**School of Psychology**

# Beyond Social Category Cues: Implicit Evaluations of Faces Based on Attractiveness, Character Information, and Minimal Group Membership Influence Emotion Perception

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**Doctor of Philosophy**

**of**

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# Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Numbers #HRE2016-0364 and #HR24/2014.

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**Abstract**

Emotion perception is a crucial aspect of our everyday life. Efficient decoding of other people's emotional states provides us with essential information which we use to guide our behavior in social interactions. An effective method of examining emotion perception is provided by a speeded two-choice emotion categorization task. Faces are presented one at a time and participants identify which emotional expression is displayed as quickly and accurately as possible. In this task, happy expressions have been found to be recognized more quickly and accurately than negative expressions, a phenomenon called "the happy face advantage". Because of its reliability, this phenomenon has been used to investigate how social category cues influence emotion perception. A happy face advantage is larger for female faces when they are categorized in the same experiment as male faces, for own-race faces when they are presented with other-race faces, and for young adult faces when presented with older adult faces. Perceptual similarity between facial features and emotional expressions, stereotype and evaluative congruence between the social group and expression have all been proposed as explanations for the effects of social category cues on the happy face advantage. To date, the evaluative congruence account has received the strongest support and predicts a larger happy face advantage for the relatively more positively evaluated social group. In a series of studies, utilizing the speeded two-choice emotion categorization task, it was examined whether evaluative information beyond facial social category cues moderated the happy face advantage and if these effects could be explained by the evaluative congruence account.

Chapter 2.1 and 2.2 examined whether attractiveness, a facial cue unrelated to clearly defined social categories, also moderates the happy face advantage and if the evaluative congruence account can explain its influence. As predicted by the evaluative congruence account, a happy face advantage was observed for the more positively evaluated attractive faces but not for unattractive faces. The combined influence of sex and attractiveness was further investigated and it was demonstrated that attractiveness still had an effect on the happy face advantage when face sex was varied within the same experiment. Overall, sex and attractiveness seemed to have an interactive influence on the happy face advantage, with the largest effect being evident for attractive females.

Chapter 3 examined whether character information also influences the happy face advantage consistent with the evaluative congruence account. Participants learnt to associate faces with positive or negative acts in order to change their evaluation. As predicted, a larger happy face advantage emerged for faces associated with positive character information compared to faces associated with negative character information. This demonstrated that emotion perception is not only influenced by preexisting evaluations about social groups based on facial attributes, but also by recently acquired information about an individual. The results provide further support for the evaluative congruence account, compared to perceptual similarity or stereotype congruence, as an explanation for social information's influence on emotion perception. That is, the evaluative information was not associated with social groups nor communicated via facial cues.

Chapter 4 examined whether randomly assigning faces in- or outgroup status was sufficient to elicit an evaluative bias in an emotion categorization task. As predicted by the evaluative congruence account, a larger happy face advantage was observed for minimal ingroup faces compared to minimal outgroup faces for both racial in- and outgroup faces when presented in separate experiments. When racial in- and outgroup faces were presented in the same experiment, race and minimal group status moderated the happy face advantage independently of each other, but with a stronger effect of race. The results further strengthen the proposition that evaluations, and not perceptual similarity or stereotypes, drive the influence of social information on emotion perception since minimal groups are neither communicated via facial cues nor associated with stereotypes.

The moderation of the happy face advantage is not limited to facial social category cues. Facial attractiveness, character information, and minimal group membership influence emotion perception in the same way as social category cues. The evaluative congruence account seems to offer the best explanation for social information's influence on emotion perception. The present results suggest that the factors that can potentially influence emotion perception are many. Thus, the extent of the flexibility of early emotion perception needs further investigation, as does our understanding of how different sources of evaluative information combine to influence emotion perception.

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## Attribution statement

All empirical chapters included in the thesis have been prepared as manuscripts for publication.

Chapter 2.1

Lindeberg, S., Craig, B. M., & Lipp, O. V. (2019a). You look pretty happy: Attractiveness moderates emotion perception. *Emotion, 19*, 1070-1080. doi:10.1037/emo0000513

| | Sofie Lindeberg | Belinda Craig | Ottmar Lipp |
|---|---|---|---|
| Conceptualisation and design | 70% | 15% | 15% |
| Data collection | 100% | - | - |
| Data analysis | 100% | - | - |
| Drafted manuscript | 100% | - | - |
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Chapter 2.2

Lindeberg, S., Craig, B. M., & Lipp, O. V. (in preparation). Pretty women: Sex and attractiveness interact to influence emotion perception.

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Chapter 3

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Chapter 4

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I acknowledge that these represent my contribution to the above research output.[1]

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## Table of contents


Chapter 1 General introduction.................................................................... 1

Chapter 2.1 You look pretty happy: Attractiveness moderates emotion perception........................................................................ 15

Chapter 2.2 Pretty women: Sex and attractiveness interact to influence emotion perception........................................................................ 45

Chapter 3 2:0 for the good guys: Character information influences emotion perception........................................................................ 72

Chapter 4 Happy to belong: Minimal group membership moderates emotion perception for both racial ingroup and outgroup faces.................. 84

Chapter 5 General discussion........................................................................ 116

Appendices ........................................................................................... 127

# Chapter 1

## General introduction

Humans' ability to decode other people's emotional states is essential to social interaction, and from an evolutionary perspective, critical to our survival (Darwin, 1872/1965; Ekman, 1992). People do decode facial expressions with remarkable efficiency and accuracy (Tracy & Robins, 2008), even with short exposure times (Kirouac & Doré, 1984), which is unsurprising given the potential social consequences of misidentifying others' emotional expressions. The universality of emotional expressions and perception, albeit with some cultural variation, is supported by research showing high emotion recognition accuracy across various cultures (e.g., Ekman, 1989), including people from cultures with minimal exposure to other ethnic groups (Ekman & Friesen, 1971). Interestingly, research has consistently revealed that happy faces are recognized with higher accuracy than any of the other so-called basic emotions (surprised, angry, fearful, sad, and disgusted; Elfenbein & Ambady, 2002), and this has furthermore, been demonstrated across different intensity levels of expressions (Hess, Blairy, & Kleck, 1997).

More recently, in attempts to better understand the processes underlying emotion perception, researchers have adopted speeded emotion recognition tasks where response time and accuracy are measured. One such example is a speeded two-choice emotion categorization task where participants are presented with one face at a time and are tasked with identifying the emotional expression as quickly and accurately as possible. These studies have reliably demonstrated that positive facial expressions are more efficiently processed than negative expressions, a phenomenon labelled "the happy face advantage" (e.g., Leppänen & Hietanen, 2003; for happy face advantages across a variety of tasks see Nummenmaa & Calvo, 2015). Many of the early studies that demonstrated this effect focused on different questions, nevertheless, happy faces were recognized faster than angry (Harrison & Gorelczenko, 1990; Harrison, Gorelczenko, & Cook, 1990; Hugdahl, Iversen, & Johnsen, 1993; Stalans & Wedding, 1985), sad (Crews & Harrison, 1994; Kirita & Endo, 1995), disgusted (Stalans & Wedding, 1985), and even neutral faces (Hugdahl et al., 1993). That the happy face advantage is evident when happy expressions are categorized with neutral expressions can better be understood when considering that neutral expressions tend to be negatively evaluated (Lee, Kang, Park, Kim, & An, 2008) and that facial expressions are evaluated in relation to the other expressions presented in a given task. A neutral face is likely to be evaluated as sad if presented simultaneously with or after a happy face (Russell & Fehr, 1987).

Different mechanisms have been proposed to explain the processing advantage for happy faces. Some of the mechanisms that have been suggested to facilitate the recognition advantage rely on visual properties of the expressions and bottom-up processes. For instance, facilitated recognition could be driven by a single low-level feature that distinguishes happy faces from other expressions (such as the distinctive smiling mouth) whereas recognition of other expressions may require additional configural processing (Adolphs, 2002; Calvo, Fernández-Martín, & Nummenmaa, 2012). It could also be easier to identify a happy expression since it shares fewer features with other expressions compared to negative expressions, which overlap more with each other (Johnston, Katsikitis, & Carr, 2001). Happy expressions have also been proposed to be easier to pose and are thus better exemplars of the expressed emotion (Dawel et al., 2017). Accounts relying on the physical properties of the expressions have not received much support (Hugenberg, 2005; Leppänen & Hietanen, 2003, 2004). Furthermore, the response format could introduce systematic differences in response speed. However, the effect cannot be accounted for by a happy/not happy response bias, without fully processing the other expression (Leppänen & Hietanen, 2003), nor can it be explained by differences in motor execution speed in response to various emotional expressions (Leppänen, Tenhunen, & Hietanen, 2003).

Explanations for the happy face advantage that encompass top-down processes have also been put forward and received some support (Calvo, Gutiérrez-García, Fernández-Martín, & Nummenmaa, 2014; Leppänen & Hietanen, 2003). It has been proposed that humans have a positive affective baseline (Headey & Wearing, 1992; Cacioppo & Berntson, 1994) and that they tend to perceive others' emotional states in line with their own (Niedenthal, Halberstadt, Margolin, & Innes-Ker, 2000; Schiffenbauer, 1974). This could result in a priming effect where processing of positive facial expressions is facilitated. Furthermore, most people report being happy most of the time (Diener & Diener, 1996; also see Diener, Diener, Choi, & Oishi, 2018) and the higher prevalence of positive affective states in everyday life could increase our expectation of encountering happy faces and our experience with processing them. This may make them more accessible and thus, more efficiently processed (Calvo et al., 2014). It has also been proposed that preferential processing of positive stimuli is a general phenomenon. For instance, as with happy faces, positive words are more frequently used and encountered than negative words (Boucher & Osgood, 1969; Zajonc, 1968), and both positive (Feyereisen, Malet, & Martin, 1986; Stenberg, Wiking, & Dahl, 1998) and frequently used words (Oldfield & Wingfield, 1965) are processed faster than negative and low-frequency words. The happy face advantage could thus, be a result of the more general finding that evaluation is faster for positive stimuli when low in arousal and faster for negative stimuli when high in arousal (Purkis, Lipp, Edwards, & Barnes, 2009; Robinson, Storbeck, Meier, & Kirkeby, 2004), since emotional face stimuli generally are rated as low to moderate in arousal (Lang, Bradley, & Cuthbert, 2008).

Although emotion perception research initially focused on the universality of emotional expressions and their processing (e.g., Darwin, 1872/1965; Ekman, 1992), to date, there is a substantial body of research demonstrating its malleability and complexity. Not only are positive expressions preferentially processed in relation to negative expressions, but emotion perception has been shown to be influenced by other facial information, such as a person’s identity (e.g., Schweinberger & Soukup, 1998), their eye gaze (e.g., Adams & Kleck, 2003), and available social category cues; sex (e.g., Atkinson, Tipples, Burt, & Young, 2005), race (e.g., Hugenberg & Bodenhausen, 2003), and age (e.g., Hass, Schneider, & Lim, 2015), but also by a range of wider contextual information (e.g., Righart & de Gelder, 2008). Evidently, emotion perception is not solely dependent on the facial structural features conveying the emotional expression. The happy face advantage, as observed in the speeded two-choice emotion categorization task, has been shown to be a useful tool to investigate how social category cues moderate emotion perception. In these experiments, participants are presented with one face at a time. Faces vary along the social category dimension under investigation and in emotional expression. Generally, the happy face advantage is larger or only observed for female faces when they are categorized together with male faces (Aguado, García-Gutierrez, & Serrano-Pedraza, 2009; Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007; Bijlstra, Holland, & Wigboldus, 2010; Craig, Koch, & Lipp, 2017; Craig & Lipp, 2017; Craig, Zhang, & Lipp, 2017; Hugenberg & Sczesny, 2006; Lipp, Craig, & Dat, 2015; Lipp, Karnadewi, Craig, & Cronin, 2015), for male own-race faces when presented together with male other-race faces (Bijlstra et al., 2010; Craig, Koch, & Lipp, 2017; Craig, Mallan, & Lipp, 2012; Hugenberg, 2005; Lipp, Craig, & Dat, 2015; but also see Kubota & Ito, 2007), and for young adult faces compared to older adult faces (Craig & Lipp, 2018).

Becker et al. (2007) explain the interaction of sex and expression by the similarities between the facial features signalling gender and expression. More specifically, they argue that there is a structural overlap between masculine features and features of anger, and between feminine features and features of happiness. If recognition is facilitated for happiness on feminine faces and anger on masculine faces, then an anger advantage for male faces would be expected and the effects should be stable across various contexts. Research has only rarely found an anger advantage for male faces in speeded emotion categorization (Becker et al., 2007; see above paragraph for the most common patterns) and even for the same set of male Caucasian faces, the size and presence of a happy face advantage is dependent on the other faces that are presented in the same task. The happy face advantage is observed for male Caucasian faces when they are presented with male other-race (African-American) faces, but absent when these same faces are presented with own- or other-race female faces (Lipp, Craig, & Dat, 2015; also see Craig, Koch, & Lipp, 2017; Craig, Zhang, & Lipp, 2017). Thus, the structural overlap of facial sex cues and expressions alone cannot account for the observed effects of sex on emotion categorization (for similar results for age cues and expression see Craig & Lipp, 2018).

Hugenberg (2005) and Hugenberg and Sczesny (2006) examined whether stereotype congruence could explain how race and sex cues influence emotion categorization. It was proposed that categorization of expressions that are consistent with the social group stereotype should be facilitated. Anger and sadness are both negative emotions but differ when it comes to their congruence with gender and other-race stereotypes. Sadness is more associated with females and anger with males (Plant, Kling, & Smith, 2004) and African American males more specifically (Devine, 1989). In separate tasks, participants categorized either happy and angry or happy and sad Caucasian male and female faces (Hugenberg & Sczesny, 2006) or male Caucasian and African American faces (Hugenberg, 2005). There was no difference in the pattern of results for the angry and sad faces in either of the studies, thus, suggesting that social group stereotypes cannot adequately account for the influence of race and sex cues on the happy face advantage (for similar results for age cues and expression see Craig & Lipp, 2018). It should be noted that stereotypes seem to influence emotion categorization in tasks where only negative expressions are presented (Bijlstra et al., 2010).

Hugenberg (2005) and Hugenberg and Sczesny (2006) proposed that evaluative congruence between the social category cues and emotional expressions were likely to facilitate categorization. Females (Eagly, Mladinic, & Otto, 1991) and own-race members (Greenwald, McGhee, & Schwartz, 1998) are evaluated more favorably than males and other-race members, and this initial evaluation of the faces based on their social category membership is thought to provide an evaluative context in which the expression is perceived. Lipp, Craig, and Dat (2015) showed that the evaluation of the social category cues is relative to the social category they are contrasted with rather than absolute. That is, evaluations of Caucasian males seemed to change depending on the relative evaluation of the contrasting social group (for similar effects see Larsen & Norris, 2009). A larger happy face advantage is observed for the relatively more positively evaluated faces. It is likely that the default happy face advantage is either enhanced or reduced by the relative evaluation of the face's social group membership. This could explain why it is rare to observe an anger advantage (or advantage for other negative expressions that are presented) for the relatively more negatively evaluated social group.

Given the reliability of the happy face advantage and its malleability by social category cues, the current series of studies will use this effect as a tool for investigating whether evaluative information beyond facial social category cues moderates the happy face advantage and whether these effects are consistent with the evaluative congruence account. Chapters 2.1 and 2.2 will examine if attractiveness, a facial cue unrelated to clearly defined social categories, influences emotion categorization. The combined influence of sex and attractiveness on the happy face advantage will also be explored.

Chapters 3 and 4 explore whether evaluations which are not associated with pre-existing social groups nor communicated via facial cues, but acquired in the experimental context can moderate the happy face advantage. This will be achieved by associating individuals with positive or negative character information (Chapter 3) or through a minimal group manipulation where both racial in- and outgroup faces are artificially assigned minimal in- or outgroup status (Chapter 4). Since the evaluative information is not conveyed on the face and not associated with stereotypes, these studies provide a direct test of the evaluative congruence account as an explanation for how social information influences emotion categorization. Chapter 5 will discuss the theoretical implications of the observed findings and suggest some future directions for research.

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# Chapter 2.1

## You look pretty happy: Attractiveness moderates emotion perception[2][3]



[3] These findings were presented at the Society for Personality and Social Psychology Annual Convention in 2018, https://osf.io/v6n2u/

## Abstract

A happy face advantage has consistently been shown in emotion categorization tasks; happy faces are categorized as happy faster than angry faces as angry. Furthermore, social category cues, such as facial sex and race, moderate the happy face advantage in evaluatively congruent ways with a larger happy face advantage for more positively evaluated faces. We investigated whether attractiveness, a facial attribute unrelated to more defined social categories, would moderate the happy face advantage consistent with the evaluative congruence account. A larger happy face advantage for the more positively evaluated attractive faces than for unattractive faces was predicted. Across 4 experiments participants categorized attractive and unattractive faces as happy or angry as quickly and accurately as possible. As predicted, when female faces were categorized separately, a happy face advantage emerged for the attractive females but not for the unattractive females. Corresponding results were only found in the error rates for male faces. This pattern was confirmed when female and male faces were categorized together, indicating that attractiveness may have a stronger influence on emotion perception for female faces. Attractiveness is shown to moderate emotion perception in line with the evaluative congruence account and is suggested to have a stronger influence on emotion perception than facial sex cues in contexts where attractiveness is a salient evaluative dimension.

Faces are an important source of information. How we perceive the wealth of social information available on a face influences how we relate to and interact with others. For instance, cues signalling sex, race, or emotion communicate information that has the potential to inhibit or facilitate social interaction. Influential theoretical models of face perception (Bruce & Young, 1986; Haxby, Hoffman, & Gobbini, 2000), offer a framework for studying how different facial attributes interact in face perception. Although relatively invariant cues (e.g., identity, sex, and race) and changeable facial attributes (e.g., emotional expressions) have been suggested to be processed by separate neural networks (Haxby et al., 2000), it has repeatedly been demonstrated that there is a bidirectional relationship between them in behavioral studies. For instance, race cues influence emotion perception (Hugenberg & Bodenhausen, 2003) and emotional expressions influence race perception (Hugenberg & Bodenhausen, 2004).

Within the emotion perception literature, there is a well-established phenomenon called “the happy face advantage,” which refers to the faster categorization of happy faces as happy than, for instance, angry faces as angry, and the effect extends to other negative and neutral expressions as well (e.g., Leppänen & Hietanen, 2003, 2004). Invariant facial cues, such as sex and race, have been shown to moderate the happy face advantage. The happy face advantage has been shown to be larger for female faces when categorized together with male faces (Bijlstra, Holland, & Wigboldus, 2010; Craig, Koch, & Lipp, 2017; Craig & Lipp, 2017; Craig, Zhang, & Lipp, 2017; Hugenberg & Sczesny, 2006; Lipp, Craig, & Dat, 2015; Lipp, Karnadewi, Craig, & Cronin, 2015), and is sometimes reversed for the male faces, with angry expressions being recognized faster (Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007). Conversely, the happy face advantage is evident for male own-race faces when categorized together with male other-race faces (Bijlstra et al., 2010; Craig, Koch, & Lipp, 2017; Craig, Mallan, & Lipp, 2012; Lipp, Craig, & Dat, 2015), and sometimes a reversed pattern has been observed on the male other-race faces, where the negative expression has been categorized faster than happy expressions (Craig et al., 2012; Hugenberg, 2005).

A study by Lipp, Craig, and Dat (2015; also see Craig, Koch, & Lipp, 2017) demonstrated that the effects of face sex and race on the happy face advantage are unlikely to be attributed to stimulus driven factors or to the facial features that distinguish happy faces from other expressions (see Adolphs, 2002; also Leppänen &

Hietanen, 2004) since the size and presence of a happy face advantage for the same set of Caucasian male faces varied as a function of the other faces they were presented with. It is observed when the Caucasian male faces are presented with other-race (African American) male faces, but absent when they were presented with both own- and other-race female faces. Similar results have been reported by Bijlstra et al. (2010). Hugenberg (2005) and Hugenberg and Sczesny (2006) compared stereotype and evaluation accounts to explain the effects of social category cues on the happy face advantage and found evidence for a role of evaluations. Participants categorized happy versus angry faces as well as happy versus sad faces. Although sadness is more strongly associated with females (Plant, Kling, & Smith, 2004) and anger with males and African American males (Devine, 1989; also see Bijlstra et al., 2010), they found that sex and race had the same influence on emotion categorization speed regardless of the negative expression used. This did not support the stereotype congruency explanation, which would predict different patterns of results depending on the degree of consistency between the emotional expression and stereotype expectancies regarding the group. Hugenberg (2005) and Hugenberg and Sczesny's (2006) results, as well as the reviewed literature, did however support the evaluative congruency account. The evaluative congruency account holds that effects of face sex and race on the happy face advantage reflect whether the social category the face represents is evaluated positively or negatively. Females (Eagly, Mladinic, & Otto, 1991) and own-race members (Degner & Wentura, 2010) are evaluated more favourably than males and other-race members, respectively, and the evaluative congruency between face and expression is suggested to facilitate categorization. The social category cues are proposed to provide an evaluative context in which the emotional expression is perceived. As has been highlighted by others (Bijlstra et al., 2010; Craig & Lipp, 2017; Lipp, Craig, & Dat, 2015), the wider context, including the faces presented on other trials and in previous tasks, determines which evaluative dimension becomes salient and how social category cues influence emotion categorization.

The influence of sex cues on emotion perception varies across different circumstances and depends on the evaluative information made salient within a particular context (Craig & Lipp, 2017). Attractiveness is another evaluative dimension that has considerable importance in everyday life (Maestripieri, Henry, & Nickels, 2017) and might account for some variance in the way sex influences emotion categorization. Attractiveness is a dimension that intersects social categories and is a basic social inference we make when encountering a face (Sutherland et al., 2013). Consensus on who is attractive is high, both within and across cultures (Langlois et al., 2000). However, attractiveness varies substantially across different photographs of the same individual, and who is perceived to be attractive has as much to do with which photograph is chosen than the individual depicted in it (Jenkins, White, Van Montfort, & Burton, 2011). The emotional expression portrayed on the face largely contributes to the variance in attractiveness judgements for the same individual (Sutherland, Young, & Rhodes, 2017), and happy faces are perceived as more attractive than faces displaying negative expressions (e.g., Mueser, Grau, Sussman, & Rosen, 1984). Consequently, facial attractiveness does not fit nicely within the theoretical models, as it cannot be categorized as an invariant or changeable attribute of a face. It is clear though, that attractiveness is not as stable across situations as might be expected and differs significantly from relatively invariant attributes, such as race and sex, which previous research has focused on. Emotional expressions influence attractiveness judgements, but whether the relationship is reciprocal, and facial attractiveness moderates emotion perception as well, or more specifically the happy face advantage, is uncertain. It is also unclear whether the potential moderating effect of attractiveness on emotion processing will be consistent with the evaluative congruence account, as seen with social category cues. Attractive people are evaluated more favorably than less attractive people (Dion, Berscheid, & Walster, 1972; Langlois et al., 2000), and therefore attractiveness could be expected to moderate emotion categorization in line with the evaluative congruence account. If attractiveness moderates emotion categorization in the same way as social category cues, then the happy face advantage should emerge for the attractive faces, but should be reduced or absent for the unattractive faces.

Previous research examining the influence of facial attractiveness on emotion perception is limited. Golle, Mast, and Lobmaier (2014) demonstrated that attractiveness facilitated correct judgements of the relatively happier face when compared to a less happy or neutral face. Furthermore, Taylor and Bryant (2016) attempted to investigate if attractiveness has an effect on emotion categorization. They reported that emotional expressions were categorized faster than neutral expressions on attractive compared to unattractive faces but did not find an interactive influence of attractiveness on emotion perception. It is possible that attractiveness does moderate emotion perception, but this experiment was not designed to maximize the likelihood of detecting this effect, as they selected faces from a small set, which limited the range of attractiveness of the faces, the results were reported collapsed over face sex, a known moderator of emotion categorization speed, and were based on a relatively small sample.

The overall aim of the present series of experiments was to examine whether attractiveness, a facial attribute unrelated to more defined social categories, would moderate the happy face advantage consistent with the evaluative congruence account. In line with the evaluative congruence account, we predicted a happy face advantage for the more favourably evaluated attractive faces, but a reduced or absent one for the unattractive faces. Participants categorized attractive and unattractive faces as happy or angry as quickly and accurately as possible. In the first two experiments, faces of only one sex were presented to avoid the previously discussed influence of sex on emotion categorization. In Experiments 3 and 4, we examined if sex and attractiveness interact to influence the happy face advantage and presented attractive and unattractive, female and male faces within the same emotion categorization task.

## Experiment 1

### Method

**Participants.** Previous studies have observed reliable effects of facial attributes such as sex and race on the happy face advantage with around 30 participants (e.g., Lipp, Craig, & Dat, 2015). Due to the uncertainty of whether a potential attractiveness effect might be weaker, a conservative approach was taken and twice as many participants were recruited. Sixty-one participants (35 males, 2 participants did not provide demographic information, $M = 35.97$ years, $SD = 11.81$ years) were recruited from Amazon Mechanical Turk and received 1.80 USD for completing the experiment. Forty-nine participants identified themselves as White/Caucasian, two as Black/African American, five as Hispanic, two as Asian, and one as “other”.

**Stimulus materials.** The stimulus materials were selected from a pilot study where 167 Caucasian faces with neutral expressions were taken from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015; 37 female and 34 male), the FACES database (Ebner, Riediger, & Lindenberger, 2010; 29 female and 29 male), and the Radboud Faces Database (Langner et al., 2010; 19 female and 19 male), and rated on attractiveness on a 7-point Likert scale. The study was completed online via Qualtrics Survey Software by 46 undergraduate students (32 female, *M* = 20.80 years, *SD* = 3.15 years) in exchange for partial course credit. The ratings are available on https://osf.io/hjbvt/. The six female and six male models with the highest and lowest attractiveness ratings who met inclusion criteria were selected. Two models were excluded because there was no happy expression with an open mouth available in the database and one model because he appeared much older in comparison to the rest of the stimuli. Two separate paired-samples *t* tests confirmed that the attractive female (*M* = 5.53, *SD* = 0.60; Models 12, 22, 24, and 27 from the Chicago Face Database; Models 115 and 152 from the FACES database) and unattractive female models (*M* = 3.01, *SD* = 0.92; Models 8, 10, 26, 28, and 34 from the Chicago Face Database; Model 22 from the Radboud Faces Database), and the attractive male (*M* = 4.94, *SD* = 0.68; Models 4 and 29 from the Chicago Face Database; Models 16, 31, 72, and 89 from the FACES database) and unattractive male models (*M* = 2.64, *SD* = 0.91; Models 10, 17, 34, and 35 from the Chicago Face Database; Models 28 and 47 from the Radboud Faces Database) differed in rated attractiveness, $t(44) = 16.08$, $p < .001$, and, $t(44) = 13.35$, $p < .001$, respectively. Pictures of each model displaying an open mouthed happy and angry expression were edited to remove clothes and background, resized, and dropped in the centre of a white background 600 × 630 pixels in size. In Experiment 1, the six attractive and six unattractive female models were utilized, each displaying a happy and an angry expression, yielding a total of 24 pictures.

**Procedure.** The experiment was run online using Millisecond’s Inquisit 4 Web. Participants completed an emotion categorization task where they indicated whether the face presented was displaying a happy or angry expression as quickly and accurately as possible, using the *S* and *L* keys on their keyboard. Response mapping was counterbalanced across participants. The task consisted of eight practice trials with error feedback and 96 task trials without feedback. Reminders of which key was assigned to “happy” or “angry” judgements were displayed throughout the task on the corresponding side of the screen. The face stimuli were presented one at a time in a randomized sequence in blocks of 24, each picture was thus presented four times. Before each face, a fixation cross was presented centred on the screen for 500 ms, immediately followed by the face which was presented for 3,000 ms or until the participant made a response. The interstimulus interval was

1,000 ms. After completion of the emotion categorization task, participants rated the happy and angry faces on attractiveness using a 7-point Likert scale in a randomized sequence and provided demographic information. The procedures were approved by the Curtin University Human Research Ethics Committee.

**Analysis.** Attractiveness ratings, response times, and error rates were subjected to separate 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) repeated measures analyses of variance (ANOVAs) with follow-up pairwise comparisons. For all experiments, interactions are followed-up with the theoretically relevant assessment of the happy face advantage (comparisons between happy and angry) within attractiveness conditions, but for completeness, comparisons within expressions and between attractiveness conditions are reported in the Supplementary Material 1. Errors (i.e., incorrect button presses; 5.98% of trials), invalid responses (i.e., trials with response times faster than 100 ms; 0.32% of trials), and outliers (i.e., response times which deviated from an individuals' mean by more than 3 *SD*; 1.49% of trials) were excluded from the response time analysis. Additionally, participants with an error rate higher than 25% or a mean response time more than 3 *SD* above the mean response time across all participants were excluded from analyses. Two participants were excluded from the analyses due to an error rate higher than 25% (36.46 and 76.04% respectively); however, preliminary analyses including these participants yielded the same pattern of results. For all experiments, participant gender was included as a between-subjects factor in a preliminary analysis. Unless reported, participant gender did not significantly influence any of the results and the results are reported collapsed across this factor. Further, preliminary analyses yielded the same pattern of results when only the Caucasian participants were included for all experiments so the results are reported including all participants.

