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ATTENTION TO GENDER STEREOTYPIC EXPRESSIONS OF THREAT: THE INTERACTIVE NATURE OF GENDER AND FACIAL MATURITY

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ABSTRACT

The current thesis examines whether attention to threatening facial expressions is moderated by face gender (Study 1), whether this effect is driven by gender categorization (Study 2a) or gender-related appearance (Study 2b), and whether attentional biases to gender-expression pairs are influenced by implicit gender stereotypes (Study 4). Across four studies, we found consistent and replicable effects for early attentional biases towards female fear (vs. male fear – stereotype congruent effect), whereas later attentional biases favored stereotype-incongruent gender-expression pairs (fearful males, angry females). A lack of early biases for anger was found across all studies, and was not impacted by the timing of the paradigm (Study 3). Further, the attentional biases found appear to be driven by gender category, not by gender related facial appearance. Additionally, preliminary evidence points to an association between implicit gender stereotypes and attentional maintenance on stereotype incongruous pairings. These findings are consistent with the conclusion that the perceptions of even basic threat-related emotions are moderated by social cues like face gender.

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Chapter 1. INTRODUCTION

As social creatures, we are constantly bombarded with social stimuli that require quick and efficient processing for us to respond in a timely and adaptive manner. Thus, our ability to filter and integrate social information in a functional manner is essential to our survival and performance as a social species. Of potential sources of social meaning, perhaps the most informative is the face. Faces convey one's current emotional state, age, gender, race, culture, and attention. While traditional models of face processing consider these separate sources of social information as involving functionally and neurally distinct processes (Bruce & Young, 1986; Haxby, Hoffman, & Gobbini, 2000, 2002), more recent findings cast doubt on such a claim (Adams & Nelson, *in press*; see also Calder & Young, 2005). This research suggests that there is considerable overlap in the perceptual mechanisms that process social stimuli, hence allowing multiple cues to contextualize one another.

The current thesis will attempt to examine how one particular social cue, gender, contextualizes the perception of facial expressions by using an attentional paradigm. This approach builds upon a burgeoning effort to "put the social" back into social perception by considering how social context can influence the perceptions of even basic facial expressions. In particular, expressions that convey threat will be used given they are more susceptible to automatic perceptual and attentional processing (Öhman, 1997). Specifically, we examine how attention is allocated to male and female faces expressing anger (a male-stereotypic threat expression) and fear (a female-stereotypic threat expression).

An Ecological Approach to Social Vision: Compound Social Cues

Previous decades of face processing research have spawned parallel but non-overlapping lines of inquiry, leaving us with a literature often fragmented and wrought with inconsistent findings. Vision scientists have focused on the perceptual features and underlying mechanisms of face processing without consideration of the socio-communicative functions the face serves. Social psychologists, on the other hand, have often focused solely on processes that occur after perception, such as categorization and stereotype activation. Without considering the intersection of visual perception and the social nature of the face, an incomplete picture of face (and social) perception has emerged. This has led to theoretical perspectives that fail to consider the social nature of the human face. Bruce and Young (1986) put forth a theory that emphasizes the functional dissociation between changeable aspects of the face (i.e., expression) and static aspects of the face (i.e., facial identity). This parsing of information certainly makes sense from an efficiency viewpoint as parallel processing can lead to faster processing. Haxby and colleagues (2000, 2002) put forth a neurological account of the original Bruce and Young (1986) model by suggesting that these changeable aspects are parsed early on, after initial structural encoding occurs in the inferior occipital gyrus. From there, changeable aspects of the face are channeled through the superior temporal sulcus, whereas static features are channeled through the lateral fusiform gyrus. Although this visual-cognitive account of face processing is not inaccurate, it is incomplete (see Adams, Franklin, Nelson, & Stevenson, 2010, for an argument of interdependency in processing of static and changeable facial features).

A movement in *social vision* is emerging that emphasizes the fact that the face is a social stimulus and is fundamentally processed as such (see Adams, Ambady, Nakayama, & Shimojo, 2010). Our perceptual systems have evolved within a social context. Therefore, in order to understand how cues are perceived in the face, consideration of their social functions is critical. In particular, one area where this perspective can inform and build upon previous research is in the domain of *compound social cues* (Adams et al., 2010). This perspective emphasizes the combinatorial nature of face processing and suggests that in order to process the face in a socially meaningful way, it is necessary to process the face not as a unitary stimulus but to consider all sources of social information being communicated in order to determine its significance to you as a social perceiver. For example, a joyful expression on a face with gaze directed towards you will represent something more positive than the same face with the gaze directed elsewhere. Likewise, a fearful face with gaze directed towards you will be less threatening to you than would a fearful face with its gaze directed elsewhere (which may be signaling threat exists in the environment). It is the combination of such information that their shared signal value can be ascertained.

This functional approach to face processing is grounded in ecological theories of face perception (Gibson, 1979; McArthur & Baron, 1983; Zebrowitz, 1997, 2006; Zebrowitz, Bronstad, & Montepare, 2010). According to the ecological perspective, behavioral affordances are offered by perceptual stimuli because they serve an adaptive function. For example, seeing baby-like (low-mature) features can lead directly to enhanced caretaking behavior (Glocker et al., 2009). This connection between baby-like features and caretaking is adaptive in that it enhances protective tendencies by adults during critical times in development. Its adaptive value can be seen as the motivation to engage in caretaking declines as the shape of an infant's head matures (Alley, 1983). Biases to such cues are seen as having obvious adaptive implications for the survival of a species (Hrdy, 2005).

Influence of Context on Basic Emotional Expression Perception

In addition to promoting a functional account of how social stimuli have evolved to serve basic communicative needs, the field of social vision also puts forth the notion that our visual worlds are indeed influenced by social context. The ability to detect basic emotions has been grounded in evolutionary theory due to the essential function it serves in survival and interpersonal relationships. The theoretical roots of emotional expressions being an innate characteristic of humans (and other animals) can be traced back to Charles Darwin (1872). In particular, Darwin (c.f. Hess & Thibault, 2009) posited three principles that dictate why humans and animals express emotions outwardly: 1) serviceable habits – the expression served a physiological purpose (e.g., wide-open eyes and raised eyebrows with fear expressions actually serve to increase how much of the environment can be seen by the individual); 2) antithesis – some expressive cues are simply the inverse of serviceable ones (e.g., lowered brows, relatively closed eyes associated with anger); and 3) direct action of the nervous system – expressions release nervous energy (e.g., laughter when in a nervous state). Interestingly, these principles show that Darwin did not posit that expressions evolved specifically to communicate emotional states to others. The principle of antithesis shows that there was a communicative nature to Darwin's thinking since a primary function of antithesis is to provide a clear display that an organism is experiencing the opposite of a state with an associated serviceable habit (Hess & Thibault, 2009). However, antithesis requires the existence of emotional expressions to have already evolved for other purposes (i.e., serviceable habits and direct action of the nervous system). Darwin's principles of expressions suggest that there are innate, hardwired mechanisms that drive expressive behavior, and that we have likely evolved to use this information to draw inferences about others (although he denied the notion that the evolution of expressions was driven by social pressures – they were just later co-opted from the existing system).

Darwin's principles were largely ignored until the 1970s when Paul Ekman began to push his neurocultural theory (Ekman, 1972). Ekman stressed that there was a core of basic emotions (i.e., anger, fear, joy, sad, disgust, surprise, contempt) in which expressions were found universally across cultures (the "neuro"), as well as those that were more culturally-specific (the "cultural"). Additionally, Ekman argued that cultural influences could moderate the expression of basic expressions (i.e., cultural display rules); however, he suggested that recognition of these expressions was universal and innate. Elfenbein and Ambady (2002) later showed, via meta-analysis, that these "universal" expressions were more accurately recognized when displayed by in-group members. They contend that there are "cultural dialects" that influence the expression and perception of such basic emotions. While not necessarily suggesting that Ekman was incorrect in his notion of universality in the expression and recognition of basic emotions, Elfenbein and Ambady provided convincing evidence that social factors can exert a powerful role over both the expression and recognition of even basic facial expressions.

Standing in more staunch opposition of Ekman, Russell (1980, Russell & Fehr, 1987) has argued that emotions are not basic, discrete categories, but rather fall in an area of "emotion space" that is determined by two underlying orthogonal factors – pleasure and arousal. While there is a large literature looking at this circumplex model in relation to emotional experience, the current review will focus on perception of emotional expressions.

Working from Russell's (1980) circumplex model, Russell and Fehr (1987) showed consistently, through six experiments, that the perceptions of faces (neutral, surprised, and angry) could be swayed depending on the expression displayed by an anchor face. They found that the presentation of expressive faces (either alongside or before the appearance of the target face) shifted subsequent ratings of the target face, whether it was neutral or expressive, on the dimensions of pleasure and arousal in the opposite direction of the anchor face. For neutral expressions, categorical labels were reliably applied to these faces (e.g., happy anchor lead to the use of sad as a label). When the targets displayed a surprised or angry expression, there were few categorical errors (most participants labeled the target correctly); however, errors that were committed were in the predicted pattern, being opposite of the anchor. This series of studies nicely demonstrated the relativity that exists in perceptions of facial expressions. Facial expressions are not judged absolutely, within a social vacuum, but rather are contextualized by other social cues in the environment (and in this case, other expressive faces).

Influence of Gender on Emotion Perception

A powerful social cue that should contextualize emotional expressions is gender. Gender and emotion are inextricably tied together through stereotypes of what it means to be "masculine" or "feminine." Because the current thesis focuses on expressions of threat, review of the literature focuses on anger and fear. Fear has been associated with femininity and anger with masculinity (Shields, 2002). In addition, men are perceived as expressing anger more often than women, whereas women are perceived as expressing fear more often than men (Fabes & Martin, 1991). Further, even when infants are labeled as "male," they are perceived to be angrier and less fearful than infants labeled as "female" (Condry & Condry, 1976). Similarly, ambiguous expressions of sadness (an expression perceived to be submissive; Knutson, 1996) and anger are more likely to be labeled as sad when displayed on a female face and anger when displayed on a male face (Plant, Hyde, Keltner, & Devine, 2000). These gender stereotypes are well established even in children as young as 3-5 years of age (Birnbaum, Nosanchuk, & Croll, 1980; Birnbaum & Croll, 1984).

The examination of facial expressions within the context of gender is particularly interesting in that gender and emotion are visually confounded in the face. In terms of facial appearance, male faces tend to be high in maturity (e.g., large jaws, lower eyebrows, angular features) and female faces tend to be lower in maturity (e.g., small jaw, higher eyebrows, round features; Friedman & Zebrowitz, 1992). Faces that are high and low in maturity have considerable overlap with the expressions of anger and fear, respectively (e.g., Marsh, Adams, & Kleck, 2005). Marsh and colleagues (2005) showed that 1) high-mature faces were judged to express more anger; low-mature faces were judged to express more fear, and 2) characteristics that have been associated with low maturity (i.e., dependence, femininity, honesty, and naïveté) were ascribed more to fearful faces than angry faces. Conversely, anger is more easily recognized when displayed on high-mature faces, and fear when displayed on low-mature faces (Adams, 2009, February). Likewise, manipulating maturity cues in faces has been found to facilitate anger and fear recognition (Sacco & Hugenberg, 2009).

Facial appearance associated with gender can influence the recognition of expression cues by enhancing or decreasing the perceptual clarity of the threat. For instance, Becker, Kenrick, Neuberg, Blackwell, and Smith (2007) showed across several studies that angry facial expressions are recognized more easily when presented on male faces, whereas happy expressions are recognized more easily on female faces. Furthermore, they found that neutral faces high and low in masculinity (closely related to maturity) are associated with anger and happy expressions respectively. The authors suggested that this is evidence that it is facial appearance, rather than stereotype-driven effects, that allow for this facilitated recognition. While Becker et al. (2007) focused on anger and happiness, fear recognition has been found to be facilitated when presented on female versus male faces (Adams, 2010, October). The benefits for identifying anger on a male face and fear on a female face actually disappear when male and female faces are matched on maturity (Adams, 2009, February).

Perhaps the most pure measure of perceptually driven effects can be examined using connectionist models. These computer-based models can examine the structure of the face in the absence of culturally driven stereotypes. Zebrowitz, Kikuchi, and Fellous (2007) showed that faces lower in facial maturity were detected to be higher in surprise (an expression closely related to fear perceptually) by a computer whereas faces higher in maturity were detected to be higher in anger. They later found that neutral male faces were detected by the computer as more angry than female faces. Likewise, neutral female faces were detected as higher in surprise (Zebrowitz, Kikuchi, & Fellous, 2010).

