The Pennsylvania State University

The Graduate School

The College of the Liberal Arts

ATTENTIONAL BIASES TO EXPRESSIVE FACES AND THE ROLE OF GENDER-EMOTION STEREOTYPES

A Dissertation in

Psychology

by

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Submitted in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

August 2015

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ABSTRACT

The human face is a source of numerous social and emotional cues. Two of these cues, gender and facial expression, were examined in the current dissertation. Study 1 demonstrated that participants hold beliefs about how often women and men both 1) experience and 2) express facial expressions. Studies 2 (anger and sad) and 3 (anger and fear) demonstrated that attentional biases to female and male expressive faces differ across visual field as well as timing of the stimuli. Early attention (i.e., 300ms) is more biased toward gender-emotion stereotype-congruent faces, particularly for sadness (Study 2) and fear (Study 3) when presented in the left visual field. Later attention (i.e., 1000ms) is more biased toward stereotype-incongruent cues (i.e., male sadness/fear, female anger) when presented to the right visual field. Study 4 demonstrates that stereotype-congruent faces tend to be encoded less deeply than stereotype-incongruent faces, and this is moderated by level of stereotype endorsement. Partial evidence was found for endorsement of gender stereotypes about expressive behavior both moderating and mediating these biases, underscoring the role that perceptual clarity plays in the perception of compound social cues.

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ACKNOWLEDGEMENTS

I dedicate this dissertation to my wife, Karri, whose unconditional love and support carried me through this long and difficult journey. I would also like to acknowledge my furchild, Samson, whose constant need for cuddles kept reminding me of what is most important in life.

Chapter 1. INTRODUCTION

The social worlds that we live in are full of potential stimuli of personal relevance. As social creatures, we must work in concert with those around us to navigate our social worlds with minimal disruption and maximum cohesiveness. To do this, we must be able to efficiently detect and predict the behavioral intentions of others. Does this individual want to harm me? Does this individual need help? Does this individual want to affiliate with me? These are all questions that have been essential to answer quickly and accurately in our ancestral past.

In order to detect information from others, we must rely upon numerous cognitive mechanisms to encode, decode, and store this information. The current dissertation will attempt to underscore how one cognitive network in particular, attention, works to allow us to 1) prioritize and allocate cognitive resources toward stimuli of social importance, 2) allow for the quick extraction of such information that is functional but may not necessarily be 100% accurate, and 3) how this efficient processing can lead to further stores of information that then influences point number 1. This results in a social perceptual system that was likely necessary for the survival of our ancestors, and for the most part works pretty well for contemporary humans. However, there are some insidious societal effects that are byproducts of this efficient system (i.e., stereotyping), which we will focus this dissertation on.

Behavioral intentions that we believe to be more probable for one group over another gives us quick and crude information about whether (and when) this person requires attention and cognitive resources. Seeing a Caucasian elderly face in a rural setting approaching is unlikely to draw the same threat response to a Caucasian individual that a young African-American male in an inner-city might. Of course, stereotypes of social categories bias our perceptions of reality, leading to the gross societal implications that face us regarding our treatment of individuals of different genders, races, and age groups. Although their existence is detrimental to society, their existence is born out of a functional system that is tuned toward perceptual efficiency (Macrae, Milne, & Bodenhausen, 1994; Macrae, Stangor, & Milne, 1994). We are bombarded with so much information that a system that can extract gist information can be highly adaptive. This dissertation will be focused on attentional and perceptual processing of perhaps the most salient social cue that we pick up on: the human face. Because of this, we will use the face as a stimulus for both social category as well as behavioral intentions throughout the dissertation.

The Human Face: A Hub of Social Information

Of all social stimuli of potential importance, perhaps none is more rich with information than the human face. The face can tell us what social groups the individual belongs to (e.g., race, gender, age group), what their current emotional state is (e.g., facial expression), and what the focus of their attention currently is (e.g., eye gaze direction). All of this information can be used to explain and predict behavior, albeit with varying degrees of veracity. Perhaps stemming from this, attention is naturally drawn to faces starting at infancy (Johnson, Dziurawiec, Ellis, & Morton, 1991). Additionally, humans show a high degree of consensus in judging trait characteristics of unfamiliar faces (Willis & Todorov, 2006). As such we form strong impressions about people from their faces (Bar, Neta, & Linz, 2006; Todorov, Pakrashi, & Oosterhof, 2009; Zebrowitz & Collins, 1997).

Because face processing is essential for social functioning, some posit that it entails special perceptual processing that differentiates it from other objects. Perception of faces, more so than other objects, is disrupted by inversion (Rossion & Gauthier, 2002; Yin, 1969), although similar effects have been found with experts in other domains (i.e., dog experts show inversion effect when presented with dogs; Diamond & Carey, 1986). Additionally, specialized brain regions have been hypothesized to mediate the processing of faces. For instance, a brain region in the lateral fusiform gyrus has been found to be highly sensitive to faces, and as such has been termed the *fusiform face area* (Kanwisher, McDermott, & Chun, 1997; Kanwisher, Tong, & Nakayama, 1998; McCarthy, Puce, Gore, & Allison, 1997). Decreased fusiform activity has been found in individuals with autism, whom are known for face processing deficits, further suggesting the fusiform is important for face processing (Dalton et al., 2005; Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2007). From this, researchers argued for modularity in face processing, although other research has suggested that this area may not necessarily be specific to faces, but also to objects of which one has a high degree of expertise (Gauthier & Curby, 2005; Gauthier & Tarr, 2002). Regardless of whether there are special modules for face perception, there is no doubt that our neural machinery puts a premium on face processing.

We are undoubtedly hardwired to extract social information from the face. By looking at the face, we can quickly gain access to multiple sources of information that could tell us how a person is going to act toward us, thereby enhancing our ability to be able to adaptively respond. Two major sources of information, of which the focus of this dissertation will lie, are on cues to 1) social category and 2) emotional state (i.e., facial expression).

The Face and Social Category

The face is a rich source of social categorical information. Facial appearance readily communicates social categories such as gender, race, and age. Even sexual orientation, a social identity that has been believed to be largely concealable (Frable, Platt, & Hoey, 1998), can be identified from faces within 50ms (Rule & Ambady, 2008; Rule, Ambady, & Hallett, 2009). Social categorization has been a cornerstone of social psychological research for decades (Allport, 1954; Tajfel, 1969). Bartlett (1932) introduced the notion that people's perceptions are driven by their beliefs and expectations. In this sense, cognition and perception is *constructive* in nature. When an individual is categorized into a social group, our beliefs and expectations about the group fundamentally filter and change what we perceive about this person.

Social category information is extracted very efficiently from the face. For instance, gender is extracted faster and more accurately than identity information from faces (Cloutier, Mason, & Macrae, 2005). Additionally, visually degrading the faces by blurring or inverting them does not disrupt this categorization process, showing how efficient this process is. Furthermore, gender information from faces moderates the efficiency of categorizing gender-typical names, further suggesting that this information from the face is processed automatically, at least under certain conditions (Macrae, Quinn, Mason, & Quadflieg, 2005).

Although social categorization is highly efficient, it can be moderated by goals. For instance, Macrae et al. (2005) showed that when the categorization of gender-typical names was based on a perceptual factor (i.e., the case of the letters), rather than a gender categorization, which is a semantic judgment, they found that mismatching gendered-faces and names did not slow categorization. This suggests that social categorization happens automatically when conceptual goals are present. One situation where conceptual goals may change is when we encounter emotionally expressive faces.

The Face and Emotional Expression

Out of all potential signals of behavior, perhaps none is more prominent in the face than emotional expression. There has been some debate as to the function of facial expressions, and whether they are actually communicative in nature. For instance, Darwin (1872) suggested that facial expressions served a functional role to the expresser rather than any communicative function. Despite this, contemporary researchers have argued that expressions also function communicatively. Ekman (1972) suggested that facial expressions serve as an external read-out of emotional states, and as such, take their form in order to send a salient signal to others. Fridlund (1994) went a step further and suggested that facial expressions specifically evolved to communicate internal states, and thus, behavioral intentions. Recently, Weisbuch and Adams (2012) put forth a functional forecast model of expression perception, arguing that expressions serve to communicate, or forecast, upcoming events. As such, we have developed specialized processing routes that are able to use this information to prepare for these events.

The Interaction Between Identity and Expression

To serve this important face processing system, we have elaborate neural networks that seem to be hardwired for efficiently processing information from faces. These distributed networks are able to parse different sources of information in the faces, presumably to assist in efficient processing (Bruce & Young, 1986). For instance, our visual systems are able to parse out information from static (unchanging) cues and dynamic (changing) cues, thereby utilizing parallel processing networks that allow for information from both channels to be processed simultaneously (Haxby, Hoffman, & Gobbini, 2000, 2002). Where traditional face processing models have fallen short is what happens after the visual parsing of information has taken place.

Vision scientists have put a lot of work in getting us to this point, but social psychology has only just recently begun to pick up where the vision scientists leave off. Because face processing is inherently social, fulfilling social needs and motives, and subject to social influences, strong social theories regarding how this information, that is static and dynamic information, is re-integrated downstream to functionally inform us of the intentions of others is necessary (Adams, Franklin, Nelson, & Stevenson, 2010; Adams & Nelson, 2011).

Most research examining intersectionality in face perception has focused on eye gaze and emotion. Adams and Kleck (2003, 2005) introduced the shared signal hypothesis, showing that the direction of eye gaze, a cue that signals the behavioral intentions of others, moderates the efficiency of identifying facial expressions. Specifically, direct eye gaze, an approach-related cue, facilitates the identification of approach-oriented emotions (i.e., anger and joy), whereas averted eye gaze, an avoidance-related cue, facilitates the identification of avoidance-oriented emotions (i.e., fear and sadness). Eye gaze and emotion integration has received widespread empirical support (Adams & Franklin, 2009; Benton, 2010; Graham & LaBar, 2007; Hess, Adams, & Kleck, 2007; Sander, Grandjean, Kaiser, Wehrle, & Scherer, 2007).