## Results and Discussion

**Manipulation check**. Fifty-nine participants provided attractiveness ratings depicted in Table 1, and the analysis confirmed the allocation of faces to conditions. There were main effects of attractiveness, $F(1, 58) = 208.61$, $p < .001$, $\eta_p^2 = .78$, and expression, $F(1, 58) = 91.08$, $p < .001$, $\eta_p^2 = .61$, confirming that the attractive and happy females overall were rated as more attractive than the unattractive and angry females. The main effects were moderated by an Attractiveness × Expression interaction, $F(1, 58) = 44.70$, $p < .001$, $\eta_p^2 = .44$. Follow-up pairwise comparisons demonstrated that faces with happy expressions were rated as more attractive than faces with angry expressions for both the attractive, $t(58) = 10.53$, $p < .001$, and the unattractive females, $t(58) = 7.49$, $p < .001$, however, this happy advantage was significantly larger for the attractive females, $t(58) = 6.69$, $p < .001$.

Table 1.

*Attractiveness ratings for happy and angry female and male faces in Experiments 1-4.*

| | Female | | Male | |
|---|---|---|---|---|
| Experiment | Happy | Angry | Happy | Angry |
| Experiment 1 | | | | |
| Attractive | 6.03 (0.61) | 4.57 (1.02) | | |
| Unattractive | 3.34 (1.18) | 2.42 (0.70) | | |
| Experiment 2 | | | | |
| Attractive | | | 5.22 (0.88) | 3.98 (1.07) |
| Unattractive | | | 3.60 (0.89) | 2.84 (0.72) |
| Experiment 3 | | | | |
| Attractive | 6.05 (0.65) | 4.83 (1.15) | 4.99 (1.18) | 3.88 (1.33) |
| Unattractive | 3.25 (1.22) | 2.57 (0.95) | 3.42 (1.09) | 2.84 (0.93) |
| Experiment 4 | | | | |
| Attractive | 5.48 (1.03) | 4.35 (1.09) | 4.72 (1.08) | 3.84 (1.19) |
| Unattractive | 3.28 (1.18) | 2.72 (0.76) | 3.29 (1.07) | 2.95 (0.88) |

*Note.* Values in parentheses represent 1 *SD*.

**Categorization times**. Figure 1 summarizes the categorization times for the happy and angry female faces as a function of attractiveness. Overall, happy faces were categorized faster than angry faces, $F(1, 58) = 10.21$, $p = .002$, $\eta_p^2 = .15$, but this main effect was qualified by the predicted Attractiveness × Expression interaction, $F(1, 58) = 10.18$, $p = .002$, $\eta_p^2 = .15$. Follow-up pairwise comparisons demonstrate a significant happy face advantage for the attractive females, $t(58) = 4.27$, $p < .001$, with the happy attractive female faces being categorized faster than the angry attractive female faces. There was no difference in categorization times for the happy and angry unattractive female faces, $t(58) = 0.38$, $p = .703$.

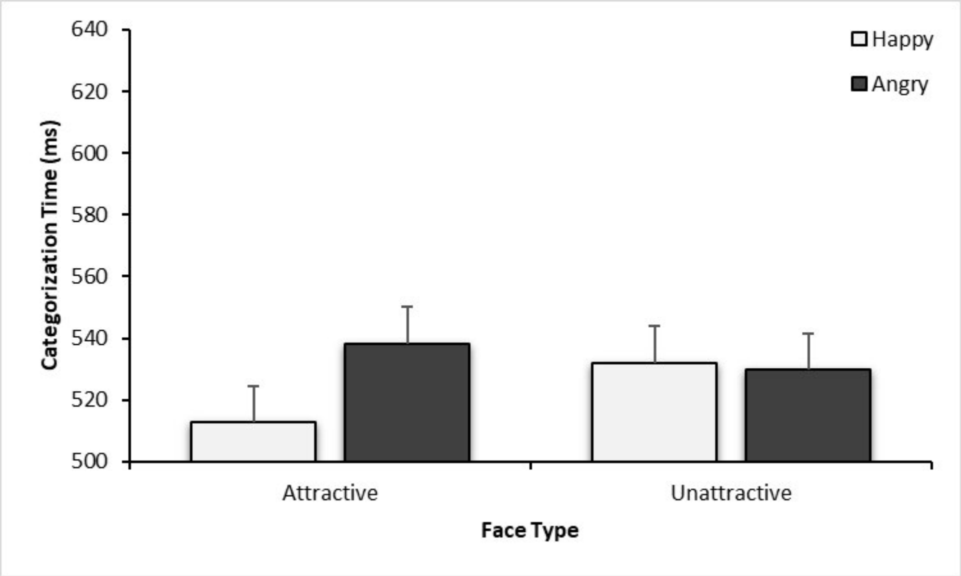


*Figure 1.* Categorization times for happy and angry expressions on female faces as a function of attractiveness in Experiment 1. Errors bars represent 1 *SEM*.

**Accuracy**. The pattern of results for the error rates (see Table 2) is in line with that of the categorization times, fewer errors were made categorizing happy than angry faces, $F(1, 58) = 4.68$, $p = .035$, $\eta_p^2 = .08$, and a significant Attractiveness × Expression interaction emerged, $F(1, 58) = 10.18$, $p = .002$, $\eta_p^2 = .15$. Follow-up comparisons revealed a lower error rate for happy compared to angry attractive females, $t(58) = 4.92$, $p < .001$, but there was no difference in error rates for the happy and angry unattractive female faces, $t(58) = 0.75$, $p = .454$.

Experiment 1 demonstrated that attractiveness moderated emotion categorization for female faces, which is a novel finding. Furthermore, attractiveness seems to influence emotion categorization in a way that is similar to other social category cues. In line with the evaluative congruence account, a happy face advantage emerged for the more positively evaluated attractive females but not for the unattractive females.

Table 2.

*Mean error percentages for categorizing happy and angry expressions on female and male faces as a function of attractiveness in Experiments 1-4.*

| | Female | | Male | |
|---|---|---|---|---|
| Experiment | Happy | Angry | Happy | Angry |
| Experiment 1 | | | | |
| Attractive | 4.10 (4.54) | 7.42 (5.31) | | |
| Unattractive | 6.92 (7.68) | 6.14 (5.86) | | |
| Experiment 2 | | | | |
| Attractive | | | 4.51 (4.12) | 6.69 (6.51) |
| Unattractive | | | 9.29 (7.62) | 8.47 (5.89) |
| Experiment 3 | | | | |
| Attractive | 3.47 (6.19) | 7.22 (8.19) | 5.56 (6.26) | 7.92 (9.13) |
| Unattractive | 6.25 (7.30) | 6.67 (8.23) | 12.36 (9.27) | 9.17 (8.77) |
| Experiment 4 | | | | |
| Attractive | 5.06 (7.57) | 7.29 (8.11) | 7.74 (10.52) | 7.74 (9.11) |
| Unattractive | 7.59 (9.44) | 4.46 (6.55) | 13.39 (12.58) | 9.23 (9.62) |

*Note.* Values in parentheses represent 1 *SD*.

## Experiment 2

Experiment 2 was designed to examine whether the attractiveness effect on emotion categorization, as demonstrated in Experiment 1, extends to male faces as well. Attractive and unattractive male faces displaying both happiness and anger were categorized by their emotional expression. In line with the evaluative congruence account and the results from Experiment 1, a happy face advantage was predicted for the attractive male faces but a reduced or absent one for the unattractive male faces.

### Method

**Participants.** Sixty-two participants (37 males, 1 participant did not provide demographic information, *M* = 35.56 years, *SD* = 11.07 years) were recruited from Amazon Mechanical Turk and received 1.80 USD for completing the experiment. Forty-six participants identified themselves as White/Caucasian, three as Black/African American, two as Hispanic, seven as Asian, one as Native American, and two as “other”.

**Stimulus materials, procedure, and analysis.** Experiment 2 was identical to Experiment 1 except for the face stimuli, which now comprised the six attractive and six unattractive male models from the pilot study. Errors (5.61% of trials), invalid responses (<0.01% of trials), and outliers (1.63% of trials), defined as for Experiment 1, were excluded from analysis of the response times. Attractiveness ratings, response times, and error rates were subjected to separate 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons. One participant with a mean response time more than 3 *SD* above the mean response time across all participants ($M$ = 1,083 ms) was excluded from analyses. Preliminary analyses demonstrated that this exclusion did not alter the pattern of results.

## Results and Discussion

**Manipulation check.** Three participants were deemed not to have engaged in the rating task (i.e., provided the same response for all faces), and thus were excluded from analysis. However, preliminary analysis demonstrated that their exclusion did not alter the pattern of results. Analysis confirmed the allocation of faces to conditions (see Table 1). There were main effects of attractiveness, $F(1, 58) = 160.17$, $p < .001$, $\eta_p^2 = .73$, and expression, $F(1, 58) = 58.59$, $p < .001$, $\eta_p^2 = .50$, demonstrating that the attractive and happy males overall were rated as more attractive than the unattractive and angry males. The Attractiveness × Expression interaction, $F(1, 58) = 17.69$, $p < .001$, $\eta_p^2 = .23$, reflected that happy expressions were rated as more attractive than the angry expressions for both the attractive, $t(58) = 7.59$, $p < .001$, and the unattractive males, $t(58) = 6.51$, $p < .001$, but the happy advantage was larger for the attractive males, $t(58) = 4.21$, $p < .001$.

**Categorization times.** Figure 2 summarizes the categorization times for the happy and angry male faces as a function of attractiveness. Happy faces were categorized faster than angry faces regardless of attractiveness, $F(1, 60) = 7.68$, $p = .007$, $\eta_p^2 = .11$, and attractive male faces were overall categorized faster than the unattractive male faces, $F(1, 60) = 36.05$, $p < .001$, $\eta_p^2 = .38$. The predicted Attractiveness × Expression interaction was not significant, $F(1, 60) = 0.17$, $p = .682$, $\eta_p^2 < .01$.

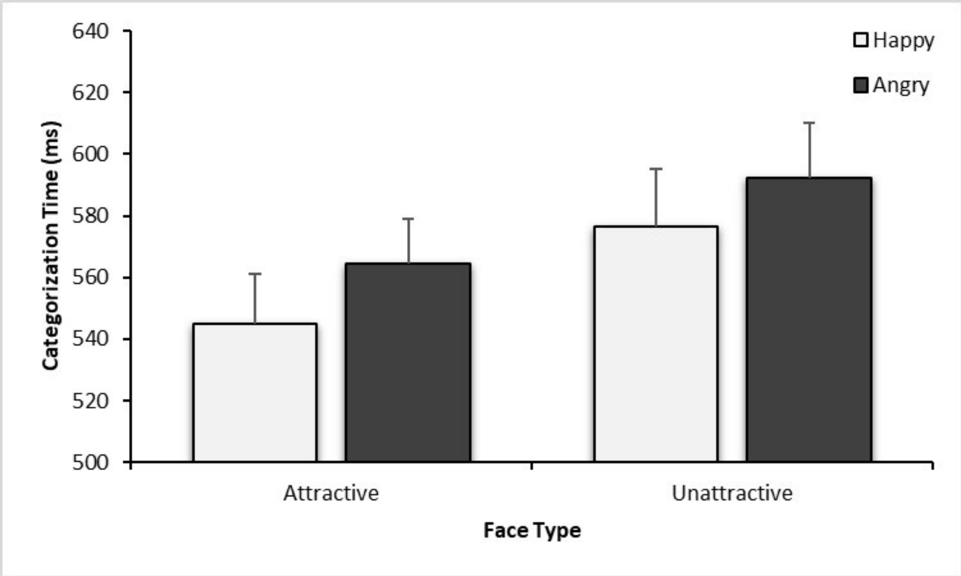


*Figure 2.* Categorization times for happy and angry expressions on male faces as a function of attractiveness in Experiment 2. Errors bars represent 1 *SEM*.

**Accuracy.** Analysis of error rates (see Table 2) indicated that attractiveness interacted with facial expression for male faces. Fewer errors were made categorizing attractive than unattractive faces, $F(1, 60) = 16.10$, $p < .001$, $\eta_p^2 = .21$, but this effect was qualified by an Attractiveness × Expression interaction, $F(1, 60) = 5.98$, $p = .017$, $\eta_p^2 = .09$. Follow-up comparisons revealed that fewer errors were made for the happy attractive males compared to the angry attractive males, $t(60) = 2.56$, $p = .013$. There was no difference in error rates for the happy and angry unattractive male faces, $t(60) = 0.71$, $p = .483$.

Although the Attractiveness × Expression interaction was not significant for the categorization times, a main effect of attractiveness was observed, indicating that attractiveness has some influence on emotion categorization for male faces. The error data, however, suggest there is an interactive effect of attractiveness on the processing of male emotional expressions in line with the evaluative congruence account. It might be possible that the attractiveness effect is weaker for male faces, which was tested in Experiment 3, where both female and male faces were presented in the same task.

## Experiment 3

Previous studies have mainly focused on how a single social category cue influences emotion perception. Given that several social category cues are simultaneously present on a face, it is important to examine how they interact. Past studies have investigated how multiple social category cues, sex and race (Craig & Lipp, 2018; Smith, LaFrance, & Dovidio, 2017), sex and age (Craig & Lipp, 2018), and race and age cues (Kang & Chasteen, 2009) simultaneously moderate emotion perception, and found evidence for a combined influence of these social cues on emotion perception. To get a more complete picture of how attractiveness influences emotion perception, the combined influence of sex and attractiveness needs to be taken into consideration. Attractiveness moderated the happy face advantage for female (Experiment 1) and male faces (Experiment 2) separately, although this was only evident in the error data for the male faces. Whether attractiveness will still have an effect on emotion categorization when both male and female faces are encountered within a single task and the influence of face sex (e.g., Becker et al., 2007; Hugenberg & Sczesny, 2006) is taken into account is unclear. If face sex is a more prominent or salient social cue than attractiveness, it could override the attractiveness effect observed in Experiments 1 and 2. In this case, the usual pattern of a happy face advantage for female faces and a reduced or absent one for male faces is predicted. Attractiveness could also moderate emotion categorization independently in the absence of an influence of sex. In this case, a happy face advantage is expected for the attractive faces and a reduced or absent one for the unattractive faces regardless of the sex of the face. If both the sex and attractiveness of the face moderate emotion perception, the largest happy face advantage might be predicted for the attractive females. As such, the aim of Experiment 3 was to examine if and how attractiveness and sex might combine to influence the happy face advantage. To this aim, participants were presented with female and male faces that varied in attractiveness and emotional expression, and categorized them by their emotional expression (happy and angry).

**Method**

**Participants.** Craig and Lipp (2018) observed effects of two different social category cues on emotion perception across tasks with around 30 participants. Although the extra factor of face sex is introduced in Experiment 3, the current study utilizes a fully repeated measures design and previous research indicates that the moderating influence of sex on emotion categorization is large. As such, a sample size similar to Experiments 1 and 2 was deemed to be sufficient to investigate the influence of sex and attractiveness on emotion categorization. Sixty-two participants

(35 males, 2 participants did not provide demographic information, *M* = 33.85 years, *SD* = 8.89 years) were recruited from Amazon Mechanical Turk and received 1.80 USD for completing the experiment. Forty-eight participants identified themselves as White/Caucasian, five as Black/African American, four as Hispanic, and three as Asian.

**Stimulus materials, procedure, and analysis.** Experiment 3 was identical to Experiments 1 and 2 except as follows. Both the female and male models from the previous experiments were included (a total of 48 pictures). Each picture was only presented twice in order to maintain a total of 96 trials in the emotion categorization task. Errors (5.54% of trials), invalid responses (<0.01% of trials), and outliers (1.75% of trials) were excluded from analysis of the response times. Attractiveness ratings, response times, and error rates were subjected to separate 2 (Target sex: female vs. male) × 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons. Two participants with a mean response time more than 3 *SD* above the mean response time across all participants (*M* = 1,222 and 1,499 ms respectively) were excluded from analyses. Preliminary analysis including these participants yielded the same pattern of results.

**Results and Discussion**

**Manipulation check.** One participant was excluded from analysis of the attractiveness ratings due to undifferentiated ratings of all faces. Preliminary analysis before exclusion yielded the same pattern of results. Analysis confirmed the allocation of faces to conditions (see Table 1). Main effects of sex, $F(1, 58) = 19.20$, $p < .001$, $\eta_p^2 = .25$, attractiveness, $F(1, 58) = 273.26$, $p < .001$, $\eta_p^2 = .83$, and expression, $F(1, 58) = 48.95$, $p < .001$, $\eta_p^2 = .46$, emerged, where female, attractive, and happy faces overall were rated as more attractive than male, unattractive, and angry faces. The Sex × Attractiveness interaction, $F(1, 58) = 85.48$, $p < .001$, $\eta_p^2 = .60$, confirmed that the attractive faces were rated as more attractive than the unattractive faces for both females, $t(58) = 17.11$, $p < .001$, and males, $t(58) = 11.09$, $p < .001$, however, the difference was larger for the female faces, $t(58) = 9.25$, $p < .001$. An Attractiveness × Expression interaction, $F(1, 58) = 51.26$, $p < .001$, $\eta_p^2 = .47$, reflected that happy expressions were rated as more attractive than angry expressions for both the attractive, $t(58) = 7.90$, $p < .001$, and the unattractive faces, $t(58) = 5.29$, $p < .001$, but the happy advantage was larger for the attractive faces, $t(58) = 7.16$, $p < .001$. The three-way Sex × Attractiveness × Expression interaction was not significant, $F(1, 58) = 0.00$, $p = 1.00$, $\eta_p^2 = .00$.

**Categorization times.** Figure 3 summarizes the categorization times for happy and angry expressions on female and male faces as a function of attractiveness. The analysis yielded a main effect of expression, $F(1, 59) = 9.01$, $p = .004$, $\eta_p^2 = .13$, where happy faces overall were categorized faster than angry faces. A main effect of attractiveness, $F(1, 59) = 27.03$, $p < .001$, $\eta_p^2 = .31$, indicated that the attractive faces overall were categorized faster than the unattractive faces. The main effects were qualified by an Attractiveness × Expression interaction, $F(1, 59) = 6.96$, $p = .011$, $\eta_p^2 = .11$. Follow-up comparisons demonstrate a happy face advantage for the attractive faces, $t(59) = 3.95$, $p < .001$, but no difference in categorization times for the unattractive faces, $t(59) = 0.76$, $p = .448$. The three-way Sex × Attractiveness × Expression interaction did not reach significance, $F(1, 59) = 2.24$, $p = .140$, $\eta_p^2 = .04$.

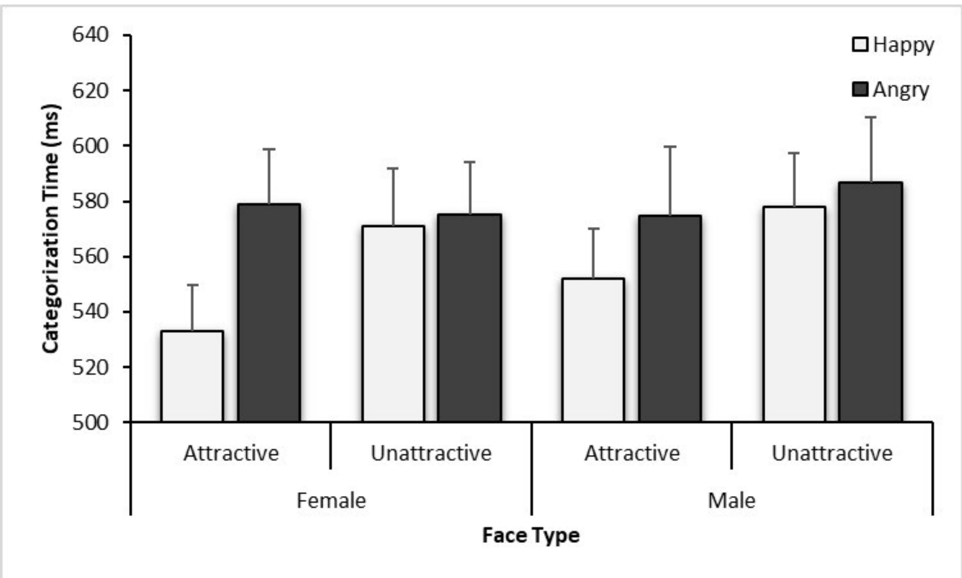


*Figure 3.* Categorization times for happy and angry expressions on female and male faces as a function of attractiveness in Experiment 3. Errors bars represent 1 *SEM*.

Overall, the pattern of results in Experiment 3, where female and male faces were categorized together, appears to be consistent with those of Experiments 1 and 2, where female and male faces were categorized separately. To further examine whether the theoretically relevant interactions from Experiment 3 were consistent with the results of Experiments 1 and 2, data from the first two experiments were combined in a 2 (Target sex: female vs. male) × 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) mixed ANOVA with target sex as a between-subjects factor. The Attractiveness × Expression interaction, $F(1, 118) = 6.15$, $p = .015$, $\eta_p^2 = .05$, still emerged, and follow-up comparisons demonstrate a happy face advantage for the attractive faces, $t(118) = 4.83$, $p < .001$, but no difference in categorization times for the unattractive faces, $t(118) = 1.35$, $p = .180$, consistent with the results of Experiment 3. The three-way Sex × Attractiveness × Expression interaction trended towards significance, $F(1, 118) = 3.54$, $p = .062$, $\eta_p^2 = .03$, likely reflecting the Attractiveness × Expression interaction for females in Experiment 1, but lack thereof for males in Experiment 2. The Sex × Expression interaction did not reach significance in Experiment 3, $F(1, 59) = 0.45$, $p = .503$, $\eta_p^2 = .01$, nor in the combined analysis of Experiments 1 and 2, $F(1, 118) = 0.63$, $p = .431$, $\eta_p^2 = .01$.

**Accuracy.** Analysis of error rates (see Table 2) suggests that both sex and attractiveness influence the categorization of facial expressions. Overall, fewer errors were made categorizing female, $F(1, 59) = 20.04$, $p < .001$, $\eta_p^2 = .25$, and attractive faces, $F(1, 59) = 15.90$, $p < .001$, $\eta_p^2 = .21$, compared to male and unattractive faces. The Sex × Attractiveness interaction, $F(1, 59) = 6.56$, $p = .013$, $\eta_p^2 = .10$, revealed that more errors were made categorizing unattractive male faces, $t(59) = 4.34$, $p < .001$, compared to attractive male faces. There was no difference in error rates for the attractive and unattractive female faces, $t(59) = 1.42$, $p = .162$. The Attractiveness × Expression interaction, $F(1, 59) = 10.78$, $p = .002$, $\eta_p^2 = .15$, showed a pattern consistent with the error rates from Experiments 1 and 2. There were fewer errors made categorizing happy attractive faces, $t(59) = 3.20$, $p = .002$, than angry attractive faces, and no difference in errors made categorizing happy and angry unattractive faces, $t(59) = 1.30$, $p = .197$. The Sex × Expression interaction trended towards significance, $F(1, 59) = 3.79$, $p = .056$, $\eta_p^2 = .06$, and reflected a lower error rate for happy female faces, $t(59) = 2.17$, $p = .034$, than for angry female faces. There was no difference in error rates for the happy and angry male faces, $t(59) = 0.41$, $p = .684$. The three-way Sex × Attractiveness × Expression interaction did not reach significance, $F(1, 59) = 0.63$, $p = .429$, $\eta_p^2 = .01$.

If facial sex cues are more prominent as a moderator of emotion categorization, the Sex × Expression interaction would be expected to reveal a happy face advantage for the female faces and a reduced or absent one for the male faces, which it did not. Somewhat surprisingly, Experiment 3 suggests that face attractiveness might have a stronger influence on emotion categorization than face sex, at least within the context of this task. Like social category cues of sex or race though, attractiveness seems to moderate the happy face advantage in emotion categorization in line with the evaluative congruence account. That is, a happy face advantage emerged for the more positively evaluated attractive faces but not for the unattractive faces.

## Experiment 4

Hair is an attribute that influences perception of attractiveness and sex. Mesko and Bereczkei (2004) revealed that adding different hairstyles to female faces rated high or low in attractiveness had a larger influence on perceived attractiveness of faces initially rated as less attractive. Given the interaction between attractiveness and hairstyles, we wanted to rule out the possibility that the results observed in Experiments 1-3 are primarily driven by posers' hairstyles rather than just the information present on the face. Previous studies have used male and female faces with (e.g., Craig & Lipp, 2017) and without (e.g., Lipp, Craig, & Dat, 2015) hair in emotion categorization tasks and demonstrated the same moderating effects of sex cues on the happy face advantage. As facial sex cues influence emotion categorization similarly when faces are presented with or without hair, it is possible that the attractiveness effect will also still be observed when the hair has been removed. Although, if hair has a larger influence on attractiveness judgements than perceptions of sex, it could be expected that sex becomes more salient than attractiveness as an evaluative dimension and overrides the attractiveness effect observed in Experiment 3. This would be indicated by a happy face advantage for the female faces and a reduced or absent one for the male faces. To rule out the possibility that differences in hairstyles might be driving the attractiveness effect in Experiments 1-3, and to establish the generality of the moderating influence of attractiveness across stimulus sets, Experiment 3 was replicated with the faces further edited to remove hair, neck, and ears, leaving just the face. Again, participants were presented with female and male faces that varied in attractiveness and emotional expression, and categorized them by their emotional expression (happy and angry).

## Method

**Participants.** Sixty-four participants (36 males, 2 participants did not provide demographic information, *M* = 31.72 years, *SD* = 26.32 years) were recruited from Amazon Mechanical Turk and received 1.80 USD for completing the experiment. Fifty participants identified themselves as White/Caucasian, three as Black/African American, three as Hispanic, and six as Asian.

**Stimulus materials, procedure, and analysis.** Experiment 4 was identical to Experiment 3 except for the face stimuli, which were further edited to remove hair, neck, and ears. Errors (9.22% of trials), invalid responses (1.01% of trials), and outliers (1.75% of trials) were excluded from analysis of the response times. Attractiveness ratings, response times, and error rates were subjected to separate 2 (Target sex: female vs. male) × 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons. Sixty-two participants completed the categorization task; one participant with a mean response time more than 3 *SD* above the mean response time across all participants (*M* = 1,101 ms) and five participants with an error rate higher than 25% (27.08, 59.38, 62.50, 66.67, and 84.38% respectively) were excluded from analyses. Preliminary analysis with these participants included yielded the same pattern of results.

## Results and Discussion

**Manipulation check.** Sixty-two participants provided attractiveness ratings and two participants were excluded from analysis due to undifferentiated ratings of all faces. Preliminary analysis before exclusion yielded the same pattern of results. Analysis confirmed the allocation of faces to conditions (see Table 1). Main effects of sex, $F(1, 59) = 13.11$, $p = .001$, $\eta_p^2 = .18$, attractiveness, $F(1, 59) = 160.11$, $p < .001$, $\eta_p^2 = .73$, and expression, $F(1, 59) = 35.27$, $p < .001$, $\eta_p^2 = .37$, emerged, where female, attractive, and happy faces were rated as more attractive than male, unattractive, and angry faces. The Sex × Attractiveness interaction, $F(1, 59) = 62.11$, $p < .001$, $\eta_p^2 = .51$, again confirmed that the attractive faces were rated as more attractive than the unattractive faces for both the females, $t(59) = 12.77$, $p < .001$, and the males, $t(59) = 10.72$, $p < .001$, with a larger difference for the female faces, $t(59) = 7.88$, $p < .001$. The Sex × Expression interaction, $F(1, 59) = 12.31$, $p = .001$, $\eta_p^2 = .17$, indicated that the happy expressions were rated as more attractive than the angry expressions on both female, $t(59) = 6.85$, $p < .001$, and male faces, $t(59) = 4.66$, $p < .001$, with a larger difference for the happy and angry female faces, $t(59) = 3.51$, $p = .001$. There was also an Attractiveness × Expression interaction, $F(1, 59) = 42.30$, $p < .001$, $\eta_p^2 = .42$, which again demonstrated that the happy expressions were rated as more attractive than the angry expressions for both the attractive, $t(59) = 7.30$, $p < .001$, and the unattractive faces, $t(59) = 3.75$, $p < .001$, with a larger happy advantage for the attractive faces, $t(59) = 6.50$, $p < .001$. The three-way Sex × Attractiveness × Expression interaction was not significant, $F(1, 59) = 0.04$, $p = .839$, $\eta_p^2 < .01$.