This all provides strong, convincing evidence for a perceptual overlap explanation for differences in expression recognition that are found when displayed by males versus females. What is unclear, however, is whether these perceptual overlaps have impacts at the level of attention. All of the aforementioned studies consist of explicit identification, labeling, or attributions of various psychological characteristics, but do they initially capture attentional resources? This question will be addressed by the current thesis.

Attention: Gateway to Downstream Processing

The current thesis used attention paradigms to assess the degree to which our social sensory perception is attuned to congruent versus incongruent gender by expression cues. Attention has been widely conceptualized as a gating mechanism by which relevant stimuli are selected for processing amongst a backdrop of countless potential other stimuli (Posner, 1980). Given our cognitive limits, some sort of system that will allow only the most relevant information through is necessary to prevent cognitive overload (Broadbent, 1957). Attention, however, is not a unitary mechanism but a constellation of bottom-up stimulus driven and top-down control-oriented processes that help guide us through our complex visual worlds. In order to understand social attention, it is important to consider how these different mechanisms influence perceptual attunement, and whether attention dynamically shifts over the course of the temporal stream.

Threat and Attention: Early Attentional Orienting vs. Late Attentional Maintenance

When a visual stimulus enters our environment, there are numerous factors that will determine whether the stimulus is attended to or not. At its most primary level, the stimulus must reach a visual threshold for detection (Posner, 1980). This is often thought of in terms of stimulus properties (e.g., luminosity, contrast); however, such thresholds can be socially weighted. Even basic visual attention is moderated by the relevance of a stimulus, particularly in more complex visual scenes. Zebrowitz and colleagues refer to this as *attentional weighting*, whereby perceptual attunements become focused towards more relevant stimulus features

(Zebrowitz et al., 2010; Zebrowitz & Montepare, 2006). This offers survival benefits by directing attention to stimuli of particular relevance to the perceiver.

Similar to the idea of attentional weighting, Compton (2003) suggests that there are two processes that direct attention to stimuli of emotional significance – 1) an automatic, pre-attentive process that assesses emotional significance, and 2) one that prioritizes selective attention via top-down modulation of attentional resources. The automatic, pre-attentive process is analogous to an attentional weighting system, whereas top-down attentional modulation can sustain, regulate, and fine-tune this attentional focus. This concept of dual-attentional pathways has been directly applied to the processing of threat cues (e.g., Mogg, Garner, & Bradley, 2007). Specifically, when stimuli appear in our environment, we are more likely to shift attention towards clear threat cues first. This is important because these stimuli may suggest that an immediate threat exists. However, attention should not be maintained on such a stimulus once it has been processed. Threatening stimuli are aversive and unpleasant stimuli, therefore it is not beneficial to maintain attention on these cues, especially when threats do not actually exist. This is a staple of emotion regulation theories (Mogg et al., 2007, Wilson & Gottman, 1996), and the inability to disengage has been implicated in anxiety disorders.

Stimuli that do not clearly signal threat are not as quickly processed because they are not weighted equally to clearly threatening stimuli. Because of this, these cues are disengaged from slower than clear threat cues presumably to allow for additional processing of the stimulus (Mogg, Millar, & Bradley, 2000; Mogg et al., 2007; Serences, Shomstein, Leber, Golay, Egeth, & Yantis, 2005). This disengagement has also been suggested to be part of an adaptive “freeze” response (e.g., Fox, Russo, Bowles, & Dutton, 2001; Salemink, van den Hout, & Kindt, 2007).

LeDoux (1996) extensively outlines the adaptive nature that "freezing" has in terms of survival – it allows an organism to plan a response while not engaging in superfluous movements (see also LeDoux, 1995).

This dual-pathway approach to attention has parallels in the threat perception literature. Most well known is Joseph LeDoux's conceptualization of the *low road* and *high road* (LeDoux, 1996). LeDoux describes the low road that is primarily made up of direct projections to the amygdala from subcortical regions (i.e., superior colliculus). This road is responsible for relaying quick, crude information about the environment. This is adaptive in terms of allowing organisms to begin to respond to threat before conscious awareness has been achieved. Meanwhile, as information is being fed directly to the amygdala, more detailed visual perception is being provided by the high road, which projects first to visual cortical areas, then to the amygdala. It is this more detailed information that can determine whether a threat exists or not, and can either allow a threat response to continue in the brain, or shut down this threat response. An example of this is the experience of becoming startled by the appearance of a snake-like figure on the ground, just to quickly realize that it is simply a stick. The low road initiates a startle response that is followed by the disengagement of this system by the high road after sufficient information has been gathered.

The low road/high road dual pathway approach has been applied to the perception of fear faces (Liddell, Williams, Rathjen, Shevrin, & Gordon, 2004; Liddell et al., 2005; Williams et al., 2004; Williams et al., 2006). Specifically, subliminally presented fear expressions have found to initiate ERP waveforms associated with initial sensory processing and orienting (i.e., N2 waveform) whereas conscious level processing has been found to initiate waveforms associated with integration of information (i.e., P3, N4 waveforms; Liddell et al., 2004; Williams et al., 2004). These dissociations between low road and high road processing of fear expressions have also been shown via fMRI (Liddell et al., 2005; Williams et al., 2006). Liddell et al. (2005) showed preferential activation of low road areas (e.g., superior colliculus, pulvinar, amygdala) to subliminally presented fear expressions. Williams et al. (2006) extended these findings showing that while subliminally presented fear expressions had a more persistent effect on amygdala activations, supraliminally (level of conscious awareness) presented fear expressions led to more persistent activity in frontal areas, predominantly the dorsal anterior cingulate.

More recently, neuroimaging work has examined how threat responses to facial expressions are moderated by eye gaze (Adams et al., *in press*; Adams et al., *under review*; Hadjikhani, Hoge, Snyder, & de Gelder, 2008). Eye gaze serves as a powerful contextual cue by which to interpret the meaning of threat expressions (Adams & Kleck, 2003, 2005). For instance, an angry face looking directly at you is a much greater signal of potential threat to you than, say, an angry face looking away from you. Likewise, a fearful face looking away from you could mean that this individual is looking at a potential threat in the environment, whereas the same face looking at you suggests that either 1) you are the threatening object (obviously not a threat to yourself) or 2) this person is in danger and needs help. In all of these cases, there is a threat expression present; however, the direction of the gaze moderates the threat value of that expression to you as a perceiver. Adams et al. (*in press*) found more widespread neural activation (including the amygdala) to congruent gaze-expression pairings (direct-anger/averted-fear) when the faces were presented rapidly (33 ms), whereas this activation was flipped towards incongruent gaze-expression pairings (direct-fear/averted-anger) when the faces were presented for longer periods of time (2 s). Adams et al. (*under review*), using only fear expressions, found more amygdala activation when the faces were presented briefly (300 ms) to averted fear (congruent cue), whereas more activation was found for direct fear (incongruent) when the faces were presented for longer periods of time (1 s).

The current thesis builds upon this literature examining dual-processing pathways that vary in their relevance to stimulus processing across time. Specifically, by manipulating both the weighting (relevance) of threat expressions with gender, as well as the timing in which the face appears, we aim to tap into these dual-pathways differentially to show that indeed, the threat value does vary as a function of gender.

Chapter 2. EXPERIMENTS

In the current studies, we manipulated how long facial expressions appear in order to tap into two attentional pathways to determine how weighting (importance/relevance) of anger and fear faces varies as a function of the context within which they are expressed (i.e., on a male versus female, or when coupled with high- versus low-mature facial appearance). For example, if there are attentional biases towards male anger when presented rapidly, we could conclude that this cue receives relatively more attentional weighting than the same anger expression on a female face. Likewise, if we find that longer stimulus displays lead to attentional biases towards female anger versus male anger, we could conclude that female anger is more ambiguous than male anger in that it demands prolonged attention to decipher.

The dot-probe paradigm (MacLeod, Mathews, & Tata, 1986) is the most commonly used tool to assess attentional biases. In the dot-probe paradigm, two cues are presented on a computer monitor for specified periods of time. After this time has elapsed, both cues disappear and a target appears at the former location of one of the cues (usually dots). The participant then needs to identify the target (usually the number of dots presented). Reaction times are recorded for the responses. If there is an attentional bias towards a cue, this will be reflected in shorter reaction times relative to the other cues of interest. The dot-probe paradigm has primarily been used in clinical contexts to assess attentional biases in individuals with high levels of anxiety (e.g., Bradley, Mogg, Falla, & Hamilton, 1998; Bradley, Mogg, White, Groom, & Bono, 1999; Mogg & Bradley, 2002) and depression (e.g., Joormann, Talbot, & Gotlib, 2007; Leyman, DeRaedt, Schacht, & Koster, 2007).

Non-clinically, the dot-probe paradigm has typically been used to examine attentional biases to functionally significant stimuli, often facial expressions (e.g., Bradley et al., 1997; Cooper & Langton, 2006). Much of this research has centered around attentional biases to threatening facial expressions, following up and extending the earlier dot-probe research examining clinical populations (e.g., Bradley et al., 1998, Mogg & Bradley, 1999), which did not report biases in non-clinical populations. As noted by Cooper and Langton (2006), this is surprising given the evolutionary and functional significance that these cues have for survival. Cooper and Langton (2006) speculated that the lack of biases for non-clinical populations was due to the timing parameters used. They hypothesized that if they used quicker stimulus display times (i.e., 100 ms), they would find attentional biases for angry facial expressions, even in non-clinical populations. They administered a dot-probe paradigm to non-clinical participants using angry-neutral and happy-neutral trials that were displayed for either 100 ms or 500 ms. They indeed found a non-significant trend towards angry faces relative to neutral faces at 100 ms. However, at 500 ms, they found biases towards happy faces relative to neutral faces. This fits with the dual-process model of attention (Mogg et al., 2000; Mogg et al., 2007) suggesting that attention will be biased to the most salient threatening stimuli initially, followed then by attentional maintenance for relatively non-threatening (or even pleasant) stimuli later on.

The current thesis used a dot-probe attention paradigm (see Figure 1) in order to assess attentional biases to threatening facial expression cues as modulated by gender cues in the face. Anger and fear are chosen as the stereotypical male and female threat expressions, respectively, because both are negatively valenced, high-arousing expressions (Russell, 1980; Watson & Tellegen, 1985). By controlling for valence and arousal, we can examine the relatively pure effects that gender has on these facial expressions.

The current thesis predicts that: 1) there will be an early attentional bias to male anger and female fear faces because these represent threatening cues that are congruent, 2) there will be a late attentional bias towards female anger and male fear faces because these are incongruent cues that require prolonged attention to decipher, and 3) the relative threat value of these stimuli are either driven by stereotypic congruence, physical resemblance (facial maturity), or both.

Study 1

Study 1 was designed as a preliminary study to determine whether attentional biases to facial expressions of threat (anger and fear) are differentially modulated by the gender of the face. We expected to find early attentional biases towards congruent gender-expression pairings (male-anger/female-fear) due to their greater threat salience, followed by later attentional biases to incongruent pairings (male-fear/female-anger).

Participants

Forty-four undergraduate participants were recruited for course credit. Two participants (1 male, 1 female) were dropped due to low accuracy (below 90%). This left us with 42 participants (20 females, 22 males), with an average age of 18.98 (1.32).

Materials

Participants were administered a dot-probe protocol on Dell Optiplex personal computers running Windows XP operating systems equipped with 17 inch Dell CRT monitors with a 75Hz refresh rate and a resolution of 1024 X 768 pixels. Presentations and responses were executed and recorded with E-Prime 1.1 SP3 (Psychology Software Tools, Inc.). Responses were recorded via mouse click. Faces were selected from the Ekman and Friesen (1976) Pictures of Facial Affect set. Four identities (two males, two females) were used. These faces displayed anger, fear, and neutral expressions.