Gender and Emotion

Another combination of social cues that has received considerable research is gender and emotion. Gender and emotion provide fertile grounds for examining how intersectionality can operate at different levels in social perception because there are 1) phenotypic differences in facial appearance between males and females that are also similarly found between various facial expressions (i.e., anger and fear), as well as 2) clear stereotypes associated with gender and the expression of emotion. Thus, gender and emotion can provide insight into how bottom-up visually-driven processing can interact with top-down stereotype-driven processing to impact social perception.

Emotionality and expressive behavior are at the core of purported differences between males and females. Females are believed to be more emotional whereas males are believed to be more stoic (Shields, 2002). Beliefs about these differences can lead to very different attributions of behavior whether the actor is a woman or a man. When females are shown displaying facial expressions, they are considered to be dispositionally emotional, but when males express the same emotions, situational attributions are made (Barrett & Bliss-Moreau, 2009). With gender, however, not all emotions are the same. In particular, emotions that convey dominance, such as anger and pride, are seen as stereotypically male emotions. Whereas males are expected to suppress the expression of all other emotions, they are expected to enhance their displays of anger (Fabes & Martin, 1991).

Stereotypes about emotional differences between males and females are prescribed starting in infancy. For instance, when participants are told that an infant is a male, they ascribe more anger and less fearfulness to that infant (Condry & Condry, 1976). In adults, when ambiguous mixes of anger and sad expressions (sadness being an emotion associated with weakness; Knutson, 1996; Tiedens, 2001) are presented, participants are more likely to label males as angry and females as sad (Plant, Hyde, Keltner, & Devine, 2000). The use and application of these stereotypes is solidified in children as young as 3-5 years old (Birnbaum, Nosanchuk, & Croll, 1980; Birnbaum & Croll, 1984).

In addition to stereotypes about gender differences in emotional expressivity, there are also sexually dimorphic differences in facial appearance between males and females that perceptually overlap with the appearance of facial expressions (Adams, Hess, & Kleck, 2015). For instance, female faces tend to be lower in facial maturity (i.e., higher brows, larger eyes, rounder features) whereas male faces tend to be higher in maturity (i.e., lower brows, smaller eyes, more angular features; Friedman & Zebrowitz, 1992). These facial appearance cues are visually confounded with the appearance of fear and anger expressions, respectively (Marsh, Adams, & Kleck, 2005). Marsh et al. (2005) found that 1) faces low in maturity were believed to express more fear, whereas faces high in maturity were believed to express more anger, and 2) traits that are associated with low maturity (i.e., dependence, femininity, honesty, and naïveté) were ascribed more to faces displaying fear versus those displaying anger. Additionally, while anger is more efficiently identified on male faces and fear on female faces, these effects disappear when matching faces on facial maturity (Adams, 2009). Even connectionist models that train computers to detect emotion in a neutral face, and thus have zero influence from top-down stereotypes, detect more anger on high-mature faces and surprise on low-mature faces (Zebrowitz, Kikuchi, & Fellous, 2007).

As outlined above, the intersection of gender and emotional expression has potential multiple, yet overlapping, sources of information that drive social perception. Despite this, little work has looked at how these sources of information, be it top-down stereotypically driven or bottom-up visually driven, drives the initial selection of such stimuli for further downstream processing. For that, we now turn to the role that attention plays in the perception of gender and emotion.

Attention: The Cognitive Gateway to Downstream Processing

We have discussed at length how face processing works, and how various social cues interact to impact our perceptions of others. We now turn to the cognitive mechanisms that underlie selection of such information for processing. Before we process cues such as gender and facial expression, we must first select that information out of an array of potential stimuli in our environments. For that, we focus on the role that attention plays in the selection of relevant stimuli.

The study of attention was one of the first cognitive phenomena studied in the laboratory. Wilhelm Wundt, credited as the first experimental psychologist, discussed work out of his laboratory on attention in his early texts (Wundt, 1897, 1912). In one study, he conducted a task using a tachistoscope where he cued attention to a spatial location on the display. This was followed by arrays of letters on the display for approximately 100ms. He then asked participants to recall as many letters as possible. He observed that participants were able to better recall letters that appeared around the cue. Wundt envisioned attention as a narrow scope around a given location that becomes gradually darker as one moves away from the focal point. Thus, although often uncredited in the literature (Leahey, 1979), Wundt was the first to propose what is colloquially referred to as the "spotlight" account of attention.

The importance of the study of attention was recognized by Titchener (1908), a student of Wundt, who claimed that the discovery of attention was one of the early great achievements in experimental psychology. Titchener argued that "sensory clearness" was at the core of attention. He outlined eight qualities that influence the clarity of a stimulus: 1) intensity, 2) form, 3) temporal relations, 4) movement, 5) novelty, 6) association, 7) fixation, and 8) cessation of consistent stimulus. Intensity largely refers to bottom-up factors such as brightness, volume, and duration. Form refers to stimuli that are inherently attention capturing. This is arguably similar to a functional affordance definition, whereby stimuli are processed as they are because they serve some benefit to our survival, and hence, our reproduction. Temporal relations, in this context, refers to the repetition of stimuli, which should make them more clear over time. Additionally, stimuli that are presented suddenly will capture our attention. Movement was defined by Titchener as a change in a stimulus. While this may be actual physical movement, this can also include factors such as changes in pitch and tone. Novelty refers to the notion that newly encountered stimuli will capture attention. Association refers to the pre-existing schemas that individuals have about an encountered stimulus. A large factor at play here is memory, which will be outlined in greater detail below. Fixation refers to the tuning of the sensory organs to a stimulus. For instance, shifting your eyes so that a stimulus is processed foveally would fall into this. Finally, Titchener talked about cessation of a stimulus as the final factor associated with clarity. This phenomenon is best demonstrated when a constant background noise (e.g., music playlist) comes to an end. While attention may have pushed the music to the background, the sudden change is detected, bringing the noise (or lack thereof) back to the forefront of attention.

Titchener acknowledged that much of his work lacked empirical testability, particularly with the limited technology accessible to him, but by and large the ideas put forth by him and Wundt are woven into current theories of attention, although they are rarely acknowledged (Leahey, 1979). By and large, attention was out of the scope of psychological science by the 1930s and did not come back to the foreground until the cognitive revolution of the 1970s, when it was largely revived by the research of Michael Posner and colleagues.

Attention serves as a gating mechanism by which relevant stimuli are selected for processing amongst a backdrop of countless potential other stimuli (Posner, 1980). Given the sheer amount of potential stimuli that we can process in the environment, we need a mechanism that can filter out the less important stimuli to allow for our limited cognitive resources to be allocated toward those that are of urgent importance (Broadbent, 1957; but see Leahey, 1979, for a review of arguments against a limited resource account). Social cognition researchers have traditionally invoked attention as a critical component to their theories. After all, cognitions about person perception can only take place if those perceptions enter our minds for processing. However, there has been a great lack of specificity in how attention, and specifically how different subcomponents of attention, play a role. Perhaps the biggest limitation that has hindered the application of attention in social psychological research has been the lack of specificity regarding the conceptualization of attention. Attention is not a unitary resource but rather a constellation of bottom-up, purely stimulus driven components and top-down, goal-oriented components, all of which coordinate to direct cognitive resources toward relevant stimuli.

As stated above, many traditional models of visual attention have used a “spotlight” metaphor to explain how visual attention occurs via a serial process as it scans the environment for relevant stimuli. While this metaphor makes intuitive sense, it has become problematic in light of evidence for divided attention. For instance, Muller, Malinowski, Gruber, and Hillyard (2003) showed participants four symbols in a row, instructing participants to pay attention to two that were either next to one another or were separated by a symbol that was to be ignored. To examine attention, they displayed each symbol at different frequencies and looked for evoked potentials at each frequency for evidence that the symbol was being attended to. The critical trials of interest were the attend-symbols with a non-attend symbol in between. If participants in fact could divide their attention, the evoked potentials from the frequencies of the two attend-symbols should show up, but not the middle one to ignore. This is exactly what they found, suggesting that attention is not a single "spotlight," but rather can be turned on and off at different spatial locations depending on task demands. Additionally, neural activation in visual areas is initially widespread (up to 200ms post-stimulus), and then as attention becomes focused toward an object, neural responses become more specified (Desimone & Duncan, 1995). This cannot be explained by a serial search mechanism, but rather a wide-casting parallel net of visual input that is then filtered as it moves from visual cortices toward anterior brain regions.

This account of attention has been referred to as the *biased competition model* (Desimone & Duncan, 1995). According to the biased competition model, attention is a constellation of emergent processes that allow for competition for limited processing resources at many different levels of visual processing. Thus, if two stimuli pop up simultaneously in the environment, visual processing will begin the initial process of encoding both. However, if the stimuli differ at all, biasing toward one stimulus will begin to emerge. This biasing can be due to either automatic/highly learned responses or due to current task goals. The more dissimilar the stimuli, either in appearance or in spatial location, the less competition that occurs. Biased competition provides an ideal model to examine social and contextual influences on attention because it provides a framework through which we can have access to various sources of information in the environment (i.e., a litany of stereotype-consistent and stereotype-inconsistent information) yet still continue to process each of these differentially, at this initial level of processing. Any differences here likely set the stage for further downstream effects, with the first stop being at memory and encoding.