**Categorization times.** Figure 4 summarizes the categorization times for happy and angry expressions on the cropped female and male faces as a function of attractiveness. The analysis yielded main effects of sex, $F(1, 55) = 9.86$, $p = .003$, $\eta_p^2 = .15$, and attractiveness, $F(1, 55) = 30.02$, $p < .001$, $\eta_p^2 = .35$, where female and attractive faces were categorized faster than male and unattractive faces. Replicating the results from Experiment 3, the main effects were qualified by the Attractiveness × Expression interaction, $F(1, 55) = 5.50$, $p = .023$, $\eta_p^2 = .09$, which demonstrated a happy face advantage for the attractive faces, $t(55) = 3.26$, $p = .002$, but no difference in categorization times for the unattractive faces, $t(55) = 0.08$, $p = .939$. The three-way Sex × Attractiveness × Expression interaction trended towards significance, $F(1, 55) = 3.81$, $p = .056$, $\eta_p^2 = .07$, reflecting a happy face advantage for the attractive females, $t(55) = 4.25$, $p < .001$, and no happy advantage for the unattractive females,

$t(55) = 0.23$, $p = .816$, nor the attractive, $t(55) = 0.24$, $p = .813$, and unattractive males, $t(55) = 0.13$, $p = .894$.[4]

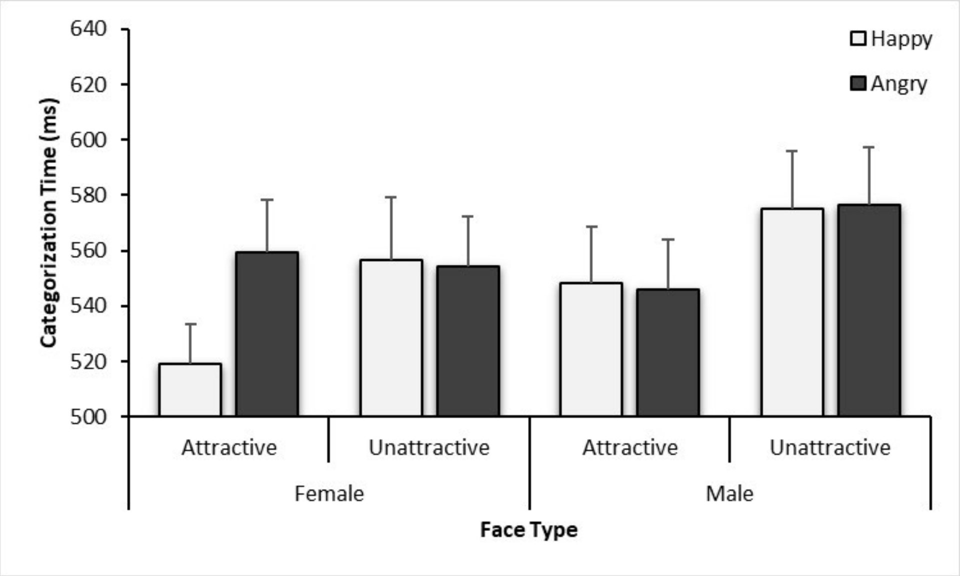


*Figure 4.* Categorization times for happy and angry expressions on the cropped female and male faces as a function of attractiveness in Experiment 4. Errors bars represent 1 *SEM*.

**Accuracy.** Analysis of the error rates (see Table 2) yielded main effects of sex, $F(1, 55) = 18.86$, $p < .001$, $\eta_p^2 = .26$, and attractiveness, $F(1, 55) = 8.58$, $p = .005$, $\eta_p^2 = .14$, where fewer errors were made categorizing expressions on female and attractive faces compared to male and unattractive faces. The Sex × Attractiveness interaction, $F(1, 55) = 5.80$, $p = .019$, $\eta_p^2 = .10$, reflected that more errors were made categorizing expressions on unattractive male, $t(55) = 3.25$, $p = .002$, than to attractive male faces. There was no difference in error rates for the

[4] The marginal three-way interaction was further moderated by participant sex, $F(1, 53) = 6.24$, $p = .016$, $\eta_p^2 = .11$. For the female participants, there was a happy face advantage for the attractive female faces, $t(53) = 4.06$, $p < .001$, but no difference for the unattractive female faces, $t(53) = 0.66$, $p = .513$. Furthermore, an unexpected anger advantage emerged for the attractive male faces, $t(53) = 2.46$, $p = .017$, and there was no difference in categorization times for the happy and angry unattractive male faces, $t(53) = 0.53$, $p = .601$. For the male participants, there was a trending happy face advantage for both the attractive female, $t(53) = 1.98$, $p = .053$, and the attractive male faces, $t(53) = 1.86$, $p = .069$. There was no categorization advantage in either direction for the unattractive female, $t(53) = 0.21$, $p = .838$, and unattractive male faces, $t(53) = 0.17$, $p = .867$.

attractive and unattractive female faces, $t(55) = 0.18$, $p = .856$. The Attractiveness × Expression interaction, $F(1, 55) = 9.79$, $p = .003$, $\eta_p^2 = .15$, indicated that more errors were made categorizing the happy unattractive faces, $t(55) = 2.58$, $p = .013$, than the angry unattractive faces. There was no difference in error rates for the happy and angry attractive faces, $t(55) = 1.13$, $p = .263$. The three-way Sex × Attractiveness × Expression interaction did not reach significance, $F(1, 55) = 0.17$, $p = .684$, $\eta_p^2 < .01$.[5]

The attractiveness effect on the happy face advantage observed in Experiment 3 was replicated in Experiment 4, with a happy face advantage for the more positively evaluated attractive faces, but not for the unattractive faces. Interestingly, the previously reported Sex × Expression effect, that is, a happy face advantage for females and the lack thereof or a reduced one for males (e.g., Becker et al., 2007; Hugenberg & Sczesny, 2006), did not emerge when attractiveness is manipulated in Experiment 3 (only a trend emerges in the error rates) nor when data from Experiment 1 and 2 were combined, but was evident in Experiment 4. One possible explanation for the more prominent moderating influence of sex on the happy face advantage in Experiment 4 could be that the faces varied less in attractiveness when their hair was cropped off reducing the salience of attractiveness as an evaluative dimension. Comparing the attractiveness ratings for Experiments 3 and 4 in an overall ANOVA with Experiment as a between-subjects factor confirms this. The Experiment × Sex × Attractiveness interaction, $F(1, 117) = 8.17$, $p = .005$, $\eta_p^2 = .07$, indicated that the attractive females were rated as more attractive in Experiment 3 when they had hair, than in Experiment 4 without hair, $t(117) = 3.47$, $p = .001$. There was no difference between experiments in rated attractiveness for the other faces. This indicates that the absence of hair reduced attractiveness judgements particularly for attractive female faces but, not for unattractive females or for male faces, which may explain the enhanced salience of face sex relative to attractiveness in Experiment 4. This finding is not inconsistent with Mesko and Bereczkei's (2004)

[5] When participant sex was included as a between-subjects factor, the four-way Participant sex × Target sex × Attractiveness × Expression interaction reached significance, $F(1, 53) = 5.66$, $p = .021$, $\eta_p^2 = .10$. The female participants made more errors categorizing angry compared to happy attractive female faces, $t(53) = 2.99$, $p = .004$, and happy compared to angry unattractive female faces, $t(53) = 2.23$, $p = .030$. There were no other significant effects of participant sex.

finding that addition of hairstyles increased the perceived attractiveness more for less attractive than for attractive females, in that removal of hair may have a stronger effect for the evaluation of previously attractive females. There are several differences between the studies however, and the hairstyles of the models used in the present experiments were not systematically controlled. Nonetheless, both results indicate that hairstyles are an important factor to consider when examining facial attractiveness.

## General Discussion

Across four experiments, novel evidence demonstrated that attractiveness moderates emotion categorization. Consistent with the evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006), we demonstrated a happy face advantage for the more favorably evaluated attractive faces but a reduced or absent one for the unattractive faces. This is thought to be due to the facilitated processing of evaluatively congruent expressions. When female and male faces were categorized separately, the happy advantage for attractive faces was clearly observable for the female faces and only evident in the error data for the male faces. This might suggest that attractiveness has a stronger influence on emotion perception for female faces. Alternatively, it could be interpreted as an additive effect where the relatively positive evaluation of female compared to male faces, combines with the relatively positive evaluation of attractive compared to unattractive faces. This results in the strongest positive evaluation and thus the largest (most statistically robust) happy advantage for attractive female faces. Furthermore, attractiveness still had an effect on emotion categorization when face sex, which reliably moderates the happy face advantage, was varied (e.g., Becker et al., 2007; Hugenberg & Sczesny, 2006). Attractiveness seems to moderate the happy face advantage in the same way as social category cues; that is, according to the evaluative congruence account, with a happy face advantage for the more favorably evaluated attractive faces but not for the unattractive faces. The moderation of emotion perception is thus not limited to invariant facial social category cues.

Although the current findings are consistent with the evaluative congruence account, there are other factors that could potentially explain the results. One might argue that the attractive and unattractive faces differ in the intensity of their emotional expressions, the perceived femininity/masculinity of the models, or how typically male or female they appear, which may have contributed to the pattern of results obtained in Experiments 1-4. For example, happy expressions might be perceived as more intense on attractive relative to unattractive faces, which could facilitate categorization of happiness (see Golle et al., 2014). Furthermore, the attractive faces could be perceived as more feminine, and as feminine facial structure overlaps with expressions of happiness (Becker et al., 2007), this could potentially explain the larger happy face advantage for attractive females. To address these alternative interpretations, a new sample of participants rated each of the faces used in Experiments 1-3 on expression intensity, femininity/masculinity, and sex typicality on 7-point Likert scales. None of the alternative explanations could adequately account for the observed attractiveness effect on emotion categorization (for a detailed report and discussion of the additional data see Supplementary Material 2). In brief, contrary to predictions, angry expressions were rated as more intense than happy expressions for attractive female and male faces, as well as for unattractive female faces, for which no happy face advantage had been observed. As predicted, the femininity/masculinity ratings demonstrated that attractive female faces were rated as more feminine than the unattractive females, but contrary to what would be expected given the categorization pattern, there was no difference in rated femininity for the attractive and unattractive male faces. Similarily, attractive faces were rated as more sex typical than the unattractive faces, which could account for the categorization time pattern for female faces, but not for male faces.

Although previous research has given strong support for the evaluative congruence account as an explanation for the effects of social category cues on emotion categorization (Hugenberg, 2005; Hugenberg & Sczesny, 2006), under some circumstances stereotypes seem to influence emotion categorization (Bijlstra et al., 2010). We did not examine the sex- or attractiveness-related stereotypes that our participants held, and thus cannot exclude that stereotypes can account for the effect of attractiveness on emotion perception. It should be noted, however, that previous evidence for the effects of stereotypes on emotion categorization only emerged in single valence categorizations, tasks that required the categorization of two negative expressions, and not in the dual valence task used here (Bijlstra et al., 2010).

Finally, it is possible that the current results reflect differences between the male and female stimuli used in the current study. In the pilot study, which employed over 160 neutral faces, the most attractive female faces were rated as more attractive than the most attractive males and the most unattractive females were rated as more attractive than the most unattractive males. Even though females were rated overall as more attractive, the relative differences between the attractive and unattractive females and males was similar. The ratings of the emotional faces provided after the emotion categorization task in Experiments 3 and 4 revealed that the difference in rated attractiveness was larger for the female than the male faces and that female faces were overall rated as more attractive. It is possible that these differences could have contributed to the weaker attractiveness effect for male faces. Matching female and male faces for attractiveness would require us to select less attractive female faces for the attractive female category and more attractive males for the unattractive male category. This would have reduced the range of attractiveness represented in the stimuli and potentially led to a smaller attractiveness effect than reported here. In doing so, we would also no longer accurately represent the natural variability in attractiveness present in our initial set of over 160 faces. We chose the more extremely rated faces to maximize our chances of finding an attractiveness effect on emotion categorization if indeed there was one. Future research should examine whether matching females and males on attractiveness alters this pattern of results.

**Broader Implications**

The current findings have broader implications for the field of emotion perception as they suggest that past studies reporting an influence of social categories (like sex) on emotion perception may have confounded sex with the relative attractiveness of the faces used. The larger happy face advantage observed for female faces may be due to researchers inadvertently selecting female faces that were more attractive than the male faces (though pilot ratings suggest that sex and attractiveness may be naturally confounded). The selection of stimulus material in past studies may exaggerate or underestimate differences between social categories due to systematic, but uncontrolled differences in the attractiveness of the faces representing the different categories. Our findings suggest that attractiveness ratings are important to include in the norming data when developing face databases and/or to pilot when selecting faces as stimuli for emotion recognition studies.

Past studies examining how multiple social category cues influence emotion perception (Craig & Lipp, 2018; Kang & Chasteen, 2009; Smith et al., 2017) indicate that the manner in which the different cues interact to moderate the happy face advantage is complex. The current work adds to this complexity by adding perceived face attractiveness, a cue that is situationally variable (and subject to a bad hair day), as a contributing factor. Particularly, in situations where attractiveness is contextually relevant, like in the current task where very attractive and unattractive faces were presented intermixed, attractiveness may even outweigh the influence of social category cues such as sex on emotion perception. Further research is needed to determine the nature of the interaction between cues of attractiveness and sex in emotion perception and to assess whether the same pattern would emerge for other social category cues such as race.

The current findings also seem relevant for the broader face processing and social categorization literature. Our findings demonstrate that facial attractiveness is processed quickly and early enough to influence emotion perception and that its influence seemed to interact with that of face sex, a basic characteristic that is processed preferentially and obligatory when encountering a face (e.g., Brewer, 1988).

**Conclusion**

In conclusion, the current study demonstrates that attractiveness moderates emotion categorization and, more specifically, the happy face advantage, consistent with the evaluative congruence account (see Hugenberg, 2005; Hugenberg & Sczesny, 2006). As for social category cues, a happy face advantage was observed for the relatively more favorably evaluated attractive faces, but not for the unattractive faces. The moderation of emotion perception is thus not limited to invariant facial social category cues (e.g., sex and race), but extends to other more situationally variable facial cues such as attractiveness.

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# Chapter 2.2

## Pretty women: Sex and attractiveness interact to influence emotion perception[6]

[6] These findings were presented at the Society for Personality and Social Psychology Annual Convention in 2018, https://osf.io/v6n2u/

**Abstract**

Faces are a rich source of social information which could potentially influence emotion perception. Despite this, most studies have only investigated effects of one social cue at a time indicating that happy expressions are categorized faster than negative expressions on faces belonging to a relatively positively evaluated social group. We used the happy face advantage to examine how sex and attractiveness together influence emotion recognition. In three experiments, participants categorized happy and angry expressions on faces varying in sex and attractiveness as quickly and accurately as possible. The present data, which partly were analysed together with data from Lindeberg, Craig, and Lipp (2019a), demonstrate that sex and attractiveness interact in their influence on emotion categorization. Overall a large happy face advantage is observed for the attractive females, faces with two relatively positively evaluated cues. The happy face advantage for the attractive females is larger than that for the attractive males, unattractive females, and unattractive males, which in turn do not notably differ from each other. This suggests that the attractive females are evaluated particularly favorably. Furthermore, the combination of one positive facial cue and one relatively less positively evaluated cue (attractive males and unattractive females) did not enhance the happy face advantage relative to faces with two relatively less positively evaluated cues (unattractive males).

Faces, and more specifically emotional expressions conveyed by a face, serve a vital function in social interaction and communication. Early emotion perception research focused on the universality of emotional expressions and their recognition (e.g., Darwin, 1872/1965; Ekman, 1992), however, emotional expressions are not encountered in isolation. They are portrayed on faces which convey a wide range of social information and are expressed in a context which can facilitate or interfere with their interpretation. A substantial body of research has demonstrated that this socially relevant information communicated via facial cues; identity (e.g., Schweinberger & Soukup, 1998), sex (e.g., Atkinson, Tipples, Burt, & Young, 2005), race (e.g., Hugenberg & Bodenhausen, 2003), age (e.g., Hass, Schneider, & Lim, 2015), attractiveness (e.g., Lindeberg, Craig, & Lipp, 2019a), and eye gaze (e.g., Adams & Kleck, 2003), as well as contextual information outside of the face (e.g., Aviezer et al., 2008), influences emotion perception. More importantly, given that all of the mentioned information can be available concurrently, a few studies have examined the combined influence of two facial cues; sex and race (Craig & Lipp, 2018b; Smith, LaFrance, & Dovidio, 2017), sex and age (Craig & Lipp, 2018b), race and age (Kang & Chasteen, 2009), and sex and attractiveness (Lindeberg et al., 2019a), on emotion perception. The findings are mixed both across and within studies where dominance of one cue, independent influences of both cues, and interactive patterns of influence all have been demonstrated. At this stage, it is difficult to compare the studies in order to understand how simultaneously available facial cues influence emotion perception given the methodological differences between them. It is also possible that the combined influence of different social cues varies. Some social cues may be preferentially processed and others may be more susceptible to influence by contextual information.

Most previous research and face perception models (Bruce & Young, 1986; Freeman & Ambady, 2011; Haxby, Hoffman, & Gobbini, 2000) have focused on core social category cues' influence on emotion perception, but other aspects of faces are evidently relevant as well. To extend our knowledge of how multiple facial cues are processed concurrently, we were interested in facial cues which communicate potentially important social information, but do not fit within the early theoretical frameworks, and how they are processed in relation to social category cues to influence emotion perception. More specifically, we chose to further examine how sex and attractiveness together influence emotion perception.

Despite high agreement on who is considered attractive (Langlois et al., 2000), perceived attractiveness varies considerably across situations and photographs for the same individual (Jenkins, White, Van Montfort, & Burton, 2011), differentiating it from face sex, which is perceived consistently across situations. Face sex has, furthermore, been assumed to be preferentially and automatically processed (e.g., Brewer, 1988) and whether the same automaticity applies to attractiveness is unclear, although, it has been demonstrated that attractiveness is a basic social dimension which we make inferences about when encountering a new face (Sutherland et al., 2013). The importance of attractiveness in everyday life has been well-established (Maestripieri, Henry, & Nickels, 2017) and attractive people are consistently ascribed other positive traits (Dion, Berscheid, & Walster, 1972; Langlois et al., 2000). It is apparent that attractiveness is a core social dimension, in addition to social category cues such as sex, which warrants further investigation.

Emotional expressions contribute considerably to the within person variance in perceived attractiveness (Sutherland, Young, & Rhodes, 2017) and happy faces are consistently judged as more attractive than faces with negative expressions (e.g., Mueser, Grau, Sussman, & Rosen, 1984). In four experiments, Lindeberg et al. (2019a) found evidence to suggest that the relationship between attractiveness and emotional expressions is reciprocal, in that attractiveness influences emotion perception as well (also see Golle, Mast, & Lobmaier, 2014; Taylor & Bryant, 2016). In this study, participants completed a speeded two-choice emotion categorization task with faces presented one at a time, varying in sex and attractiveness, and emotional expression. Participants were asked to categorize the faces' emotional expressions as quickly and accurately as possible. This task has successfully been used in several studies examining how social category cues influence emotion perception. Generally, happy faces are categorized faster than negative expressions if faces belong to a relatively positively evaluated social group and the effect is absent or reduced for relatively less positive or negatively evaluated faces (female, own-race, and young adult faces compared to male, other-race, and older adult faces respectively; Aguado, García-Gutierrez, & Serrano-Pedraza, 2009; Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007; Bijlstra, Holland, & Wigboldus, 2010; Craig, Koch, & Lipp, 2017; Craig & Lipp, 2017; Craig & Lipp, 2018a; Craig, Mallan, & Lipp, 2012; Craig, Zhang, & Lipp, 2017; Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lipp, Craig, & Dat, 2015; Lipp, Karnadewi, Craig, & Cronin, 2015).

These findings are commonly explained by the evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006), which states that existing evaluations or attitudes about social groups are quickly activated by facial cues, creating a context in which the emotional expression is perceived. The consistency between evaluations of the social group and expression valence is suggested to facilitate processing of the emotional expression, for instance, resulting in faster and more accurate categorization of a happy than a negative expression on a female than a male face. It seems likely that the default happy face advantage (e.g., Leppänen & Hietanen, 2003) is either enhanced or reduced by the relative evaluation of the social group. This would explain why an advantage for negative expressions on faces belonging to a negatively evaluated social group is observed rarely.

In line with previous research and the evaluative congruence account, Lindeberg et al. (2019a) observed a happy face advantage for the more positively evaluated attractive faces but not for unattractive faces, when female and male faces were categorized separately. The effect was, however, only observed in the error rates for male faces, indicating that the moderation of emotion recognition by attractiveness might be stronger for females. Furthermore, in two experiments, female and male faces were categorized in the same task to investigate the combined influence of sex and attractiveness on emotion categorization. A happy face advantage was again observed for attractive faces but not for unattractive faces in both experiments. Interestingly, the effect of sex on emotion categorization which previously had appeared to be very robust (e.g., Becker et al., 2007; Hugenberg & Sczesny, 2006) was only observed as a marginal effect in the error rates in one experiment and as a marginal interaction between sex and attractiveness on the happy face advantage in the categorization times of the other, where a happy face advantage emerged only for the attractive females. Taken together, there was no clear evidence that sex and attractiveness interacted in their influence on emotion categorization, but they instead appeared to independently moderate the happy face advantage, with attractiveness exerting a stronger influence.

Lindeberg et al. (2019a) suggested that attractiveness had a more consistent influence on emotion categorization than sex. To establish the robustness of this finding, Experiment 1 of the current study aims to replicate Lindeberg et al.'s (2019a) Experiment 3, which was conducted online via Amazon Mechanical Turk, in a lab environment that offers increased control and therefore, possibly a decrease of noise in the data. Participants are presented with happy and angry, attractive and unattractive male and female faces and tasked with categorizing them by their emotional expression as quickly and accurately as possible. Based on previous findings, we expected to find a happy face advantage for the attractive faces and not for the unattractive faces. Whether an effect of sex or an interactive effect of sex and attractiveness on the happy face advantage would be observed was more unclear.

The happy face advantage is larger for the relatively more favorably evaluated social group and in the previous experiments, four social groups could be considered to be included (attractive females, attractive males, unattractive females, and unattractive males), which offers several potential contrasts between each of them. It is possible that they are perceived in terms of their combined characteristics rather than one dimension being more salient than the other. A simplified design might, thus, better address whether sex or attractiveness has a larger influence on emotion categorization. In Experiment 2, emotions expressed by attractive males and unattractive females are categorized to examine whether sex or attractiveness is more prominent and, therefore, exerts a stronger influence. If sex is more salient than attractiveness, we would expect to see a larger happy face advantage for the unattractive female faces compared to the attractive male faces. If attractiveness is more salient, then the reversed pattern should emerge, with a larger happy face advantage for the attractive male faces compared to the unattractive female faces.

## Experiment 1

### Method

**Participants.** The sample size was based on Lindeberg et al. (2019a), where attractiveness repeatedly was demonstrated to moderate the happy face advantage with around 60 participants. Given the increased control and potentially decrease of noise in the data when conducting experiments in a lab environment compared to online, we considered a similar sample size to be sufficient. Sixty-six undergraduate students (55 female, $M$ = 21.61 years, $SD$ = 5.91 years) participated in the experiment for partial course credit. Forty-four participants identified themselves as Caucasian, nine as Asian, two as Indian, four as African, and seven as “other”.

**Stimulus materials and apparatus.** The stimulus materials were the same as those utilized by Lindeberg et al. (2019a). The faces, six attractive female ($M$ = 5.53, $SD$ = 0.60; Models 12, 22, 24, and 27 from the Chicago Face Database, Ma, Correll, & Wittenbrink, 2015; Models 115 and 152 from the FACES database, Ebner, Riediger, & Lindenberger, 2010) and six unattractive female models (*M* = 3.01, *SD* = 0.92; Models 8, 10, 26, 28, and 34 from the Chicago Face Database, Ma et al., 2015; Model 22 from the Radboud Faces Database, Langner et al., 2010), and six attractive male (*M* = 4.94, *SD* = 0.68; Models 4 and 29 from the Chicago Face Database, Ma et al., 2015; Models 16, 31, 72, and 89 from the FACES database, Ebner et al., 2010) and six unattractive male models (*M* = 2.64, *SD* = 0.91; Models 10, 17, 34, and 35 from the Chicago Face Database, Ma et al., 2015; Models 28 and 47 from the Radboud Faces Database, Langner et al., 2010), were selected in a pilot study (for details see Lindeberg et al., 2019a). To maintain consistency across pictures from different databases, pictures of each model displaying an open mouthed happy and angry expression were edited to remove clothes and background, resized, and placed in the center of a white background 600 × 630 pixels in size. All experiments were run on LED monitors with either a resolution of 1,920 × 1,080 pixels and a refresh rate of 120 Hz or with a resolution of 1,680 × 1,050 pixels and a refresh rate of 60 Hz, using Millisecond’s Inquisit 4 Lab (Inquisit, 2015), which controlled stimulus presentation and recorded response time.

**Procedure.** Experiment 1 employed the same procedures as did Experiment 3 by Lindeberg et al. (2019a). Participants were tested individually or in small groups of up to four in individual cubicles. Participants completed an emotion categorization task where they indicated whether the face presented was displaying a happy or angry expression by pressing the *S* and *L* keys on their keyboard as quickly and accurately as possible. Reminders of the key assignment were displayed on the corresponding side of the screen throughout the task. Response mapping was counterbalanced across participants. On each trial, a fixation cross was presented centrally on the screen for 500 ms, and replaced by the face for 3,000 ms or until a response was made. The interstimulus interval was 1,000 ms. The task commenced with eight practice trials with error feedback followed by 96 test trials without feedback. The face stimuli were presented in a randomized sequence, one at a time in blocks of 48. Each picture was presented twice, once in each block.

After completion of the emotion categorization task, the happy and angry faces were rated on attractiveness in a randomized sequence on a 7-point Likert scale, ranging from “*Very unattractive*” to “*Very attractive*”. The procedures were approved by the Curtin University Human Research Ethics Committee.

**Analysis.** Data processing and analysis were consistent with Lindeberg et al. (2019a). Incorrect responses, trials with response times faster than 100 ms, and outliers, defined as response times which deviated from a participants' mean by more than 3 *SDs*, were excluded from the response time analysis and included in the analysis of error rates (5.92% of trials). Participants with an error rate higher than 25% or a mean response time more than 3 *SDs* above the mean response time across all participants were excluded from analyses. No participant met exclusion criteria in Experiment 1. Attractiveness ratings, response times, and error rates were analysed with separate 2 (Target sex: female vs. male) × 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons. There was no consistent nor meaningful participant sex effects in Lindeberg et al. (2019a) and given the small number of males in the current experiments, participant sex was not included as a factor in the analyses. Preliminary analysis excluding non-Caucasian participants were conducted for all experiments and yielded the same pattern of results, therefore, the results are reported including all participants.

**Results and Discussion**

**Manipulation check.** One participant provided the same response for all faces and was therefore, considered not to have engaged in the rating task and excluded from analysis. Preliminary analysis before exclusion yielded the same pattern of results. Analysis confirmed the allocation of faces to conditions (see Table 1). Main effects of sex, $F(1, 64) = 73.92$, $p < .001$, $\eta_p^2 = .54$, attractiveness, $F(1, 64) = 213.64$, $p < .001$, $\eta_p^2 = .77$, and expression, $F(1, 64) = 235.13$, $p < .001$, $\eta_p^2 = .79$, demonstrated that female, attractive, and happy faces overall were rated as more attractive than male, unattractive, and angry faces. The three two-way interactions were significant; Sex × Attractiveness, $F(1, 64) = 14.12$, $p < .001$, $\eta_p^2 = .18$, Sex × Expression, $F(1, 64) = 8.02$, $p = .006$, $\eta_p^2 = .11$, and Attractiveness × Expression, $F(1, 64) = 77.69$, $p < .001$, $\eta_p^2 = .55$, and qualified by the higher order Sex × Attractiveness × Expression interaction, $F(1, 64) = 11.17$, $p = .001$, $\eta_p^2 = .15$. Follow-up pairwise comparisons demonstrated that happy faces were rated as more attractive than angry faces for attractive, $t(64) = 14.51$, $p < .001$, and unattractive females, $t(64) = 12.78$, $p < .001$, as well as for attractive, $t(64) = 15.71$, $p < .001$, and unattractive males, $t(64) = 10.60$, $p < .001$. While there was no difference in the magnitude of the attractiveness benefit for happy faces for the attractive females and males, $t(64) = 0.26$, $p = .799$, both were larger than the attractiveness benefit for happy faces for the unattractive females, $t(64) = 4.94$, $p < .001$, and , $t(64) = 5.43$, $p < .001$, respectively, which in turn was larger than for the unattractive males, $t(64) = 4.14$, $p < .001$.