Design and Procedure

Participants were brought into the laboratory in pairs of two at a time. They were seated in a dimly lit room with a divider between two computers. The study consisted of 16 practice trials, followed by 288 trials (128 anger trials, 128 fear trials, 32 neutral trials for filler). Each trial began with a fixation point at the center of the screen, which lasted for 1000 ms. This was followed by the presentation of two faces, one male and one female that were matched for emotional expression, to the left and right of fixation. The faces remained up on the screen for 300 ms or 1000 ms (half of trials for each). The selection of 300 ms and 1000 ms is based upon Adams et al.'s (*in press*) findings of greater neural activity for congruent cues at 300 ms and incongruent cues at 1000 ms. Following this, the faces disappeared and one or two dots appeared in the former location of one of the faces. These remained on the screen until a response was given, or for 2000 ms, whichever came first. Participants responded by indicating whether they saw one or two dots by clicking corresponding buttons on the mouse. Reaction time and accuracy were recorded for each trial. Participants were instructed to ignore the faces and to respond to the number of dots they saw. They were told to respond as quickly, but accurately, as possible.

Results

Inaccurate trials (2.9%) and trials with responses quicker than 100 ms or greater than 1000 ms (2.6%) were dropped. We chose 100 ms as a low cut-off given that initial visual orienting of attention does not appear until around 100 ms (e.g., Posner, 1980). The selection of 1000 ms as a high cut-off is based on the notion that selective attention effects are found earlier than 1000 ms (Duncan, Ward, & Shapiro, 1994). Remaining trials were then submitted to logarithmic transformations to normalize the data. To ease in interpretation, reaction times were back transformed into milliseconds (see Table 1). Note that the neutral expression trials were not included in analyses.

The data were submitted to a 2 (face gender – male/female) by 2 (expression – anger/fear) by 2 (stimulus duration – 300/1000 ms) repeated measures ANOVA[1]. There was a main effect of expression, $F(1, 41) = 7.80$, $p = .008$, $\eta^2 = .160$, with faster reaction times to anger ($M = 563$, $SD = 54$) than fear ($M = 572$, $SD = 54$). There was an interaction between face gender and expression, $F(1, 41) = 6.92$, $p = .012$, $\eta^2 = .144$, with a trend towards faster responses to female anger ($M = 563$, $SD = 56$) than male anger ($M = 569$, $SD = 53$), $t(41) = 1.86$, $p = .070$, $\eta^2 = .078$, and a trend towards faster responses to male fear ($M = 571$, $SD = 56$) than female fear ($M = 577$, $SD = 54$), $t(41) = 1.91$, $p = .063$, $\eta^2 = .082$. There was also an interaction between face gender and stimulus duration, $F(1, 41) = 10.46$, $p = .002$, $\eta^2 = .203$, with faster responses to females ($M = 565$, $SD = 55$) than males ($M = 574$, $SD = 58$) at 300 ms, $t(41) = 2.62$, $p = .012$, $\eta^2 = .144$, and faster responses to males ($M = 566$, $SD = 54$) than females ($M = 575$, $SD = 56$) at 1000 ms, $t(41) = 2.52$, $p = .016$, $\eta^2 = .134$. Importantly, these effects were further qualified by

[1] Participant gender was initially included as a between subjects factor across all studies. It did not significantly interact with any of the variables, so therefore is not discussed further.

the predicted three-way interaction, $F(1, 41) = 33.29$, $p < .001$, $\eta^2 = .448$.

In order to interpret the 3-way interaction, we calculated a pair of 2 (face gender – male/female) by 2 (stimulus duration – 300/1000 ms) repeated measures ANOVAs, broken down by expression. The 2-way interaction was significant for fear, $F(1, 41) = 44.42$, $p < .001$, $\eta^2 = .520$, driven by faster responses to female fear ($M = 565$, $SD = 57$) than male fear ($M = 585$, $SD = 63$) at 300 ms, $t(41) = 4.13$, $p < .001$, $\eta^2 = .294$, and faster reaction times to male fear ($M = 559$, $SD = 56$) than female fear ($M = 590$, $SD = 55$) at 1000 ms, $t(41) = 6.18$, $p < .001$, $\eta^2 = .483$. Surprisingly, for anger, the 2-way interaction was not significant, $F(1, 41) = 2.39$, $p = .130$, $\eta^2 = .055$, although there was a main effect for faster reaction times to female anger ($M = 561$, $SD = 62$) than male anger ($M = 573$, $SD = 58$) at 1000 ms, $t(41) = 2.30$, $p = .027$, $\eta^2 = .114$. There was no significant difference in responses to male and female anger at 300 ms ($p > .93$). Figure 2 depicts these results as bias scores by calculating reaction times to dots behind female faces from reaction times to dots behind male faces ($RT_{male} – RT_{female}$).

Discussion

Study 1 offers preliminary evidence that gender moderates attention to threatening facial expressions. Overall, there are attentional biases towards incongruent gender-expression pairings – male fear and female anger. As predicted, however, this was moderated by stimulus duration such that short durations (300 ms) led to a bias towards the congruent female fear versus male fear. Unexpectedly, there was not a similar bias for male anger versus female anger. For longer durations (1000 ms), however, we found the predicted incongruity effect with attentional biases towards both incongruent cues (male fear, female anger).

This is the first study, to our knowledge, to demonstrate the impact of gender on attentional biases to basic facial expressions, and in particular to threat expressions. These findings are significant in that they suggest that, even amongst very basic, survival-relevant expressions of threat, that social cues, such as gender, moderate the relevance of these cues. This is consistent with the notion that "basic expressions" can be contextualized (Russell & Fehr, 1987), challenging a strict notion of the existence of basic expressions. Rather, this adds to the ever-increasing evidence for the powerful impact that social cues exert on visual-perceptual processing.

That said, the mechanism by which gender moderates attention to expressions remains unspecified. It could be driven by stereotype congruency, perceptual resemblance, or both. As stated above, previous evidence suggests that interactions between expression and gender are actually mediated by gender-specific facial appearance (maturity; Adams, 2010, October). However, there is evidence to suggest that top-down factors have a pivotal influence even on early visual orienting effects (Pashler, Johnston, & Ruthruff, 2001). Additionally, gender categorization occurs as early as 25 ms (Macrae & Martin, 2007), suggesting that even the automatic process of visual attention can be influenced by gender categorization. Teasing apart these factors is the goal for Study 2.

Although finding the predicted 3-way interaction, Study 1 failed to find the hypothesized attentional benefit for male versus female anger at the short stimulus duration. A few potential explanations may account for this null effect. For one, there is a large body of literature that implicates anger in pre-attentive processing, but not necessarily fear (Pinkham, Griffin, Baron, Sasson, & Gur, 2010; Williams & Mattingley, 2006). Thus, anger may simply be too salient of a threat cue to be modulated early on by gender in any appreciable way. This is consistent with our general finding that anger was responded to faster than fear overall. Additionally, stereotypes of females, but not males, are dynamic and changing as females are being seen as more agentic than they historically have been by our society (Diekman & Eagly, 2000). It is possible that the effects for fear, but not anger, are found because it is never appropriate for males to express fear due to static views on masculinity, but is more acceptable for females to express anger.

Given that, overall, Study 1 does provide evidence that gender moderates attention to basic threat expressions, Study 2 was designed to examine whether attention to expressions is moderated by gender categorization (stereotype-driven effects) or by facial maturity (perceptually-driven effects).

Study 2

Study 2 was designed to examine whether gender categorization or facial maturity drives the attentional biases found in Study 1. In order to examine this issue, two separate sub-studies were designed, one in which androgynous male and female faces (which are thus matched for maturity differences, and all other facial appearance cues) were pitted against one another with hairstyle differentiating gender category, and one in which high-mature faces and low-mature faces are pitted against each other. By examining the effects of gender while controlling for facial appearance (Study 2a), and by examining the effects of facial maturity while controlling for gender (Study 2b), we aimed to examine the influences of each of these factors independently of one another. It is possible, therefore, that any of the following three hypotheses may be supported: 1) gender categorization will solely drive attentional biases, 2) facial maturity will solely drive attentional biases, or 3) both gender categorization and facial maturity will drive these attentional biases.

Method

Participants

Forty-one undergraduates participated in the study for course credit. Six participants (5 females, 1 male) were dropped due to having low accuracy (below 90%), so this left us with 35 participants (26 females, 9 males) with an average age of 19.06 (1.03).

Measures

Face stimuli were created using FaceGen Modeller 3.4 (Singular Inversions, Inc.). This software allows for the creation of computer-generated faces that vary in many different aspects. For this particular study, we focused the manipulations on the Gender and Expression features for the androgynous faces, and the Gender, Expression, and Face Shape for the maturity faces.

Androgynous Faces

Initially, five template androgynous faces were created and piloted (N = 20 - 12 males, 8 females). Participants were instructed to label the face as male or female by pressing a key on a keyboard (1 = male; 2 = female). The template face we chose was slightly labeled as female more (M = 1.65), however, this was much closer to the midpoint than the purely 50-50 male-female template initially provided by FaceGen, which was overwhelmingly labeled as male (M = 1.1). These faces were subsequently given stereotypical male or female hairstyles by cropping hairstyles obtained through internet image searches. The faces were then grey-scaled to make the face and hairstyle look more natural in appearance. Four identities were created by using four different hairstyles - two per gender. After applying gender stereotypic hairstyles, an independent sample of 44 participants (28 males, 16 females) judged the gender of the androgynous faces in a forced choice task. The gender manipulation worked, with most participants labeling the female-hairstyle face as female (98%) and the male-hairstyle face as male (92%). The template faces were then uploaded into FaceGen and the expression was manipulated by setting anger to 100% for angry faces and fear to 100% for fear expressions. Hence, two expressions were generated for each face identity – one depicting anger and one depicting fear. Ratings show that these angry and fearful expressions were indeed perceived as such (97% accuracy for both) on a forced choice task.[2] Figure 3 provides examples of these androgynous faces.

Maturity Faces

Two template faces were initially created for the maturity trials – one female and one male. These faces were set to the average female and male settings in FaceGen, respectively. These faces were each manipulated for maturity in the following ways: brow ridge (lower for high-mature; higher for low-mature), chin (jutting for high-mature; retracted for low-mature), and eyes (smaller for high-mature; larger for low-mature). These manipulations were based on manipulations used by Friedman and Zebrowitz (1992). This led to two versions of each template face – one high in maturity and one low in maturity (babyface). The same hairstyles used for the androgynous faces were used for the maturity manipulated faces to create four identities – 2 females and 2 males. Ideally, we would have been able to assess maturity while completely controlling for gender by not including gender hairstyles; however, the manipulation of maturity would have simply led to gender categorizations. Therefore, we attempted to make

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[2] These faces were also rated for maturity to ensure there were no differences in physical appearance. There was no significant difference ($p = .47$) with both hovering around the midpoint of a 7 point scale (males = 3.85, females = 4.02).

the gender category clear and simply pitted the cues of interest (high- versus low-mature) within trials.

An independent sample of 26 participants (21 females, 5 males) rated the mature faces gender and maturity. Gender was dummy coded with 1 = "male" and 2 = "female." For male faces, gender ratings did not differ between high-mature and low-mature male faces (98% for both). For female faces, however, low-mature female faces (M = 1.88) were significantly more likely to be labeled as female than female mature faces (M = 1.42), t(25) = 5.57, p < .001, η^2 = .554. Because of this unexpected categorization effect for females, we present the results in the results section broken down by face gender.

For maturity ratings, the same participants rated on a scale from 1 to 7 on how mature the faces appeared, with 1 = "babyface" and 7 = "mature face." Crucially, high-mature male faces (M = 6.38) were rated higher in maturity than low-mature male faces (M = 4.42), t(25) = 7.26, p < .001, η^2 = .678, and high-mature female faces (M = 4.98) were rated higher in maturity than low-mature female faces (M = 3.50), t(25) = 3.40, p = .002, η^2 = .316. Figure 4 provides examples of these maturity-manipulated faces.

Procedure

The procedure for Study 2 was similar to Study 1, except the neutral trials were eliminated due to time constraints, and participants now completed two 256 trial blocks instead of one. Half of participants completed the androgynous faces block first, followed by the maturity faces block. This order was reversed for the other half of participants. Practice trials were completed only before the first block. At the beginning of the second block, participants were told that the task instructions were the same.

Results

As with the analyses in Study 1, the analyses in Study 2 were initially stripped of outliers (responses faster than 100 ms or slower than 1000 ms) and incorrect trials (3.5% of trials). The remaining data were then submitted to logarithmic transformations to normalize the data. These values were then back transformed into milliseconds to ease in interpretation (see Table 1 for reaction times for Study 2a). For both sub-studies, block order was initially introduced as a between subjects variable; however, it did not significantly moderate any effects, so it was left out of the analyses mentioned below.