Working from a biased competition framework, our previous research (Nelson & Adams, in preparation) utilized a dot-probe paradigm (MacLeod, Mathews, & Tata, 1986) to identify whether 1) attention was differentially allocated to expressive cues (i.e., anger and fear) as a function of gender, and 2) if so, were these due to top-down stereotypes associated with expressive behavior, were they due to bottom-up perceptual overlap (i.e., anger signal more clear on male versus female faces because they are more mature looking, hence already look more angry), or some combination of both. Using highly standardized images of males and females expressing anger and fear, we found an early attentional bias (i.e., when faces were present for 300 ms) toward female faces (relative to male faces) expressing fear. Conversely, when the faces were presented longer (i.e., 1000 ms), we found attentional biases toward male fear (relative to female fear) and female anger (relative to male anger). In subsequent studies, we found this exact pattern of findings for androgynous faces that were completely matched on facial appearance, with a simple difference in hairstyles denoting gender. This suggests that, at least for attention, simple social categorical cues are enough to trigger differential processing and this appears to be driven by stereotypes. A major focus of the current dissertation will be to explore the endorsement of stereotypes as a moderator and/or mediator of these attentional biases.

While we found a general pattern of attention to stereotype-consistent faces early in attention, with a later bias toward stereotype-inconsistent faces, these effects were much stronger for fearful faces than angry faces. Fear is an emotion that conveys weakness and lower status (Tiedens, 2001). As such, seeing this expression displayed by males, whom hold power and higher status in society, may be particularly attention capturing later in attention. Groups in power require solidarity to maintain their status, and anything that may challenge that (i.e., expressing weakness) may be particularly damaging for that group (Zelditch, 2001). As for anger, there are some potential reasons why we find smaller effects, two of which, including changes in stereotypes and threat to traditional gender norms by females expressing anger, will be examined in this dissertation.

The dot-probes used by Nelson and Adams (in preparation) consisted of trials in which one female and one male face, each expressing the same emotion, were presented against each other within each trial. This differs from most dot-probe paradigms where the stimulus of interest (usually positively or negatively valenced) is pitted against a neutral stimulus. The argument justifying this is that if attention is biased toward a stimulus of interest, there will be faster reaction times to targets that appear at its former location. Conversely, if there are faster reaction times to targets that appear at the former location of the neutral stimulus, then the argument is that the stimulus of interest is being avoided. This is based on the assumption that the neutral stimulus does not itself hold any attentional value. This notion has been challenged by others. For instance, when examining attentional biases to angry and happy faces, Cooper and Langton (2006) found evidence that attention was allocated toward the relatively more threatening stimulus early (100ms), with a subsequent allocation of attention toward the relatively less threatening stimulus later (500ms). Thus, in happy-neutral trials, they found greater biases toward the neutral face early and the happy face later. However, when the trials consisted of angry and neutral faces, they were biased toward the angry faces early and the neutral faces later. Thus, attention to neutral faces differed depending on how relatively threatening it appeared within the context of each trial. Context has been shown to play an important role in how we identify facial expressions. For instance, seeing a neutral face paired along with an angry face will shift the perceptions of the neutral face into the opposite arousal/valence quadrant on a classical circumplex model (Russell & Fehr, 1987). Thus in this example, the neutral face may appear to be sleepy or relaxed. Conversely, if a face is demonstrating happiness, a neutral face would be judged as more sad. In film making, there is even a phenomenon coined the *Kuleshov effect*, where the context of a scene will dictate how an actor's emotional disposition will be perceived (Mobbs et al., 2006). As such, neutral faces do not serve as a clean baseline by which to compare the stimuli of interest.

In regard to the current studies, not only can neutral faces be perceived differently depending on the expressive face they are paired with, but neutrality in a face can be perceived differently as a function of gender. Neutral expressions displayed by males are seen as more dominant whereas the same expressions by females are seen as more submissive (Hareli, Shomrat, & Hess, 2009). Additionally, whereas females are expected to express their emotions (with notable exception of power-related emotions, to be discussed later), males by and large are expected to remain stoic and suppress the outward expression of their emotional state (Fabes & Martin, 1991).

A limitation of not having a baseline within trials is that indeed, no strong conclusions can be firmly drawn regarding whether attention to one stimulus is a function of 1) an actual shift of attention toward this stimulus, 2) an avoidance of the other stimulus, or 3) a combination of both. This could be concerning when looking at attention to faces across time because the biases found at 1000ms may simply be a function of the disengagement of attention from the faces that were attended to at 300ms. Our data on anger suggest that this is not the case. While there are no biases toward anger at 300ms, we consistently find a bias toward female anger faces at 1000ms. If attention to faces at 1000ms were simply due to a shift from the face that was attended to at 300ms to the other stimulus, then we should find no biases at 1000ms for anger.

Attention and Stereotypes

Now that we have discussed visual attention in detail, it is now time to turn toward a real-world manipulation of signal clarity – stereotypes. Given we have found that attentional biases to male and female faces expressing anger or fear seem to be driven by top-down stereotypes (Nelson & Adams, in preparation), we now turn our focus to the role that attention plays in stereotyping. The acquisition and utilization of stereotypes is dependent upon the ability to attend to the information that ultimately forms the stereotype.

It is well known that stereotypes are powered through confirmatory biases in processing (Hamilton & Sherman, 1994; Hilton & von Hippel, 1996). That is, by holding the stereotypes, we are then biased to process information that is consistent with these schemas, and to weigh inconsistent information less heavily. However, when we begin to examine how this weighting is applied, the picture begins to get quite complex. For instance, there is a wide range of evidence showing attentional biases to either stereotype-consistent or stereotype-inconsistent information based on the presence of important moderators (Sherman, Allen, & Sacchi, 2012).

For instance, when cognitive load is high, participants will pay more attention to stereotype-inconsistent information than consistent information (Sherman, Lee, Bessenoff, & Frost, 1998). This finding was surprising in light of the cognitive miser/motivated tactician (Fiske & Taylor, 1984, 1991) theories of the day that would predict that when resources are low, efforts would be best spent on processing information that does not require additional cognitive resources (consistent information). These findings, instead, fit within the encoding flexibility model (Sherman, Conrey, & Groom, 2004; Sherman et al., 1998), suggesting that when resources are low, they should be focused on information that can be helpful to the individual while filtering out information that can be processed easily. In this case, participants can quickly process stereotype-consistent information, thereby freeing what little resources they have left for the “heavy lifting” associated with processing stereotype-inconsistent information. Individual differences also play a role in attending to stereotype-consistent and -inconsistent information. For instance, Sherman, Stroessner, Conrey, and Azam (2005) found that individuals who were higher in prejudice against gay men paid more attention to (and subsequently remembered) stereotype-inconsistent information about a gay man, but only when they were not under cognitive load. The authors argued that those high in prejudice will avoid stereotype-disconfirming information unless they have the cognitive resources available to explain the counterstereotypical information away.

Thus far, the work examining attention and stereotyping has been limited by the lack of systematic examination of the role that attention plays in processing stereotype-consistent and stereotype-inconsistent information over time. Many of the paradigms used thus far utilize long stimulus durations (i.e., 1500ms), long after initial shifts in attention have taken place. Therefore, to say that in some conditions, people may show more attentional biases toward stereotype-consistent information, whereas at other times they may show more biases toward stereotype-inconsistent information, may only be part of the picture. How do these attentional biases shift across early attentional processing? Can attentional biases predicted by the encoding flexibility model be found simply by looking earlier in attentional processing?

Additionally, much of this work has been focused on using stereotypical words. While words are a very effective proxy for evaluating attentional biases to conceptual stimuli, there are some key differences using words that the current dissertation will address. For one, words serve as a symbolic cue of a stereotypical concept, however, our perceptions of others are conceptually filtered through our perceptions of their actions and behaviors. Therefore, to understand how stereotypes bias attention of others, we must move beyond words to look at these behaviors and actions. As stated before, the face is perhaps the most salient transmitter of social information (i.e., social category, behavioral intent), and as such, is a valid starting point to determine how person perception is biased by stereotypes.

Words are processed differently from faces, and therefore we cannot know for sure whether attentional patterns found for words translate to perceptions of behavior. For instance, when words and faces are presented together, the ability to identify both is enhanced when faces are presented to the left visual field (right hemisphere) and words are presented to the right visual field, which is fed into the left hemisphere (Klein, Moscovitch, & Vigna, 1976; Pirozzolo & Rayner, 1977). This suggests that the brain is wired to differentially process these types of stimuli. ERP studies suggest that faces are identified approximately 100ms faster than words (Pegna, Khateb, Michel, & Landis, 2004), which in the context of attention is a quite significant difference in latency of processing. Additionally, research has shown that the N170, an early ERP component associated with visual encoding, is much stronger for faces than it is for words and non-face objects (Bentin & Carmel, 2002; Itier & Taylor, 2004). This suggests that faces are processed earlier than words and other objects. It should be noted that a difference of 100ms is very significant in attentional terms. The temporal processing of faces puts them in a more favorable position to be processed by earlier attentional components (i.e., visual orienting).

Stereotypes, Attention, and Laterality

We now turn our focus to an additional important moderator of attention: laterality. The human brain demonstrates asymmetries in function that lead to specialized parallel processing of our complex worlds. Humans, as a land-living primate, show more enhanced cueing of attention along the horizontal plane of vision relative to the vertical plane (Nomura, Katahata, & Hashiya, 2005). In general, we have greater initial attentional biases either to the left or right visual fields depending on the directionality of reading (i.e., left-to-right or right-to-left). For instance, English-speaking participants show a larger left-to-right attentional bias due to the direction of reading, whereas Arabic-/Hebrew-speaking participants, whom read from right-to-left, show the opposite effect (Pollatsek, Bolozky, Well, & Rayner, 1981; Spalek & Hammad, 2005).