Table 1.

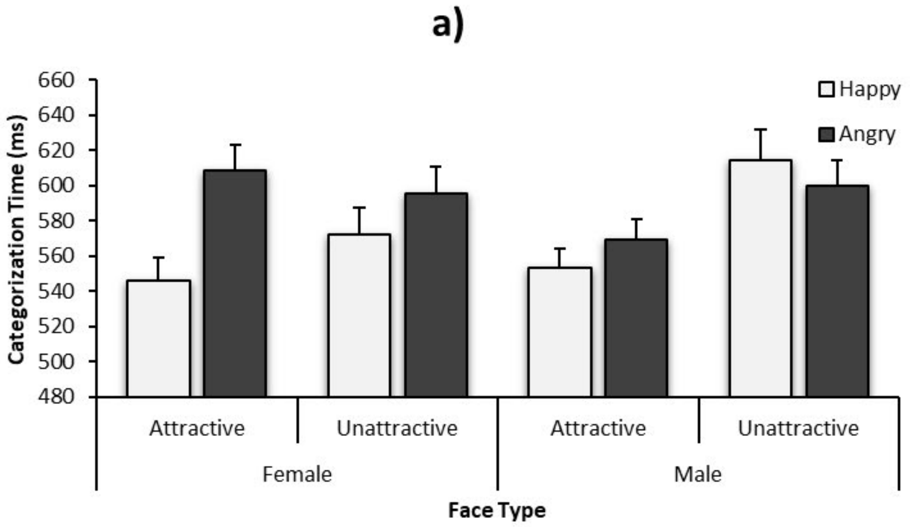
*Attractiveness ratings for happy and angry female and male faces in Experiments 1-3.*

| | Female | | Male | |
|---|---|---|---|---|
| Experiment | Happy | Angry | Happy | Angry |
| Experiment 1 | | | | |
| Attractive | 5.82 (0.60) | 3.86 (0.85) | 5.30 (0.67) | 3.32 (0.89) |
| Unattractive | 4.12 (0.86) | 2.64 (0.54) | 3.63 (0.88) | 2.51 (0.64) |
| Experiment 2 | | | | |
| Attractive | - | - | 5.36 (0.73) | 3.33 (0.88) |
| Unattractive | 4.42 (1.00) | 2.63 (0.62) | - | - |
| Experiment 3 | | | | |
| Attractive | 5.84 (0.51) | 3.56 (1.18) | - | - |
| Unattractive | - | - | 4.26 (1.07) | 2.60 (0.68) |

*Note.* Values in parentheses represent 1 *SD*.

**Categorization times.** Figure 1a summarizes the categorization times for happy and angry expressions on female and male faces as a function of attractiveness. The analysis yielded main effects of attractiveness, $F(1, 65) = 31.75$, $p < .001$, $\eta_p^2 = .33$, and expression, $F(1, 65) = 24.42$, $p < .001$, $\eta_p^2 = .27$, where attractive and happy faces were categorized faster than unattractive and angry faces. The main effects were qualified by three two-way interactions. The Sex × Attractiveness interaction, $F(1, 65) = 26.97$, $p < .001$, $\eta_p^2 = .29$, showed that attractive males were categorized faster than unattractive males, $t(65) = 6.47$, $p < .001$, and that there was no difference for attractive and unattractive females, $t(65) = 1.46$, $p = .149$. The Sex × Expression interaction, $F(1, 65) = 14.09$, $p < .001$, $\eta_p^2 = .18$, yielded a happy face advantage for the female faces, $t(65) = 5.41$, $p < .001$, and no difference in categorization times for the male faces, $t(65) = 0.12$, $p = .905$. The

Attractiveness × Expression interaction, $F(1, 65) = 19.33$, $p < .001$, $\eta_p^2 = .23$, demonstrated a happy face advantage for the attractive faces, $t(65) = 6.13$, $p < .001$, but no difference in categorization times for the unattractive faces, $t(65) = 0.78$, $p = .437$. The three-way Sex × Attractiveness × Expression interaction was not significant, $F(1, 65) = 0.34$, $p = .561$, $\eta_p^2 < .01$.



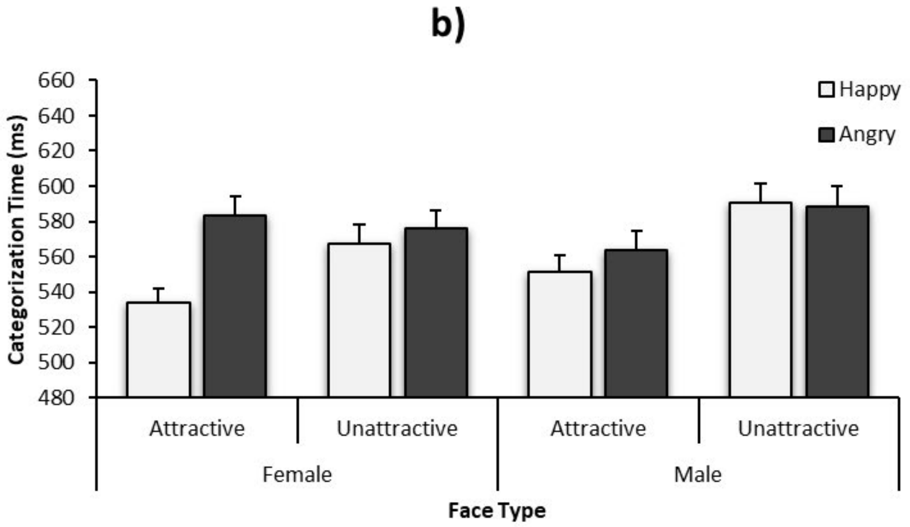




*Figure 1*. Categorization times for happy and angry expressions on female and male faces as a function of attractiveness in Experiment 1 (a) and in the combined analysis (b). Errors bars represent 1 *SEM*.

**Accuracy.** The pattern of results for the error rates (see Table 2) is in line with that of the categorization times. Main effects of sex, $F(1, 65) = 9.26$, $p = .003$, $\eta_p^2 = .13$, and attractiveness, $F(1, 65) = 11.02$, $p = .001$, $\eta_p^2 = .15$, demonstrated that fewer errors were made categorizing female and attractive faces compared to male and unattractive faces. The Sex × Attractiveness interaction, $F(1, 65) = 17.40$, $p < .001$, $\eta_p^2 = .21$, revealed that more errors were made categorizing the unattractive male faces than attractive male faces, $t(65) = 5.16$, $p < .001$, and there was no difference in error rates for attractive and unattractive female faces, $t(65) = 0.88$, $p = .383$. The Sex × Expression interaction, $F(1, 65) = 20.77$, $p < .001$, $\eta_p^2 = .24$, revealed that fewer errors were made categorizing happy than angry female faces, $t(65) = 3.24$, $p = .002$, and that fewer errors were made categorizing angry male faces compared to when they were happy, $t(65) = 3.81$, $p < .001$. The Attractiveness × Expression interaction, $F(1, 65) = 17.04$, $p < .001$, $\eta_p^2 = .21$, demonstrated a lower error rate for happy compared to angry attractive faces, $t(65) = 2.62$, $p = .011$, and a lower error rate for angry than happy unattractive faces, $t(65) = 3.48$, $p = .001$. The three-way Sex × Attractiveness × Expression interaction was not significant, $F(1, 65) = 0.03$, $p = .874$, $\eta_p^2 < .01$.

Table 2.

*Mean error percentages for categorizing happy and angry expressions on female and male faces as a function of attractiveness in Experiments 1-3.*

| | Female | | Male | |
|---|---|---|---|---|
| Experiment | Happy | Angry | Happy | Angry |
| Experiment 1 | | | | |
| Attractive | 2.40 (6.16) | 8.33 (8.65) | 5.18 (7.84) | 3.79 (5.10) |
| Unattractive | 4.67 (6.22) | 4.55 (8.03) | 12.75 (10.86) | 5.68 (7.18) |
| Experiment 2 | | | | |
| Attractive | - | - | 5.51 (4.95) | 6.09 (5.32) |
| Unattractive | 5.26 (4.62) | 6.28 (5.52) | - | - |
| Experiment 3 | | | | |
| Attractive | 2.84 (3.20) | 5.43 (4.85) | - | - |
| Unattractive | - | - | 8.21 (6.54) | 7.26 (7.64) |

*Note.* Values in parentheses represent 1 *SD*.

**Combined analysis.** The attractiveness effect on the happy face advantage observed by Lindeberg et al. (2019a), was replicated in the current experiment. The influence of sex on emotion categorization, as observed in previous research (e.g., Becker et al., 2007; Hugenberg & Sczesny, 2006), but which was not clearly evident when attractiveness was included as a factor in Lindeberg et al.'s (2019a) study, was also found in the present experiment. The current findings indicate that sex and attractiveness equally and independently influence the happy face advantage, in contrast to Lindeberg et al. (2019a) where attractiveness seemed to have a stronger influence. To examine these inconsistencies, the categorization data from the current experiment and from Experiment 3 and 4 from Lindeberg et al. (2019a), were combined in an overall mixed ANOVA with experiment as a between-subjects factor (see Figure 1b). Experiment did not moderate the theoretically relevant Sex × Expression, Attractiveness × Expression, or Sex × Attractiveness × Expression interactions and was therefore dropped from the current analysis and the subsequent Bayesian analysis. Both the Sex × Expression, $F(1, 181) = 12.52$, $p = .001$, $\eta_p^2 = .07$, and the Attractiveness × Expression, $F(1, 181) = 28.88$, $p < .001$, $\eta_p^2 = .14$, interactions were significant, demonstrating a happy face advantage for the female, $t(181) = 6.48$, $p < .001$, and attractive faces, $t(181) = 7.61$, $p < .001$, respectively, and no difference for the male, $t(181) = 1.11$, $p = .267$, and unattractive faces, $t(181) = 0.86$, $p = .393$. More interestingly, the Sex × Attractiveness × Expression interaction was significant, $F(1, 181) = 5.91$, $p = .016$, $\eta_p^2 = .03$. It is possible that the failure to see this interaction in the separate experiments was due to insufficient power. The follow-up comparisons demonstrate a happy face advantage for both the attractive female, $t(181) = 8.42$, $p < .001$, and attractive male faces, $t(181) = 2.16$, $p = .032$, however, the happy face advantage was significantly larger for the attractive females compared to the males, $t(181) = 4.45$, $p < .001$. There was no difference in categorization times for the happy and angry unattractive female, $t(181) = 1.54$, $p = .125$, and unattractive male faces, $t(181) = 0.30$, $p = .763$.

**Bayesian repeated measures ANOVA.** The combined ANOVA suggest that sex and attractiveness do interact in their influence on the happy face advantage. Bayesian analysis allows for comparison of the statistical models and is an appropriate way to test the relative influence of sex and attractiveness on the happy face advantage and if their influence is best explained by dominance of one cue, independent influences of both cues, or an interactive influence (Kass & Raftery, 1995; Rouder, Engelhardt, McCabe, & Morey, 2016). The combined data from the three experiments were therefore also submitted to a Bayesian repeated measures ANOVA with default priors, using JASP software package (JASP Team, 2018; Rouder, Morey, Speckman, & Province, 2012). A Bayes Factor (BF) is provided for each statistical model and indicates how much more likely that model is to explain the data in comparison to the null. The model which best fit the data is the one with the largest BF (Rouder et al., 2016). The interpretation conventions for BFs vary slightly but generally a BF between 1-3 is considered providing anecdotal evidence, a BF between 3-20 provides positive evidence, a BF between 20-150 offers strong evidence, and a BF larger than 150 provides very strong evidence for the alternative model over the null (see Kass & Raftery, 1995). The analysis yielded very strong evidence for all models which included any of the theoretically relevant interactions, all $BF_{10} > 2.32 \times 10^9$. The model including all three main effects, the three two-way interactions, and the three-way interaction best fitted the observed data, $BF_{10} = 7.88 \times 10^{26}$. This model was 1.57 times more likely to account for the data than the model with the second strongest support, which only differed from the first model in that it does not include the three-way interaction, $BF_{10} = 5.03 \times 10^{26}$. Thus, the Bayesian analyses indicate that sex and attractiveness may interact in their moderation of the happy face advantage. However, although the model including the three-way interaction is the best fit for the data, its comparison to the model which does not include the three-way interaction, is only regarded as providing anecdotal evidence in favor of the former over the latter.

## Experiment 2

In Experiment 2 we took another approach in our attempt to disentangle the relative contributions of sex and attractiveness on emotion categorization. The unattractive females and attractive males from Experiment 1 were presented together in an emotion categorization task. If sex is more salient as a moderator of emotion categorization compared to attractiveness, then we would expect to see a larger happy face advantage for the unattractive female faces than for the attractive male faces. On the other hand, as the attractive males are rated as more attractive than the unattractive females, $t(44) = 12.60$, $p < .001$, and if attractiveness has a stronger influence, then the reversed pattern should emerge, with a larger happy face advantage for the attractive male faces than for the unattractive female faces.

## Method

**Participants**. Sixty-six undergraduate students (50 female, $M = 21.77$ years, $SD = 5.20$ years) participated in the experiment for partial course credit. Forty-two participants identified themselves as Caucasian, ten as Asian, two as Indian, three as African, and nine as “other”.

**Stimulus materials, apparatus, procedure, and analysis.** Experiment 2 was identical to Experiment 1 except as follows. Only the six unattractive females and the six attractive males from Experiment 1 were included. The experiment thus included 24 pictures which were presented in blocks of 24. Each picture was presented four times, once in each block, in order to maintain a total of 96 trials in the emotion categorization task. Errors, invalid responses, and outliers, as defined for Experiment 1, comprised 6.47% of trials and were excluded from the response time analysis and included in the analysis of error rates. Attractiveness ratings, response times, and error rates were analysed with separate 2 (Face type: unattractive female vs. attractive male) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons. One participant with an error rate higher than 25% (51.04%) was excluded from analyses, however, preliminary analyses demonstrated that this exclusion did not alter the pattern of results.

## Results and Discussion

**Manipulation check.** One participant was considered not to have engaged in the rating task and was thus, excluded from analysis. Preliminary analysis before exclusion yielded the same pattern of results. Analysis confirmed the allocation of faces to conditions (see Table 1). Main effects of face type, $F(1, 64) = 79.05$, $p < .001$, $\eta_p^2 = .55$, and expression, $F(1, 64) = 168.28$, $p < .001$, $\eta_p^2 = .72$, confirmed that the attractive male and happy faces overall were rated as more attractive than the unattractive female and angry faces. The Face type × Expression interaction, $F(1, 64) = 7.37$, $p = .009$, $\eta_p^2 = .10$, demonstrated that faces with happy expressions were rated as more attractive than faces with angry expressions among both attractive males, $t(64) = 12.40$, $p < .001$, and unattractive females, $t(64) = 12.43$, $p < .001$, although, this difference was larger for attractive males, $t(64) = 2.71$, $p = .009$.

**Categorization times.** Figure 2 summarizes the categorization times for happy and angry expressions on unattractive females and attractive males. Happy faces were categorized faster than angry faces, $F(1, 64) = 10.48$, $p = .002$, $\eta_p^2 = .14$, and attractive male faces were categorized faster than unattractive female faces regardless of expression, $F(1, 64) = 5.39$, $p = .023$, $\eta_p^2 = .08$. The Face type × Expression interaction was not significant, $F(1, 64) < 0.01$, $p = .954$, $\eta_p^2 < .01$.

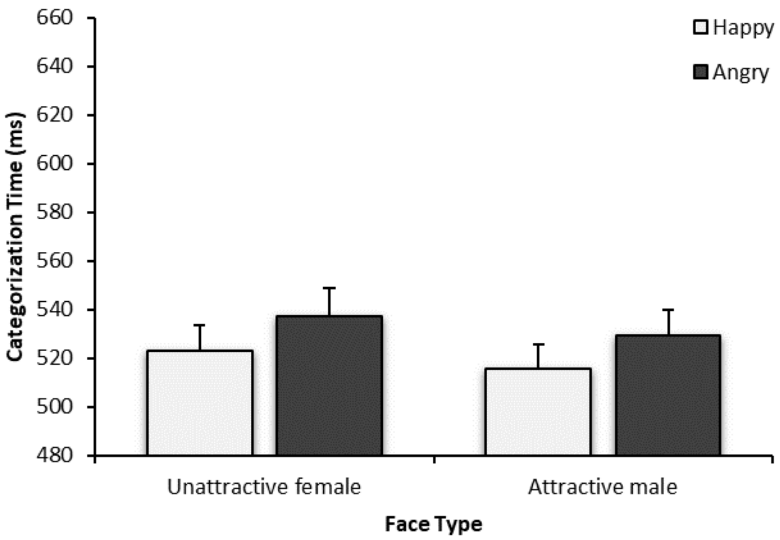



*Figure 2.* Categorization times for happy and angry expressions on unattractive female and attractive male faces in Experiment 2. Errors bars represent 1 *SEM*.

**Accuracy.** Analysis of error rates yielded no significant main effects or interaction, all $F$s$(1, 64) < 1.61$, $p$s $> .210$, $\eta_p^2 < .02$. Numerically, the pattern of error rates is consistent with that of the categorization times (see Table 2).

The lack of a Face type × Expression interaction indicated that neither sex nor attractiveness had a stronger influence on the happy face advantage than the other. Females are generally evaluated more favorably than males (Eagly, Mladinic, & Otto, 1991) and attractive people compared to unattractive people (Dion et al., 1972; Langlois et al., 2000). This relative positivity of females and attractiveness compared to males and unattractiveness, respectively, might have combined to change the overall evaluation of the faces to an equal degree, thus, rendering the unattractive females and attractive males similar in positivity. This could explain the absence of the Face type × Expression interaction.

## Experiment 3

It has been demonstrated that sex and race cues' influence on the happy face advantage is sensitive to the number of stimuli encountered in a task (Craig et al., 2012; Lipp, Karnadewi, et al., 2015). To rule out the possibility that the decrease in the number of different female and male faces which were presented could explain the absence of a Face type × Expression interaction in Experiment 2, the attractive females and unattractive males were instead included in an emotion categorization task. The task contained the same number of unique individuals and repetitions of each picture as in Experiment 2. If the change in stimulus set size accounted for the results, a replication of Experiment 2 is predicted. On the other hand, if the interaction of sex and attractiveness explained the results in Experiment 2, by altering the evaluation of the faces to a similar degree, the additive effect of two relatively positively evaluated cues for the attractive females compared to the unattractive males, should result in a happy face advantage for the attractive females and no difference for the unattractive males.

### Method

**Participants.** Sixty-six volunteers (55 female, *M* = 24.24 years, *SD* = 8.99 years) participated in the experiment for partial course credit or a small monetary compensation. Forty-five participants identified themselves as Caucasian, thirteen as Asian, two as African, and six as "other".

**Stimulus materials, apparatus, procedure, and analysis.** Experiment 3 was identical to Experiment 2 except for the face stimuli, which now included the six attractive female and the six unattractive male models from Experiment 1. Attractiveness ratings, response times, and error rates (5.93% of trials) were analysed with separate 2 (Face type: attractive female vs. unattractive male) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons. No participant met exclusion criteria.

### Results and Discussion

**Manipulation check.** Analysis confirmed the allocation of faces to conditions (see Table 1). Main effects of face type, $F(1, 65) = 95.60$, $p < .001$, $\eta_p^2 = .60$, and expression, $F(1, 65) = 186.98$, $p < .001$, $\eta_p^2 = .74$, confirmed that attractive female and happy faces overall were rated as more attractive than unattractive male and angry faces. The Face type × Expression interaction, $F(1, 65) = 62.08$, $p < .001$, $\eta_p^2 = .49$, reflected that faces with happy expressions were rated as more attractive than faces with angry expressions among both attractive females, $t(65) = 14.82$, $p < .001$, and unattractive males, $t(65) = 11.41$, $p < .001$, although, this difference was larger for attractive females, $t(65) = 7.88$, $p < .001$.

**Categorization times.** Figure 3 summarizes the categorization times for happy and angry expressions on attractive females and unattractive males. Main effects of expression, $F(1, 65) = 19.28$, $p < .001$, $\eta_p^2 = .23$, and face type, $F(1, 65) = 65.30$, $p < .001$, $\eta_p^2 = .50$, showed that happy and attractive female faces were categorized faster than angry and unattractive male faces. The main effects were qualified by the predicted Face type × Expression interaction, $F(1, 65) = 51.08$, $p < .001$, $\eta_p^2 = .44$, with a happy face advantage for attractive females, $t(65) = 8.79$, $p < .001$, and no difference in categorization times for happy and angry unattractive male faces, $t(65) = 1.11$, $p = .272$.

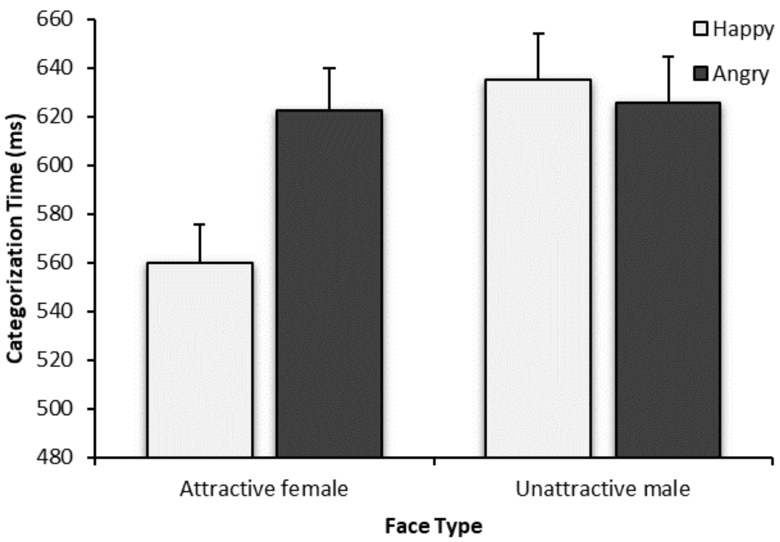



*Figure 3.* Categorization times for happy and angry expressions on attractive female and unattractive male faces in Experiment 3. Errors bars represent 1 *SEM*.

**Accuracy.** The pattern of results for the error rates (see Table 2) is in line with that of the categorization times, with a main effect of face type, $F(1, 65) =$

36.88, $p < .001$, $\eta_p^2 = .36$, indicating that fewer errors were made categorizing attractive females compared to unattractive males. The Face type × Expression interaction, $F(1, 65) = 5.43$, $p = .023$, $\eta_p^2 = .08$, reflected a lower error rate for happy compared to angry attractive females, $t(65) = 3.66$, $p = .001$, and no difference in error rates for happy and angry unattractive male faces, $t(65) = 0.76$, $p = .448$.

Experiment 3 clearly demonstrated a happy face advantage only for the attractive females and not the unattractive males. Thus, the change in stimulus set size is unlikely to explain the results of Experiment 2. The different results in Experiment 2 and 3 provide additional evidence that attractiveness influences the way sex moderates emotion categorization.

## General Discussion

The study aimed to investigate how sex and attractiveness together influence emotion perception. Experiment 1 indicated that sex and attractiveness independently and equally moderated emotion categorization, yielding a happy face advantage for female and attractive faces but not male and unattractive faces respectively. These results partially replicate Lindeberg et al.'s (2019a) findings, since they suggested that attractiveness had a stronger effect on emotion categorization than sex. When data from Experiment 1 were analysed together with those from two similar experiments from Lindeberg et al. (2019a), an interactive influence of sex and attractiveness was evident. A happy face advantage was observed for both the attractive females and attractive males, but it was larger for the attractive females, and no happy face advantage was observed for the unattractive females and males. Although the Bayesian analysis provided the strongest evidence for the statistical model which included the three-way interaction, the support for an interactive pattern over a model including independent influences of sex and attractiveness on emotion categorization is only anecdotal.

After first glance, the results from the combined analysis seem to suggest that attractiveness had a stronger influence than sex, since a significant happy face advantage emerged for the attractive females and attractive males, but not for the unattractive females (see also Experiment 2). However, inspection of the means suggests that there is no notable difference between the happy face advantages for the attractive males and unattractive females. Furthermore, if the effects of face sex and attractiveness were strictly additive, the largest happy face advantage should be observed for the group with two relatively positive cues, the attractive females. A smaller happy face advantage should be evident for the two groups with one relatively more and one relatively less positive cue, the attractive males and unattractive females, which between themselves should not differ in magnitude of the happy face advantage. These happy face advantages should, furthermore, both be larger than that for the group with two relatively less positively evaluated cues, the unattractive males. Again, inspection of the categorization times suggests this might not be the case. The magnitude of the happy face advantage for each of the four stimulus categories was, therefore, compared using paired-samples *t* tests. The happy face advantage for the attractive females was larger than that for the attractive males (see results of the combined analysis) and, as expected, larger than the happy face advantage for the unattractive females, $t(181) = 5.55$, $p < .001$, and unattractive males, $t(181) = 5.94$, $p < .001$. More interestingly, there was no difference in the magnitude of the happy face advantage for the attractive males and unattractive females, $t(181) = 0.43$, $p = .665$, which is inconsistent with a stronger influence of attractiveness compared to sex, but is consistent with an additive pattern. Furthermore, there was a marginal difference in the magnitude of the happy face advantage for the attractive and unattractive males, $t(181) = 1.90$, $p = .060$, but there was no difference between the happy face advantages for unattractive females and males, $t(181) = 1.20$, $p = .232$. This is inconsistent with an additive pattern. The evaluative congruence account predicts a larger happy face advantage for the more positively evaluated set of faces. If evaluations can account for the combined influence of sex and attractiveness on emotion categorization, it would conclude that the attractive females are evaluated as the most positive and that the effect of one positive cue in the presence of one relatively less positively evaluated cue, is negligible.

The results of Experiments 2 and 3, furthermore, provide evidence for the influences of both sex and attractiveness on emotion categorization. Experiment 2 directly tested the relative influence of sex and attractiveness. If either sex or attractiveness were more salient than the other, this would have been evident in a larger happy face advantage for the unattractive females if sex was most salient, and for the attractive males if attractiveness was most salient. Neither was observed. In contrast, and in line with the combined analysis, Experiment 3 demonstrated a large happy face advantage for the attractive females, faces with two favorably evaluated cues, when presented with the unattractive males. If attractiveness did not influence the way sex moderates emotion categorization, we should have observed a larger happy face advantage for the female faces in both Experiments 2 and 3. If sex did not have an influence on the way attractiveness moderates emotion categorization, we would have observed a larger happy face advantage for the attractive faces in both Experiments 2 and 3. The current results seem to suggest that the influences of sex and attractiveness on emotion categorization is interactive. Given the mixed findings of how two facial cues combine to influence emotion perception in previous research (Craig & Lipp, 2018b; Kang & Chasteen, 2009; Lindeberg et al., 2019a; Smith et al., 2017), further studies are needed to clarify what factors determine how different facial cues combine to moderate emotion perception.

The current data corroborate Lindeberg et al.'s (2019a) suggestion that the influence of attractiveness on emotion categorization might be stronger for female than male faces. If the influence of sex and attractiveness on emotion recognition is explained by the evaluative congruence account, the larger happy face advantage for the attractive females compared to the attractive males, would be due to the former being evaluated more favorably than the latter. It is, however, not yet possible to determine if this difference is due to the fact that attractive females in general are evaluated more favorably than attractive males, or if it can be attributed to the observed difference in the attractiveness ratings, where the attractive females depicted in the current experiments were rated as more attractive than the attractive males. A stimulus set matched on attractiveness across gender would be needed to determine the difference. It should however be noted that Experiment 2 demonstrates that a simple difference in rated attractiveness is not enough to drive the moderating influence on the happy face advantage. If differences in perceived attractiveness alone drove evaluations, a larger happy face advantage should have been observed for the attractive males when they were presented together with the unattractive females. It is possible that being attractive and female combines and renders the attractive females the most positively evaluated group.

The current findings are compatible with the evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006), but other accounts can potentially also accommodate the results. Stereotypes could have facilitated the recognition of stereotype congruent emotional expressions. We did not measure the specific stereotypes participants held regarding attractive females, attractive males, unattractive females, and unattractive males, and can therefore not rule out the possibility that stereotypes could explain how sex and attractiveness combine to influence emotion categorization. Such an account seems unlikely however, considering that previous research has not provided support for stereotypes as an explanation for the influence of social category cues on the happy face advantage (Craig, Koch, & Lipp, 2017; Craig & Lipp, 2018a; Craig, Zhang, & Lipp, 2017; Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lipp, Craig, & Dat, 2015), expect for situations when two negative emotions are displayed and categorized (Bijlstra et al., 2010). These data are also consistent with other studies finding evidence for the evaluative congruence account. For example, Lindeberg, Craig, and Lipp (2019b) demonstrated that recently learned individuating character information, an evaluative cue which is unlikely to be associated with stereotypes, moderated the happy face advantage in the same way as attractiveness and social category cues.