Study 2a - Androgynous

Data were submitted to a 2 (face gender- male/female) by 2(expression – anger/fear) by 2 (stimulus duration – 300/1000 ms) repeated measures ANOVA. There were no significant main effects, although expression approached significance, $F(1, 34) = 2.42$, $p = .129$, $\eta^2 = .066$, with slightly faster responses to anger trials ($M = 510$, $SD = 58$) than fear trials ($M = 514$, $SD = 60$) overall. There was a significant interaction between face gender and expression, $F(1, 34) = 5.45$, $p = .026$, $\eta^2 = .138$, with a trend towards faster responses to female anger ($M = 507$, $SD = 53$) versus male anger ($M = 513$, $SD = 57$), $t(34) = 1.69$, $p = .101$, $\eta^2 = .077$, and faster responses to male fear ($M = 511$, $SD = 56$) than female fear ($M = 516$, $SD = 59$), $t(34) = 2.12$, $p = .041$, $\eta^2 = .117$. There was also a significant interaction between face gender and stimulus duration, $F(1, 34) = 11.85$, $p = .002$, $\eta^2 = .259$, with faster responses to females ($M = 510$, $SD = 53$) than males ($M = 517$, $SD = 55$) at 300 ms, $t(34) = 2.66$, $p = .012$, $\eta^2 = .172$, and faster responses to males ($M = 506$, $SD = 61$) than females ($M = 513$, $SD = 60$) at 1000 ms, $t(34) = 2.42$, $p = .021$, $\eta^2 = .147$. Critically, these effects were qualified by the predicted 3-way interaction, $F(1,34) = 34.34$, $p <$

.001, $\eta^2 = .502$.

Two 2 (face gender – male/female) by 2 (stimulus duration – 300/1000 ms) ANOVAs were calculated, one for each expression. For fear, this interaction was significant, $F(1, 34) = 50.95$, $p < .001$, $\eta^2 = .600$. At 300 ms, responses were faster to female fear ($M = 509$, $SD = 57$) than male fear ($M = 524$, $SD = 53$), $t(34) = 4.45$, $p < .001$, $\eta^2 = .368$. At 1000 ms, male faces ($M = 498$, $SD = 64$) were responded to faster than female faces ($M = 524$, $SD = 66$), $t(34) = 6.22$, $p < .001$, $\eta^2 = .532$. For anger, the interaction was marginally significant, $F(1, 34) = 4.10$, $p = .051$, $\eta^2 = .108$. The effect was significant at 1000 ms with faster responses to female anger ($M = 502$, $SD = 58$) than male anger ($M = 515$, $SD = 61$), $t(34) = 2.41$, $p = .021$, $\eta^2 = .146$. This effect was nonsignificant for anger ($p > .86$). These effects mirror those found in Study 1, with an attentional bias for female fear versus male fear at the short stimulus duration (300 ms), followed by attentional biases towards incongruent cues (male fear, female anger) at the long stimulus duration (1000 ms). Figure 5 depicts these results as bias scores by calculating reaction times to dots behind female faces from reaction times to dots behind male faces ($RT_{male} – RT_{female}$).

Study 2b - Maturity

Overall

Data were initially collapsed across face gender and submitted to a 2 (maturity – high/low) by 2 (expression – anger/fear) by 2 (stimulus duration – 300/1000 ms) repeated measures ANOVA. The only main effect approaching significance was expression, $F(1, 34) = 2.58$, $p = .118$, $\eta^2 = .070$, with faster responses on fear trials ($M = 523$, $SD = 53$) than anger trials ($M = 527$, $SD = 50$). There was a significant maturity by stimulus duration interaction, $F(1, 34) = 15.56$, $p < .001$, $\eta^2 = .314$. This was driven by faster responses to high-mature ($M = 519$, $SD =$

49) than low-mature (*M* = 529, *SD* = 50) faces at 300 ms, *t*(34) = 3.31, *p* = .002, η^2 = .244, and faster responses to low-mature (*M* = 520, *SD* = 54) versus high-mature (*M* = 532, *SD* = 54) faces at 1000 ms, *t*(34) = 3.26, *p* = .003, η^2 = .238.

This effect was moderated by expression as demonstrated by a significant maturity by expression by stimulus duration interaction, *F*(1, 34) = 5.38, *p* = .026, η^2 = .137. When broken down by expression, this effect was significant for fear, *F*(1, 34) = 20.08, *p* < .001, η^2 = .371, and nonsignificant for anger, *F*(1, 34) = 2.27, *p* = .141, η^2 = .063. This suggests that, particularly for fear expressions, attention is biased towards high-mature faces at 300 ms and low-mature faces at 1000 ms, which is counter to our initial hypotheses.

Male Trials Only

Since our task consisted of trials with male and female faces, we were able to examine our initial three-way interaction within each face gender. For males, there was a main effect of expression, *F*(1, 34) = 11.52, *p* = .002, η^2 = .253, with faster responses on fear trials (*M* = 520, *SD* = 53) than anger trials (*M* = 528, *SD* = 53). There was a significant maturity by expression interaction, *F*(1, 34) = 16.84, *p* < .001, η^2 = .331, with faster responses to anger expressions on high-mature (*M* = 524, *SD* = 51) versus low-mature (*M* = 532, *SD* = 54) faces, *t*(34) = 2.32, *p* = .026, η^2 = .137, and faster responses to fear expressions on a low-mature (*M* = 516, *SD* = 52) versus high-mature (*M* = 525, *SD* = 54) face, *t*(34) = 3.00, *p* = .005, η^2 = .209. This suggests that, for males, there is an overall congruency effect. There was also a maturity by stimulus duration interaction, *F*(1, 34) = 10.45, *p* = .003, η^2 = .235, with faster responses at 300 ms to high-mature (*M* = 521, *SD* = 48) versus low-mature (*M* = 531, *SD* = 50) faces at 300 ms, *t*(34) = 2.89, *p* = .007, η^2 = .197, and faster responses at 1000 ms to low-mature (*M* = 517, *SD* = 58) versus high-mature (*M* = 527, *SD* = 59) faces, $t(34) = 2.30$, $p = .028$, $\eta^2 = .209$.

Both of these effects were moderated by the three-way maturity by expression by stimulus duration interaction, $F(1, 34) = 4.70$, $p = .037$, $\eta^2 = .122$. When broken down by expression, this effect is greater for fear expressions, $F(1, 34) = 13.57$, $p = .001$, $\eta^2 = .285$, while nonsignificant for anger expressions ($F < .28$). This suggests that, for male faces, there is a flip from high-mature fear to low-mature fear across the temporal stream. For anger, this effect is not significant, and it appears that regardless of stimulus duration, there is a benefit for high-mature versus low-mature angry faces.

Female Trials Only

For females, there was a main effect of stimulus duration, $F(1, 34) = 6.99$, $p = .012$, $\eta^2 = .171$, with faster responses at 300 ms (*M* = 522, *SD* = 53) than 1000 ms (*M* = 531, *SD* = 52). There was a significant maturity by expression interaction, $F(1, 34) = 4.30$, $p = .046$, $\eta^2 = .112$, with marginally faster responses to low-mature anger (*M* = 521, *SD* = 49) than high-mature anger (*M* = 529, *SD* = 51), $t(34) = 1.87$, $p = .070$, $\eta^2 = .094$. For fear, the results were in the opposite direction, but nonsignificant, $t(34) = 1.03$, $p = .312$, $\eta^2 = .030$ (high-mature *M* = 524, *SD* = 53; low-mature *M* = 529, *SD* = 55). This was opposite of what was found for male faces. There was also a maturity by stimulus duration interaction, $F(1, 34) = 9.58$, $p = .004$, $\eta^2 = .220$, with faster responses at 300 ms to high-mature (*M* = 517, *SD* = 52) than low-mature (*M* = 526, *SD* = 53) faces, $t(34) = 2.22$, $p = .033$, $\eta^2 = .126$, and faster responses at 1000 ms to low-mature (*M* = 524, *SD* = 50) than high-mature (*M* = 537, *SD* = 54) faces, $t(34) = 2.54$, $p = .015$, $\eta^2 = .162$. Additionally, the expression by stimulus duration interaction was approaching significance, $F(1, 34) = 2.96$, $p = .094$, $\eta^2 = .080$, with significantly faster responses on fear trials at 300 ms (*M* =

519, *SD* = 55) than 1000 ms (*M* = 534, *SD* = 54), $t(34) = 3.21$, $p = .003$, $\eta^2 = .232$. The effect was nonsignificant for anger ($p > .64$). Additionally, the three-way interaction was not significant ($F < .80$).

Discussion

The results of Study 2 suggest that the attentional biases found to expressive faces as a function of gender are, indeed, due to top-down gender categorization factors rather than perceptual overlap of facial maturity cues with expressions. As in Study 1, for Study 2a (androgynous faces), we found clear biases for female fear at 300 ms, and female anger and male fear at 1000 ms. This suggests that, with the exception of anger at 300 ms, attentional biases exist for congruent pairings of cues early in the attentional processing stream, whereas later in this stream, there are greater biases towards incongruent cues.

Study 2a shows that a simple cue of gender category (hairstyle) exerts a contextual cue that influences implicit attentional biases to threatening expressions. This is in line with research showing that person construal occurs automatically and rapidly (Macrae & Martin, 2007). Additionally, this study suggests that the lack of anger effects at 300 ms in Study 1 is not due to stimulus-related features of the face. This leaves us with two potential explanations for this lack of findings – 1) anger is too salient of a threat to be moderated by gender, or 2) changing stereotypes for females but not males (e.g., Diekman & Eagly, 2000). The fact that biases are found at 1000 ms for female anger, suggesting that this is an incongruent pairing, point to the former explanation, which is the focus of Study 3.

For mature faces, Study 2b fails to support the notion that differential attentional biases to anger and fear expressions on male and female faces is moderated by the maturity of the faces.

Instead, we find evidence that early attention is more biased towards high-mature faces, whereas later attention is biased towards low-mature faces. This was especially found for fear expressions, which does not support a perceptual overlap account for attentional biases to threatening expressions. This finding is not consistent with our previous work showing interactions between facial maturity and expression in speeded reaction time tasks (Adams, 2009, February). The discrepancy may result from differences in the tasks - explicit identification of expressions versus implicit attention. While facial appearance may play an important role in emotion perception, it appears to have no impact on this implicit measure of attention.

Additionally, Study 2b also showed top-down gender categorization effects since there were differences found on male trials versus female trials. For males, there was an overall congruency effect, with faster responses to high-mature anger and low-mature fear. For females, the opposite pattern was found. In this regard, the female faces more closely mirror the findings of Study 1 and Study 2a, with overall incongruity effects. As noted earlier, the maturity manipulations actually influenced the gender categorization of female faces, but not male faces, on a ratings task. Therefore, the mirroring of findings in this regard may be because the high-mature faces actually appeared to be relatively more male than the low-mature faces.

Because facial appearance did not moderate attention to facial expressions (absent of its potential effects on gender categorization), the remainder of the thesis focuses on gender categorization in the absence of perceptual differences.

Study 3

Study 1 and Study 2a both show the predicted attentional biases towards fearful females at 300 ms, however, the predicted biases towards male anger are not found. Anger, especially with direct gaze – as all of the faces are in these studies, is a more salient threat to a perceiver than fear (Adams & Kleck, 2003, 2005). Therefore, the lack of results for anger may be due to differences in salience. Additionally, pre-attentive processing has also been found to be particularly attuned to anger expressions (Pinkham et al., 2010; Williams & Mattingley, 2006). It is possible that our null results for differences in early biases toward anger in Studies 1 and 2 may be due to our operationalization of "early attention" as 300 ms. In traditional attention literatures, attentional orienting, or shifts of attention, are believed to begin as early as 50-100 ms (Posner, 1980). It is possible that while 300 ms may provide an appropriate window for fear effects, the effects for anger may be happening sooner due to greater direct threat value. Study 3 was designed to examine this by repeating Study 2a with stimulus durations of 100 ms (early condition) and 1000 ms (late condition).

Method

Participants

Fifty undergraduate participants were initially recruited to participate for course credit. Of those, five were dropped due to having low accuracies (below 90%). This left us with 45 participants (35 females, 10 males) with an average age of 19.73 (2.90).