Neurally, visuospatial attention elicits greater widespread activity in the right hemisphere (Kim et al., 1999). Disrupting neural activity over the right parietal lobe using transcranial magnetic stimulation (TMS) also disrupts visuospatial attention in the left visual field when applied at approximately 270ms post-stimulus (Müri et al., 2002). Interestingly, no effects were found in the right visual field, and neither ipsilateral or contralateral effects were found when disrupting left parietal activity. The left visual field advantage is also found in studies that examine attention to relevant stimuli. For instance, attention in the left visual field is biased toward the faces of babies (Brosch, Sander, & Scherer, 2007). Additionally, laterality in attention is found when examining global versus local processing. Numerous studies have demonstrated that global processing is carried out more by the right hemisphere, whereas local processing is carried out more by the left hemisphere (Posner & Petersen, 1990; Yamaguchi, Yamagata, & Kobayashi, 2000). We will discuss this more later in the dissertation.

Laterality in Emotion and Face Processing

Perhaps no other line of research has examined laterality effects more than emotional experience and perception research. While there are many different models of emotional experience, including the right-hemisphere bias hypothesis, the valence hypothesis (Davidson & Hugdahl, 1995), and the approach-avoidance hypothesis (Harmon-Jones, 2003; Harmon-Jones & Allen, 1998; Harmon-Jones & Sigelman, 2001), most work looking at perception of emotions has found evidence primarily for the right-hemisphere bias hypothesis (Alves, Aznar-Casanova, & Fukusima, 2009; Borod et al., 1998; Lindell, 2013). Much of the support for this hypothesis has come from studies where participants have suffered from permanent (Adolphs, Damasio, Tranel, & Damasio, 1996; Borod et al., 1998) and temporarily induced (Ahern et al., 1991) damage to their right hemisphere. These participants show disruptions in the identification of facial expressions compared to their normal functioning right-hemisphere counterparts. Additionally, ERP (Kestenbaum & Nelson, 1992) and fMRI (Narumoto, Okada, Sadato, Fukui, & Yonekura, 2001) studies have also shown greater widespread activation in the right hemisphere.

Laterality effects have also been examined across presentation time. Adams, Franklin, et al. (2012) found evidence that clear threat cues (i.e., fearful faces with averted gaze, both signaling withdrawal) activate the right amygdala more at shorter stimulus durations (i.e., 300ms), whereas ambiguous threat cues (i.e., fearful faces with direct gaze, one signaling approach, the other signaling withdrawal) activate the left amygdala more at longer stimulus durations (i.e., 1000ms). This research parallels previous work we have conducted (Nelson & Adams, in preparation), demonstrating that congruent compound social cues (i.e., female displaying fear expression) elicit a larger attentional bias at 300 ms stimulus duration in the left visual field, which feeds primarily to the right hemisphere, whereas incongruent, or ambiguous cues (i.e., males displaying a fearful expression) elicits a larger attentional bias at 1000 ms and in the right visual field (left hemisphere). This is in line with previous research on amygdala activation to reflexive versus reflective processing of threat cues. For instance, Morris, Öhman, and Dolan (1998) demonstrated that subliminally presented threat cues activate the right amygdala more whereas supraliminally presented threat cues activate the left amygdala more. Additionally, Adams et al. (2011) found greater right-lateralized activation overall (i.e., number of voxels) for clear eye gaze and emotion threat cues, while the reverse was true for ambiguous signals of threat, providing further evidence that social cues interact to influence perceptual processing, and this is differentially driven by lateralized differences in brain processing.

The Amygdala and Attention

In addition to processing compound social cues, the amygdala has been implicated in attentional processing, particularly in response to threat (Armony & Dolan, 2002; Monk et al., 2004). A meta-analysis and subsequent neural modeling of dot-probe studies examining attention to threat cues has found that individual differences in amygdala activation mediates the differential attentional biases to threat between high and low anxiety participants on the dot-probe task (Frewen, Dozois, Joanisse, & Neufeld, 2008). Although the amygdala is most readily associated with threat detection, other researchers have argued that the amygdala functions as a “relevance detector” more broadly (Sander, Grafman, & Zalla, 2003). Indeed, amygdala activation is found when engaging in gender stereotyping, presumably to evaluate the relevance of the stimuli to an individual (Quadflieg et al., 2009). As such, the amygdala is a likely source for driving attentional biases.

Why Attention Matters: Downstream Effects on Memory

In the stereotyping literature, a widely-held belief has been that, once obtained, stereotypes are maintained via biases in memory (Fyock & Stangor, 1994; Stangor & McMillan, 1992). Whether the information that is more likely to be remembered is stereotype-consistent or stereotype-inconsistent is differentially found across a wide-range of studies and subject to numerous moderators (Rojahn & Pettigrew, 1992; Stangor & McMillan, 1992).

One moderator that appears to influence whether stereotype-consistent or stereotype-inconsistent information is remembered better is based on how this information is encoded. Stereotype-inconsistent information, because of its novelty and unexpectedness, is subject to more processing resources, and as such, is encoded more perceptually, thereby the visual features of the stimulus (assuming a vision-based paradigm) are remembered to a greater extent. Stereotype-consistent information, on the other hand, is not subject to such additional resources under most conditions because this is easily assimilated into an existing stereotype. Thus, visual processing of the stimulus is often cut off to free up resources for other demands, particularly under conditions in which processing capacity is reduced (Sherman et al., 1998).

Intersection of Attention and Memory

Attention and memory are inextricably linked to one another. Attention serves to filter what is encoded in memory to prevent information overload by focusing on only relevant stimuli, and memory helps direct attention toward stimuli that have been personally relevant to the individual (Chun & Turk-Browne, 2007). Neurally, there is a large degree of overlap in activation for spatial attention and working memory (LaBar, Gitelman, Parrish, & Mesulam, 1999). Desimone and Duncan (1995) suggest that memory is an additional "attentional template" that can be applied to the visual field to bias attention toward items. For instance, with repeated practice using certain visual stimuli on a task, participants are unable to ignore them, even when these stimuli become irrelevant on subsequent tasks (Shiffrin & Schneider, 1977).

In addition to providing an "attentional template" that is used to select items in the environment to process, memory can differentially influence attention based on the clarity of the stimulus. For instance, learned stimuli that are degraded in their visual appearance will actually show enhanced activity in V4 relative to conditions where the stimulus is not degraded. V4 is a visual cortical area that is associated with visual attention (Moran & Desimone, 1985). When the image is degraded, this suggests that memory is filling in the missing gaps in the percept (Rainer, Lee, & Logothetis, 2004). Alternatively, when stimuli are not degraded, attention-related neural activity is greater for novel stimuli than familiar stimuli (Desimone, 1996; Grill-Spector, Henson, & Martin, 2006).

The intersection of attention and memory can also be seen when attempting to engage in stereotype suppression. When trying to suppress stereotypical thoughts, participants will actually show enhanced memory for stereotype-consistent behaviors relative to stereotype-inconsistent behaviors perceived in others (Macrae, Bodenhausen, Milne, & Wheeler, 1996; Sherman, Stroessner, Loftus, & Deguzman, 1997). One explanation for this comes from ironic processing theory (Wegner, 1994) which states that in order for a thought to be suppressed, cues of that thought must be monitored for and selected (i.e., attention) in order to be suppressed. Thus, we see an example of the influence that attention has over memory. With that, we now turn to an overview of the current studies in this dissertation.

Chapter 2: STUDIES

The current studies will attempt to address the following: 1) establish the mechanism that drives attentional biases across space and time, and 2) begin to identify potential downstream effects of attentional biases. Study 1 examines the extent to which college students believe that males and females experience and express basic emotions. Building upon this, Studies 2 and 3 examine the extent to which biases on these measures mediates attentional biases to male and female expressive faces. Finally, Study 4 is designed to examine potential downstream effects of differential attentional biases by having participants complete a dot-probe followed by a face memory task.

Study 1

The purpose of Study 1 is to replicate a study conducted by Fabes and Martin (1991) in a contemporary setting with college students. In this original study, the authors find that, overall, gender stereotypes about the experience and expression of emotions are largely driven by a deficit model of male expressive behavior, whereby men are expected to suppress any emotion they are experiencing, with the notable exception of anger. However, stereotypes of women are changing, while the same is not true for men (Diekman & Eagly, 2000). Women are being seen as more agentic and powerful, whereas men are still unable to express weakness. Thus, we wanted to assess these stereotypes on the population that we have been studying – contemporary college students.

In particular, we were interested in the extent to which participants believed that the average woman and man would 1) experience each of the six basic emotions, and 2) express each of the emotions. To the extent that gender stereotypes have not changed too dramatically in the last 25 years, we expect to find that all emotions, with the exception of anger, should be both experienced and expressed more by women than men. Additionally, the discrepancy between expression and experience, which reflects the extent to which women and men either masked or enhanced their expression, should show the most drastic differences in emotions of weakness (i.e., fear and sadness) because men are not allowed to express weakness.

Method

Participants

A total of 53 (42 female) participants, mean age of 19.15 (SD = 1.08, range = 18-22) completed the survey for partial course credit. Although unbalanced, an examination of participant gender revealed no differences in responses, as is expected given that women and men both endorse gender stereotypes. The survey was administered after participants completed tasks associated with an unrelated study on eye gaze cueing.

Survey

Participants were administered questions that were adapted from Fabes and Martin (1991). For each question, participants were asked to imagine either the “average male” or the “average female” and to rate, on a scale from 0-100, the extent to which this average male/female 1) experiences and 2) expresses each of the following basic emotions: anger, fear joy, sad, disgust, and surprise. See Figure 1 for a screenshot of one of the questions as administered.

Imagine the average FEMALE. How much do you expect this average female to EXPRESS the following emotions? Note that this is different from how much you expect them to EXPERIENCE emotions, which you were asked about before.