Another potential explanation for the current findings is based on Becker et al.'s (2007) argument that there is a structural overlap between facial features of anger and masculinity, and between features of happiness and femininity. These similarities are proposed to facilitate recognition of happiness on feminine faces and anger on masculine faces. Previous research has demonstrated that a structural overlap of facial sex cues and emotional expressions cannot adequately account for the observed effects of sex on the happy face advantage (Craig, Koch, & Lipp, 2017; Craig, Zhang, & Lipp, 2017; Lindeberg et al., 2019b; Lipp, Craig, & Dat, 2015). It is, however, possible that attractiveness enhances sex cues and therefore facilitates emotion recognition, which could potentially account for some discrepancies in previous research. It would mean that attractive females are perceived as more feminine than unattractive females, and attractive males are perceived as more masculine than unattractive males. However, given that a happy face advantage is observed for both the attractive females and attractive males, and that cues of femininity (but not masculinity) are proposed to facilitate recognition of happiness, an enhancement of sex cues cannot account for the observed findings. Lindeberg et al. (2019a) also explored this possibility and had the faces used in their and the current experiments rated on femininity/masculinity. They found that rated femininity/masculinity could explain the results for the female faces only. The attractive females were rated as more feminine than the unattractive females, but there was no difference in rated femininity for the attractive and unattractive males.

An attractiveness effect on emotion perception has been replicated in Lindeberg et al. (2019a) and in the present experiments. The robustness of the influence of attractiveness on emotion perception, and in relation to face sex, could be explored using less extremely attractive and unattractive faces in future studies. This would also reduce the perceptual contrast that may have been created with the current stimuli given that attractiveness is relative and evaluated contextually. It would also be interesting to use average/neutrally rated or androgynous faces as a comparison to the attractive and unattractive faces to determine whether being attractive or unattractive has a stronger influence on emotion perception than the other.

As mentioned by Lindeberg et al. (2019a), these findings have implications for emotion recognition studies where facial stimuli are used. It is possible that previous studies reporting on the influence of sex cues on emotion perception are confounded by differences in attractiveness and that effects may inadvertently be underestimated or exaggerated because of it. This seems likely considering that the female faces used in the current experiments were rated as more attractive than the male faces and these were selected in a pilot study which included most of the faces from three frequently used face databases (Ebner et al., 2010; Langner et al., 2010; Ma et al., 2015). Facial attractiveness should therefore be taken into consideration when selecting stimuli for emotion recognition studies. This would be aided if attractiveness ratings were included in the norming data for face databases. Furthermore, the current findings add to the broader face processing literature. Social category cues, such as sex, have long been assumed to be preferentially processed (e.g., Brewer, 1988), but the current results emphasize the importance of more situationally variable facial cues such as attractiveness as well. Even more so, they stress the importance of examining the influence of multiple facial cues on emotion perception concurrently.

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# Chapter 3

## 2:0 for the good guys: Character information influences emotion perception[7][8]



[8] These findings were presented at the 18th General Meeting of The European Association of Social Psychology in 2017.

## Abstract

Previous research has demonstrated that facial social category cues influence emotion perception such that happy expressions are categorized faster than negative expressions on faces belonging to positively evaluated social groups. We examined whether character information that is experimentally manipulated can also influence emotion perception. Across two experiments, participants learned to associate individuals posing neutral expressions with positive or negative acts. In a subsequent task, participants categorized happy and angry expressions of these same individuals as quickly and accurately as possible. As predicted, a larger happy face advantage emerged for individuals associated with positive character information than for individuals associated with negative character information. These results demonstrate that experimentally manipulated evaluations of an individual's character are available quickly and affect early stages of face processing. Emotion perception is not only influenced by preexisting attitudes based on facial attributes, but also by information about a person that has been recently acquired.

Every day around the world judges, jurors, and law enforcement officers are tasked with the role of detecting truth and lies, often relying on body language and facial expressions to do so. But are their judgements already biased? Can preexisting beliefs about whether someone is “good” or “bad” alone shift perception of emotional expressions?

Quickly and accurately perceiving others’ emotional expressions is critical in social interactions, but accumulating evidence indicates that emotion perception is biased by social information available from a face (e.g., Aguado, Garcia-Gutierrez, & Serrano-Pedraza, 2009; Hugenberg & Bodenhausen, 2003). For example, the happy face advantage, the finding that happy expressions are recognized more quickly than negative expressions like anger or disgust (Leppänen & Hietanen, 2003), is larger for female than male faces (e.g., Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007; Hugenberg & Sczesny, 2006) and own-race faces when categorized together with other-race faces (e.g., Hugenberg, 2005; Lipp, Craig, & Dat, 2015). Across a number of studies, it has been demonstrated that this bias is due to the evaluative congruence between preexisting attitudes about social attributes and emotional expressions. Social category cues are quickly extracted and evaluated prior to the expression judgement, providing an evaluative context in which the emotional expression is perceived. Positive expressions are recognized more quickly than negative expressions on relatively positively evaluated faces but not on relatively negatively evaluated faces (Bijlstra, Holland, & Wigboldus, 2010; Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lipp et al., 2015). This influence on emotion recognition is not limited to social category cues, but has recently been extended to facial attractiveness as well (Lindeberg, Craig, & Lipp, 2019).

To date, studies have shown that people’s preexisting positive and negative attitudes about social dimensions recognizable on a face can influence emotion perception, but in these studies, the “positive” or “negative” category was always confounded with the visual structural information present on the faces. Whether an influence of social evaluations on emotion perception can be observed while holding visual structural information constant and manipulating only the evaluation of the face is currently unknown. Furthermore, previous studies have focused on the influence of evaluations based on knowledge associated with social categories, whereas the current study addresses the question of whether evaluations based on knowledge about specific individuals moderates emotion categorization.

To test this, we experimentally manipulated the same faces to be evaluated as positive or negative by providing participants with character information. Participants then completed an emotion categorization task to detect the influence of these experimentally created evaluations on emotion perception. In line with the evaluative congruence account, it was predicted that the happy face advantage should be larger for faces associated with positive information than for faces associated with negative information. To determine the robustness of the phenomenon, Experiment 1, conducted in a laboratory setting, was replicated online in Experiment 2.

## Experiment 1

### Method

**Participants**. Reliable effects of facial attributes such as sex and race on the happy face advantage have been observed with around 30 participants (e.g., Lipp et al., 2015). Given that the effect of manipulating the valence of faces by personal information might be weaker, we oversampled. Forty-seven undergraduate students (39 female, $M$ = 20.17 years, $SD$ = 3.16 years) participated for partial course credit. Thirty-three participants identified themselves as Caucasian, four as Asian, three as Indian, one as African, and six as “other”.

**Stimulus materials and apparatus**. Photographs of eight male Caucasian models, each displaying a happy, angry, and neutral expression, were selected from the Radboud Faces Database (Langner et al., 2010; Models 5, 7, 9, 15, 23, 24, 33, and 71) and resized to 238 × 358 pixels. The experiment was run on a LED monitor with a resolution of 1,920 × 1,080 pixels and a refresh rate of 120 Hz, controlled by DMDX (Forster & Forster, 2003).

**Procedure**. Participants were tested individually or in small groups of no more than three, separated by partitions to minimize distraction. Participants were instructed to learn information about people. Eight short sentences providing character information, four negative (e.g., “*This is John. John was recently arrested and charged with drink driving after he crashed into another car holding a family of four”*) and four positive (e.g., “*This is Daniel. Daniel just spent his summer holiday volunteering with children in need in Indonesia”*), were paired with the models displaying a neutral expression. The valence associated with a particular model was counterbalanced across participants. The faces and information were presented for at least 6 s after which participants could press the space bar to move to the next screen. After the learning phase, we tested participants’ memory of the association between the faces and character information. For each face, participants were asked to indicate whether the person depicted did something good or bad using the left and right shift keys. Response mapping was counterbalanced across participants. Participants received feedback as to whether their responses were “correct” or “wrong”. This learning/test phase was completed three times in total.

After the learning phase, participants completed an emotion categorization task with pictures of the eight models displaying happy and angry expressions. Participants were instructed to categorize the facial expressions as happy or angry as quickly and accurately as possible, using the left and right shift keys. Response mapping was counterbalanced across participants. The task consisted of eight practice trials and 96 test trials. Face stimuli were presented one at a time in a randomized sequence in blocks of eight; each picture was thus presented six times. Before each face appeared, a fixation cross was presented centred on the screen for 500 ms, immediately followed by the face which was presented for 3,000 ms or until a response was made. The intertrial interval was 1,000 ms.

After completing the emotion categorization task, participant’s memory of the association between the faces and the valence of the character information was tested again. Participants also rated the neutral faces on pleasantness on a 7-point Likert scale in a randomized sequence to evaluate the effectiveness of the valence manipulation. The procedures were approved by the Curtin University Human Research Ethics Committee.

**Analysis**. Errors (i.e., incorrect button presses), invalid responses (i.e., trials with response times faster than 100ms), and outliers (i.e., response times which deviated from an individuals’ mean by more than 3 *SD*s) were excluded from the response time analysis (3.92% of trials). Additionally, participants with an error rate higher than 25% or a mean response time more than 3 *SDs* above the mean response time across all participants were excluded from analyses (no participant met exclusion criteria in Experiment 1). Mean response times and error rates were subjected to separate 2 (Character: positive vs. negative) × 2 (Expression: happy vs. angry) repeated measures analyses of variance (ANOVAs) with follow-up pairwise comparisons. Preliminary analyses including and excluding non-Caucasian participants yielded the same pattern of results for Experiments 1 and 2, so the results are reported including all participants. Participant gender was included as a between-subjects factor in preliminary analyses for Experiment 1 and 2, and did not moderate the theoretically relevant Character × Expression interaction and therefore, the results are reported collapsed across this factor.

**Results**

**Manipulation check**. To evaluate the effectiveness of the valence manipulation, we analyzed the accuracy of the good/bad judgements using a 2 (Character: positive vs. negative) × 4 (Block: 1 - 4) repeated measures ANOVA. This yielded a main effect of block, $F(3, 44) = 18.60$, $p <. 001$, $\eta_p^2 = .56$, which demonstrated that performance improved from Block 1 (accuracy 73.14%) to Block 2 (85.11%), $t(46) = 4.29$, $p <. 001$, and from Block 2 to Block 3 (92.55%), $t(46) = 3.79$, $p <. 001$. Importantly, there was no difference between Block 3 (before the emotion categorization task) and Block 4 (after the emotion categorization task, 90.69%), $t(46) = 1.10$, $p = .279$. There was no main effect of character, $F(1, 46) = 0.02$, $p = .881$, $\eta_p^2 < .01$, or Character × Block interaction, $F(3, 44) = 0.79$, $p = .508$, $\eta_p^2 = .05$, indicating that participants learnt the positive and negative associations equally well. Faces associated with positive information ($M = 4.16$, $SD = 0.95$) were rated as more pleasant than faces associated with negative information ($M = 3.52$, $SD = 0.79$), $t(46) = 4.34$, $p < .001$, indicating that the explicit face valence was manipulated successfully.

**Emotion categorization times**. As depicted in Figure 1a, the manipulated face valence influenced how quickly emotional expressions were categorized. Happy faces were categorized faster than angry faces, $F(1, 46) = 11.16$, $p = .002$, $\eta_p^2 = .20$, but this main effect was qualified by the predicted Character × Expression interaction, $F(1, 46) = 6.09$, $p = .017$, $\eta_p^2 = .12$. Follow-up comparisons demonstrate a happy face advantage for the faces associated with positive character information, $t(46) = 4.00$, $p < .001$, but not for the faces associated with negative character information, $t(46) = 0.64$, $p = .524$.

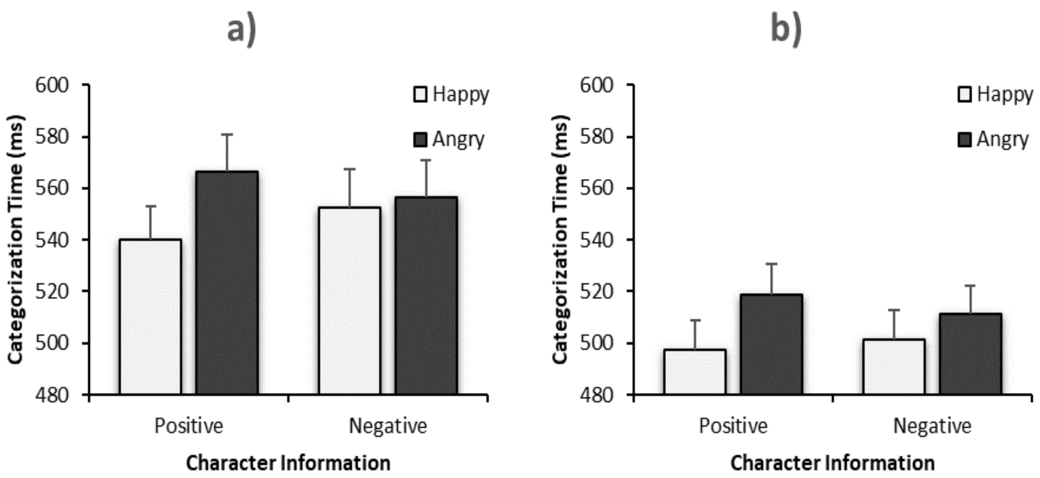


*Figure 1*. Categorization times for happy and angry expressions as a function of the character information provided in Experiment 1 (a) and Experiment 2 (b). Error bars represent 1 *SEM*.

**Accuracy**. Analysis of error rates yielded no significant main effects or interaction, all *F*s(1, 46) < 3.23, *p*s > .079, $\eta_p^2$ < .07. Numerically, the pattern of error rates is consistent with the categorization times (Table 1).

Table 1.

*Mean error percentages for categorizing happy and angry expressions as a function of the character information provided in Experiments 1 and 2*.

| Experiment | Happy | Angry |
|---|---|---|
| Experiment 1 | | |
| Positive | 3.37 (3.32) | 4.34 (4.51) |
| Negative | 3.55 (4.43) | 4.43 (5.02) |
| Experiment 2 | | |
| Positive | 5.05 (4.76) | 6.01 (5.31) |
| Negative | 5.45 (5.75) | 3.37 (4.21) |

*Note*. Values in parentheses represent 1 *SD*.

## Experiment 2

### Method

**Participants**. Fifty-four participants (28 female, *M* = 38.35 years, *SD* = 10.89 years) were recruited from Amazon Mechanical Turk and received 3.60 USD for completing the experiment. Forty-one participants identified themselves as White/Caucasian, five as Black/African American, two as Hispanic, five as Asian, and one as "other".

**Stimulus materials, procedure, and analysis**. Experiment 2 was identical to Experiment 1 except as follows. The experiment was run online using Millisecond's Inquisit 4 Web (Inquisit, 2015) which resulted in some minor stylistic changes throughout the experiment. Error feedback was provided during the practice trials in the emotion categorization task to ensure participants learnt the response mapping in the absence of the experimenter. The *S* and *L* keys were used as the response keys and reminders of which key was assigned to "happy" or "angry" judgements were displayed throughout the task on the corresponding sides of the screen. Errors, invalid responses, and outliers, as defined for Experiment 1, comprised 4.90% of trials and were excluded from analysis of the response times. Data were analysed as described above. Two participants with a mean response time more than 3 *SDs* above the mean across all participants ($M$ = 978 and 1,037 ms respectively) were excluded from analyses. Preliminary analyses including these participants yielded the same pattern of results.

**Results**

**Manipulation check.** As in Experiment 1, performance on the memory task improved across blocks, $F(3, 51) = 20.74$, $p < .001$, $\eta_p^2 = .55$, with an increase in accuracy from Block 1 to Block 2, $t(53) = 4.39$, $p < .001$, and from Block 2 to Block 3, $t(53) = 4.13$, $p < .001$. Again, there was no difference between Blocks 3 and 4, before and after the emotion categorization task, $t(53) = 1.43$, $p = .159$. The Character × Block interaction, $F(3, 51) = 3.26$, $p = .029$, $\eta_p^2 = .16$, reflected that participants learned the negative information (accuracy 80.09%) better than the positive information (68.98%) in Block 1, $t(53) = 2.61$, $p = .012$. There was no difference in accuracy in Blocks 2 (positive: 88.89%, negative: 82.87%), $t(53) = 1.72$, $p = .091$, Block 3 (positive: 92.13%, negative: 93.98%), $t(53) = 0.73$, $p = .470$, or Block 4 (positive: 90.74%, negative: 91.67%), $t(53) = 0.33$, $p = .742$. Faces associated with positive information ($M = 4.11$, $SD = 1.09$) were again rated as more pleasant than faces associated with negative information ($M = 3.50$, $SD = 0.95$), $t(53) = 3.68$, $p = .001$, confirming that the manipulation of explicit face valence was successful.

**Emotion categorization times**. As depicted in Figure 1b, the manipulated valence of the faces affected the emotion categorization speed. Happy faces were categorized faster than angry faces, $F(1, 51) = 15.74$, $p < .001$, $\eta_p^2 = .24$, and this main effect was again qualified by the predicted Character × Expression interaction, $F(1, 51) = 8.25$, $p = .006$, $\eta_p^2 = .14$. A happy face advantage was evident for both the faces associated with positive, $t(51) = 4.22$, $p < .001$, and negative character information, $t(51) = 2.69$, $p = .010$, however, the happy face advantage was larger for the faces associated with positive character information.

**Accuracy**. The error rates (see Table 1) show a pattern similar to the categorization times. The Character × Expression interaction, $F(1, 51) = 4.98$, $p = .030$, $\eta_p^2 = .09$, emerged as participants were more accurate categorizing angry than happy faces associated with negative character information, $t(51) = 2.11$, $p = .040$, but not with positive character information, $t(51) = 1.08$, $p = .286$.

**Combined analysis**. To summarize the findings from Experiments 1 and 2, we conducted fixed effects mini meta-analyses for the emotion categorization times and error rates separately using the Metafor package 1.9-9 (Viechtbauer, 2010) in R 3.5.1 (R Core Team, 2018). For the categorization times, a happy face advantage was evident for faces associated with positive, mean weighted $d_z = 0.58$, 95% CI [0.36-0.79], $SE = 0.11$, $z = 5.30$, $p < .001$, and negative character information, mean weighted $d_z = 0.23$, 95% CI [0.03-0.43], $SE = 0.10$, $z = 2.27$, $p = .023$, but the advantage was larger for faces associated with positive character information, $d_z = 0.37$, 95% CI [0.17-0.58], $SE = 0.10$, $z = 3.60$, $p < .001$. The combined effect for the error rates was not significant for faces associated with positive, mean weighted $d_z = 0.16$, 95% CI [-0.03-0.36], $SE = 0.10$, $z = 1.63$, $p = .104$, or with negative character information, mean weighted $d_z = -0.06$, 95% CI [-0.26-0.14], $SE = 0.10$, $z = -0.54$, $p = .588$.

## General Discussion

Across two experiments, provision of character information to experimentally manipulate evaluations of faces moderated emotion perception. Consistent with the evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006), we observed a happy face advantage for faces associated with positive character information, and a reduced or absent happy face advantage for faces associated with negative character information.

As mentioned above, previous studies of the effect of social category cues on emotion perception cannot completely rule out stimulus artifacts as the faces used are evaluated more or less positively based on interpretation of facial cues. For instance, it is possible that the way females express emotions differs from males or that structural differences between female and male, or own- and other-race faces introduce the observed bias in emotion perception (although see Craig, Koch, & Lipp, 2017; Craig, Zhang, & Lipp, 2017; Lipp et al., 2015). In the present study, the same faces were manipulated to be evaluated positively or negatively across participants and we demonstrate for the first time that the influence of evaluations on emotion recognition is independent of the unique qualities of the face.

This finding is consistent with recent person perception models (Freeman & Ambady, 2011) which propose that top-down knowledge influences recognition of social information like emotional expressions. Although Freeman and Ambady (2011) did not specifically identify character information as a source of top-down knowledge, the current results demonstrate that such information modulates emotion categorization. This finding could be considered a demonstration of how top-down knowledge about a person interacts with bottom-up information to influence emotion perception and is consistent with the model.

The factors that moderate emotion perception seem to be broader than initially thought and not limited to evaluations primed by facial social category cues. The present study supports the premise that it is the overall evaluation of a particular individual, which is determined by the salient evaluative information available at any given time, which influences emotion perception. Moreover, we demonstrate for the first time that this top-down knowledge about an individual’s character, and not only knowledge related to their social group, is available early enough to influence emotion perception.

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# Chapter 4

## Happy to belong: Minimal group membership moderates emotion perception for both racial ingroup and outgroup faces[9]

[9] These findings were presented at the Society for Personality and Social Psychology Annual Convention in 2019, https://osf.io/hjgd4/. Data from Experiments 2 and 3 are available from https://osf.io/y7mej/.

**Abstract**

Happy expressions are categorized faster than negative expressions. This happy face advantage is moderated by social category cues in evaluatively congruent ways, and is larger for relatively positively evaluated faces. We examined whether randomly assigning faces in- or outgroup status is sufficient to influence the speed and accuracy of emotion recognition. In three experiments, following a minimal group manipulation, Caucasian and/or Middle Eastern faces were categorized as happy and angry as quickly and accurately as possible. Consistent with the evaluative congruence account, a larger happy face advantage was predicted for minimal ingroup faces compared to minimal outgroup faces. As predicted, minimal group membership was sufficient to elicit an evaluative bias in emotion categorization for both racial in- and outgroup faces separately. When Caucasian and Middle Eastern faces were presented in the same task, race and minimal group status moderated the happy face advantage independent of each other, but with a stronger effect of race. The happy face advantage was evident for Caucasian faces, but not for Middle Eastern faces, and was larger for minimal ingroup faces than for minimal outgroup faces. The results strengthen the proposition that evaluations, and not stimulus driven factors or stereotypes, drive the influence of social information on emotion perception since minimal group membership is neither communicated via facial cues nor associated with stereotypes.

We are constantly decoding facial expressions of people around us, which provides us with an indication of a person's feelings and intentions, information that could be utilized to facilitate social interaction. Emotion perception has, however, been demonstrated to be quite malleable and is influenced by facial information signalling social category membership like sex (e.g., Atkinson, Tipples, Burt, & Young, 2005), race (e.g., Hugenberg & Bodenhausen, 2003), and age (e.g., Craig & Lipp, 2018a), or by perceptions of attractiveness (Lindeberg, Craig, & Lipp, 2019a). An effective method for examining how social category cues influence emotion perception is provided by a speeded two-choice emotion categorization task. Faces, varying on the social category dimension of interest and emotional expression, are presented one at a time and participants are tasked with identifying the emotional expression as quickly and accurately as possible. The general effect in this paradigm is that participants are faster and more accurate to recognize happy expressions as happy than angry expressions as angry. Similar results have been found for other negative and neutral expressions as well (e.g., Leppänen & Hietanen, 2003). Interestingly, this happy face advantage is influenced by facial cues communicating social category information. The happy face advantage is larger or only observed for female faces when they are presented in the same experiment as male faces (Aguado, García-Gutierrez, & Serrano-Pedraza, 2009; Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007; Bijlstra, Holland, & Wigboldus, 2010; Craig, Koch, & Lipp, 2017; Craig & Lipp, 2017; Craig, Zhang, & Lipp, 2017; Hugenberg & Sczesny, 2006; Lipp, Craig, & Dat, 2015; Lipp, Karnadewi, Craig, & Cronin, 2015), for own-race faces when they are categorized together with other-race faces (Bijlstra et al., 2010; Craig, Koch, & Lipp, 2017; Craig, Mallan, & Lipp, 2012; Hugenberg, 2005; Lipp, Craig, & Dat, 2015), and for attractive faces compared to unattractive faces (Lindeberg et al., 2019a). There have been a number of different mechanisms proposed to explain the influence of this social information on emotion recognition; perceptual similarity, stereotype congruence, and evaluative congruence (Becker et al., 2007; Bijlstra et al., 2010; Hugenberg, 2005; Hugenberg & Sczesny, 2006).

The perceptual similarity account relies on the similarity between the features that signal emotional expressions and social category information. For instance, features that make a face happy are said to be more feminine whereas features that make a face angry overlap with masculinity (see Becker et al., 2007). This stimulus driven account is unlikely to provide a comprehensive explanation of the influence of social information on emotion recognition as Lipp, Craig, and Dat (2015; also see Craig, Koch, & Lipp, 2017; Lindeberg et al., 2019a) demonstrated that the size and presence of the happy face advantage for the same set of male Caucasian faces was dependent on the other faces that were presented in the same task. The happy face advantage was observed for male Caucasian faces when they were presented with male other-race (African-American) faces, but absent when these same faces were presented with own- or other-race female faces. The stereotype account proposes that stereotypes about social groups facilitate categorization of stereotype congruent expressions. This account also cannot explain the observed effects of social category cues on the happy face advantage as the same effects have been observed for a range of negative expressions regardless of whether the negative expression was congruent with social group stereotypes (Bijlstra et al., 2010; Hugenberg, 2005; Hugenberg & Sczesny, 2006).

The evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006) seems to offer the most comprehensive explanation for the influence of social category cues on the happy face advantage. This account proposes that faces are evaluated based on their social category membership, as signalled by facial cues. These evaluations can facilitate or inhibit emotion categorization depending on the congruence between the valence of the social category and the emotional expression. As Lipp, Craig, and Dat (2015) demonstrated, the social cues are not evaluated in absolute terms, but in relation to the social cues they are contrasted with and thus, their effects are context dependent. A larger happy face advantage is observed for the category of faces that is evaluated as relatively more positive.

Lindeberg, Craig, and Lipp (2019b) demonstrated that face valence does not have to be communicated through visual cues available on the face nor does it need to be associated with social groups. They manipulated the valence of individuals by providing character information that was clearly positive or negative. A larger happy face advantage was observed for faces of Caucasian males associated with positive character information than for faces of Caucasian males associated with negative information.

In the current study, we wanted to further Lindeberg et al.'s (2019b) conceptual extension of how evaluative information moderates emotion categorization, by examining whether recently acquired knowledge about a person's group membership, as opposed to character information, would elicit a comparable evaluative bias. Similar to Lindeberg et al. (2019b), this information will not be communicated by facial cues thus, ruling out the possibility of results being confounded by facial structural information. This is something previous studies examining group differences regarding sex, race, and age, have not been able to do. It will also be possible to determine whether evaluations triggered by a person's in- or outgroup status alone are sufficient to elicit the evaluative bias since no other previous knowledge about the person is provided. To achieve this, a minimal group manipulation will be used.

The minimal group manipulation involves creating new artificial groups within the experimental context (e.g., Tajfel, Billig, Bundy, & Flament, 1971). This can be done in a number of different ways, for example by randomly assigning participants to groups based on a bogus personality test (Bernstein, Young, & Hugenberg, 2007; Young & Hugenberg, 2010). All methods have in common, that participants are randomly assigned to a group that has no prior meaning. Previous studies have demonstrated that ingroup status alone results in participants evaluating ingroup members more favorably than outgroup members (e.g., Brewer, 1979). If we observe a larger happy face advantage for ingroup members compared to outgroup members, it will provide evidence that mere group membership is sufficient to influence emotion perception. It will also provide further support for the evaluative congruence account as an explanation for how social information moderates emotion perception since group membership is the sole source of evaluative information, as minimal groups are not associated with established stereotypes nor communicated via facial cues.

Previous findings from related paradigms utilizing a minimal group manipulation, have shown that ingroup status alone can alter face processing. For instance, participants were better at recognizing faces of ingroup members compared to outgroup members (Bernstein et al., 2007; also see Van Bavel, Packer, & Cunningham, 2011) and more likely to categorize angry compared to happy faces as belonging to an outgroup than ingroup (Dunham, 2011). Participants also judged ingroup members facial expressions as more positive than outgroup members expressions (Lazerus, Ingbretsen, Stolier, Freeman, & Cikara, 2016) and were more accurate identifying the emotional expression on ingroup than outgroup faces when discriminating amongst five different emotional expressions (Young & Hugenberg, 2010). Utilizing a similar minimal group manipulation to Bernstein et al. (2007) and

Young and Hugenberg (2010), we examine whether minimal group membership also can modulate the speed and accuracy of recognising particular emotional expressions in line with the evaluative congruence account.

The present series of experiments has two aims. Firstly, to establish if randomly assigning faces in- or outgroup status is sufficient to elicit an evaluative bias that influences emotion recognition. In two experiments, following a minimal group manipulation, Caucasian or Middle Eastern faces are presented in an emotion categorization task. Consistent with the notion that emotion recognition can be affected by arbitrarily assigned group membership, a larger happy face advantage is hypothesized for ingroup faces than for outgroup faces, regardless of ethnicity. Secondly, we wanted to examine whether this newly acquired ingroup membership would be salient enough to override the a-priori race bias that has been shown in the emotion categorization task (e.g., Bijlstra et al., 2010; Hugenberg, 2005). In Experiment 3, Caucasian and Middle Eastern faces are therefore presented together in the same task.