Measures and Procedure

The measures and procedure for Study 3 were identical to those used in Study 2a. The only difference is that now the faces were displayed for either 100 ms (instead of 300 ms) or 1000 ms.

Results

As with the analyses in Studies 1 and 2, outlier trials (responses faster than 100 ms or slower than 1000 ms) and incorrect trials (3.6% of trials) were dropped from analyses. The remaining data were then submitted to logarithmic transformations to normalize the data. These values were then back transformed into milliseconds to ease in interpretation (see Table 1).

Data were submitted to a 2 (face gender – male/female) by 2 (expression – anger/fear) by 2 (stimulus duration – 100/1000 ms) repeated measures ANOVA. These analyses revealed no main effects (all *F*s < 1.5). There was a significant interaction between face gender and expression, $F(1, 44) = 22.85$, $p < .001$, $\eta^2 = .342$, with faster responses to female anger ($M = 516$, $SD = 59$) than male anger ($M = 524$, $SD = 59$), $t(44) = 3.08$, $p = .004$, $\eta^2 = .177$. The opposite pattern was found for fear, with faster responses to male faces ($M = 517$, $SD = 56$) than female faces ($M = 526$, $SD = 55$), $t(44) = 3.77$, $p < .001$, $\eta^2 = .244$. There was also a significant interaction between face gender and stimulus duration, $F(1, 44) = 4.94$, $p = .032$, $\eta^2 = .101$, with a trend towards faster responses at 1000 ms to male faces ($M = 519$, $SD = 58$) than female faces ($M = 524$, $SD = 60$), $t(44) = 1.90$, $p = .065$, $\eta^2 = .076$. An opposite, but nonsignificant pattern, was found for the faces at 100 ms, $t(44) = 1.23$, $p = .225$, $\eta^2 = .033$ (female $M = 519$, $SD = 56$; male $M = 522$, $SD = 59$). These effects were qualified by the overall predicted three-way interaction, $F(1, 44) = 64.71$, $p < .001$, $\eta^2 = .595$.

The three-way interaction was broken down by expression into two 2 (face gender – male/female) by 2 (stimulus duration – 100/1000 ms) repeated measures ANOVAs. For anger, this interaction is significant, $F(1, 44) = 13.88$, $p = .001$, $\eta^2 = .240$, with faster responses at 1000 ms to female anger ($M = 514$, $SD = 64$) than male anger ($M = 530$, $SD = 60$), $t(44) = 4.49$, $p < .001$, $\eta^2 = .315$. Like in the previous studies that used 300 ms as an early stimulus duration, the use of 100 ms in this study did not yield significant results ($p > .70$). The interaction for fear faces was also significant, $F(1, 44) = 51.39$, $p < .001$, $\eta^2 = .539$, with faster responses at 100 ms to female fear ($M = 519$, $SD = 55$) than male fear ($M = 527$, $SD = 59$), $t(44) = 2.26$, $p = .029$, $\eta^2 = .104$, and faster responses at 1000 ms to male fear ($M = 508$, $SD = 58$) than female fear ($M = 534$, $SD = 59$), $t(44) = 7.14$, $p < .001$, $\eta^2 = .537$. Figure 6 depicts these results as bias scores by calculating reaction times to dots behind female faces from reaction times to dots behind male faces ($RT_{male} – RT_{female}$).

Discussion

The results of Study 3 replicate those of Studies 1 and 2a, with early attentional biases to female fear, and late attentional biases to male fear and female anger. This suggests that the lack of early attentional biases to male anger found in the previous studies is not due to faster speed of processing.

We can only speculate as to why there is a lack of early attentional bias to male anger (versus female anger). As stated previously, anger, but not fear, have been implicated in pre-attentive processing (Pinkham et al., 2010; Williams & Mattingley, 2006). Therefore, anger is presumably receiving preferential treatment by attentional systems before all cues have been put together (i.e., gender). Additionally, as previously argued, gender stereotypes may be changing for females, but not males, as female roles change (Diekman & Eagly, 2000). The biases at 1000 ms towards female anger argue against this point by suggesting that female anger is less congruent than male anger. If changes in stereotypes are indeed driving the lack of attentional biases, presumably those who still hold implicit gender stereotypes will indeed show the early attentional biases towards male anger at 300 ms. Study 4 was designed in an effort to examine this.

Study 4

Studies 1, 2a, and 3 consistently show an early attentional bias to female fear and late biases to male fear and female anger. Notably missing from this is an early attentional bias to male versus female anger. It is possible that, in the general population, female stereotypes have changed (e.g., Diekman & Eagly, 2000), allowing females to be perceived as being able to express anger. By utilizing an implicit measure of the degree to which individuals hold gender stereotypes, we may be able to clean up the effect for anger by only finding it amongst those who still highly endorse gender stereotypes. Study 4 was designed to examine this by repeating Study 2a and including a gender stereotype implicit association test (IAT).

Method

Participants

Fifty-three undergraduate participants were recruited for course credit. Three participants were dropped due to having low accuracies (below 90%). This left us with 50 participants (39 females, 11 males), with an average age of 19.38 (1.31).

Measures

The measures were the same as the androgynous portion of Study 2, with the addition of a gender stereotype IAT (Rudman & Kilianski, 2000). The IAT consisted of 15 common male names (e.g., Mark, Matthew, David) and 15 common female names (e.g., Mary, Katie, Lisa), and 6 agentic (i.e., independent, competitive, autonomous, individual, hierarchical, self-sufficient) and 6 communal adjectives (i.e., communal, attached, cooperative, together, kinship, commitment). The adjectives have been pretested in a previous study to be matched on valence (see Rudman & Kilianski, 2000).

Procedure

The procedure for the dot-probe is identical to the androgynous portion of Study 2. The gender stereotype IAT immediately followed the dot-probe. The IAT is a task that measures the degree to which participants hold implicit beliefs about a particular topic. The gender stereotype IAT consisted of 5 blocks to examine the association between gender and communality/agency (both stereotyped to be associated with females and males, respectively). Block 1 consisted of the names only with participants pressing the right arrow on the keyboard if the name was female; left arrow if male. Block 2 consisted of agentic and communal adjectives, with participants pressing the right arrow if the word was communal; left if agentic. Block 3 consisted of both of names and adjectives, with female/communal being associated with right arrow presses; male/agentic with left arrow presses. Block 4 was the same as Block 1, except that the arrow assignments were reversed. Block 5 was the same as Block 3, except that female/agentic were associated with the right arrow key; male/communal with the left arrow key. Blocks 3 and 5 were counterbalanced across participants. Implicit associations were examined by subtracting reaction times in Block 3 from reaction times in Block 5, hence the more positive the value, the greater the implicit bias held by the participant.

Results

Dot-Probe

As in Studies 1 and 2, outliers (responses faster than 100 ms or slower than 1000 ms) and incorrect trials (3.4% of trials) were initially removed. The remaining data log transformed to normalize the data. These values were then back transformed into milliseconds to ease in interpretation (see Table 1).

A 2 (face gender – male/female) by 2 (expression – anger/fear) by 2 (stimulus duration – 300/1000 ms) repeated measures ANOVA yielded a main effect of face gender, $F(1, 49) = 8.36$, $p = .006$, $\eta^2 = .146$, with faster responses to male faces ($M = 522$, $SD = 53$) than female faces ($M = 526$, $SD = 52$). There was also a main effect of stimulus duration, $F(1, 49) = 11.53$, $p = .001$, $\eta^2 = .190$, with faster reaction times at 1000 ms ($M = 519$, $SD = 53$) than 300 ms ($M = 529$, $SD = 52$). There was an interaction between face gender and expression, $F(1, 49) = 23.66$, $p < .001$, $\eta^2 = .326$, with faster responses to male fear ($M = 518$, $SD = 49$) than female fear ($M = 530$, $SD = 50$), $t(49) = 5.36$, $p < .001$, $\eta^2 = .370$. The opposite pattern emerged for anger, but not significantly, $t(49) = 1.18$, $p = .245$, $\eta^2 = .027$ (female $M = 522$, $SD = 48$; male $M = 526$, $SD = 53$). There was an interaction between face gender and stimulus duration, $F(1, 49) = 31.12$, $p < .001$, $\eta^2 = .388$, with a trend towards faster responses at 300 ms to females ($M = 527$, $SD = 50$) than males ($M = 531$, $SD = 53$), $t(49) = 1.74$, $p = .088$, $\eta^2 = .058$, and faster responses at 1000 ms to males ($M = 513$, $SD = 51$) than females ($M = 526$, $SD = 51$), $t(49) = 5.52$, $p < .001$, $\eta^2 = .383$. There was also an interaction between expression and stimulus duration, $F(1, 49) = 7.28$, $p = .010$, $\eta^2 = .129$, with a trend towards faster responses to anger trials at 1000 ms ($M = 521$, $SD = 51$) than at 300 ms ($M = 527$, $SD = 50$), $t(49) = 1.94$, $p = .058$, $\eta^2 = .071$, and the same pattern, but stronger, for fear trials, with faster responses at 1000 ms ($M = 517$, $SD = 50$) than at 300 ms ($M = 531$, $SD = 52$), $t(49) = 3.72$, $p = .001$, $\eta^2 = .220$. These were qualified by the predicted overall three-way interaction, $F(1,49) = 51.15$, $p < .001$, $\eta^2 = .511$.

The three-way interaction was broken down into two 2 (face gender – male/female) by 2 (stimulus duration – 300/1000 ms) repeated measures ANOVAs for each expression. For anger, the interaction was significant, $F(1, 49) = 5.00$, $p = .030$, $\eta^2 = .093$, with faster responses at 1000 ms to female anger ($M = 518$, $SD = 50$) than male anger ($M = 525$, $SD = 55$), $t(49) = 2.32$, $p = .025$, $\eta^2 = .099$. The effect was nonsignificant at 300 ms ($p > .52$). For fear, the interaction was also significant, $F(1, 49) = 64.85$, $p < .001$, $\eta^2 = .570$. At 300 ms, responses were faster to female fear ($M = 527$, $SD = 51$) than male fear ($M = 536$, $SD = 55$), $t(49) = 2.77$, $p = .008$, $\eta^2 = .135$. At 1000 ms, responses were faster to male fear ($M = 500$, $SD = 49$) than female fear ($M = 534$, $SD = 54$), $t(49) = 9.10$, $p < .001$, $\eta^2 = .628$. Figure 7 depicts these results as bias scores by calculating reaction times to dots behind female faces from reaction times to dots behind male faces ($RT_{male} – RT_{female}$).

Gender Stereotype IAT

The IAT effect is calculated by subtracting reaction times in the stereotype-congruent block from those in the stereotype-incongruent block. Overall, we replicated the IAT effect with faster reaction times to the stereotype congruent pairings (705 ms) than reaction times to stereotype incongruent pairings (783 ms), $t(49) = 7.71$, $p < .001$, $\eta^2 = .548$.

Aggregate scores were calculated from the dot-probe by taking reaction times on all incongruent trials (male fear and female anger) and subtracting reaction times on all congruent trials (male anger and female fear) from them. This congruence bias score did not significantly correlate with the IAT effect, $r(48) = -.192$, $p = .182$. We then broke down the congruence scores by time, such that we calculated separate bias scores for the 300 ms condition and the 1000 ms condition. At 1000ms, a nonsignificant trend emerged, $r(48) = -.236$, $p = .098$, with greater implicit endorsement of gender stereotypes associated with attentional biases towards incongruent cues (male fear, female anger). There was no correlation at 300 ms ($r < .01$). This suggests that implicitly held stereotypes may only exert an influence later in processing.

Discussion

Study 4 provides a replication of the effects found in Studies 1, 2a, and 3 and further expands upon these findings by showing that implicit gender stereotypes are associated with late attentional biases towards fear expressions on a male face.

The gender stereotypes IAT was not associated with any other biases. Notably absent from this is an association between implicit gender stereotypes and early attentional biases towards male (relative to female) anger. This provides further evidence that the lack of significant early biases for anger are likely due to the salience of anger as a threatening cue, rather than top-down driven by changing gender stereotypes of female emotional expressivity.