	1 - Almost Never	2	3	4	5	6	7 - Very Often
Anger	○	○	○	○	○	○	○
Fear	○	○	○	○	○	○	○
Joy	○	○	○	○	○	○	○
Sadness	○	○	○	○	○	○	○
Disgust	○	○	○	○	○	○	○
Surprise	○	○	○	○	○	○	○

Figure 1. Screenshot example of question from Experience-Express survey used throughout the dissertation. While this example is from Studies 3-4, Studies 1-2 differed only on the scale, which was a sliding scale of 0-100.

Results

First, two bias scores were computed from the data by subtracting responses for males from responses for females for the 1) experience and 2) expression of each basic emotion. Then, a third bias score of enhancement was computed by subtracting the bias from the experience from the bias of the express for each gender, and then these values for males are then subtracted from those of females. This left us with 3 bias scores where negative values indicated a bias toward males, whereas positive values indicated a bias toward females. These bias scores were submitted to three separate multivariate linear models to examine gender differences in each of these factors for the six basic expressions. Because bias scores were used for each, the intercept was entered as the predictor in these models. Negative beta values indicate a bias toward males, whereas positive values indicate bias toward females. For experience, the multivariate analysis was significant, $F(6,45) = 15.18$, $p < .001$, $\eta^2 = .669$. Figure 2 shows the ratings for each emotion while Table 1 shows the individual effects for each.

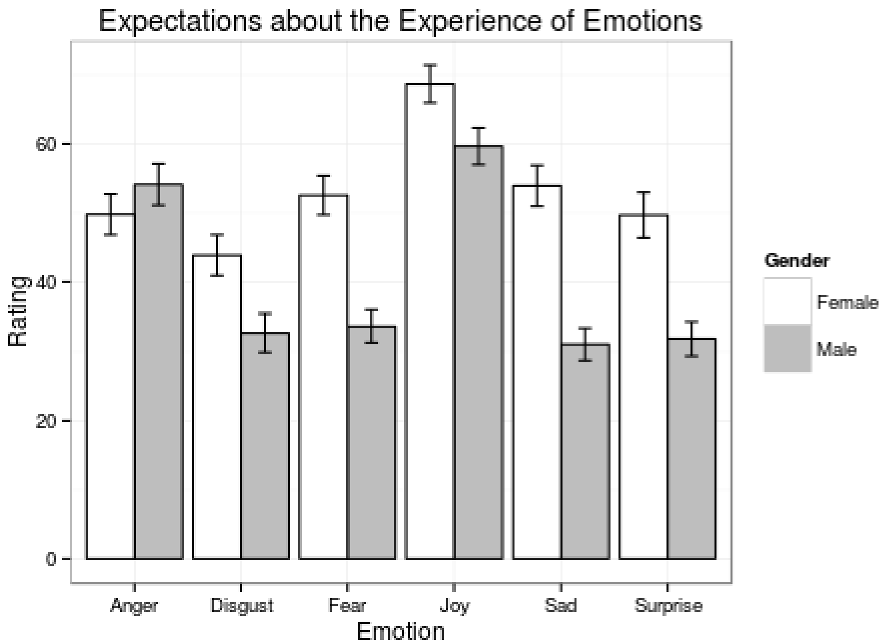

Figure 2. Ratings of expectations about how much males and females experience each of the six basic emotions.

Table 1. Ratings of expectations about how much males and females experience each of the six basic emotions. Positive values indicate that women experience more of the emotion than men, whereas the opposite is true for negative values.

Emotion	*b*	*SE*	*t*	*df*	*p*
Anger	-4.47	2.47	-1.81	50	.077#
Fear	20.04	2.66	7.52	50	< .001***
Joy	8.04	1.83	4.39	50	< .001***
Sad	23.79	2.77	8.59	50	< .001***
Disgust	10.69	3.18	3.36	50	.002**
Surprise	18.43	2.72	6.77	50	< .001***

Notably, all emotions except for anger are significantly biased toward females. Anger is biased toward males, albeit only marginally. For expression, we again find a significant multivariate effect, $F(6,45) = 31.95$, $p < .001$, $\eta^2 = .810$. Figure 3 shows the ratings for each emotion while Table 2 shows the individual effects for each emotion. This time, all effects are significant, with anger biased toward males, and all other emotions biased toward females.

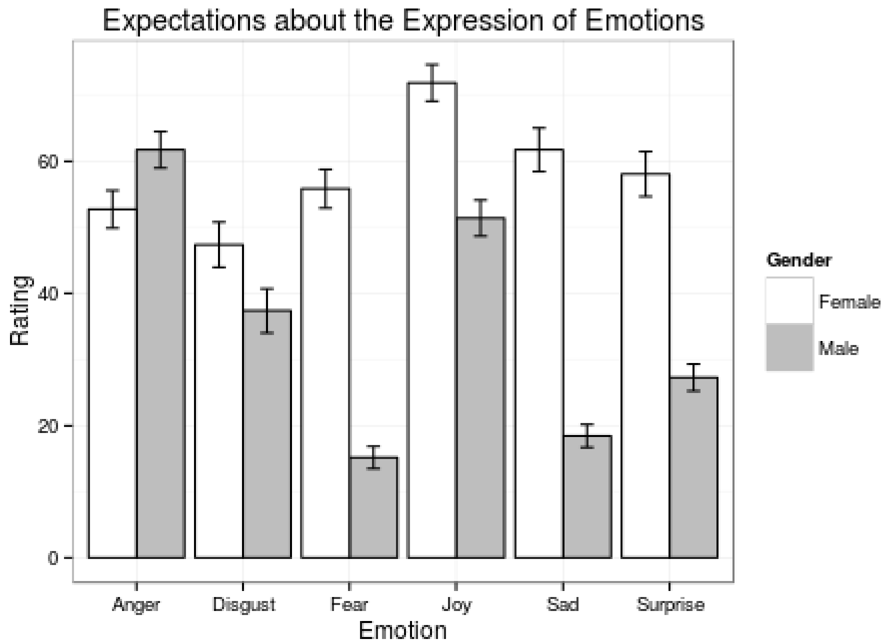

Figure 3. Ratings of expectations about how much males and females express each of the six basic emotions.

Table 2. Ratings of expectations about how much males and females express each of the six basic emotions. Positive values indicate that women express more of the emotion than men, whereas the opposite is true for negative values.

Emotion	*b*	*SE*	*t*	*df*	*p*
Anger	-9.31	3.06	-3.05	50	.004**
Fear	42.22	3.18	13.29	50	< .001***
Joy	21.71	2.96	7.35	50	< .001***
Sad	43.69	3.55	12.29	50	< .001***
Disgust	9.45	3.84	2.46	50	.017*
Surprise	31.02	3.18	9.74	50	< .001***

Finally, to assess the bias in enhancement/suppression of emotional expressions, we first run a multivariate linear model on the enhancement bias scores. This multivariate analysis is significant, $F(6,43) = 10.07$, $p < .001$, $\eta^2 = .584$. Figure 4 shows the difference scores for each emotion while Table 3 shows the individual effects for each emotion. This time, there are no significant effects for anger or disgust, although the former was in the predicted direction toward male enhancement. The other four expressions are significantly biased toward females, suggesting that they are more likely to enhance these expressions than males.

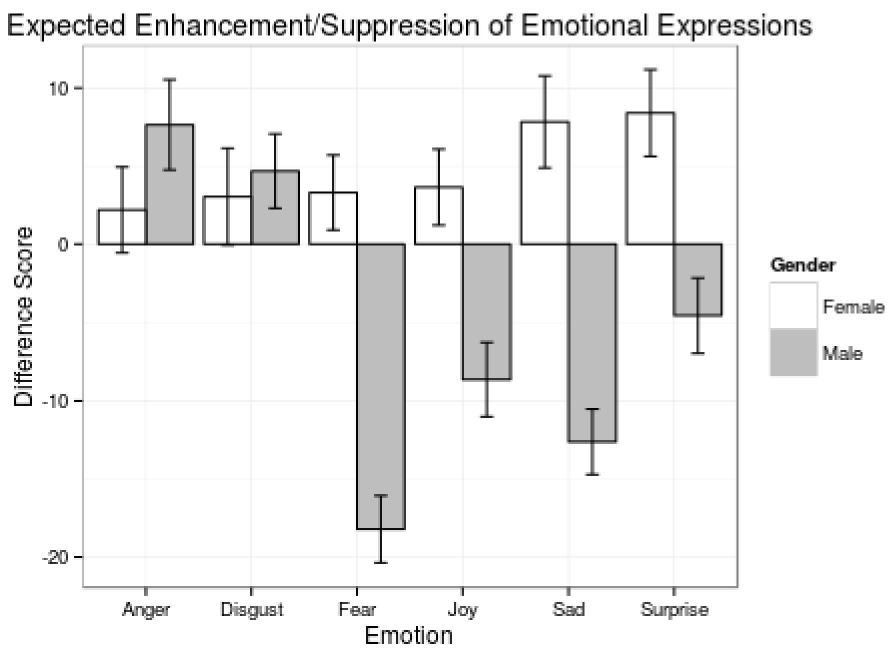

Figure 4. Difference scores between express and experience expectations. A positive value indicates an expectation that females/males enhance their expression whereas negative values mean they suppress the expression.

Table 3. Difference scores between express and experience expectations. A positive value indicates an expectation that women enhance their expression more than men whereas negative values mean that men enhance their expression more than women.