## Experiment 1a

### Method

**Participants.** Reliable effects of race and sex on the happy face advantage are observed with approximately 30 participants (e.g., Hugenberg, 2005; Lipp, Craig, & Dat, 2015). Furthermore, Bernstein et al. (2007) and Young and Hugenberg (2010) found minimal group effects in related tasks using a similar minimal group manipulation as the present experiments with 20-40 participants. If ingroup status alone is sufficient to elicit an evaluative bias in emotion categorization, we wanted to maximize our chances of finding it, thus, a conservative approach was taken and we aimed to recruit around 100 participants for Experiments 1a and 1b. Ninety-six undergraduate students (91 female, $M$ = 22.19 years, $SD$ = 7.28 years) participated in Experiment 1a for partial course credit. Sixty-five participants identified themselves as Caucasian, fifteen as Asian, five as Indian, five as African, and six as “other”.

**Stimulus materials and apparatus.** Photographs of eight male Caucasian models, each displaying a happy, angry, and neutral expression, were selected from the Radboud Faces Database (Langner et al., 2010; Models 5, 7, 9, 15, 23, 24, 33, and 71) and resized to 238 × 358 pixels. Each picture was dropped on both a green and an orange background. The experiment was run on a LED monitor with a resolution of 1,920 × 1,080 pixels and a refresh rate of 120 Hz, and controlled by DMDX (Forster & Forster, 2003).

**Procedure.** Participants were tested in groups of no more than four with partitions separating them. Group membership was created using Gosling, Rentfrow, and Swann's (2003) Ten-Item Personality Inventory. One item was presented at a time and responses were made on a 7-point Likert scale which indicated the degree of agreement with each statement. When complete, participants were told to wait while their answers were being processed. After a 15 second delay, they were informed that their personality type was either "Green" or "Orange", accompanied by a picture demonstrating the color, and that they would be provided with a description of their personality type at the end of the experiment. Participants were randomly assigned to either the Green or Orange personality type and their responses to the personality test were not analyzed.

To increase the salience of the manipulation, participants were instructed to categorize faces based on whether they had the same personality type as them, in a task where the background color in the face photographs indicated that individual's personality type. Each individual was only presented on one background color for each participant. Four individuals were presented on the green background and the other four on the orange background. Color assignment for the individuals was counterbalanced across participants. Each individual with a neutral expression was categorized based on their group membership with the labels "My group" or "Not my group" displayed in the upper right and left corner of the screen respectively, using the corresponding right or left shift keys. In the first block, each individual was categorized once with feedback, as to whether their responses were "correct" or "wrong". In the second block, after reading the instructions again, each individual was categorized three times without feedback. Faces were presented one at a time in a randomized sequence in blocks of eight.

Participants subsequently completed an emotion categorization task. Pictures of the same eight individuals with the same background color as in the group categorization task, displaying happy and angry expressions, were categorized as quickly and accurately as possible by their emotional expression. The task consisted of eight practice trials and 96 test trials. Faces were presented one at a time in a randomized sequence in blocks of eight, with each individual presented once in each block. Four of the pictures displayed happy expressions (two green and two orange) and the other four displayed angry expressions (two green and two orange). Each picture was presented six times in total. On each trial, a fixation cross was presented for 500 ms, followed by the face which was presented for 3,000 ms or until a response was made. Responses were made using the right or left shift keys, with response mapping counterbalanced across participants. The intertrial interval was 1,000 ms.

After completion of the emotion categorization task, the faces with a neutral expression on the same background color as in previous tasks, and the green and orange colors were rated on pleasantness on a 7-point Likert scale to evaluate the effectiveness of the minimal group manipulation. Participants also categorized the neutral faces by their group membership again, but now without the background color to assist them. This was to examine whether they explicitly remembered which individual belonged to which group. The procedures were approved by the Curtin University Human Research Ethics Committee.

**Analysis.** Mean response times and error rates from the emotion categorization task were subjected to separate 2 (Group: ingroup vs. outgroup) × 2 (Expression: happy vs. angry) repeated measures analyses of variance (ANOVAs) with follow-up pairwise comparisons. Three participants misremembered the response mapping of which button was assigned to happy and angry faces (100, 100, and 95% error rates respectively). Their responses were reversed and included in the analysis, however, preliminary analysis excluding these participants yielded the same pattern of results. Responses which deviated more than 3 *SDs* from each participant's mean response time were coded as outliers and were removed from analysis of response times, together with incorrect responses and invalid responses, which were defined as response times faster than 100 ms. These trials were included in the analysis of error rates (4.24% of trials). Furthermore, participants with a higher than 25% error rate or a mean response time more than 3 *SDs* above the mean response time across all participants were excluded from analyses. One participant with a mean response time more than 3 *SDs* above the mean response time across all participants ($M$ = 880 ms) was excluded from analyses. The exclusion did not alter the pattern of results. Preliminary analyses excluding non-Caucasian participants were conducted for all experiments and yielded the same pattern of results, therefore, the results are reported including all participants. Participant gender was included as a between-subjects factor in preliminary analyses for all experiments. Unless reported, participant gender did not significantly moderate any of the results and the results are reported collapsed across this factor.

## Results and Discussion

**Manipulation checks.** There was no difference in pleasantness ratings (see Table 1) for in- and outgroup faces, $t(95) = 0.67$, $p = .506$, indicating that the minimal group manipulation did not change explicit evaluations of the faces. This result did not change when the 18 participants who provided the same response for all faces were removed from analysis (suggesting they did not engage in the task). Participants tended to rate the color signalling ingroup membership as more pleasant than the color signalling outgroup membership, $t(95) = 1.84$, $p = .069$.

The accuracy of group categorization was analyzed with a 2 (Group: ingroup vs. outgroup) × 3 (Block: 1-3) repeated measures ANOVA. A main effect of block, $F(2, 94) = 155.32$, $p < .001$, $\eta_p^2 = .77$, demonstrated that there was no difference in performance between Block 1 (accuracy 95.83%) and Block 2 (95.66%), $t(95) = 0.16$, $p = .874$. There was, however, a decline in performance from Block 2 to Block 3 (56.51%), after the emotion categorization task when participants did not have the background color to assist them, $t(95) = 17.33$, $p < .001$. The main effect of group, $F(1, 95) = 18.43$, $p < .001$, $\eta_p^2 = .16$, was further qualified by a Group × Block interaction, $F(2, 94) = 6.68$, $p = .002$, $\eta_p^2 = .12$. There was no difference in accuracy for in- and outgroup faces in Block 1 (ingroup: 95.05%, outgroup: 96.61%), $t(95) = 1.10$, $p = .276$, or in Block 2 (ingroup: 95.05%, outgroup: 96.27%), $t(95) = 1.62$, $p = .109$. In Block 3, participants were more accurate categorizing outgroup faces (65.63%) than ingroup faces (47.40%), $t(95) = 4.00$, $p < .001$. One sample t-tests revealed that accuracy for ingroup faces in Block 3 did not differ from chance performance, $t(95) = 0.80$, $p = .423$, but was better than chance for outgroup faces, $t(95) = 5.44$, $p < .001$.

Table 1.

*Pleasantness ratings for Caucasian and Middle Eastern faces and colors as a function of minimal group membership in Experiments 1-3.*

| Experiment | Caucasian | Middle Eastern | Color |
|---|---|---|---|
| Experiment 1a | | | |
| Ingroup | 4.02 (0.84) | | 4.90 (1.46) |
| Outgroup | 4.08 (0.75) | | 4.47 (1.55) |
| Experiment 1b | | | |
| Ingroup | | 4.17 (0.59) | 4.98 (1.20) |
| Outgroup | | 4.08 (0.71) | 4.35 (1.30) |
| Experiment 2 | | | |
| Ingroup | 4.12 (0.94) | | 5.14 (1.36) |
| Outgroup | 4.04 (0.97) | | 4.30 (1.58) |
| Experiment 3 | | | |
| Ingroup | 4.15 (0.99) | 4.18 (1.01) | 5.04 (1.34) |
| Outgroup | 4.01 (0.99) | 4.06 (1.01) | 4.27 (1.51) |

*Note.* Values in parentheses represent 1 *SD*.

**Emotion categorization times.** Figure 1a summarizes the categorization times for happy and angry faces as a function of minimal in- and outgroup status. Analysis only yielded a main effect of expression, $F(1, 94) = 23.04$, $p < .001$, $\eta_p^2 = .20$, demonstrating that happy faces were categorized faster than angry faces regardless of group membership. The predicted Group × Expression interaction was not significant, $F(1, 94) = 2.70$, $p = .104$, $\eta_p^2 = .03$.

**Accuracy.** Analysis of error rates (see Figure 1b) indicated that group membership interacted with the categorization of facial expressions. Fewer errors were made categorizing happy than angry faces, $F(1, 94) = 4.07$, $p = .046$, $\eta_p^2 = .04$, but this effect was qualified by a Group × Expression interaction, $F(1, 94) = 6.63$, $p = .012$, $\eta_p^2 = .07$. Follow-up comparisons revealed that fewer errors were made for happy ingroup faces than angry ingroup faces, $t(94) = 3.55$, $p = .001$. There was no difference in error rates for happy and angry outgroup faces, $t(94) = 0.65$, $p = .518$.

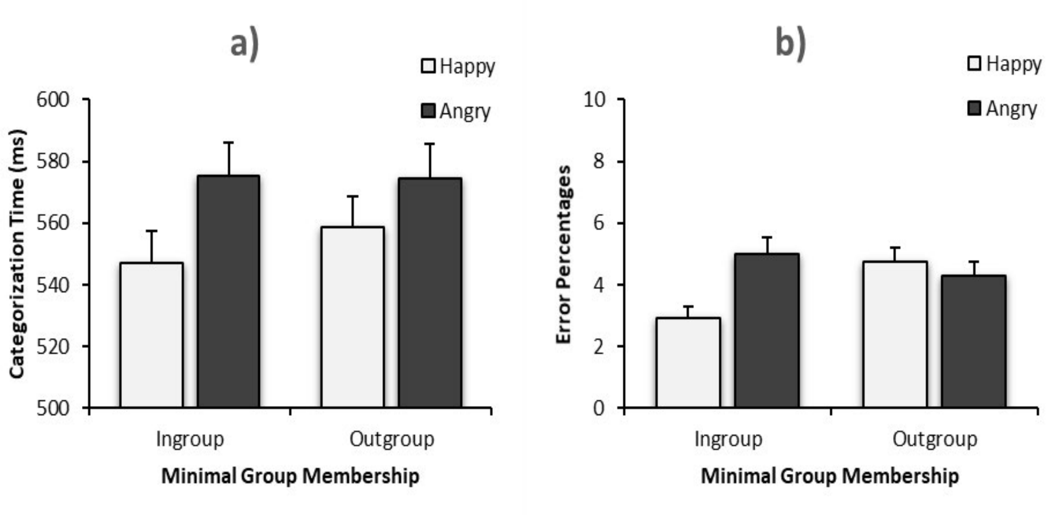


*Figure 1*. Categorization times (a) and error rates (b) for happy and angry expressions on Caucasian faces as a function of minimal group membership in Experiment 1a. Errors bars represent 1 *SEM*.

The primary dependent measure of interest in this study is categorization time, but the error rates are also informative as response speed and accuracy generally covary, that is, the influence of social context on emotion recognition can also be observed in error rates. Although the Group × Expression interaction was not significant for the categorization times, the error data indicate that mere group membership does moderate emotion categorization. The interactive effect demonstrated in the error data is in line with the influence of social category cues on emotion categorization that has been observed in previous studies (e.g., Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lindeberg et al., 2019a). This supports the evaluative congruence account as an explanation for previous and current findings as opposed to mechanisms that rely on visual stimulus properties or stereotype congruence, as minimal groups are neither associated with stereotypes nor communicated via facial cues.

Although the moderation of emotion recognition was not as clear as in previous research with social groups, we did demonstrate that group status alone is sufficient to influence the processing of emotional expressions. Initial group status may influence the ease of manipulating evaluations about people based on their group membership. It might be harder to change the evaluations and group status of initial ingroup members, for them to be perceived as part of an outgroup, than to include previous outgroup members in our ingroup. To explore this possibility, Experiment 1a was replicated with racial outgroup faces.

## Experiment 1b

A minimal group effect on the happy face advantage was observed in the error data for Caucasian male faces in Experiment 1a. As we are unaware of a prior study that assessed the effect of minimal groups in racial ingroup and outgroup faces separately, it is unknown whether the minimal group effect would be expected to be the same, larger or smaller for a-priori racial outgroup faces than for racial ingroup faces. Studies which have included both racial in- and outgroup faces in the same experiment have demonstrated that minimal group membership can influence implicit evaluations of both racial ingroup and outgroup faces (Contreras-Huerta, Baker, Reynolds, Batalha, & Cunnington, 2013; Van Bavel & Cunningham, 2009, 2012). Before extending our results and examine how face race and minimal group membership might interact to moderate the happy face advantage, we deemed it important to establish whether a minimal group effect on the happy face advantage would be observed with racial outgroup faces. Experiment 1b was therefore, designed to examine whether the results from Experiment 1a extend to racial outgroup faces. We chose to replicate the experiment with another racial group to investigate if initial ingroup or outgroup status matters when manipulating minimal group membership. If mere ingroup status is sufficient to produce an evaluative bias with racial outgroup faces, a larger happy face advantage is predicted in categorization times or error rates for minimal ingroup faces compared to minimal outgroup faces. In line with Experiment 1a, following the minimal group manipulation, happy and angry Middle Eastern faces were categorized by their emotional expression.

### Method

**Participants.** For Experiment 1b, we aimed to collect around 100 Caucasian participants because we anticipated that participant ethnicity might have an influence on the success of the minimal group manipulation, given the initial outgroup status of the Middle Eastern faces. In compliance with our ethical clearance, we tested all participants who signed up for the study. One hundred and twenty-eight undergraduate students (97 female, $M$ = 20.87 years, $SD$ = 4.13 years) participated in the experiment for partial course credit. Ninety-two participants identified themselves as Caucasian, sixteen as Asian, four as Indian, two as African, three as Middle Eastern, and eleven as “other”.

**Stimulus materials, procedure, and analysis.** Experiment 1b was identical to Experiment 1a except for the photographs used. Photographs of eight male Moroccan models, each displaying a happy, angry, and neutral expression, were selected from the Radboud Faces Database (Langner et al., 2010; Models 29, 51, 52, 55, 60, 69, 70, and 73) and edited in the same way as in Experiment 1a. Response times and error rates (4.43% of trials) were analyzed as described in Experiment 1a. Two participants with a mean response time more than 3 *SDs* above the mean response time across all participants ($M$ = 893 and 916 ms respectively) were excluded from analyses. The exclusion did not alter the pattern of results.

**Results and Discussion**

**Manipulation checks.** There was no difference in pleasantness ratings (see Table 1) for in- and outgroup faces, $t(127) = 1.55$, $p = .125$, again indicating that the minimal group manipulation did not change explicit evaluations of the faces. This did not change when the 13 participants who provided the same response for all faces were excluded from analysis. Participants rated the color signalling ingroup membership as more pleasant than the color signalling outgroup membership, $t(127) = 3.74$, $p < .001$.

As in Experiment 1a, analysis of the group categorization yielded a main effect of block, $F(2, 126) = 190.97$, $p < .001$, $\eta_p^2 = .75$, which showed that performance improved from Block 1 (accuracy 94.92%) to Block 2 (98.01%), $t(127) = 3.04$, $p = .003$, and then declined from Block 2 to Block 3 (61.33%), $t(127) = 19.15$, $p < .001$. The main effect of group, $F(1, 127) = 5.73$, $p = .018$, $\eta_p^2 = .04$, was further qualified by a Group × Block interaction, $F(2, 126) = 4.51$, $p = .013$, $\eta_p^2 = .07$. There was no difference in accuracy for in- and outgroup faces in Block 1 (ingroup: 93.75%, outgroup: 96.09%), $t(127) = 1.59$, $p = .115$, or in Block 2 (ingroup: 98.18%, outgroup: 97.85%), $t(127) = 0.51$, $p = .610$. In Block 3, participants were again more accurate categorizing outgroup faces (65.63%) than ingroup faces (57.03%), $t(127) = 2.28$, $p = .025$. Accuracy in Block 3 was better than chance performance for both ingroup faces, $t(127) = 2.49$, $p = .014$, and outgroup faces, $t(127) = 6.26$, $p < .001$.

**Emotion categorization times.** Figure 2a summarizes the categorization times for happy and angry Middle Eastern faces as a function of minimal in- and outgroup status. Happy faces were again categorized faster than angry faces, $F(1, 125) = 44.74$, $p < .001$, $\eta_p^2 = .26$, but the main effect was qualified by the predicted Group × Expression interaction, $F(1, 125) = 15.63$, $p < .001$, $\eta_p^2 = .11$. A happy face advantage emerged for both ingroup, $t(125) = 7.93$, $p < .001$, and outgroup faces, $t(125) = 3.39$, $p = .001$, however, the happy face advantage was larger for ingroup faces, $t(125) = 3.95$, $p < .001$.

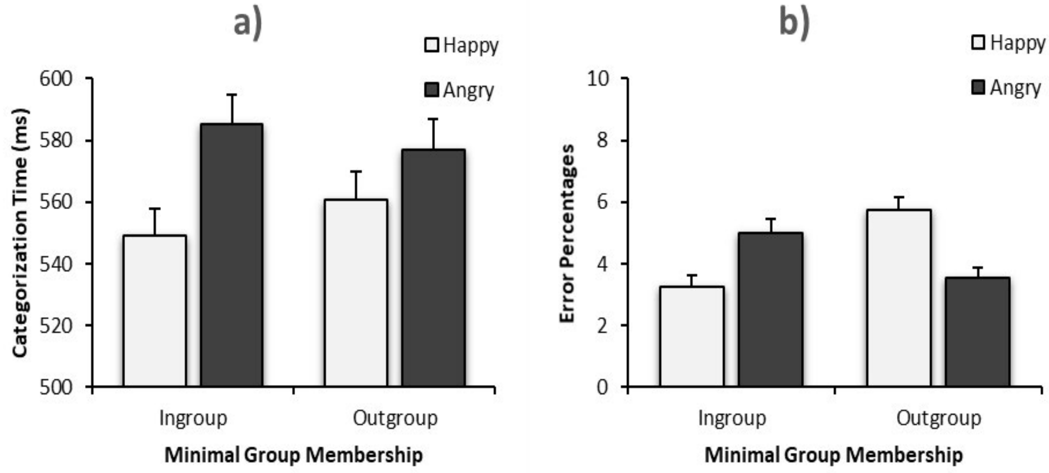


*Figure 2.* Categorization times (a) and error rates (b) for happy and angry expressions on Middle Eastern faces as a function of minimal group membership in Experiment 1b. Errors bars represent 1 *SEM.*

**Accuracy.** Analysis of error rates (see Figure 2b) yielded a Group × Expression interaction, $F(1, 125) = 23.47$, $p < .001$, $\eta_p^2 = .16$, which demonstrated that participants made fewer errors for happy ingroup faces than angry ingroup faces, $t(125) = 3.15$, $p = .002$, and more errors for happy outgroup faces compared to angry outgroup faces, $t(125) = 4.13$, $p < .001$.

We wanted to examine the generality of minimal group effects on emotion recognition and explore if initial group status influences the ease of manipulating minimal group membership by replicating Experiment 1a with another racial group. The pattern of results for Middle Eastern faces was in line with previous studies examining social category cues' influence on the happy face advantage and consistent with the evaluative congruence account (e.g., Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lindeberg et al., 2019a). In comparison to racial ingroup/Caucasian faces, the predicted moderation of minimal group membership on categorization times was observed for racial outgroup/Middle Eastern faces. The effect was, however, observed in the error data for both racial in- and outgroup faces. It may be easier to include previous outgroup members in an ingroup, than to exclude previous ingroup members. It is possible that this could be explained by participants having less experience with racial outgroup members, although this was not measured, which may have made them more susceptible to a change in valence. These results suggest that initial ingroup status or a-priori valence of available facial social category cues, should be taken into consideration in studies that aim to change group membership status or evaluations of individuals.

## Experiment 2

We wanted to determine if the reason we did not find an effect of minimal group membership in the categorization times for Caucasian faces in Experiment 1a was a type II error due to insufficient power. Experiment 2 therefore, aimed to replicate Experiment 1a with a larger sample size. If the absence of an interaction between minimal group membership and emotional expression on categorization times was due to a type II error in Experiment 1a, we expect to observe a larger happy face advantage for ingroup Caucasian faces than for outgroup Caucasian faces, as initially predicted and observed in Experiment 1b with Middle Eastern faces. If, on the other hand, it is easier to manipulate group membership for racial outgroup faces than racial ingroup faces, a replication of the results in Experiment 1a is expected with no minimal group effect in the categorization times.

### Method

**Participants.** We conducted a power analysis to estimate how many participants were required to observe a larger happy face advantage for ingroup faces compared to outgroup faces based on the effect size of the Group × Expression interaction in Experiment 1a ($d_z = 0.169$). It was estimated that 277 participants would be required to have an 80% chance of detecting a significant effect (alpha = .05). Based on the power analysis and anticipating some data loss, we aimed to recruit around 300 participants.

Due to an error in the programming of the experiment, half of the participants saw the faces on the wrong background color in the emotion categorization task. After adjusting the programming, 152 new participants completed the sequences that previously had contained the error. The only difference between the groups was the counterbalancing of the background color of the faces. Initial analysis with time of completion as a between-subjects factor demonstrated that this did not influence the pattern of results and this factor is therefore not discussed further. In total, 453 participants were recruited from Amazon Mechanical Turk and received 2.80 USD for completing the experiment. The 154 participants who completed the sequences that contained the error were not included in analyses. Results are based on the remaining 299 participants (168 male, 130 female, and 1 participant identified themselves as “other”, $M$ = 36.18 years, $SD$ = 10.88 years). Two hundred and twenty-seven participants identified themselves as White/Caucasian, thirty-one as Black/African American, thirteen as Hispanic, eighteen as Asian, three as Native American, and seven as “other”.

**Stimulus materials, procedure, and analysis.** Experiment 2 was identical to Experiment 1a except as follows. The experiment was run online using Millisecond’s Inquisit 4 Web (Inquisit, 2015) which resulted in some minor changes in the presentation of the experiment. Responses were made with the *S* and *L* keys and reminders of the response mapping were added to the emotion categorization task and displayed on the corresponding side of the screen throughout the task. Error feedback was added in the second block of the group categorization task and in the practice trials before the emotion categorization task to ensure participants learnt the response mapping in the absence of the experimenter.

Response times and error rates (7.08% of trials) were analyzed as described in Experiment 1a. Four participants with a mean response time more than 3 *SDs* above the mean response time across all participants ($M$ = 1,068-1,503 ms) and ten participants with an error rate higher than 25% (25.00-86.46%) were excluded from analyses. The exclusions did not alter the pattern of results.

## Results and Discussion

**Manipulation checks.** Participants tended to rate ingroup faces as more pleasant than outgroup faces (see Table 1), $t(298) = 1.83$, $p = .068$.[10] This did not change when the 33 participants who provided the same response for all faces were excluded from analysis. This indicated that the minimal group manipulation tended to change explicit evaluations of the faces. Participants rated the color signalling ingroup membership as more pleasant than the color signalling outgroup membership, $t(298) = 6.60$, $p < .001$.

Analysis of the group categorization responses yielded a main effect of block, $F(2, 297) = 344.86$, $p < .001$, $\eta_p^2 = .70$, which showed that performance again improved from Block 1 (accuracy 89.97%) to Block 2 (95.69%), $t(298) = 6.75$, $p < .001$, and then declined from Block 2 to Block 3 (61.54%), $t(298) = 25.83$, $p < .001$. The main effect of group, $F(1, 298) = 7.95$, $p = .005$, $\eta_p^2 = .03$, was qualified by a Group × Block interaction, $F(2, 297) = 3.42$, $p = .034$, $\eta_p^2 = .02$. There was no difference in accuracy for in- and outgroup faces in Block 1 (ingroup: 89.55%, outgroup: 90.38%), $t(298) = 0.75$, $p = .454$, or in Block 2 (ingroup: 95.37%, outgroup: 96.01%), $t(298) = 1.16$, $p = .248$. In Block 3, participants were again more accurate categorizing outgroup faces (64.80%) than ingroup faces (58.28%), $t(298) = 2.88$, $p = .004$. Accuracy in Block 3 was better than chance for both ingroup, $t(298) = 4.83$, $p < .001$, and outgroup faces, $t(298) = 8.95$, $p < .001$.

**Emotion categorization times.** Figure 3a summarizes the categorization times for happy and angry Caucasian faces as a function of minimal in- and outgroup status. Happy faces were again categorized faster than angry faces, $F(1, 284) = 34.70$, $p < .001$, $\eta_p^2 = .11$, but the main effect was qualified by the predicted Group × Expression interaction, $F(1, 284) = 31.46$, $p < .001$, $\eta_p^2 = .10$. A happy face advantage emerged for ingroup faces, $t(284) = 8.31$, $p < .001$, but there was no difference in categorization times for happy and angry outgroup faces, $t(284) = 0.75$, $p = .454$.

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[10] When only the Caucasian participants were included in the analysis, the difference reached significance, $t(226) = 2.18$, $p = .030$.

**Accuracy.** Analysis of error rates (see Figure 3b) yielded a Group × Expression interaction, $F(1, 284) = 11.38$, $p = .001$, $\eta_p^2 = .04$, which again demonstrated that participants made fewer errors for happy ingroup faces than angry ingroup faces, $t(284) = 2.59$, $p = .010$, and more errors for happy outgroup faces compared to angry outgroup faces, $t(284) = 2.69$, $p = .008$.

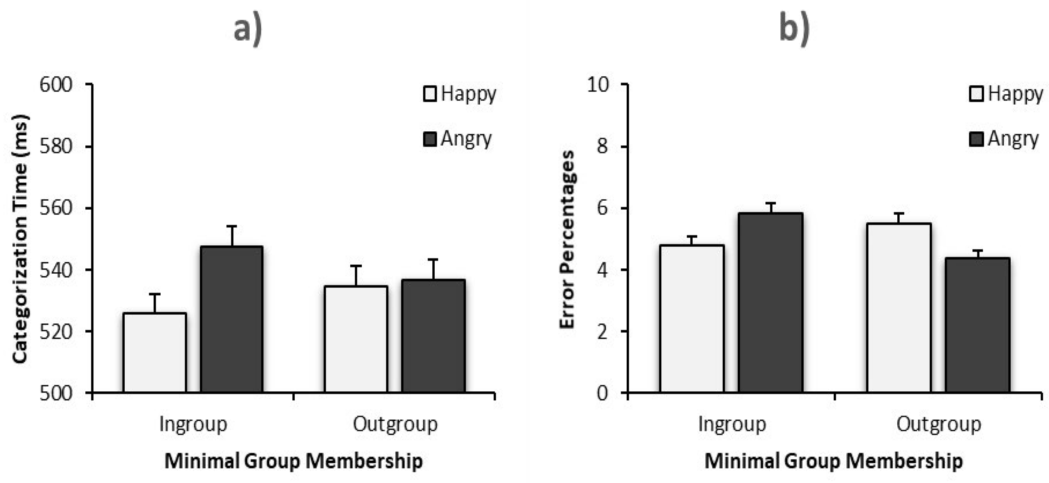


*Figure 3*. Categorization times (a) and error rates (b) for happy and angry expressions on Caucasian faces as a function of minimal group membership in Experiment 2. Errors bars represent 1 *SEM.*

A happy face advantage was observed for ingroup Caucasian faces but not for outgroup Caucasian faces. This pattern is consistent with previous studies investigating social category cues and the evaluative congruence account (e.g., Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lindeberg et al., 2019a), as well as Experiment 1b with Middle Eastern faces and in error rates in Experiment 1a with Caucasian faces. The current results suggest that the absence of an effect of group membership on the categorization times in Experiment 1a might have been a type II error.

## Experiment 3

Including both Caucasian and Middle Eastern faces in the same experiment gives us an idea of the importance of initial ingroup status or a-priori valence of social category cues available on the face when manipulating group membership. More specifically, we can test if recently acquired ingroup membership would be salient enough to override the established race bias on the happy face advantage (e.g., Bijlstra et al., 2010; Hugenberg, 2005).