It is also possible that the choice of IAT is not appropriate for addressing stereotypes of expressivity. Looking at gender stereotypes of communality versus agency do not necessarily map onto stereotypes of emotionality, although the concepts are closely related to the concepts of dominance and affiliativeness – which have been implicated in gender stereotypes and facial expressions. For example, Hess, Adams, and Kleck (2005) showed that judgments of how appropriate displaying anger expressions are on males are mediated by perceived level of dominance. Likewise, the appropriateness of smiling on females is mediated by perceived levels of affiliativeness. Like smiling, it has been suggested that fear can also be an affiliative stimulus because it can signal to the perceiver that the expresser needs help (Marsh, Ambady, & Kleck, 2005). Other types of implicit measures (e.g., different IAT terms) or even explicit measures of gender stereotypes should be implemented in future research to determine what factors are driving attentional biases to facial expressions based on gender.

Chapter 3. GENERAL DISCUSSION

Through four studies, this thesis provides evidence that the gender of a face can moderate the degree to which attention is biased towards threatening facial expressions. These effects appear to be driven by gender categorization rather than facial maturity, and later attentional biases towards an incongruent male expression (fear) are associated with the degree to which participants hold implicit gender stereotypes. This is the first series of studies, to our knowledge, that has examined the moderating influence of gender on attention to facial expressions. This has a wide range of implications for several different lines of research, each of which we address below.

First, these findings add to the amassing body of literature examining how threat is perceived, both broadly and specifically in term of facially-communicated threat. Broadly, these findings are in line with dual-process models of threat perception and attention (LeDoux, 1996; Mogg et al., 2007), with evidence towards congruent threat early in processing (at least for fear), followed by attentional biases towards incongruent threat later in the processing. This dual-process system is adaptive by dividing processing amongst different routes in order to maximize perception of, and subsequently responses to, threat in the environment.

In line with recent neuroscience work (Adams et al., *in press*; Adams et al., *under review*; Hadjikhani et al., 2008), we find that compound social cues exert differential impacts on processing across time. Using attentional and neuroscience paradigms, we are beginning to circle in on a mechanism of threat perception that is moderated by the contextual cues that are provided by compound social cues. A potential extension of the current thesis would be to run fMRI studies similar to those by Adams, Hadjikhani, and colleagues. If similar amygdala activation were found when crossing gender by expression, this would suggest that there is an underlying mechanism that drives the processing of both cues.

Additionally, these findings add to the growing social vision literature, showing that processing of basic emotions can be moderated by social factors, such as gender. Since the early 1970s, the predominant assumption has been that basic facial expressions are universal, and as such, are processed similarly, regardless of whom the expresser or perceiver is (Ekman, 1972). This is not, of course, to say that millisecond differences in processing suggest that Ekman was incorrect in his assumptions of universality. Findings like this simply build upon the foundations set by Ekman and suggest that subtle measures of the processing of basic expressions show variations that can be important for understanding the social dynamics of facial expression processing.

What is Different About Anger?

Across four studies, we consistently find no differences in early attentional biases to angry expressions when displayed on a male face versus a female face. Study 3 showed that the operationalization of early timing did not influence this outcome, and Study 4 showed that it was also not associated with implicit gender stereotypes. The fact that, across all four studies, we do find the incongruency effect for anger later suggests that stereotypes must be playing a role in the perception of anger. Why, then, would we not find these effects early? As was previously suggested, anger has been associated with pre-attentive processing (Pinkham et al., 2010; Williams & Mattingley, 2006). Additionally, all of the faces in these four studies utilized direct gaze. We know from some of the original work examining compound social cues, that eye gaze direction moderates the perceptions of facial expressions, particularly anger and fear (Adams & Kleck, 2003, 2005; Adams et al., *in press*, Adams et al., *under review*, Hadjikhani et al., 2008). Direct gaze enhances the threat value of an angry face because it suggests to the perceiver that he/she is the target of potential aggression from the expresser. Likewise, an averted gaze enhances the threat value of fear because this suggests that a threat exists in the environment. A direct gaze with a fear expression is a more ambiguous threat because it can suggest that 1) you are the source of threat to the expresser, or 2) the threat may exist somewhere in the environment, but the location is undetermined based on the gaze. Therefore, having all faces with a direct gaze led to angry expressions always possessing more clear threat value to the perceiver than fear. An interesting test of this would be to re-run these studies using averted gaze faces, thereby making anger more ambiguous overall than fear. If the effects flipped, such that the early biases existed for angry male faces versus female faces, and the effects were washed out for fear, this would demonstrate that threat value moderates early attentional biases, above and beyond gender.

Attention and Stereotypes

Moving beyond basic threat perception and attention, the findings from this line of studies has implications for stereotype research. Attentional biases, like those found in the currently studies, which presumably arise from stereotypes, can help maintain and strengthen the stereotypes that drive them. Stereotypes can be powerful schemata that influence what information in our environment is processed and integrated (Fiske & Neuberg, 1990). By exerting a top-down influence on what we attend to, stereotypes are self-perpetuating in nature (Stangor & Lange, 1994). We more efficiently process what is stereotype-congruent, therefore strengthening the stereotype.

Stereotypes have already been found to exert a powerful influence on visual attention. For instance, being primed with black stereotype-congruent objects gives rise to greater attentional shifting towards black relative to white faces (Eberhardt, Goff, Purdie, & Davies, 2004), suggesting top-down modulation of attention due to stereotype activation. In addition, stereotypes have been conceptualized as “resource-preserving” (Macrae, Milne, & Bodenhausen, 1994; Sherman, Macrae, & Bodenhausen, 2000), and provide a powerful implicit context that exerts influence on social perception (Banaji & Greenwald, 1995; Banaji, Hardin, & Rothman, 1993). This makes them particularly susceptible to biasing attention.

Even some longstanding traditions in social psychology are beginning to be modified based on the notion of top-down influences over automatic, bottom-up processing. A salient example of this exists in the attitude literature, where traditional dual-process models have had a prominent role in describing how current evaluations and more stable attitudes interact. Specifically, these dual-process models delineate a separate automatic versus controlled set of processes. These are thought to function independently, leading to dissociations in the attitudes that people hold (Greenwald & Banaji, 1995; Greenwald, Banaji, Rudman, Farnham, Nosek, & Mellott, 2002). Alternatively, an iterative-reprocessing model has also been posited, whereby bottom-up and top-down information consistently interact with one another in iterative loops, which ultimately give rise to behavior (Cunningham & Zelazo, 2007). This approach is grounded in recent findings about neural architecture and functioning. It makes sense, given this shift towards recognizing the dynamic nature of neural processing, that top-down factors can have a significant impact on even low-level visual processes (see Kveraga, Ghuman, & Bar, 2007).

Some research is beginning to show that attention can work in the reverse – that it can have a causal impact on behaviors and cognitions. In the anxiety literature, attentional biases have been manipulated experimentally to show that they can have a causal impact on anxiety symptoms. MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) administered a modified dot-probe to non-anxious participants in which dots always appeared behind threat words for one group and neutral words for the control group. Participants in the threat word condition showed greater attentional biases towards threat words in a subsequent dot-probe (50/50 threat/neutral words) than the control condition participants. They also experienced more symptoms of anxiety on a subsequent stress task. Eldar, Rincon, and Bar-Haim (2008) replicated this finding in children as young as 7 years old.

Whether attentional biases to facial expressions because of gender can be manipulated experimentally is a question for future research to examine. If biases can be manipulated (i.e., always display dots behind a male anger face), and these manipulations lead to downstream effects, such as greater endorsement of gender stereotypes of emotionality or greater implicit biases on an IAT, this could begin to provide concrete evidence for how attentional biases can impact gender stereotypes. Conversely, it may be possible to attenuate downstream stereotype effects by training attention away from stereotype-congruent stimuli towards stereotype-incongruent stimuli. A new line of research on *attention bias modification* is emerging in the phobia literature, whereby patients with phobias are trained to pay attention to stimuli that they are phobic towards (Bar-Haim, 2010). Cognitive models of anxiety implicate avoidance as a cause for the maintenance of phobias. Attention bias modification reduces avoidance of these stimuli, therefore helping to break the fear association with the stimulus. Training individuals to pay attention to stereotype-incongruent stimuli early in processing may help to cut off stereotypes at their automatic roots.

A Note on Dot-Probe Methodology

The current dot-probe paradigms presented in this thesis deviate from previous iterations of the dot-probe. While previous iterations have often utilized pairings of expressive and neutral stimuli within each trial (e.g., Cooper & Langton, 2006), the current studies pair the stimuli of interest within each trial (i.e., pit male versus female (Study 1, 2a, 3, 4), or high-mature versus low-mature (Study 2b)). We did this for a few reasons. First, we felt that neutral faces did not serve as a sufficient control to compare attentional biases to. There is literature suggesting that neutral faces are perceived as different expressions depending on the context they are presented in (Russell & Fehr, 1987) and do not serve as adequate baselines (Lee, Kang, Park, Kim, & An, 2008). In the current studies, the expressive face in the pairings provides a context by which these “neutral” faces can be interpreted otherwise. For example, when a fear-neutral face pairing is presented, the fear face may bias the neutral face to look more angry due to contrast effects (perceptually, it deviates from fear in terms of smaller eyes, lower brows – which is characteristic of anger). The opposite would hold true for anger-neutral pairings. Essentially, you have a control condition that ostensibly varies between conditions. This may help explain some of the unreliability reported in previous dot-probe studies (Cooper, Rowe, Penton-Voak, & Ludwig, 2009; Schmukle, 2005; Staugaard, 2009). Another reason for pitting the factors of interest was that we were interested in *relative* biases within trials (male versus female, or high-mature versus low-mature). Trials employing expression-neutral pairings are often trying to disentangle *vigilance* from *avoidance,* which was traded-off in the current design for a more reliable paradigm. We cannot make inferences about whether our effects were driven by vigilance or avoidance, although the findings are consistent with dual-pathway accounts of attention that have linked vigilance to early attentional biases and avoidance to late attentional biases (e.g., Cooper & Langton, 2006; Mogg et al., 2007).

By pitting the conditions of interest (male versus female; high- versus low-mature) within each trial, it could be argued that the attentional biases at 1000 ms actually reflect *inhibition of return* (tendency for attention to shift away from previously attended to locations to continue scanning the environment; Posner & Cohen, 1984). For example, in 1000 ms fear trials, attention is shifted towards the female fear face first. At some point after 300 ms, attention then shifts to the other side of the monitor to the male face. It is quite possible that inhibition of return may be driving some of the later attentional biases; however, the findings for anger suggest that other factors are at play. Given anger is equally attended to on male and female faces, we would not predict that inhibition of return would lead to late attention biases towards female anger, yet we find these biases across all four studies. Therefore, we can conclude that the incongruity of the stimulus is partially driving the attentional biases at 1000 ms.

Conclusion

Attention is a fundamental cognitive mechanism by which stereotypes are maintained through selective filtering of information into existing cognitive schemata. The current thesis provides evidence that gender stereotypes of emotional expressivity lead to differential attentional biases to anger and fear. Specifically, early attentional biases are found for female fear (relative to male fear), and late attentional biases are found for male fear (relative to female fear) and female anger (relative to male anger). The flip in attentional biases from congruent cues to incongruent cues over time is consistent with dual-pathway attention models that include preferential attentional biases towards immediate threat early in temporal processing, followed by a later bias towards more ambiguous threat. The lack of an early attentional bias towards male anger (relative to female anger) may be due to changing gender stereotypes, however, the data support the notion that anger may simply be too salient of a threat to be moderated by gender in any appreciable way. Future research is needed to examine this. This preliminary work also sets the groundwork for a new line of research looking at modifying automatic attentional biases in an effort to attenuate the degree to which stereotypes drive what is attended to in the environment. By breaking automatic attentional biases, we may be able to reduce an important element in the self-perpetuating nature of stereotypes.