Emotion	*b*	*SE*	*t*	*df*	*p*
Anger	-4.53	3.00	-1.51	48	.138
Fear	21.86	2.88	7.58	48	$< .001^{***}$
Joy	14.10	2.83	4.99	48	$< .001^{***}$
Sad	20.00	3.21	6.23	48	$< .001^{***}$
Disgust	-0.71	3.44	-0.21	48	.836
Surprise	12.43	2.77	4.49	48	$< .001^{***}$

Because a large discrepancy in magnitude is apparent between the male-typical emotion (anger) and the female-typical emotions (fear, sadness), we computed paired-sample *t*-tests between the magnitudes of the effect (i.e., multiply the anger values by -1 to put it on the same scale as the female emotions) for anger and fear, and then anger and sadness. Additionally, we computed paired-sample *t*-tests between the two prominent female-stereotypical emotions, fear and sadness, to see if these statistically differ from one another. Table 4 shows each of these results.

Table 4. Paired sample t-tests for the magnitudes of each effect. The effects were significantly stronger for fear and sadness, relative to anger, for experience, express, and enhance indexes. This suggests stereotype differences for fear and sadness are much larger than they are for anger. Fear and sadness, the two stereotypically female emotions, do not differ from one another.

Emotion 1	Emotion 2	Rating	M_{diff}	t	df	p
Fear	Anger	Experience	15.44	4.62	51	$< .001^{***}$
		Express	32.67	7.46	51	$< .001^{***}$
		Enhance	16.78	4.37	51	$< .001^{***}$
Sad	Anger	Experience	18.51	4.65	52	$< .001^{***}$
		Express	34.87	8.17	51	$< .001^{***}$
		Enhance	16.19	4.45	51	$< .001^{***}$
Fear	Sad	Experience	-3.46	-1.46	51	.151
		Express	-2.19	-0.81	51	.422
		Enhance	0.88	0.31	50	.756

Notably, the magnitude of the effects are much larger for the female-stereotypical emotions (i.e., fear and sad) than they are for the male-stereotypical emotion (i.e., anger). This is true for ratings of experience, ratings of likelihood to express, and the index of enhancement. Overall, this suggests that stereotype differences about fear and sadness are much more pronounced for fear and sadness, both emotions that convey weakness, than they are for the power-oriented emotion of anger. Additionally, no differences were found between fear and sadness on all three bias scores, suggesting that these stereotypes are equal in magnitude.

Results Compared to Fabes and Martin (1991)

Given a nearly identical study was run by Fabes and Martin (1991), we compared effect sizes from their study with ours to examine changes in the magnitude gender emotion stereotype endorsement for the emotions most relevant to the current dissertation: anger, fear, and sadness. We computed effect sizes for the Fabes and Martin data using the methods of computing effect sizes from p values as outlined by Rosenthal (1991), given effect sizes were not originally reported. Fisher z comparisons between our study and Fabes and Martin were computed for each emotion. Our results did not significantly differ from any of theirs (all ps > .45), suggesting that the magnitude of these stereotypes has not drastically changed over time.

Discussion

The results of Study 1 largely confirm our predictions about gender stereotypes of emotional experience and expression. By and large, females are expected to express and experience more emotion than males, with the notable exception of anger. Anger, being a power-oriented emotion, is expected to be experienced and expressed more by males, although the magnitude of this effect appears to be much smaller than the more female-stereotypical expressions, such as fear and sadness.

These results are in line with findings from Fabes and Martin (1991). Like us, they found greater expression biases for female sadness and fear, whereas they found a greater expression bias toward male anger. Interestingly, our effect sizes did not significantly differ from those found by Fabes and Martin, suggesting that the magnitude of these stereotypes has not significantly changed over time. Thus, despite stereotypes presumably changing for females, but not males, allowing for females to be seen as more agentic than in previous years (Diekman & Eagly, 2000), women are still expected to express less anger than men, although the magnitude of this difference has been to a lesser extent than the magnitude of the differences for fear and sadness.

This difference in magnitude of stereotype, whereby anger shows a much smaller difference between genders than does fear or sadness, has been reflected in our previous research on attentional biases to expressive faces (Nelson & Adams, in preparation). While fear shows stronger attentional biases, both early (toward females) and late (toward males) in attention, anger shows a much smaller effect. Whether this difference is associated with these different strength of stereotypes found in the current study will be examined in both Studies 2 and 3.

Study 2

In Study 1, we find evidence that women are expected to experience and express more basic emotions than men, with the notable exception of anger. Additionally, these differences were much greater for fear and sadness – emotions that convey weakness. While our previous research (Nelson & Adams, in preparation) has extensively examined anger and fear within a dot-probe paradigm, sadness has been yet to be examined. Study 2 attempts to study this by examining sadness and anger in a dot-probe. If we find that sadness shows a similar effect as fear does (i.e., early attentional bias toward female sadness, later bias toward male sadness), this will lend support that attentional biases are driven by expectations of emotional expressive behavior. Finally, unlike previous research, we now collect the same experience/express stereotype measure in this study to specifically examine this relationship using mediation analyses.

To examine attentional biases, we will utilize a dot-probe protocol (MacLeod et al., 1986). The design of the dot-probe is based on previous research we have conducted on this topic (Nelson and Adams, in preparation). The dot-probe consists of displaying a cuing stimulus, followed by a target that appears in the former location of one of the cuing stimuli. How quickly one responds to the target is a proxy by which to assess the extent to which the stimulus preceding the dot captured attention. Longer reaction times suggest that participants were not attending to the previous stimulus as much, hence a shift of attention is needed before the target can be responded to.

In the current study, we predict that attentional biases will vary as a function of 1) timing of the stimulus presentation and 2) the visual field that the target ultimately ends up in. Specifically, stereotype-consistent combinations of gender and expression cues, because they are easier to process given they match with pre-existing schemas, should be attended to first. This should be followed by a shift in bias from stereotype-consist to stereotype-inconsistent cues, given additional attentional resources are needed to understand the violation of the held schemas. Additionally, these should also differ across visual field. Given previous research on amygdala activation in response to perceiving compound social cues, we expect to find more attentional biases to stereotype-consist cues in the left visual field, particularly at 300ms, as congruent cues activate the right amygdala more than the left, and vice versa for stereotype-inconsistent cues at 1000ms. Finally, to the extent that these biases are driven by the strength of stereotype endorsement, we should expect to find that stereotype endorsement will mediate and/or moderate these effects.

Method

Subjects

A total of 31 undergraduates (27 females) with an average age of 19.13 (*SD* = 1.18; 18-22) participated for partial course credit. Notably, in four previous studies utilizing the current dot-probe paradigm, none demonstrated any evidence of differences as a function of participant gender, hence no efforts were made to control for gender in the current study.

Materials

Face stimuli for this study were created using FaceGen Modeller software (Singular Inversions, Inc.). Five faces that were made to look androgynous were evaluated for gender in a pilot study (N = 20, 8 females). Participants labeled each face as either 1 = male, or 2 = female. Ultimately, the most androgynous looking face (i.e., closest to the midpoint of 1.5 in terms of gender ratings) was rated as slightly more female overall (M = 1.65). Notably, the exact 50-50 template produced by FaceGen was overwhelmingly labeled as male (M = 1.1). Despite the template initially leaning toward female in appearance, there is literature demonstrating the power that hairstyles play in our detection of gender (Macrae & Martin, 2007). Even when faces are clearly male or female, a mismatching hairstyle will initially lead to incorrect identification of gender. As such, the template face was subsequently given male or female hairstyles by cropping hairstyles obtained through an internet image search. Four exemplars were created from the template by using four different hairstyles – two females and two males. An independent sample of 44 participants (28 males, 16 females) judged the gender of the androgynous faces with the hairstyles in a forced choice task. The gender manipulation was successful, with participants overwhelmingly labeling the faces with the female hairstyles as female (98%) and the faces with the male hairstyles as male (92%). These faces were then uploaded back into FaceGen and the expression was created by changing the anger setting to 100% for angry faces and the fear setting to 100% for fear expressions. This left us with two expressions for each exemplar– 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. Figure 5 provides examples of these stimuli.

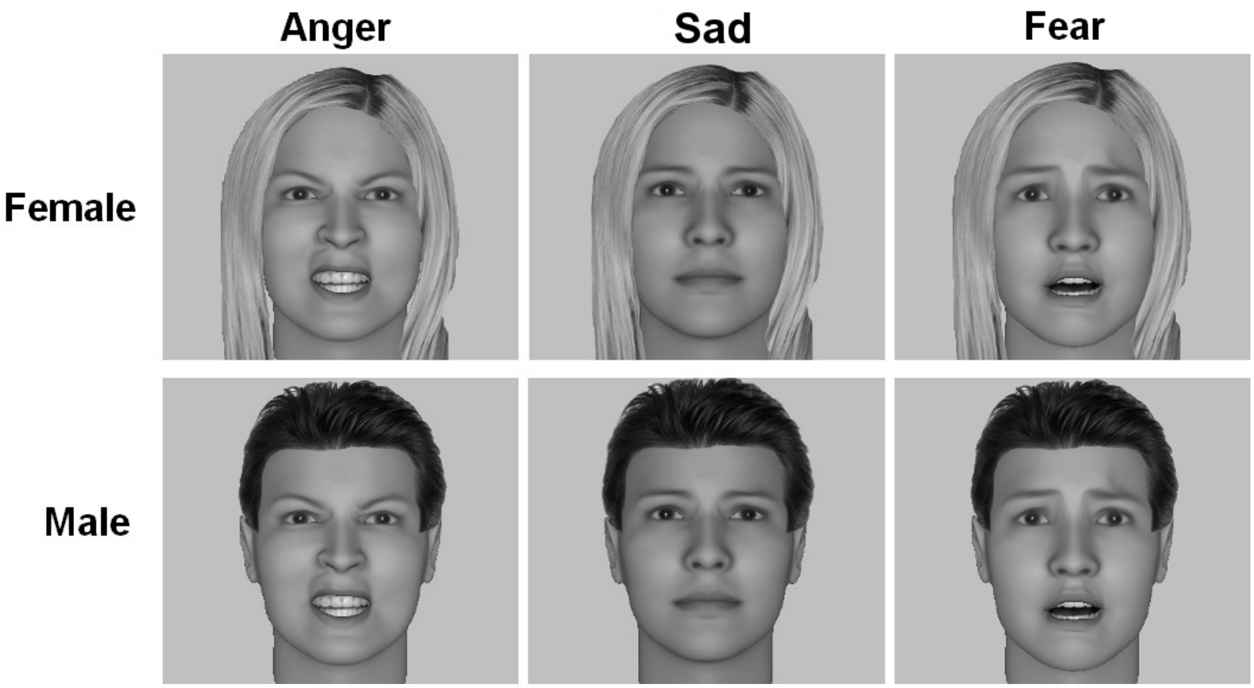

Figure 5. Example stimuli for Study 2 (Anger and Sad) and Study 3 (Anger and Fear).

