for implicit and explicit processing (Kliemann, et al., 2013). These tasks may require individuals to process the emotional expressions differently, relying on different areas of the brain for decoding, this processing difference may be observed through eye-tracking data (viewing time/response time, fixations made etc.).

In sum, the current results provide further support for the fact that the differences in the perception of masking smile expressions may vary as a function of the hidden negative emotions and location of the presented microexpression (e.g. angry mouth vs. angry brow) even when the expressions are rated as a function of their positive and negative dimensions. It may seem that masking a negative emotion with a smile may be an effective deception strategy, as participants seem sensitive to the differences between the enjoyment and masking smile expressions but still remain confused regarding the masked emotions within the expressions, as there were significant differences in the perception of the smiles (e.g. angry brows rated positively).

The difficulty observed in the judgment task could be due to the fact that the expressions contain characteristics associated with both enjoyment and the negative emotion instead of characteristics associated with just the negative emotion, thus making the task extremely complex because it entails the differentiation between two separate emotions within one expression. Moreover, the difficulty faced by individuals during the judgment task could be due to the fact that participants are not fully attending to the specific area of the face where the cue to the masked emotion is expressed (e.g. the nose for disgust smiles and the mouth for angry mouth expressions etc.).

Limitations

There remain a couple noteworthy limitations to the current study. Firstly, the sample was mostly recruited through psychology courses because of the incentive of bonus marks that are given to students to participate in such studies. Due to this, the sample included mostly female students taking psychology courses. Although previous studies that examined gender differences in the judgment of emotional facial expressions found no differences between males and females (Frank et al., 1993; Thibault, Gosselin, Brunel, & Hess, 2009), the unbalanced gender representation in this study may still be considered a limitation and thus future research should consider using equal gender groups.

Secondly, the current study used stimuli previously created for the Perron et al. (2016) study, thus as with that study, some of the encoders of the stimuli images were either unable to activate the required muscular movements of the face without opening the mouth (AU 25) or without keeping the mouth closed. This limitation is not surprising considering the breadth of research that indicates the difficulty associated with the voluntary control and activation of facial muscles (e.g. see Gosselin, Perron, & Beaupre, 2010). Thus some of the smile prototypes in the current study included the opening of the mouth (AU 25) while others did not. One way in which this factor could have affected the results of the smile judgment tasks would be that individuals' attention might have been directed more so towards the mouth region. The only smile expression whereby zone was significantly different was for the smiles containing traces of fear and anger in the brow, thus the characteristics associated with the negative emotion were presented in the eyebrows so the effects of the muscular activation of the mouth should not have hindered judgment of the expression. Nevertheless, future research should ensure that the muscular activations of the expression stimuli are controlled for equally.

Conclusion

In conclusion, the current study examined the differences in the perception of smile expressions that contained traces of fear, anger, sadness, and disgust. Results indicated that participants were sensitive to the various emotional expressions, and that variations in judgment occurred as a function of the negative emotions. Enjoyment smiles were rated significantly more quickly and positively than the masking smile expressions, indicating its perception as an expression mostly associated with happiness, while masking smile expressions containing traces of fear were mostly perceived as being a negative emotional expression when compared to the other masking smile expressions. Furthermore, variations were also observed as a function of the location of the trace of negative emotion (eyes or mouth). For instance, masking smile expressions containing traces of anger in the brow area were rated significantly more positively than anger expressions that contained its trace in the mouth. The use of positive-negative dimensional rating scales in the judgment tasks of enjoyment and masking smile expressions did not alter the way these expressions were perceived when comparing to the forced-choice measures of previous studies. Like previous studies, individuals seem without knowledge as to the negative emotions hidden within the masking smiles and thus future research should continue to explore different rating measures in the smile judgment tasks and they should also explore the implicit processes and strategies used by individuals during these tasks.