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Appendix. Figures and Tables

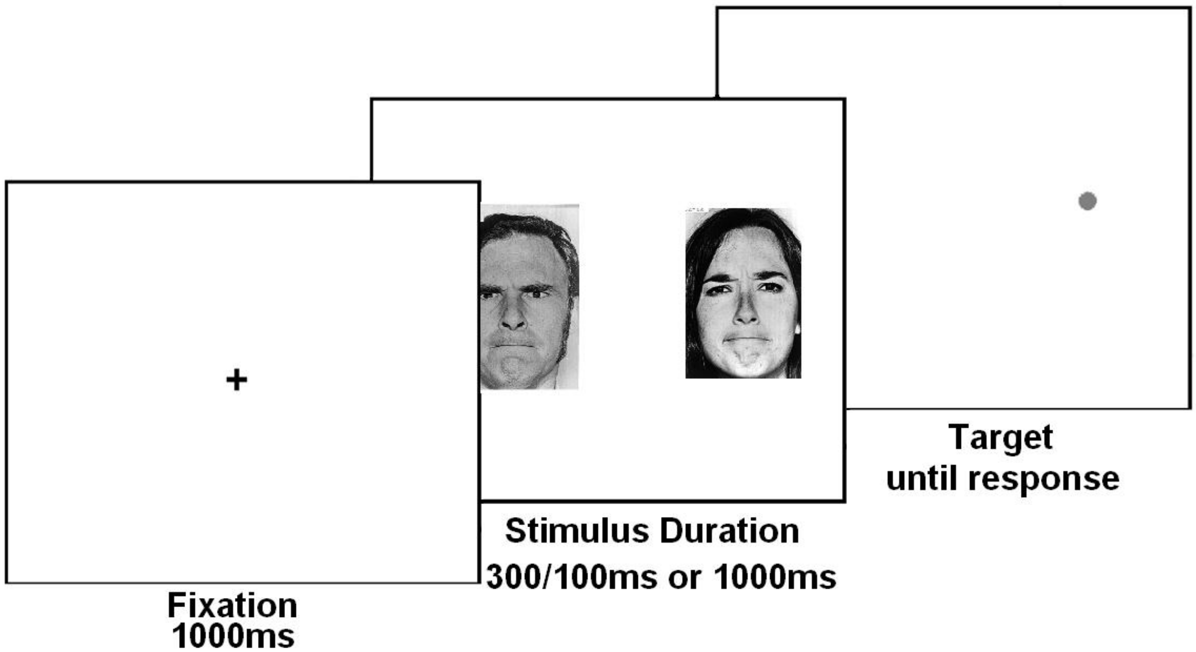

Figure 1. *Example of the dot-probe paradigm. A fixation initially appears for 1000 ms, followed by the presentation of faces (matched for expression, male versus female for Studies 1, 2a, 3, and 4; high- versus low-mature faces in Study 2b). These faces were on the screen for either 300 ms (100 ms for Study 4) or 1000 ms.*

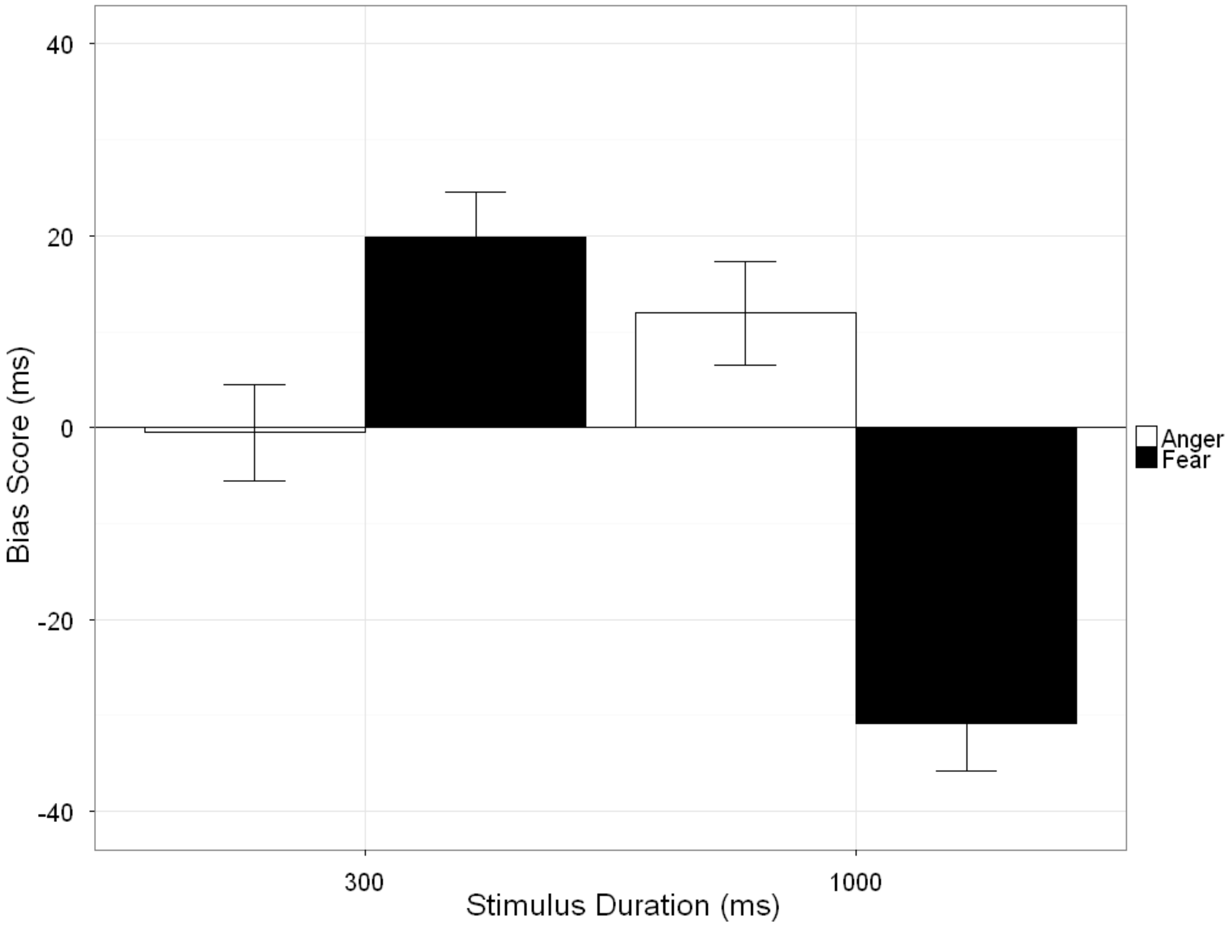

Figure 2. *Bias scores (in milliseconds) for Study 1. Positive values represent a bias towards female faces; negative values represent a bias towards male faces.*