Experience-Express Stereotypes

In addition to the dot-probe, participants also completed the same experience-express stereotype survey used in Study 1.

Procedure

The dot-probe was presented on Dell 17 inch CRT monitors at a refresh rate of 75Hz and a resolution of 1024 by 768 pixels. Participants were situated 45 cm from the monitor and their placement was held via a chin rest. The dot-probe consisted of 16 practice trials followed by 288 experimental trials. There were 128 trials each of anger expressions and sad expressions, along with 32 trials that consisted of neutral expressions to serve as a baseline. Each trial started with a fixation point at the center of the screen for 1000ms, followed by the presentation of two faces, one male and one female, matched for expression, that appeared 7.6° from the left and right sides of the screen. The faces were sized 6.5° by 13° and remained on the monitor for one of two stimulus durations: 300ms and 1000ms. After this time elapsed, the faces disappeared and either one or two dots immediately appeared in the former location of one of the faces. The dot(s) remained up until a response, or 2000ms, whichever came sooner. Participants were instructed to respond, via mouse click, whether they saw one or two dots, and to make this response as quickly but accurately as possible. Figure 6 depicts the flow of each dot-probe trial. After the dot-probe, participants completed the experience-express stereotype survey.

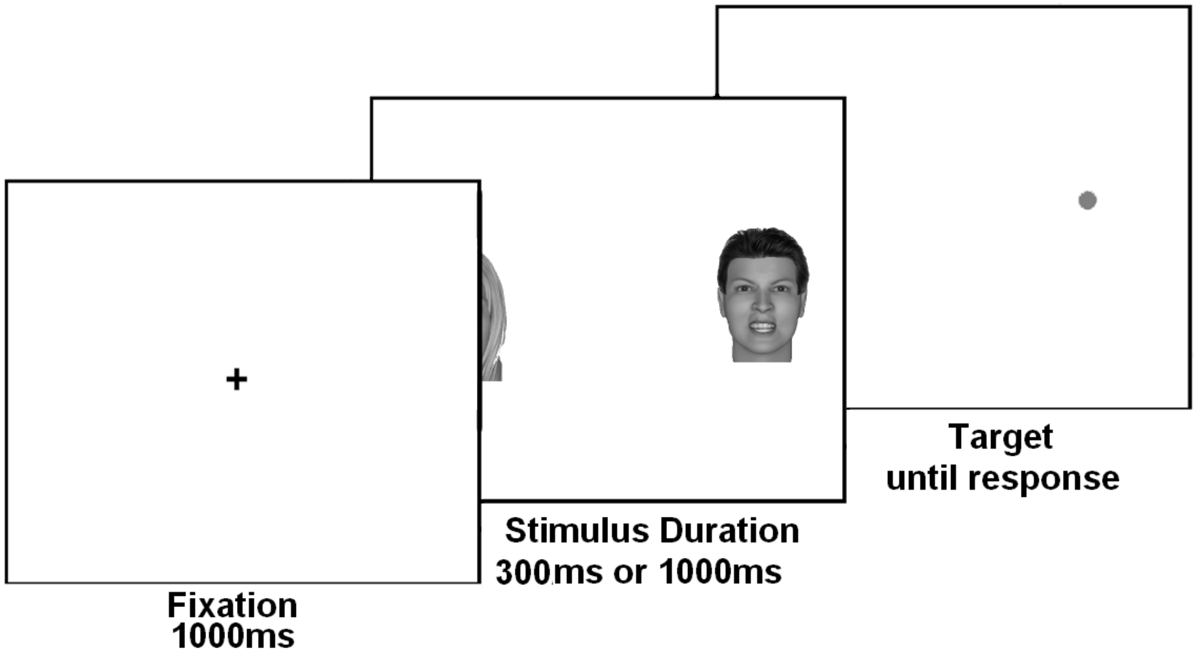

Figure 6. A depiction of an individual dot-probe trial. Each trial begins with a fixation cross for 1000ms, followed by the presentation of two faces, one female and one male, matched for facial expression, for either 300ms or 1000ms. After this, one or two dots appeared in the former location of one of the faces. Participants indicated via mouse click whether they saw 1 or 2 dots.

Results

It is well known that linear mixed models that include categorical predictors have more difficulties in converging, particularly when the random effects term becomes complex, as is the case with designs looking at higher order within-subjects interactions (i.e., 3-way, 4-way). This often necessitates a reduction of the complex random effects term to reach convergence, but exactly how it is best to do so is still being debated. Barr, Levy, Scheepers, and Tily (2013) demonstrate, through simulations, that it is critical for the highest level within-subjects interaction be present in the random effects term to not increase the risk of Type I error. Based on their recommendations, the following steps were used to specify the random effects terms in all models presented in this manuscript. First, a fully parameterized model was attempted for each, including random intercepts and random slopes for all within-subjects variables, as well as their interactions. When this failed, a model was specified that examined the random intercept separately from all possible random slopes, hence dropping the correlations between the intercept and slopes. Further simulations from Barr et al. (2013, supplementary materials) demonstrate that this is reasonable, particularly when between-subjects variables are included in the model, as they currently are with the individual difference measures. Finally, if this failed to converge, random slopes for the highest level within-subjects interactions were included without first, their main effects, and then their lower-order interactions if this failed. Again, simulations by Barr et al. (2013) demonstrate that this yields similar Type I error levels as a fully parameterized model.

It should be noted that those not familiar with linear mixed models may find the degrees of freedom to be puzzling for some models. There is still debate on how to estimate degrees of freedom for linear mixed models. Currently, many researchers recommend the Kenward-Roger approximation (Judd, Westfall, & Kenny, 2012). While this approach yields similar degrees of freedom as would be expected from a traditional ANOVA for many of the models, some models, in particular where lower level interactions and main effects had to be removed from the random effects term, yield inflated degrees of freedom. Again, the betas through these different model production efforts yield very similar results. Additionally, the significance values approximate other methods of computing degrees of freedom (i.e., Satterthwaite approximation).

Effect sizes are notably absent from analyses presented in this dissertation. There currently is no consensus on how to best compute effect size indicators from linear mixed models. Attempts at producing analogues to traditional R^2 methods can yield negative values, which makes their interpretation meaningless. As such, we refrain from including these values here to avoid misleading the reader. Note that some alternatives have been suggested (Nakagawa & Schielzeth, 2013; Xu, 2003), and we look forward to a consensus being reached on an appropriate method of computing these important values. With this said, we now move onto the analyses.

Beta values and standard errors were computed for all models below with raw reaction times for ease of interpretation. Inferential statistics and significance were computed using logarithmic transformed reaction times to correct for normality in the distribution. Attentional bias scores were computed by subtracting the transformed reaction times for trials when the dots were cued by the female faces from trials when the dots were cued by the male faces. This was done for each combination of laterality, expression, and stimulus duration. These values were then submitted to a linear mixed model analysis using the *lmerTest* package (Kuznetsova, Brockhoff, & Christensen, 2014) with laterality (-0.5 = left visual field; 0.5 = right visual field), expression (-0.5 = anger; 0 = neutral; 0.5 = sadness), stimulus duration (-0.5 = 300ms; 0.5 = 1000ms), and all combinations of their interactions entered both as fixed factors as well as random factors relative to the participant to account for the repeated measures nature of these variables. The random intercept was dropped in order to obtain an appropriate model fit. Degrees of freedom and significance values of mixed models are computed using the Kenward-Roger approximation.

First, there was a significant main effect of stimulus duration (controlling for all other factors), $b = -9.79$ ms, $SE = 4.50$ ms, $F(1,30) = 4.50$, $p = .042$, indicating that attention is biased more toward female faces at 300ms and male faces at 1000ms. There was a laterality by expression interaction, $b = -43.66$ ms, $SE = 11.07$ ms, $F(1,30) = 16.77$, $p < .001$. Testing each effect against a null of 0, angry faces show a larger attentional bias toward males in the left visual field, $b = -12.40$ ms, $SE = 5.41$ ms, $t(41) = -2.23$, $p = .031$, whereas anger in the right visual field is biased toward females, $b = 16.20$ ms, $SE = 4.68$ ms, $t(41) = 3.50$, $p = .001$. For sadness, the pattern was reversed, albeit only the right visual field bias toward males was significant, $b = -8.13$ ms, $SE = 4.59$ ms, $t(45) = -2.05$, $p = .046$ (left visual field $p > .21$). This suggests that, when controlling for stimulus duration, stereotype-consistent faces garner greater attentional biases in the left visual field, whereas stereotype inconsistent faces garner greater biases in the right visual field.