People belong to multiple social groups and several of these are evident on the face. Despite that, most previous research has focused on how one social category cue at a time influences emotion perception. In order to get a more complete understanding of what happens in real life situations, it is necessary to examine if and how the different social identities interact in their influence on emotion perception. A few studies have investigated how two social cues; sex and race (Craig & Lipp, 2018b; Smith, LaFrance, & Dovidio, 2017), sex and age (Craig & Lipp, 2018b), race and age (Kang & Chasteen, 2009), and sex and attractiveness (Lindeberg et al., 2019a), concurrently influence emotion perception and found evidence for dominance of one cue, independent influences of both cues, and interactive patterns of influence. Given that minimal group membership cues differ from invariant facial social category cues, which have been suggested to be obligatory processed when encountering a face (e.g., Brewer, 1988), and that previous research suggests that the way facial cues simultaneously influence emotion perception is complex, it is unclear how and whether the minimal group manipulation will have an effect on emotion categorization when both Caucasian and Middle Eastern faces are presented together in the same experiment. Related research using other implicit paradigms has demonstrated that minimal group effects can override race biases (Contreras-Huerta et al., 2013; Van Bavel & Cunningham, 2009, 2012), suggesting that recently acquired group membership can be sufficient to override evaluations associated with racial groups.

If minimal group membership is the most salient evaluative dimension in the context of the present task, a larger happy face advantage for minimal ingroup faces than minimal outgroup faces is predicted, irrespective of race. If race is the most prominent evaluative dimension, the usual pattern of a happy face advantage only for own-race (Caucasian) faces is expected (e.g., Hugenberg, 2005; Lipp, Craig, & Dat, 2015). It is possible that the two evaluative cues interact or have an additive effect which might result in the largest happy face advantage for ingroup Caucasian faces. That is, ingroup members are evaluated more positively than outgroup members, and Caucasian faces compared to Middle Eastern faces, which could render ingroup Caucasian faces with the most positive evaluation. To further be able to compare the relative influence of race and minimal group membership, Bayesian analysis which permits the comparison of different statistical models; dominance of one factor, independent influence of both factors, or interactive influence of both factors (Kass & Raftery, 1995; Rouder, Engelhardt, McCabe, & Morey, 2016), will complement the ANOVAs reported.

## Method

**Participants.** Craig and Lipp (2018b) and Lindeberg et al. (2019a) used the methodology most similar to the current research to examine how two different facial social cues influence emotion perception and found effects with around 30-60 participants. Race is added as a factor in Experiment 3, and previous research has shown reliable effects of race on the happy face advantage with around 30 participants (e.g., Hugenberg, 2005; Lipp, Craig, & Dat, 2015). Given this and the fact that the experiment still uses a repeated measures design, a similar sample size to Experiment 2 was deemed to be sufficient to investigate the influence of race and minimal group membership on emotion categorization.

Participant ethnicity may moderate the potential interaction between race and minimal group membership on the happy face advantage and to maximize the possibility of finding a three-way interaction if there indeed was one, only Caucasian participants were requested from Amazon Mechanical Turk. Three hundred and four participants (160 male, $M$ = 37.35 years, $SD$ = 10.75 years) were recruited and received 2.80 USD for completing the experiment. Two hundred and ninety-seven participants identified themselves as White/Caucasian, two as Black/African American, two as Asian, one as Native American, and two as “other”.

**Stimulus materials, procedure, and analysis.** Experiment 3 was identical to Experiment 2 except as follows. The eight Caucasian and eight Middle Eastern models from the previous experiments were included. In order to maintain the number of models that were assigned the green and orange background color and the memory load, each participant was only presented with four of the Caucasian and four of the Middle Eastern models. Two Caucasian and two Middle Eastern models were presented on the green background, and two Caucasian and two Middle Eastern models were presented on the orange background. The models used and their color assignment were counterbalanced across participants.

Mean response times and error rates from the emotion categorization task were subjected to separate 2 (Race: Caucasian vs. Middle Eastern) × 2 (Group: ingroup vs. outgroup) × 2 (Expression: happy vs. angry) repeated measures

ANOVAs with follow-up pairwise comparisons. Response times and error rates (6.56% of trials) were processed as described in Experiment 1a. Three participants with a mean response time more than 3 *SDs* above the mean response time across all participants ($M$ = 888-1,103 ms) and five participants with an error rate higher than 25% (41.67-88.54%) were excluded from analyses. The exclusions did not alter the pattern of results.

**Results and Discussion**

**Manipulation checks.** Participants rated ingroup faces as overall more pleasant than outgroup faces (see Table 1), $F(1, 303) = 6.79$, $p = .010$, $\eta_p^2 = .02$, and the Race × Group interaction was not significant, $F(1, 303) = 0.02$, $p = .887$, $\eta_p^2 < .01$, indicating that the minimal group manipulation did change explicit evaluations of the faces. The results did not change when the 28 participants who provided the same response for all faces were excluded from analysis. Participants rated the color signalling ingroup membership as more pleasant than the color signalling outgroup membership, $t(303) = 6.09$, $p < .001$.

The accuracy of the group categorization was analyzed with a 2 (Race: Caucasian vs. Middle Eastern) × 2 (Group: ingroup vs. outgroup) × 3 (Block: 1-3) repeated measures ANOVA. A main effect of block, $F(2, 302) = 371.78$, $p < .001$, $\eta_p^2 = .71$, again showed that performance improved from Block 1 (accuracy 89.89%) to Block 2 (96.00%), $t(303) = 7.16$, $p < .001$, and then declined from Block 2 to Block 3 (62.25%), $t(303) = 26.98$, $p < .001$. The main effect of race, $F(1, 303) = 10.14$, $p = .002$, $\eta_p^2 = .03$, and the Race × Group interaction, $F(1, 303) = 14.02$, $p < .001$, $\eta_p^2 = .04$, were qualified by a Race × Group × Block interaction, $F(2, 302) = 4.00$, $p = .019$, $\eta_p^2 = .03$. There was no difference in accuracy for in- and outgroup Caucasian faces in Block 1 (ingroup: 91.28%, outgroup: 89.31%), $t(303) = 1.25$, $p = .211$, in Block 2 (ingroup: 96.88%, outgroup: 96.33%), $t(303) = 0.96$, $p = .337$, or in Block 3 (ingroup: 66.78%, outgroup: 62.66%), $t(303) = 1.30$, $p = .196$. For the Middle Eastern faces, participants were more accurate categorizing outgroup faces than ingroup faces in Block 1 (ingroup: 87.83%, outgroup: 91.12%), $t(303) = 2.22$, $p = .027$, and in Block 3 (ingroup: 55.43%, outgroup: 64.14%), $t(303) = 2.73$, $p = .007$. There was no difference in accuracy in Block 2 (ingroup: 94.96%, outgroup: 95.83%), $t(303) = 1.49$, $p = .138$. Accuracy in Block 3 was better than chance performance for Caucasian ingroup, $t(303) = 7.73$, $p < .001$, and outgroup faces, $t(303) = 5.87$, $p < .001$, and for Middle Eastern ingroup, $t(303) = 2.39$, $p = .017$, and outgroup faces, $t(303) = 6.71$, $p < .001$.[11]

**Emotion categorization times.** Figure 4a summarizes the categorization times for happy and angry expressions on Caucasian and Middle Eastern faces as a function of minimal in- and outgroup status. Main effects of race, $F(1, 295) = 7.16$, $p = .008$, $\eta_p^2 = .02$, and expression, $F(1, 295) = 47.41$, $p < .001$, $\eta_p^2 = .14$, indicated that Caucasian and happy faces overall were categorized faster than Middle Eastern and angry faces. The main effects were qualified by a Race × Expression, $F(1, 295) = 31.94$, $p < .001$, $\eta_p^2 = .10$, and a Group × Expression interaction, $F(1, 295) = 7.79$, $p = .006$, $\eta_p^2 = .03$. A happy face advantage emerged for Caucasian faces, $t(295) = 8.95$, $p < .001$, but there was no difference in categorization times for Middle Eastern faces, $t(295) = 1.09$, $p = .277$. Furthermore, a happy face advantage was also evident for both minimal ingroup, $t(295) = 7.05$, $p < .001$, and minimal outgroup faces, $t(295) = 3.63$, $p < .001$, although, it was larger for minimal ingroup faces, $t(295) = 2.79$, $p = .006$. The three-way Race × Group × Expression interaction did not reach significance, $F(1, 295) = 0.03$, $p = .854$, $\eta_p^2 < .01$.

**Accuracy.** Analysis of error rates (see Figure 4b) yielded a Race × Expression interaction, $F(1, 295) = 14.79$, $p < .001$, $\eta_p^2 = .05$, which demonstrated that participants made fewer errors for happy Caucasian faces than angry Caucasian faces, $t(295) = 2.76$, $p = .006$, and more errors for happy Middle Eastern faces compared to angry Middle Eastern faces, $t(295) = 2.65$, $p = .009$. The Group × Expression interaction, $F(1, 295) = 11.22$, $p = .001$, $\eta_p^2 = .04$, again showed that participants made fewer errors for happy minimal ingroup faces than angry minimal ingroup faces, $t(295) = 2.81$, $p = .005$, and more errors for happy minimal outgroup faces compared to angry minimal outgroup faces, $t(295) = 2.39$, $p = .017$. The three-

[11] When participant sex was included as a between-subjects factor, the Participant sex × Group × Block interaction reached significance, $F(2, 301) = 4.01$, $p = .019$, $\eta_p^2 = .03$. The female participants were more accurate categorizing outgroup faces than ingroup faces in Block 1 (ingroup: 86.11%, outgroup: 89.58%), $t(302) = 2.35$, $p = .020$. There were no other significant effects of participant sex.

way Race × Group × Expression interaction was not significant, $F(1, 295) < 0.01$, $p = .979$, $\eta_p^2 < .01$.

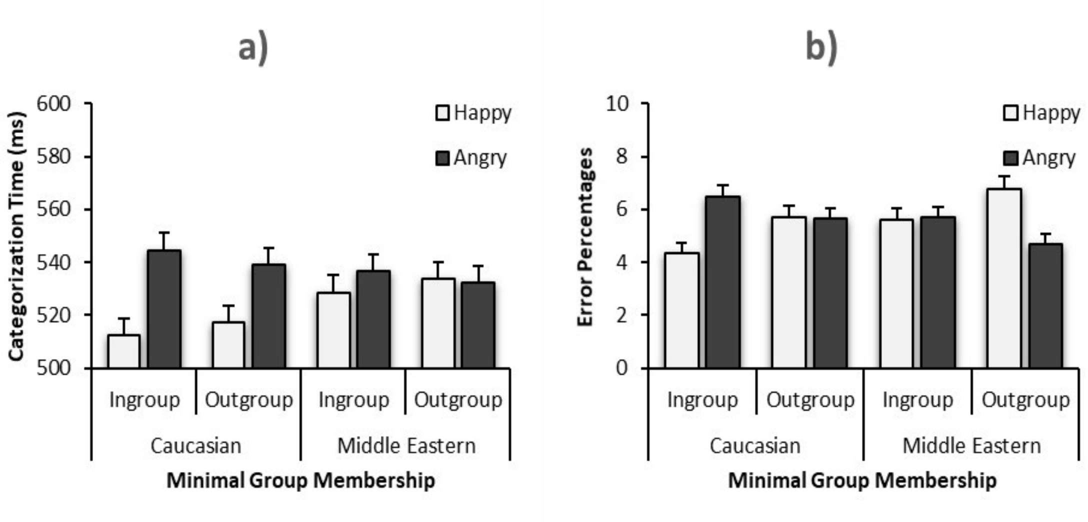


*Figure 4*. Categorization times (a) and error rates (b) for happy and angry expressions on Caucasian and Middle Eastern faces as a function of minimal group membership in Experiment 3. Errors bars represent 1 *SEM*.

**Bayesian repeated measures ANOVA.** The ANOVA indicated that the happy face advantage was moderated by race and minimal group membership independently, being significant for Caucasian faces but not for Middle Eastern faces, and larger for minimal ingroup faces than for minimal outgroup faces. To be able to examine the relative influence of race and minimal group membership on the happy face advantage, a Bayesian repeated measures ANOVA with default priors was conducted using JASP software package (JASP Team, 2018; Rouder, Morey, Speckman, & Province, 2012). Bayesian analysis allows for comparison of the different statistical models; including the main effects, two- and three-way interactions, and indicates which model best fit the observed data. For each model, the Bayes Factor (BF) indicates how much more likely the model is to explain the data compared to the null. The model with the largest BF has the strongest support and is the best fit for the data (Rouder et al., 2016). For Experiment 3, there was very strong evidence for all models including the relevant Race × Expression, Group × Expression, or Race × Group × Expression interactions, or combinations of these, all $BF_{10} > 3.47 \times 10^{11}$. The model including the main effects of race and expression and the Race × Expression interaction provided the best fit for the observed data, $BF_{10}$ = $4.97 \times 10^{21}$. The model including the main effects of race, group, and expression and the Race × Expression and Group × Expression interactions had the second strongest support, $BF_{10} = 6.87 \times 10^{20}$. Comparing these two models reveals that the former model which only includes the Race × Expression interaction was 7.23 times more likely to account for the data than the model which includes both the Race × Expression and Group × Expression interactions, suggesting that race had a stronger moderating influence than minimal groups on emotion categorization according to interpretation conventions of BFs (Kass & Raftery, 1995).

Race and minimal group membership independently moderated the happy face advantage in line with previous research examining the effects of social category cues and consistent with the evaluative congruence account (e.g., Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lindeberg et al., 2019a). When taking a closer look at their relative influence with the Bayesian analysis, it was evident that race had a stronger influence on emotion categorization times than minimal group membership.

## General Discussion

In three experiments, we demonstrated that randomly assigning faces in- or outgroup status is sufficient to elicit an evaluative bias in an emotion categorization task. Minimal group membership moderated the happy face advantage in the same way as social category cues and consistent with the evaluative congruence account (e.g., Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lindeberg et al., 2019a). A larger happy face advantage was observed for the more positively evaluated group, in this case, minimal ingroup faces compared to minimal outgroup faces. This was demonstrated for both racial in- and outgroup faces separately, something previous research has not investigated. When similar sample sizes were used in Experiments 1a and 1b, the moderation of minimal group status on emotion perception was observed in categorization times only for Middle Eastern faces and evident in error rates for Caucasian and for Middle Eastern faces. When Experiment 1a was replicated with a relatively larger sample, the predicted pattern was also observed in categorization times for Caucasian faces. The results suggest that the absence of an effect of group membership on the categorization times in Experiment 1a might have been a type II error. This is also supported by the similar effect sizes of Experiment 1b ($\eta_p^2$ = .11) and Experiment 2 ($\eta_p^2$ = .10).

Secondly, we wanted to examine whether this newly acquired ingroup membership would be salient enough to override the pre-existing race bias in the emotion categorization task (e.g., Bijlstra et al., 2010; Hugenberg, 2005). Minimal group membership did not override the race bias, but instead, both race and minimal group status were found to moderate the happy face advantage independently of each other. A happy face advantage was evident for Caucasian faces but not for Middle Eastern faces, and was larger for minimal ingroup faces than for minimal outgroup faces. The Bayesian analysis indicated that race had a stronger influence than minimal group membership on emotion perception. This is consistent with other implicit paradigms which show minimal group effects in mixed-race experiments (Contreras-Huerta et al., 2013; Van Bavel & Cunningham, 2009, 2012).

The explicit evaluations of the faces were not consistently altered by the minimal group manipulation. In Experiments 1a and 1b, there was no difference in pleasantness ratings for in- and outgroup faces, suggesting that the minimal group manipulation did not change explicit evaluations of the faces. In Experiments 2 and 3, ingroup faces were however, rated as more pleasant than outgroup faces, indicating that the minimal group manipulation changed the explicit evaluations of the faces. The effects sizes for the different experiments were small but similar (Experiment 1a: $d$ = .07, Experiment 1b: $d$ = .14, Experiment 2: $d$ = .11, Experiment 3: $d$ = .15), which suggests that Experiments 1a and 1b might have been insufficiently powered to detect a small change in explicit evaluations.

The current minimal group manipulation differs from manipulations used in previous research on emotion perception in a number of important ways, which might help bring some clarity to our understanding of the mechanism behind the effect of social cues on emotion perception. Most of the early research was conducted using faces varying in aspects that signalled social group membership via facial cues. Facial sex (e.g., Hugenberg & Sczesny, 2006), race (e.g., Hugenberg, 2005), and age cues (e.g., Craig & Lipp, 2018a) all influence emotion categorization in the same way, with a larger happy face advantage for the more positively evaluated social group. Lindeberg et al. (2019a) extended this and showed that not only facial cues that signal social category membership, but also situationally variable facial cues such as attractiveness, can produce the same effect. This suggests that the effect might be more general than previously assumed and not specific to social category cues. Lindeberg et al. (2019b) added to this. They manipulated the character information associated with individuals and observed a larger happy face advantage for faces associated with positive information than for faces associated with negative information. This demonstrated that face valence does not have to be communicated through facial cues nor does it need to be associated with social groups.

In contrast to most previous studies, but similarly to Lindeberg et al. (2019b), the evaluative information in the current study was not derived from facial cues, but the information participants learnt about the faces was instead related to their group membership as opposed to character information. No other evaluative information except group membership was provided. The background color signalled whether the face belonged to their group or not, and although group membership itself was not indicated by a facial cue, it was associated with a visual cue external to the face. It is unlikely that the observed effects could have been driven by the specific colors used in the experiment. The assignment of in- or outgroup status of the colors was random and counterbalanced, as was the matching of background color to faces, in an attempt to avoid any systematic bias. The fact that the color signalling ingroup membership was consistently rated as more pleasant than the color signalling outgroup membership throughout the experiments, supports the premise that the specific colors cannot account for the observed effects and indicates that the minimal group manipulation changed the valence of the colors. Comparably, Bernstein et al. (2007) included a control condition in their study in which no meaning or information about the background color was provided, as opposed to signalling group membership, where they did not observe a moderating effect of background color on face recognition.

The current study leaves it unclear whether emotion perception was moderated by the valence associated with the individual posers assigned to the ingroup or outgroup or with the color cue which signalled group membership. The latter may have occurred as the participants learned that the color signals something that is relevant to themselves and that the minimal group manipulation simply made the ingroup color more positive than the outgroup color. This explanation is consistent with the observation that the background on which a face is presented can influence emotion perception. Righart and de Gelder (2008a, 2008b) presented faces on emotional background scenes (e.g., images of garbage or a car crash), and found that recognition of emotional expressions was facilitated if the emotional content of background scenes and facial expressions matched (for a review of contextual influences on emotion perception see Wieser & Brosch, 2012). We used a common minimal group manipulation, using a color to signal group membership, and did not require the participants to remember which individual belonged to which group since the color cue was always present. With more extensive training and if participants were required to remember the individuals' group membership, the faces might acquire more valence, as opposed to the color cue. Ingroup faces could then be presented with the outgroup cue, and vice versa, to tease apart the source of the evaluation. This is, however, beyond the scope of the present paper. It should be noted that even if it were the group membership cue, in this case the background color, that drives the effect and not the individual faces, this still means that the minimal group manipulation was successful as the color only acquired its valence because of the minimal group manipulation.

It seems like it does not matter from where the evaluation is derived. Many sources of evaluation can influence emotion recognition processes whether it is related to facial cues, personality characteristics, or the wider context. The current results support a broad interpretation of the evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006) in that evaluations, whether they are derived from the individual or the context, prime an individual to process evaluatively congruent expressions more efficiently. A pleasant context facilitates the processing of positive expressions and it is the salient evaluative information in a given situation that determines this influence. What makes one or more social cues salient over others is still not well examined. In the current study, both race and minimal group membership influenced emotion perception in the same way independently of each other, however, the Bayesian analysis indicated that race had a stronger influence. Finding an additive influence of two social cues is consistent with some previous research investigating the influence of multiple social category cues on emotion perception (e.g., Craig & Lipp, 2018b). Furthermore, Lindeberg et al.'s (2019a) results show that it is not necessarily the invariant social category cue which has the strongest influence, since attractiveness had a more consistent influence on emotion perception than face sex. The inconsistencies in the previous research (Craig

& Lipp, 2018b; Kang & Chasteen, 2009; Lindeberg et al., 2019a; Smith et al., 2017) show that our understanding of how multiple evaluative cues interact in their effect on emotion perception is incomplete and needs further exploration.

In conclusion, the results demonstrated that minimal group membership is sufficient to elicit an evaluative bias in an emotion categorization task for both racial in- and outgroup faces separately. Minimal group status still had an effect on emotion perception when both racial in- and outgroup faces were presented in the same experiment. Consistent with previous research examining social category cues and the evaluative congruence account (e.g., Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lindeberg et al., 2019a), a larger happy face advantage was observed for minimal ingroup faces compared to minimal outgroup faces. The results further strengthen the proposition that evaluations, and not stimulus driven factors or stereotypes, drive the influence of social information on emotion perception in a speeded two-choice emotion categorization task. The sole source of evaluative information to explain the effect of the minimal group manipulation on the happy face advantage is derived from the meaning ascribed to group membership and minimal group membership is neither communicated via facial cues nor associated with stereotypes.

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# Chapter 5

## General discussion

Across a series of experiments, it has been demonstrated that emotional expression perception is more malleable than previously known. It was shown that a broad range of factors in the social environment moderated the speed and accuracy of emotion recognition. Previous studies have focused on social category cues' influence on the happy face advantage and showed a consistent pattern of results across different cues, such as sex (e.g., Hugenberg & Sczesny, 2006), race (e.g., Hugenberg, 2005), and age (e.g., Craig & Lipp, 2018a), where a larger happy face advantage is observed for the relatively more positively evaluated social group. Here, it was demonstrated that facial attractiveness, recently acquired character information, and artificially created group membership influenced the happy face advantage in a similar way as do social category cues, that is, with a larger happy face advantage for the more attractive person, the person associated with positive character information, or the member of the ingroup. Chapters 2.1 and 2.2 revealed that attractiveness, a facial cue in addition to clearly defined social categories, influenced emotion categorization. Chapter 3 demonstrated that the social information affecting emotional expression perception does not have to be communicated via facial, or even visual, cues. Furthermore, it was shown that the evaluative information does not have to be associated with social groups, but character information associated with an individual is also available in the early stages of face processing and influences emotion perception. Chapter 4 added to this by demonstrating that cues relating to artificial and randomly assigned in- and outgroup memberships also moderated the happy face advantage. Preexisting attitudes about social groups which are primed by facial cues are not necessary. The fact that the manipulations of face valence, by providing character information and the minimal group paradigm, both were acquired within the experimental situation particularly emphasizes the flexibility of early emotion perception.

The evaluative congruence account (Hugenberg, 2005; Hugenberg & Sczesny, 2006) has received the strongest support in previous research and seems to offer the most comprehensive explanation for social category cues' influence on the happy face advantage (Craig, Koch, & Lipp, 2017; Craig & Lipp, 2018a; Craig, Zhang, & Lipp, 2017; Hugenberg, 2005; Hugenberg & Sczesny, 2006; Lipp, Craig, & Dat, 2015). The experiments in Chapters 3 and 4 were also designed to test the evaluative congruence account's ability to explain the influence of social information on the happy face advantage, beyond social category cues. The evaluative information that affected emotional expression perception in these studies was not communicated via facial cues nor associated with existing social groups, which excludes perceptual similarity or stereotype congruence as likely explanations for social information's influence on the happy face advantage.

A strength of the present series of studies is that they make use of a reliable effect, the happy face advantage, as a tool to examine social information's influence on emotion perception. This offers an opportunity to compare different studies which examine the influence of the same cue on emotion perception to each other. This will enhance our understanding of what factors contribute to the moderation of emotion categorization by social information and under which circumstances the effect is present. Furthermore, the use of the same paradigm across studies examining various social cues' influence on emotion categorization improves our understanding of their relative influence. Much of the previous research examining different cues' influence on emotion perception has used various methods (e.g., Atkinson, Tipples, Burt, & Young, 2005; Elfenbein & Ambady, 2002; Hass, Schneider, & Lim, 2015; Hugenberg & Bodenhausen, 2003; Schweinberger & Soukup, 1998). This is also important because it establishes the robustness of the malleability of emotion perception across situations and confirms that it is not conditional on specific and artificial experimental circumstances. However, the use of various methods makes it difficult to estimate how different cues relate to each other in their influence on emotion perception. For this purpose, it is more suitable to use a reliable effect, such as the happy face advantage, across studies to better estimate the relative influence of various social cues on emotion perception.

We have a good understanding of how a single evaluative cue influences emotion categorization, but in everyday life, multiple evaluative cues are available in any situation. It is therefore, important to understand how all available evaluative information combines to influence emotion perception. Although the use of a reliable paradigm gives us some insight into the relative influence of various social cues on emotion perception, this is not sufficient for a comprehensive understanding of how they may interact in their influence. To date, only a few studies have examined how two social cues; sex and race (Craig & Lipp, 2018b; Smith, LaFrance, & Dovidio, 2017), sex and age (Craig & Lipp, 2018b), or race and age (Kang & Chasteen, 2009), concurrently influence emotion perception. The methodologies differ across studies, which makes it hard to compare them in order to get a more comprehensive understanding of how simultaneously available evaluative information combines to influence emotion perception. However, Craig and Lipp (2018b) as well as the studies reported in Chapters 2.1, 2.2, and 4, all utilise the happy face advantage as an instrument, which could be a starting-point to achieve a better understanding of how multiple social cues together influence emotion perception. Social category cues have long been assumed to be preferentially processed (e.g., Brewer, 1988), but as demonstrated in Chapter 2.2, sex and attractiveness interact to influence the happy face advantage. Furthermore, as observed in Chapter 4, although race had a stronger influence, minimal group membership still had an effect on the happy face advantage when both of these evaluative cues were varied in the same experiment. More extensive investigations are needed to determine which cues might be preferentially processed. It is, however, possible that emotion categorization is moderated by the evaluative information which is made salient in any given context and that no cues are preferentially processed by default. Given the malleability of emotion perception and previous findings, such as Lipp et al. (2015) demonstrating that the influence of the same set of cues varied depending on the social cues communicated by the other faces presented in the same task, it is likely that the processing of evaluative information and its influence on emotion perception is more complex than previously thought.

Another strength of the present series of studies is that all main novel findings have been replicated, which substantially increases the credibility of the findings. This was deemed especially important in light of the current reproducibility crisis in psychological science, where numerous seminal research findings have failed to replicate (see Open Science Collaboration, 2015). For all three social cues examined, a direct replication of one of the experiments was conducted, but with a different population and experimental setting. Furthermore, attractiveness' influence on the happy face advantage was observed across seven experiments in Chapters 2.1 and 2.2. The influence of character information on emotion categorization was observed across two experiments in Chapter 3. In Chapter 4, it was demonstrated across four experiments that random assignment of in- and outgroup membership influenced the happy face advantage.

**Limitations**

The presented data support the proposition that evaluations are driving the influence of social information on emotion categorization. Chapters 3 and 4 were designed to test the evaluative congruence account and given that the evaluative information was not derived from facial cues or associated with established social groups, the main alternative explanations which have been proposed, perceptual similarity and stereotype congruence, seem unlikely to be able to account for the effect of social information on emotion categorization. These findings provide strong evidence in favor of the evaluative congruence account as an explanation for the influence of social information on the happy face advantage under the present circumstances. These experiments did, however, not explicitly test the alternative explanations or offer an opportunity to attain positive evidence in favor of either of them. This limits the generalisability of the results to different contexts where other mechanisms may have a stronger influence on emotion perception. As demonstrated in Chapters 3 and 4, pre-existing attitudes and available stereotypes about social groups which are primed by facial cues or similarity between the facial features of the social cue and the emotional expression, are not necessary in order to moderate the happy face advantage. However, it is possible that they may contribute to the effect in some instances. This was evidenced by Bijlstra, Holland, and Wigboldus' (2010) demonstration that recognition of the expressions which were consistent with the social group stereotype was facilitated when two negative expressions were categorized. This suggests that it may not be an all-or-nothing situation and that the three explanations may account for the influence of social information on emotion categorization under different circumstances. If this is the case, it would be important to more clearly identify these conditions.

Several previous studies have demonstrated that the influence of different social cues is similar irrespective of which negative emotion the happy faces are contrasted with, which also provides evidence for evaluative congruence over stereotype congruence (e.g., Bijlstra et al., 2010; Craig, Koch, & Lipp, 2017; Craig & Lipp, 2017; Craig & Lipp, 2018a; Hugenberg, 2005; Hugenberg & Sczesny, 2006). For consistency and comparison, we used happy and angry faces across all studies. Considering that we have extended previous findings to include social information which had previously not been examined; attractiveness, character information, and minimal group membership, replications using different emotional expressions is needed to determine the generalisability of the findings.