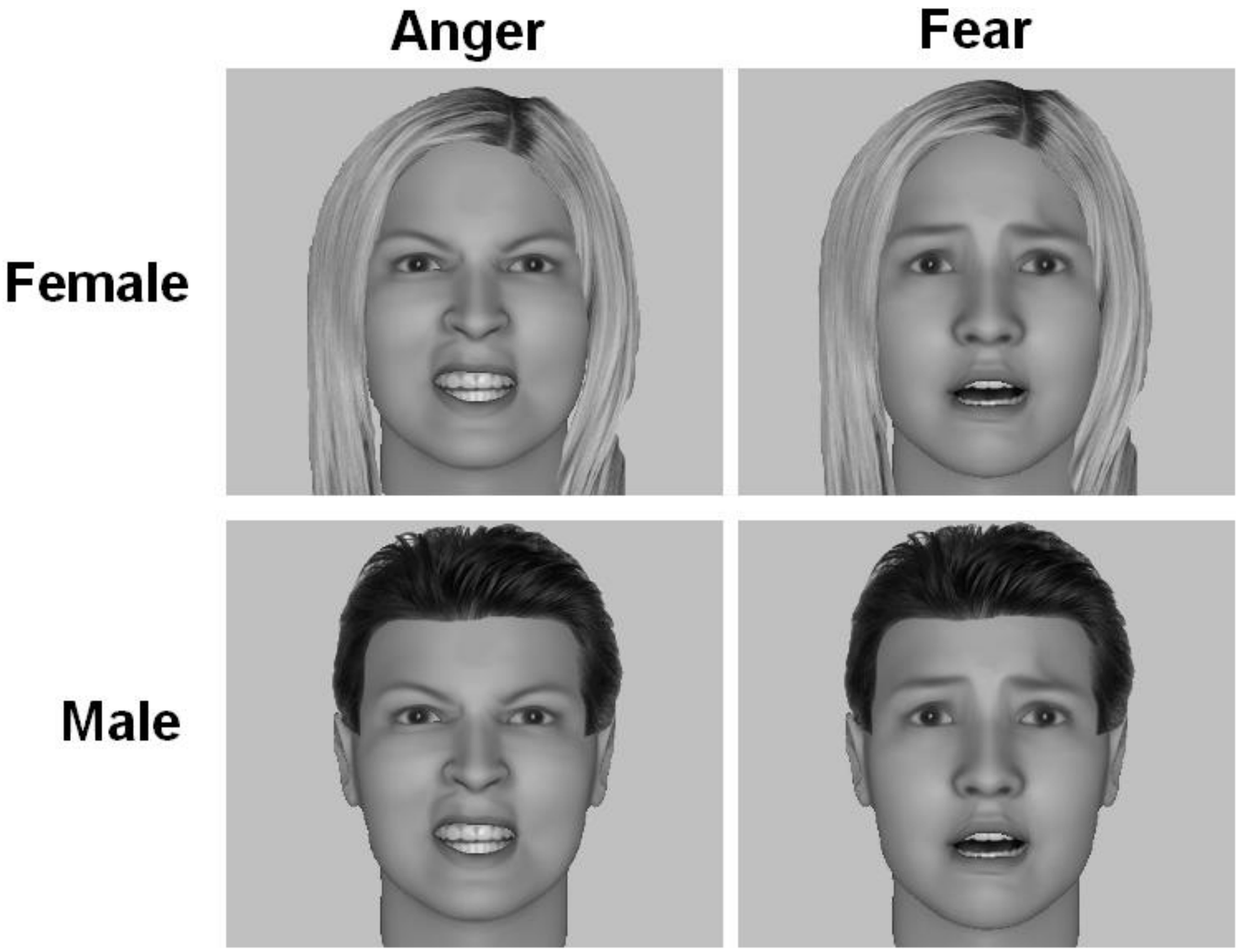

Figure 3. *Examples of the androgynous faces used in Studies 2a, 3 and 4.*

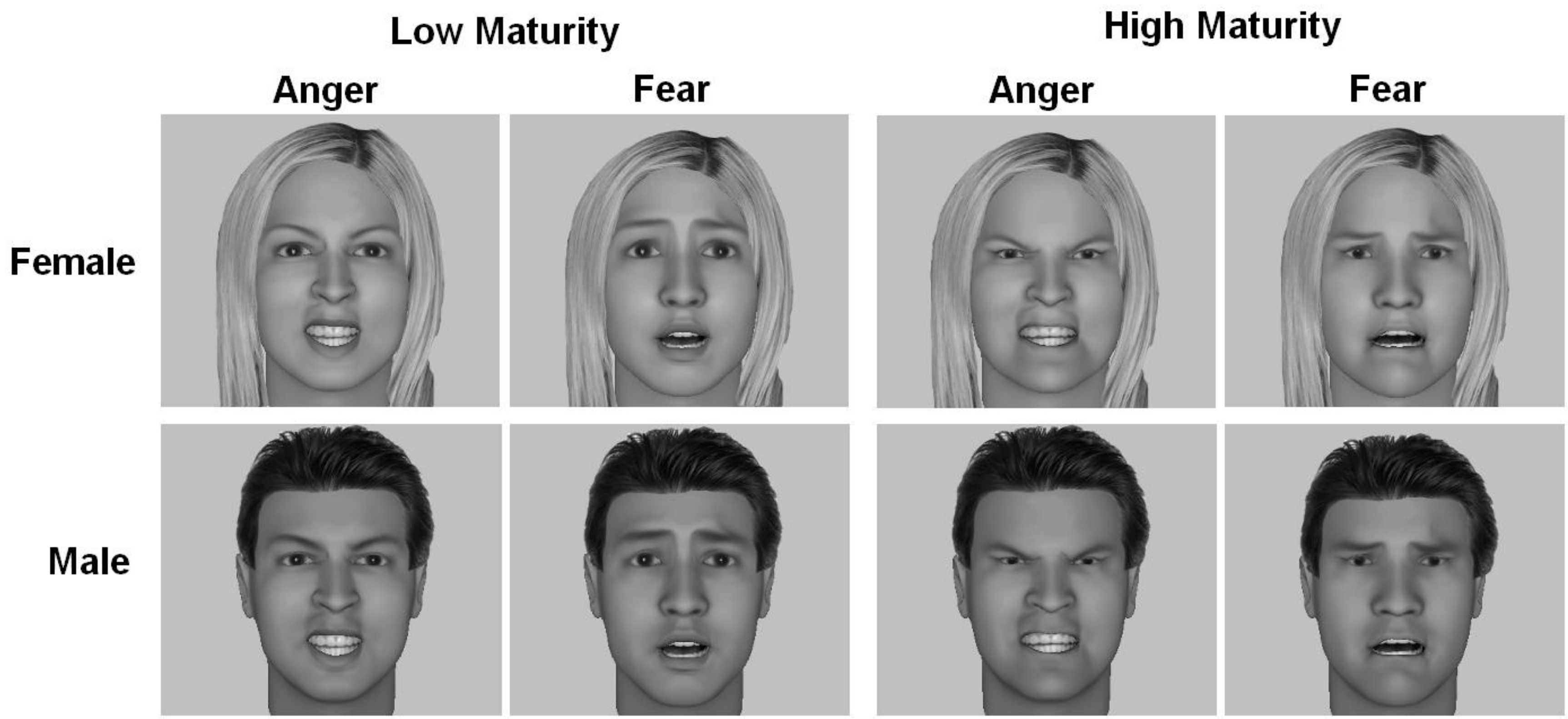

Figure 4. *Examples of the maturity-manipulated faces used in Study 2b.*

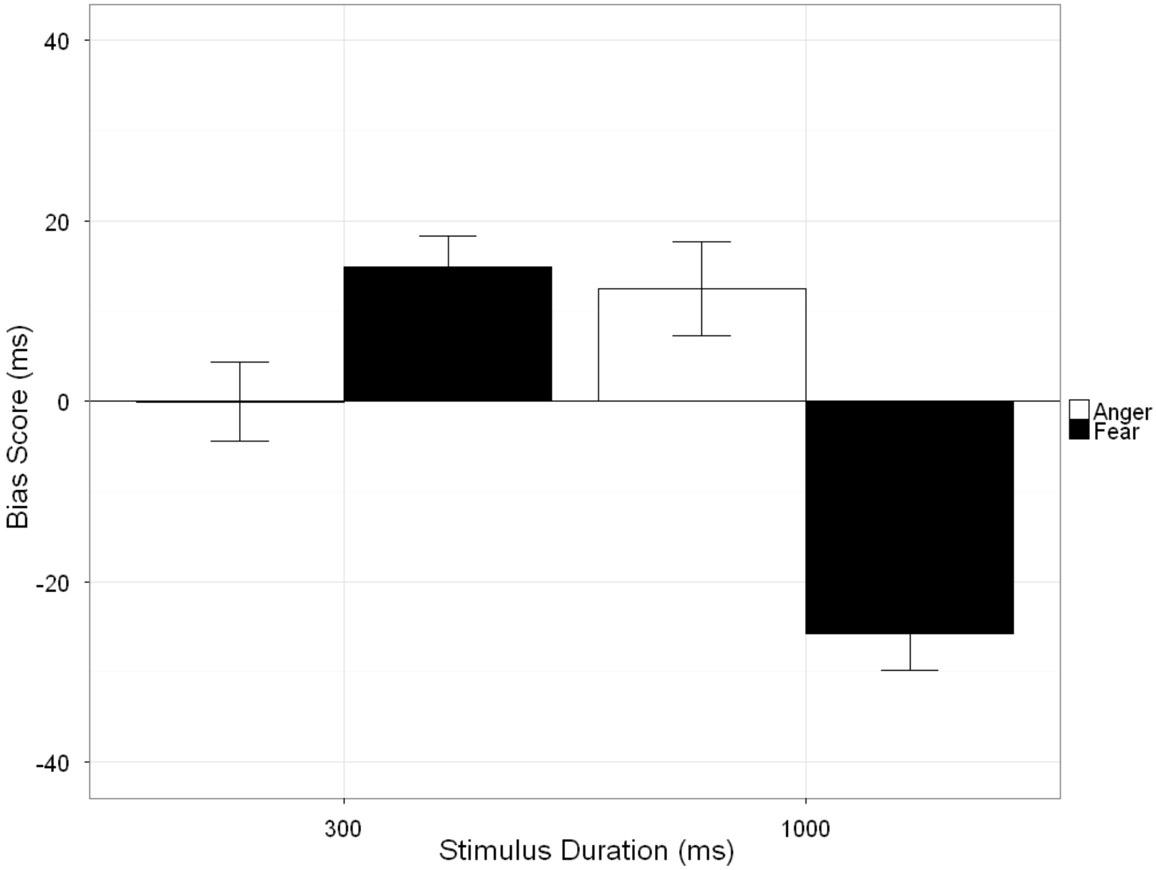

Figure 5. *Bias scores (in milliseconds) for Study 2a (androgynous faces). Positive values represent a bias towards female faces; negative values represent a bias towards male faces.*

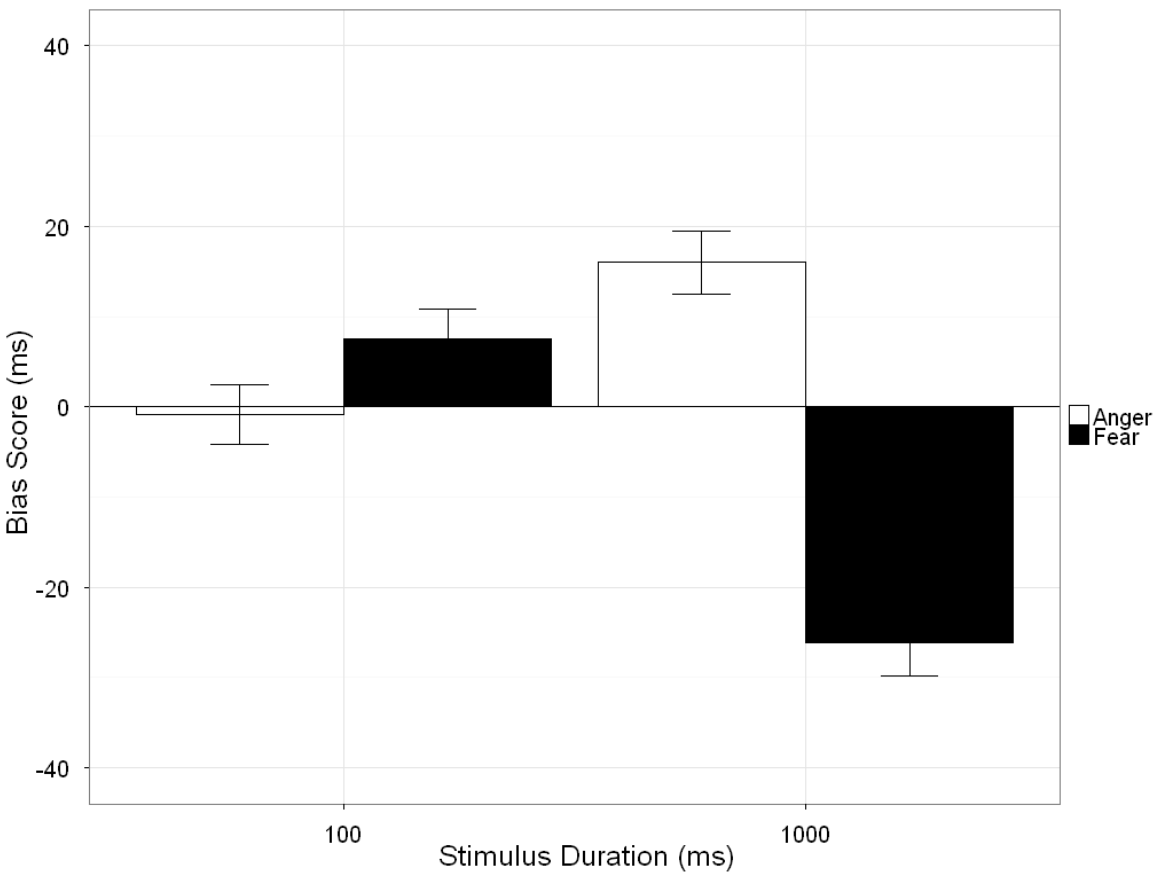

Figure 6. *Bias scores (in milliseconds) for Study 3 (100/1000 ms stimulus durations). Positive values represent a bias towards female faces; negative values represent a bias towards male faces.*

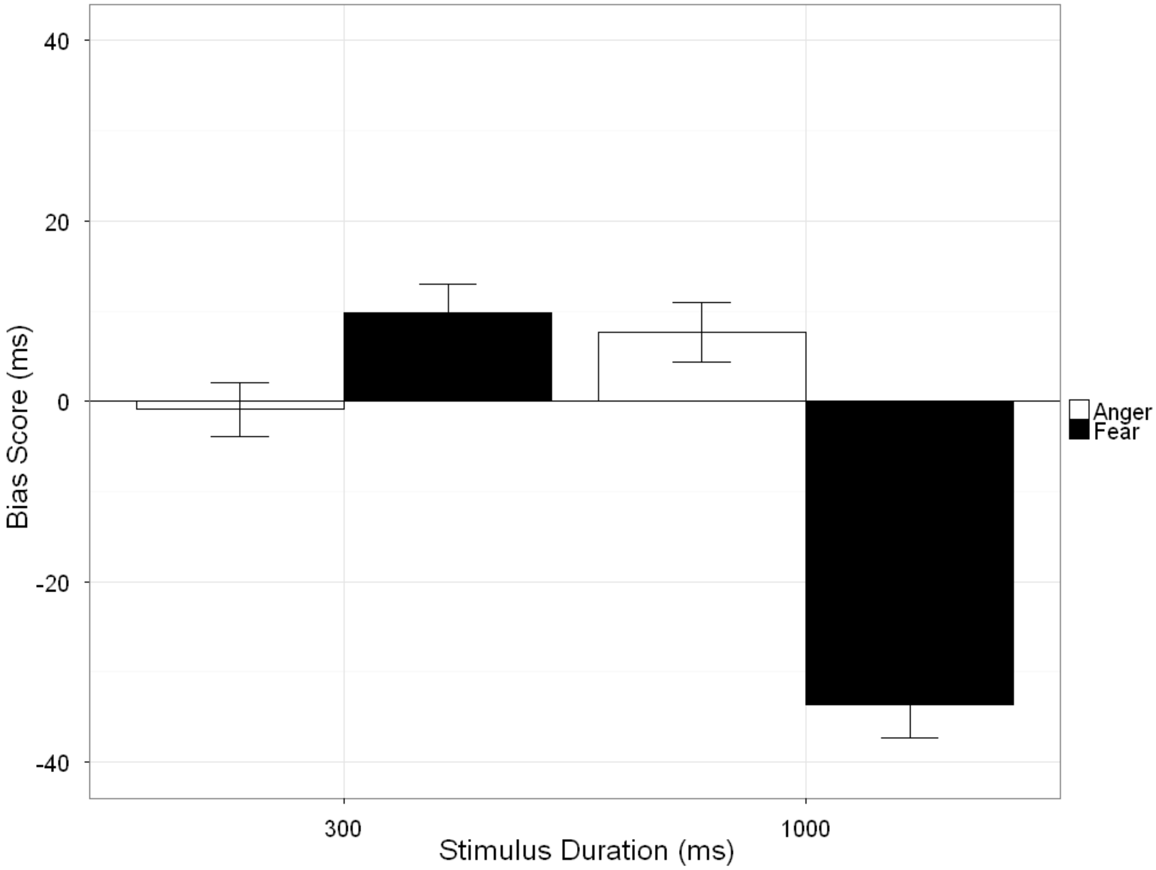

Figure 7. *Bias scores (in milliseconds) for Study 4. Positive values represent a bias towards female faces; negative values represent a bias towards male faces.*

	Early				Late			
	Anger		Fear		Anger		Fear	
	Male	Female	Male	Female	Male	Female	Male	Female
Study 1	565 (56)	565 (58)	585 (63)	565 (57)	573 (58)	561 (62)	559 (56)	590 (55)
Study 2a	511 (59)	511 (52)	524 (53)	509 (57)	515 (61)	502 (58)	498 (64)	524 (66)
Study 3	518 (62)	519 (59)	527 (59)	519 (55)	530 (60)	514 (64)	508 (58)	534 (59)
Study 4	526 (53)	527 (51)	536 (55)	526 (51)	525 (56)	517 (50)	500 (49)	534 (55)
Total	530 (58)	531 (55)	543 (58)	530 (55)	536 (59)	524 (59)	516 (57)	546 (59)

Table 1. Reaction times (SD) to male versus female faces as a function of stimulus duration (early versus late) and expression (anger versus fear) across all four studies.