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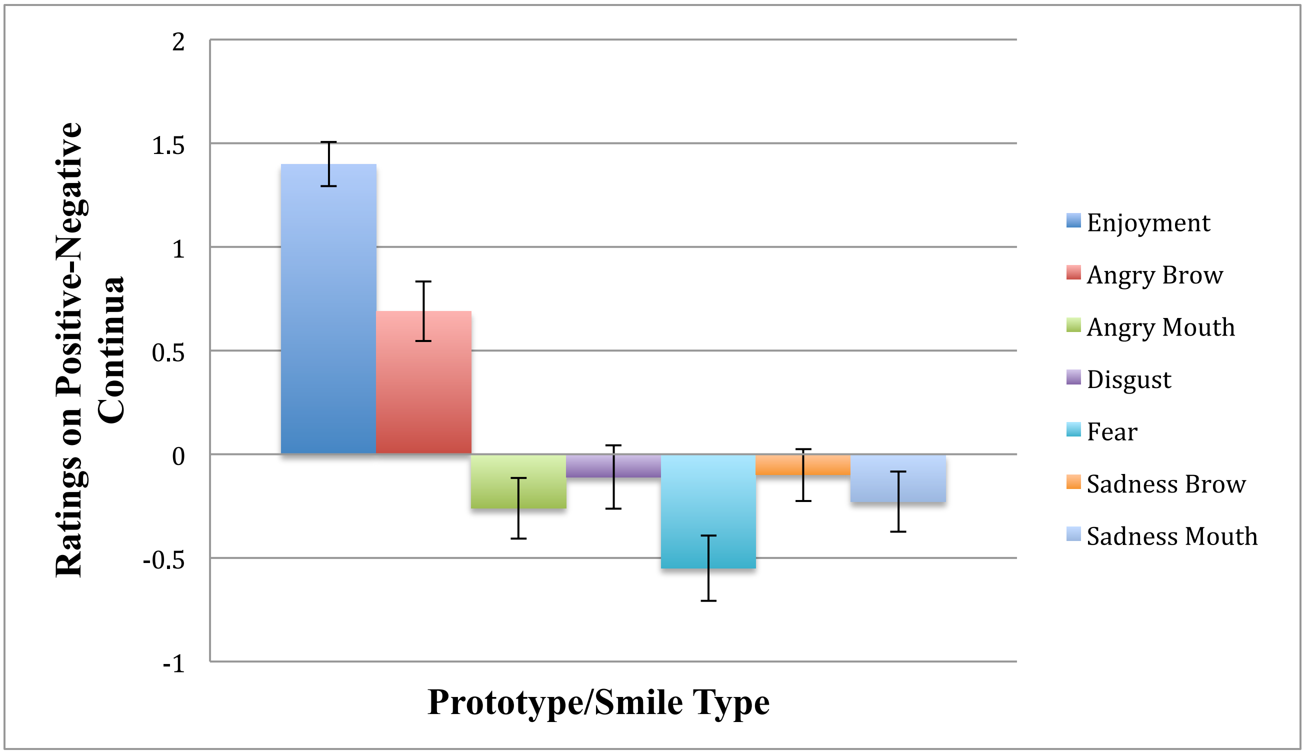

Figure 1. Mean ratings of smile prototypes on the positive-negative continua. Error bars represent standard error. F (6, 186) = 72.84, p = .000, $\eta^2_p = .70$

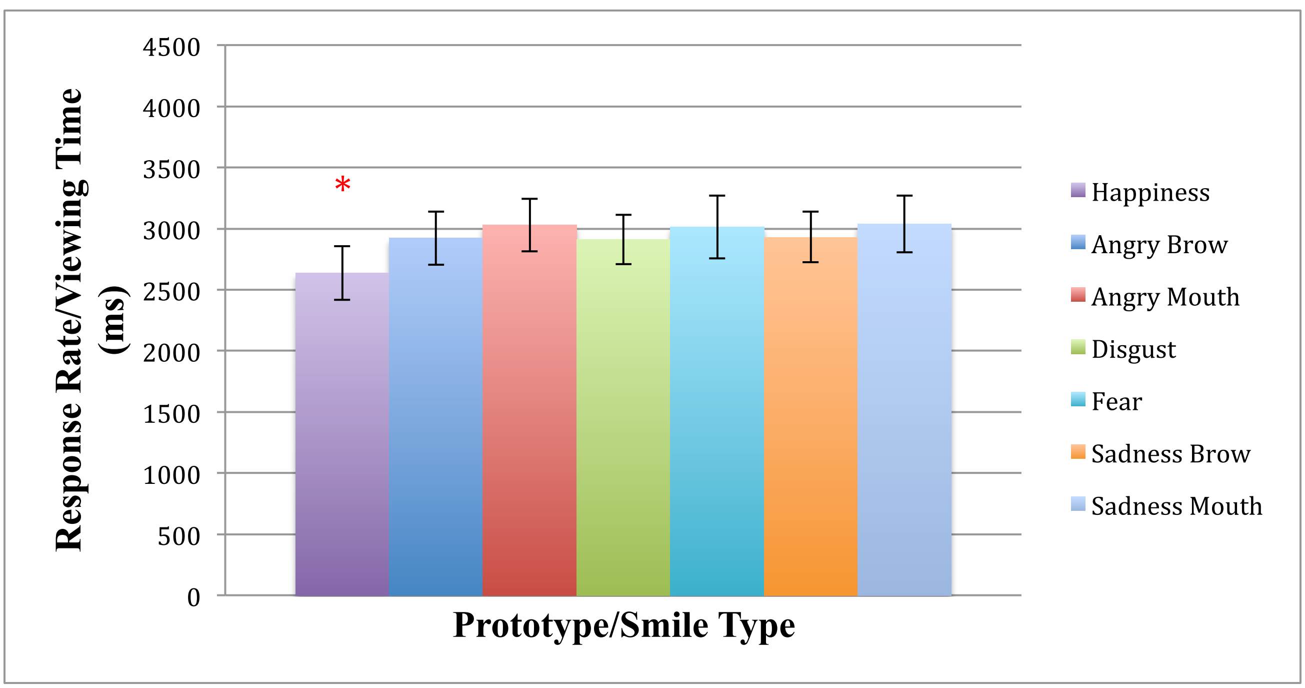

Figure 2. Mean response rate/viewing time of smile prototypes. Error bars represent standard error. F (6, 186) = 3.121, p = .006, $\eta^2_p = .09$

Appendix A

Example of each of the smile expressions used within the current study.

Happiness

Disgust

Sad Mouth

Sad Brow

Fear

Angry Mouth

Angry Brow

Appendix B

Angry Mouth
(AU's 6+12+24)
This same image is rated on each of the four scales separately