**Future directions**

We provided further support for the evaluative congruence account as the most comprehensive explanation for the influence of social information on the happy face advantage. The evaluations in the current studies and previous research are all derived from some degree of meaningful information which provides participants with knowledge about the individuals depicted in the photographs. In previous research, the evaluations are derived from social group membership, such as whether the faces are male or female, and in Chapters 2.1 and 2.2, they are derived from facial attractiveness. In both these instances, the facial cues activate stereotypes which inform participants about characteristics the individual might possess. In Chapter 3, the character information participants learn to associate with individuals directly provides them with meaningful knowledge about these individuals. The minimal group manipulation in Chapter 4 was based on a personality test and although no information about the personality types are provided, participants learnt which individuals share personality characteristics with them and could make assumptions about the individuals based on this knowledge. It would be interesting to examine whether the way the evaluations are formed or the content on which they are based influences their ability to moderate emotion perception. This may also give us a better understanding of why some evaluative cues may have a stronger influence than others.

One approach would be to attempt to change the evaluation of the faces without providing information that enables participants to infer any meaningful information about the individuals depicted. Londhe (2019) used evaluative conditioning in an attempt to change the valence of the faces before an emotion categorization task. Positive or negative pictures were paired with neutral faces in the evaluative conditioning task and participants' evaluation of the faces changed accordingly. However, when happy and angry expressions of the same faces were categorized, there was no moderation of the happy face advantage by the acquired valence of the faces. The lack of moderation of the happy face advantage could be a type II error due to insufficient power since only 48 participants were recruited, assuming that the effect is small. If that is not the case, the results could be interpreted to suggest that the evaluation of faces may need to be derived from information which can be related to the individuals or from which participants can infer meaningful information about the individual. This would need to be confirmed in future studies.

Another study, which followed up on the experiments described in Chapter 3, suggested that descriptive character information about the individuals may have been necessary to change the valence of the faces (Vidovich, 2019). In Chapter 3, it was not conclusive whether the descriptive information was needed or if simply learning which individual was “good” or “bad” would have produced the same results. The memory test and manipulation check highlighted the valence dichotomy by asking participants to indicate whether the individual did something good or bad. In two experiments, Vidovich (2019) used a similar methodology as described in Chapter 3, except that the faces were only paired with the labels Good and Bad instead of full sentences describing each individual’s acts. The manipulation was only successful in changing participants’ evaluation of the faces in one of the experiments and there was no moderation of the happy face advantage by the valence manipulation. These follow up studies suggest that the content from which the evaluations are derived does matter and suggest that it needs to provide participants with detailed and meaningful knowledge about the individuals. To provide this knowledge while still only associating a label with a face, a current study in our lab is using person related valenced labels, such as hero and murderer, in an evaluative conditioning paradigm. This will give an indication of whether the more detailed descriptive information used in Chapter 3 (albeit one sentence is not lengthy information) about positive or negative acts which individuals have carried out is needed in order to influence how participants process these individuals’ emotional expressions or if a label representing positive or negative acts is sufficiently meaningful to produce the same effect.

Another important next step for emotion perception research is to examine the concurrent influence of more than two social cues in the same experiment. As previously stated, a wide range of evaluative information is present in any given situation and to really understand how this range simultaneously influences how we perceive emotions from facial expressions, we need to examine it together. This would also be an important step in investigating if social information derived from social category cues, such as sex, race, and age, is special in the way it is processed or if it is processed similarly to social information which is conveyed via non-facial cues and is more situationally variable. The results presented throughout the chapters here suggest that different types of information are processed similarly and influence emotion perception in a comparable way. Additionally, this knowledge would better inform theoretical models of face perception which historically have lacked this complexity.

Early theoretical frameworks of face processing focused on so called invariant facial cues such as identity and core social category cues (sex, race, and age) which are fairly stable across situations and on how they are largely processed independently from changeable facial cues such as emotional expression, eye gaze, and speech cues, which can change rapidly within a situation (Bruce & Young, 1986; Haxby, Hoffman, & Gobbini, 2000). Freeman and Ambady's (2011) model of person construal, however, recognises that top-down knowledge and bottom-up visual facial information are integrated when we categorize social information such as emotional expressions. The evaluative cues which have been investigated here; attractiveness, character information and minimal group membership, communicate important social information but they are not explicitly identified in the model. However, when reinterpreting our findings in their theoretical framework, it is possible that the meaningful information on which the evaluations are based, through attractiveness-related stereotypes, character information, and group membership status, could be regarded as sources of top-down knowledge as described in the model. The current findings can be considered an illustration of the importance of top-down knowledge for emotion perception and to be consistent with Freeman and Ambady's (2011) model of person construal.

Whether we are encountering a person for the first time, whether we are in a meeting at work, or interact with patients as a professional – we are constantly trying to interpret people's emotional expressions in order to understand their intentions and emotional states, information which we then use to guide our own behavior. The importance of achieving a better understanding of the mechanisms which drive the moderation of early emotion perception and the factors which contribute to it, is highlighted by its potential consequences on the manner in which we respond to a person. We need to investigate how the malleability of early emotion perception influences further processing of an individual's behavior or our interpretation of what they are telling us. Furthermore, we need to examine whether this flexibility of emotion perception translates into changes in our behavior in response to an individual's emotional expressions.

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# Appendices[13]

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## Supplementary Material 1

Significant interactions emerging from ANOVAs in the main text are followed-up with the theoretically relevant assessment of the happy face advantage (comparisons between happy and angry) within attractiveness conditions. For completeness, comparisons within expressions and between attractiveness conditions are reported here.

### Experiment 1

**Categorization times**. Overall, happy faces were categorized faster than angry faces, $F(1, 58) = 10.21$, $p = .002$, $\eta_p^2 = .15$, but this main effect was qualified by the predicted Attractiveness × Expression interaction, $F(1, 58) = 10.18$, $p = .002$, $\eta_p^2 = .15$. Follow-up pairwise comparisons demonstrate that happy expressions were categorized faster on attractive than unattractive females, $t(58) = 3.48$, $p = .001$. There was no difference in categorization times for angry expressions between the attractive and unattractive female faces, $t(58) = 1.62$, $p = .110$.

**Accuracy**. Fewer errors were made categorizing happy than angry faces, $F(1, 58) = 4.68$, $p = .035$, $\eta_p^2 = .08$, and a significant Attractiveness × Expression interaction emerged, $F(1, 58) = 10.18$, $p = .002$, $\eta_p^2 = .15$. Follow-up comparisons revealed a lower error rate for happy expressions on attractive compared to unattractive females, $t(58) = 3.19$, $p = .002$, but there was no difference in error rates for angry expressions on attractive and unattractive female faces, $t(58) = 1.34$, $p = .187$.

### Experiment 2

**Categorization times.** Happy faces were categorized faster than angry faces regardless of attractiveness, $F(1, 60) = 7.68$, $p = .007$, $\eta_p^2 = .11$, and attractive male faces were overall categorized faster than the unattractive male faces, $F(1, 60) = 36.05$, $p < .001$, $\eta_p^2 = .38$. The predicted Attractiveness × Expression interaction was not significant, $F(1, 60) = 0.17$, $p = .682$, $\eta_p^2 = .003$.

**Accuracy.** Analysis of error rates indicated that attractiveness interacted with facial expression for male faces. Fewer errors were made categorizing attractive than unattractive faces, $F(1, 60) = 16.10$, $p < .001$, $\eta_p^2 = .21$, but this effect was qualified by an Attractiveness × Expression interaction, $F(1, 60) = 5.98$, $p = .017$, $\eta_p^2 = .09$.

Follow-up comparisons revealed that fewer errors were made for happy expressions on attractive compared to unattractive males, $t(60) = 4.29$, $p < .001$, whereas there was no difference for angry expressions, $t(60) = 1.93$, $p = .059$.

**Experiment 3**

**Categorization times.** The analysis yielded a main effect of expression, $F(1, 59) = 9.01$, $p = .004$, $\eta_p^2 = .13$, where happy faces overall were categorized faster than angry faces. A main effect of attractiveness, $F(1, 59) = 27.03$, $p < .001$, $\eta_p^2 = .31$, indicated that the attractive faces overall were categorized faster than the unattractive faces. The main effects were qualified by an Attractiveness × Expression interaction, $F(1, 59) = 6.96$, $p = .011$, $\eta_p^2 = .11$. Follow-up comparisons demonstrate that happy expressions were categorized faster on attractive than unattractive faces, $t(59) = 4.61$, $p < .001$. There was no difference in categorization times for attractive and unattractive angry expressions, $t(59) = 0.76$, $p = .447$. The three-way Sex × Attractiveness × Expression interaction did not reach significance, $F(1, 59) = 2.24$, $p = .140$, $\eta_p^2 = .04$.

**Accuracy.** Analysis of error rates suggests that both sex and attractiveness influence the categorization of facial expressions. Overall, fewer errors were made categorizing female, $F(1, 59) = 20.04$, $p < .001$, $\eta_p^2 = .25$, and attractive faces, $F(1, 59) = 15.90$, $p < .001$, $\eta_p^2 = .21$, compared to male and unattractive faces. The Sex × Attractiveness interaction, $F(1, 59) = 6.56$, $p = .013$, $\eta_p^2 = .10$, revealed that more errors were made categorizing unattractive male faces, $t(59) = 4.34$, $p < .001$, compared to attractive male faces. There was no difference in error rates for the attractive and unattractive female faces, $t(59) = 1.42$, $p = .162$. The Attractiveness × Expression interaction, $F(1, 59) = 10.78$, $p = .002$, $\eta_p^2 = .15$, showed a lower error rate for happy expressions on attractive compared to unattractive faces, $t(59) = 5.02$, $p < .001$, but there was no difference in error rates for angry expressions on attractive and unattractive faces, $t(59) = 0.38$, $p = .706$. The Sex × Expression interaction trended towards significance, $F(1, 59) = 3.79$, $p = .056$, $\eta_p^2 = .06$, and reflected a lower error rate for happy female than happy male faces, $t(59) = 4.96$, $p < .001$. There was no difference in error rates for the angry female and male faces, $t(59) =$

1.64, $p$ = .107. The three-way Sex × Attractiveness × Expression interaction did not reach significance, $F(1, 59) = 0.63$, $p$ = .429, $\eta_p^2$ = .01.

**Experiment 4**

**Categorization times.** The analysis yielded main effects of sex, $F(1, 55)$ = 9.86, $p$ = .003, $\eta_p^2$ = .15, and attractiveness, $F(1, 55)$ = 30.02, $p$ < .001, $\eta_p^2$ = .35, where female and attractive faces were categorized faster than male and unattractive faces. The main effects were qualified by the Attractiveness × Expression interaction, $F(1, 55)$ = 5.50, $p$ = .023, $\eta_p^2$ = .09, which demonstrated that both happy, $t(55)$ = 4.71, $p$ < .001, and angry expressions, $t(55)$ = 2.76, $p$ = .008, were categorized faster on attractive than unattractive faces, although the difference was larger for the happy faces, $t(55)$ = 2.35, $p$ = .023. The three-way Sex × Attractiveness × Expression interaction trended towards significance, $F(1, 55)$ = 3.81, $p$ = .056, $\eta_p^2$ = .07, reflecting that happy expressions were categorized faster on attractive female, $t(55)$ = 3.38, $p$ = .001, and attractive male, $t(55)$ = 3.48, $p$ = .001, compared to unattractive females and unattractive males respectively. Angry expressions were also categorized faster for attractive than unattractive male faces, $t(55)$ = 3.04, $p$ = .004, but there was no difference for the angry attractive and unattractive female faces, $t(55)$ = 0.60, $p$ = .550. The magnitude of the categorization advantage for attractive faces did not differ across the happy female, happy male, and angry male faces, $t(55)$ = 0.83, $p$ = .412, $t(55)$ = 0.27, $p$ = .791, and, $t(55)$ = 0.56, $p$ = .577, respectively.

**Accuracy.** Analysis of the error rates yielded main effects of sex, $F(1, 55)$ = 18.86, $p$ < .001, $\eta_p^2$ = .26, and attractiveness, $F(1, 55)$ = 8.58, $p$ = .005, $\eta_p^2$ = .14, where fewer errors were made categorizing expressions on female and attractive faces compared to male and unattractive faces. The Sex × Attractiveness interaction, $F(1, 55)$ = 5.80, $p$ = .019, $\eta_p^2$ = .10, reflected that more errors were made categorizing expressions on unattractive male, $t(55)$ = 3.25, $p$ = .002, than on attractive male faces. There was no difference in error rates for the attractive and unattractive female faces, $t(55)$ = 0.18, $p$ = .856. The Attractiveness × Expression interaction, $F(1, 55)$ = 9.79, $p$ = .003, $\eta_p^2$ = .15, indicated a lower error rate for happy expressions on attractive compared to unattractive faces, $t(55)$ = 3.90, $p$ < .001, but there was no difference in error rates for angry expressions, $t(55)$ = 0.78, $p$ = .440.

The three-way Sex × Attractiveness × Expression interaction did not reach significance, $F(1, 55) = 0.17$, $p = .684$, $\eta_p^2 < .01$.

## Supplementary Material 2

The intensity of emotional expressions has been suggested to facilitate accurate identification of the expressed emotion, although, happiness is easily recognized even at low intensity levels (Hess, Blairy, & Kleck, 1997). Golle, Mast, and Lobmaier (2014) demonstrated that it was easier to decide which of two happy faces is happier when the happiest face was more attractive. There is thus, a possibility that attractiveness interacts with emotion intensity to enhance perceptions of happiness. The attractiveness effect on emotion categorization observed in Experiments 1-4 could potentially be explained by happy attractive models being perceived as happier than happy unattractive models and resulting in faster categorization than their respective angry expression. The main pattern of results across the experiments is an Attractiveness × Expression interaction that reflects a happy face advantage for the attractive, but not for the unattractive faces. There is also a tendency indicating that this attractiveness effect is stronger among the female faces. If these results were driven by the intensity of the expressions, we would expect the happy expressions to be perceived as more intense than the angry expressions on the attractive faces but not on the unattractive faces, and potentially more so for the attractive female compared to the attractive male faces.

Furthermore, it has been argued that there is an overlap in morphology between masculine features and angry expressions, and between feminine features and happy expressions (Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007). If femininity/masculinity covaries with attractiveness, this could contribute to the results. If the recognition of happiness on feminine faces and anger on masculine faces is facilitated, then a happy face advantage would be predicted for more feminine faces and an anger advantage for more masculine faces. If the pattern of results, a happy face advantage for the more attractive faces but not for the unattractive faces, for both female and male faces, is driven by the perceived femininity or masculinity of the faces, then both the attractive female and male faces would be expected to be perceived as more feminine than the unattractive female and male faces.

A further potential explanation is that attractiveness covaries with sex typicality and that sex typicality is influencing emotion categorization. If attractive females are more feminine than unattractive females and femininity cues facilitate recognition of happiness, a larger happy face advantage should be observed for attractive female faces. At the same time, if attractive males would be rated as more masculine we would not expect to observe a happy face advantage (but potentially even an anger advantage) for attractive males relative to unattractive males (which is contrary to what we observed). For sex typicality to explain the pattern of categorization times, we should observe that attractive females are perceived as more sex typical than unattractive females, but unattractive males should be perceived as more sex typical than attractive males. To examine these alternative explanations for the observed results, we collected expression intensity, femininity/masculinity, and sex typicality ratings for the faces used in Experiments 1-3.

**Method**

**Participants**. Fifty participants (28 males, $M$ = 33.24 years, $SD$ = 9.69 years) were recruited from Amazon Mechanical Turk and received $2 US for completing the experiment. Thirty-seven participants identified themselves as White/Caucasian, 3 as Black/African American, 4 as Hispanic, 4 as Asian, 1 as Native American, and 1 participant did not provide information about their ethnicity.

**Stimulus materials, procedure, and analysis**. The attractive and unattractive, female and male models used in Experiments 1-3, were rated on the intensity of their emotional expression, their perceived femininity/masculinity, and how typically male or female they appear on 7-point Likert scales. The ratings were completed online using Qualtrics Survey Software. In a first block, participants were presented with all faces one at a time in a randomized sequence and asked to "*Please indicate how intense you find the expression on the face.*". The scale was anchored at 1=*Not at all*, 2=*Very weak*, 3=*Weak*, 4=*Moderate*, 5=*Strong*, 6=*Very strong*, 7=*Extreme*. In a second block, participants were asked to "*Please indicate how typically female (male) you find the face.*", with anchors 1=*Very atypical*, 2=*Atypical*, 3=*Somewhat atypical*, 4=*Neither atypical nor typical*, 5=*Somewhat typical*, 6=*Typical*, 7=*Very typical*, and "*Please indicate how masculine or feminine you find the face.*", with anchors 1=*Very masculine*, 2=*Masculine*, 3=*Somewhat masculine*, 4=*Neither masculine nor feminine*, 5=*Somewhat feminine*, 6=*Feminine*, 7=*Very feminine*. The intensity, femininity/masculinity, and sex typicality ratings were subjected to separate 2 (Target sex: female vs. male) × 2 (Attractiveness: attractive vs. unattractive) × 2 (Expression: happy vs. angry) repeated measures ANOVAs with follow-up pairwise comparisons.

**Results and Discussion**

**Intensity ratings**. Analysis of the intensity ratings (see Figure 1) yielded main effects of sex, $F(1, 49) = 4.70$, $p = .035$, $\eta_p^2 = .09$, attractiveness, $F(1, 49) = 59.25$, $p < .001$, $\eta_p^2 = .55$, and expression, $F(1, 49) = 10.21$, $p = .002$, $\eta_p^2 = .17$, where female, attractive, and angry faces were rated as having more intense emotional expressions than male, unattractive, and happy faces respectively. The three two-way interactions were significant; Sex × Attractiveness, $F(1, 49) = 32.23$, $p < .001$, $\eta_p^2 = .40$, Sex × Expression, $F(1, 49) = 4.10$, $p = .048$, $\eta_p^2 = .08$, and Attractiveness × Expression, $F(1, 49) = 13.88$, $p = .001$, $\eta_p^2 = .22$, and qualified by the higher order Sex × Attractiveness × Expression interaction, $F(1, 49) = 14.63$, $p < .001$, $\eta_p^2 = .23$. Angry expressions were rated as more intense than the happy expressions for the attractive females, $t(49) = 3.48$, $p = .001$, unattractive females, $t(49) = 3.37$, $p = .002$, and the attractive males, $t(49) = 3.86$, $p < .001$, but there was no difference in the rated intensity of the happy and angry expressions for the unattractive males, $t(49) = 1.37$, $p = .176$. Furthermore, there was no difference in the magnitude of the intensity difference for the happy and angry expressions across the attractive males, attractive females, and unattractive females, $t(49) = 1.34$, $p = .187$, $t(49) = 0.56$, $p = .579$, and, $t(49) = 1.53$, $p = .132$, respectively.

Contrary to what was predicted if the intensity of the expressions was driving the attractiveness effect on emotion categorization, the angry expressions were perceived as more intense than the happy expressions for attractive female and male faces, as well as for unattractive female faces, for which no difference in emotion categorization had been observed. Differences in the perceived intensity of the emotional expressions can therefore not account for the results observed in Experiments 1-3.

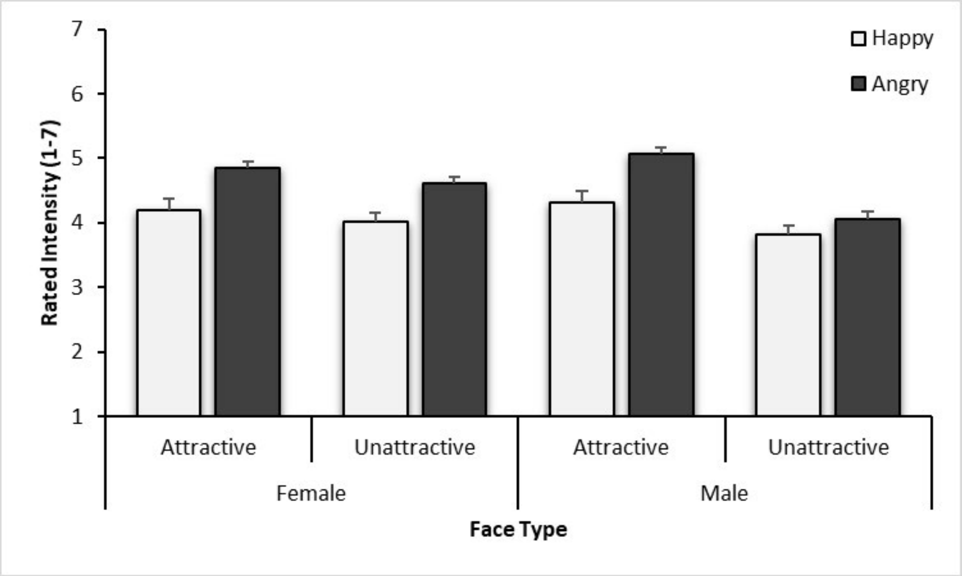


*Figure 1.* Intensity ratings for attractive and unattractive, female and male faces with happy and angry expressions. Errors bars represent 1 *SEM*.

**Femininity/masculinity ratings**. Analysis of the femininity/masculinity ratings (see Figure 2) yielded main effects of sex, $F(1, 49) = 185.28$, $p < .001$, $\eta_p^2 = .79$, attractiveness, $F(1, 49) = 70.40$, $p < .001$, $\eta_p^2 = .59$, and expression, $F(1, 49) = 33.57$, $p < .001$, $\eta_p^2 = .41$, where female, attractive, and happy faces were rated as more feminine than male, unattractive, and angry faces. The Sex × Attractiveness interaction, $F(1, 49) = 95.81$, $p < .001$, $\eta_p^2 = .66$, emerged as attractive females were rated as more feminine than the unattractive females, $t(49) = 10.19$, $p < .001$. There was no difference in rated femininity/masculinity for the attractive and unattractive males, $t(49) = 1.18$, $p = .241$. The Sex × Expression interaction, $F(1, 49) = 8.18$, $p = .006$, $\eta_p^2 = .14$, reflected that happy expressions were rated as more feminine than angry expressions on both female, $t(49) = 5.55$, $p < .001$, and male faces, $t(49) = 3.80$, $p < .001$, with a larger difference for the female faces, $t(49) = 2.86$, $p = .006$. The Attractiveness × Expression interaction, $F(1, 49) = 4.84$, $p = .033$, $\eta_p^2 = .09$, demonstrated that happy expressions were rated as more feminine than angry expressions for both the attractive, $t(49) = 5.74$, $p < .001$, and unattractive faces, $t(49) = 4.90$, $p < .001$, although the difference in rated femininity was larger for the attractive faces, $t(49) = 2.20$, $p = .033$. The three-way Sex × Attractiveness × Expression interaction was not significant, $F(1, 49) = 0.75$, $p = .391$, $\eta_p^2 = .02$.

The analysis confirms that happy expressions are perceived as more feminine than angry expressions. The difference was larger for the attractive faces relative to the unattractive faces, which could contribute to the facilitated processing of happy expressions on attractive faces. More importantly, as predicted, the attractive female faces were rated as more feminine than the unattractive females, but contrary to prediction, there was no difference in rated femininity for the attractive and unattractive male faces. Thus, differences in the perceived femininity/masculinity of the faces cannot fully account for the attractiveness effect observed in emotion categorization.

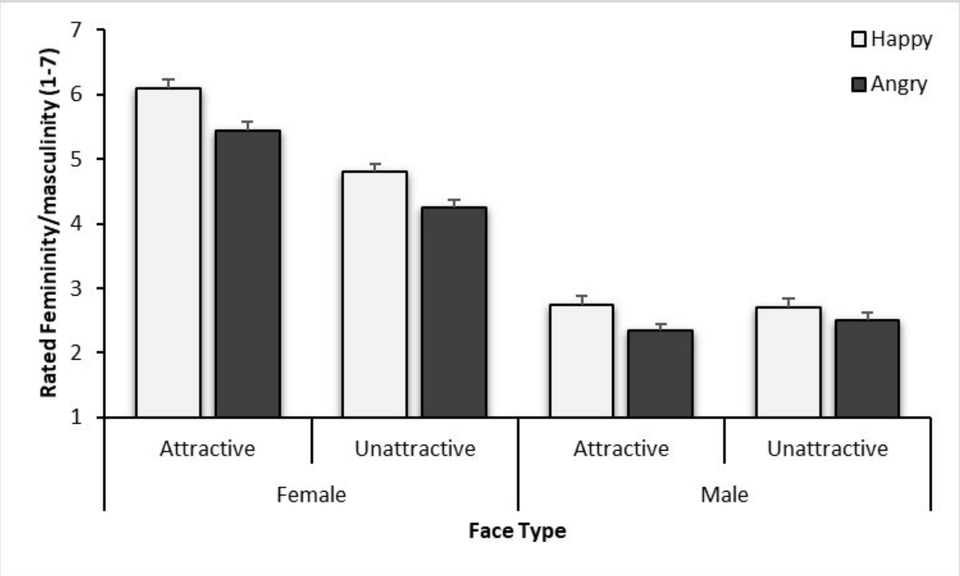


*Figure 2.* Femininity/masculinity ratings for attractive and unattractive, female and male faces with happy and angry expressions. Errors bars represent 1 *SEM*.

**Sex typicality ratings**. Analysis of the sex typicality ratings (see Figure 3) yielded main effects of sex, $F(1, 49) = 10.16$, $p = .002$, $\eta_p^2 = .17$, attractiveness, $F(1, 49) = 40.25$, $p < .001$, $\eta_p^2 = .45$, and expression, $F(1, 49) = 22.19$, $p < .001$, $\eta_p^2 = .31$, where male, attractive, and happy faces were rated as being more sex typical than female, unattractive, and angry faces. The Sex × Attractiveness interaction, $F(1, 49) = 32.60$, $p < .001$, $\eta_p^2 = .40$, demonstrated that the attractive faces were rated as more sex typical than the unattractive faces for both females, $t(49) = 6.94$, $p < .001$, and males, $t(49) = 4.04$, $p < .001$, however, the difference was larger for the female faces, $t(49) = 5.71$, $p < .001$. The Sex × Expression interaction, $F(1, 49) = 12.04$, $p =$

.001, $\eta_p^2$ = .20, reflected that happy faces were rated as more sex typical than angry faces for both females, $t(49) = 5.16$, $p < .001$, and males, $t(49) = 2.36$, $p = .023$, although, the difference was again larger for female faces, $t(49) = 3.47$, $p = .001$. The three-way Sex × Attractiveness × Expression interaction was not significant, $F(1, 49) = 2.28$, $p = .137$, $\eta_p^2 = .05$.

The attractive faces were rated as more sex typical than the unattractive faces, thus, sex typicality could account for the categorization time pattern for female faces, but not for male faces. Furthermore, happy expressions were rated as more sex typical than angry expressions for both female and male faces, but no interaction with attractiveness was observed. If the pattern of categorisation results observed were driven by sex typicality, the difference in ratings of happy and angry expressions would be expected to be larger for the attractive female and male faces compared to unattractive female and male faces, respectively. Sex typicality does vary with attractiveness, but cannot account for the categorization time patterns observed.

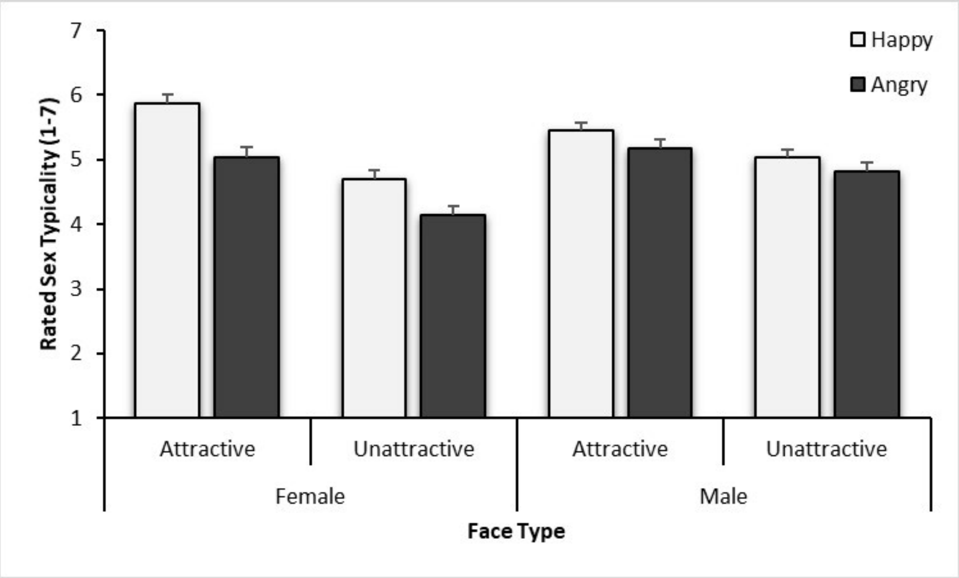


*Figure 3.* Sex typicality ratings for attractive and unattractive, female and male faces with happy and angry expressions. Errors bars represent 1 *SEM*.

## References

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