Next, there was an expression by stimulus duration interaction (controlling for laterality), $b = -52.05$ ms, $SE = 11.46$ ms, $F(1,30) = 21.66$, $p < .001$. At 300ms, attentional biases were found for female sadness faces, $b = 17.32$ ms, $SE = 4.73$ ms, $t(45) = 3.63$, $p = .001$, while attention was biased toward male anger faces, albeit non-significantly, $b = -6.22$ ms, $SE = 4.69$ ms, $t(45) = -1.40$, $p = .168$. At 1000ms, attention is biased toward stereotype-inconsistent faces (anger: $b = 10.02$ ms, $SE = 5.33$ ms, $t(41) = 2.09$, $p = .043$; sadness: $b = -18.50$ ms, $SE = 6.01$ ms, $t(38) = -3.16$, $p = .003$).

Finally, there was a significant laterality by expression by stimulus duration interaction, $b = -59.33$ ms, $SE = 23.07$ ms, $F(1,30) = 5.79$, $p = .022$ (see Figure 7). As predicted, attention was biased toward stereotype-congruent faces on the left side at 300ms (anger: $b = -12.24$ ms, $SE =$

6.66 ms, $t(37) = -1.97$, $p = .057$; sadness: $b = 18.30$ ms, $SE = 6.86$ ms, $t(36) = 2.75$, $p = .009$). At 300ms on the right side, we also find a bias toward female sadness, $b = 16.34$ ms, $SE = 6.52$ ms, $t(37) = 2.33$, $p = .025$. There was no bias for anger ($p > .97$). At 1000ms, we find the predicted attentional biases toward stereotype incongruent faces (i.e., angry female, sad male) in the right visual field (anger: $b = 32.59$ ms, $SE = 6.54$ ms, $t(37) = 5.08$, $p < .001$; sadness: $b = -32.59$ ms, $SE = 6.50$ ms, $t(36) = -5.13$, $p < .001$). There were no significant biases in the left visual field ($p > .16$).

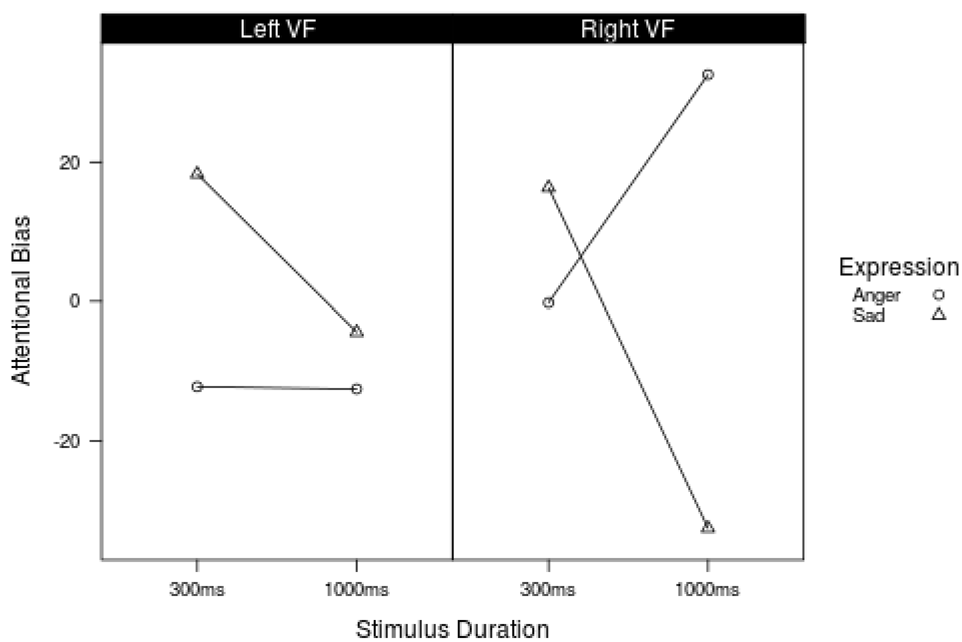

Figure 7. Attentional biases to anger and sad faces (Study 2). VF = visual field. Positive values = female bias, negative values = male bias.

Mediation

Next, we set up four mediation analyses to examine the degree to which a participant's explicitly held stereotype about expressive behavior[1] mediated attentional biases in each of the following conditions: 1) left visual field at 300ms, 2) left visual field at 1000ms, 3) right visual field at 300ms, and 4) right visual field at 1000ms. The expressive stereotype bias was computed by subtracting the extent to which they expected the average male to express the emotion from the extent to which they expected the average female to express that same emotion. This created a bias score where negative values indicated a higher expectation for males while positive values indicated a higher expectation for females, matching the indices of attentional biases. This expressive stereotype index was entered as a mediating variable with emotion (anger/sadness) as the causal variable and attentional bias as the outcome. Notably, we used only the expectations of expressions as the experience and the enhancement/suppression indexes failed to yield any results. Full mediation requires the following four criteria to be met: 1) the causal variable must predict the outcome variable, 2) the causal variable must predict the mediator, 3) the mediator (controlling for the causal variable) must predict the outcome variable, and 4) the causal variable, after controlling for the mediator, must no longer predict the causal variable (Baron & Kenny, 1986). Each of the analyses presented below was computed using linear mixed models in order to specify a random effects term to account for the repeated measures nature of the dot-probe (i.e., emotion was entered as a random effect within participant).

1 We initially examined mediation and moderation using three different indexes from the experience-express stereotype measure – responses on the experience of emotions, expression of emotions, and the difference between the two which reflects the enhancement/suppression of an emotion. Only the express items yielded meaningful results for each of the following studies in this dissertation, thus all analyses focus on this factor.

We found evidence for mediation at 2 of the 4 conditions: the left visual field at 300ms and the right visual field at 1000ms. For the left visual field at 300ms, we first find that emotion significantly predicts attentional biases, $b = 30.53$ ms, $SE = 10.09$ ms, $F(1,30) = 9.45$, $p = .004$. Next, emotion predicts the stereotype index of expressive behavior, $b = 47.85$, $SE = 6.51$, $F(1,30) = 53.93$, $p < .001$. In step 3, the stereotype index of expressive behavior, controlling for emotion, predicts attentional biases, albeit nonsignificantly, $b = 0.35$ ms, $SE = 0.21$ ms, $F(1,57) = 2.68$, $p = .107$. Finally, in step 4, emotion, controlling for expressive stereotypes, is no longer significant, $b = 11.94$ ms, $SE = 14.16$ ms, $F(1,45) = 0.71$, $p = .403$. To assess the significance of the mediation effect, bootstrapping analyses (5000 repetitions) were computed using the MBESS package in R (Kelley & Lai, 2012). This effect is marginally significant, $b = 16.75$ [90% CI: 0.67, 31.92].

We find stronger evidence for mediation in the right visual field at 1000ms. First, emotion significantly predicts the attentional bias, $b = -65.18$ ms, $SE = 9.36$ ms, $F(1,30) = 47.04$, $p < .001$. Next, emotion predicts the expressive stereotype index, $b = 47.85$, $SE = 6.51$, $F(1,30) = 53.93$, $p < .001$. In step 3, the expressive stereotype index, controlling for expression, predicts attentional biases, $b = -0.52$ ms, $SE = 0.19$ ms, $F(1,57) = 5.46$, $p = .019$. As expected, this indicates that participants demonstrated more attentional biases toward faces that were stereotypically incongruent. In step 4, we find that emotion still predicts attentional biases, albeit at a reduced level, $b = -38.95$ ms, $SE = 12.75$ ms, $F(1,45) = 10.08$, $p = .003$. This suggests that partial mediation has been found, given the direct effect remains significant. A follow up analysis using bootstrapping (5000 repetitions) demonstrated that, indeed, the mediation effect was significant, $b = -25.10$ [95% CI: -43.45, -9.31]. Thus, we can say that the degree of stereotype endorsement of expressive behavior of females and males partially mediates attentional biases to female and male expressive faces in the right visual field at 1000ms.

Moderation

In addition to examining expressive behavior stereotypes as a mediator of attentional biases, we also looked to see if it moderated the laterality by expression by stimulus duration interaction. Ultimately, the 4-way interaction was not significant, $p > .41$.

Inhibition of Return

Given we find that expressive stereotype endorsement partially mediates attentional biases in the left visual field at 300ms and the right visual field at 1000ms, it is possible that the right visual field effect could be simply due to inhibition of return. To assess this, we examined the correlations between bias scores in each condition. Presumably, if inhibition of return is at play, we should find negative correlations between these reaction time biases. Notably, the correlations for anger, $r(29) = .152$, $p = .415$ and sadness, $r(29) = .113$, $p = .545$ are not significant and are in the opposite direction of what would be expected. Thus, inhibition of return does not appear to be driving this effect.

Discussion

The pattern of attentional biases found in Study 2 with anger and sad facial expressions mirror those found in our previous research using anger and fear expressions (Nelson & Adams, in prep). Specifically, we demonstrate that attention is biased more toward female sadness when presented in the left visual field at 300ms, whereas attention is more biased toward stereotype-inconsistent faces (i.e., female anger, male sadness) in the right visual field at 1000ms. Notably, as we have found previously, no evidence for an attentional bias toward angry male faces was found at 300ms. We will discuss this more below.

Additionally, we find evidence that stereotype expectations about expressive behavior between genders partially mediates attention to faces in the left visual field at 300ms (positively) and the right visual field at 1000ms (negatively). This not only suggests that expectations about expressive tendencies plays a role in attentional biases, but also that these biases differ depending on what visual field, and ultimately, what brain hemisphere, the processing predominantly occurs in. The left visual field is sensitive to stereotype-congruency whereas the right hemisphere is more sensitive to stereotype-incongruency. This is in line with neuroimaging research on the processing of eye gaze and emotion, where early (i.e., 300ms) processing elicits greater right amygdala activation in response to congruent combinations of signals (e.g., averted eye gaze coupled with fearful expression) while later processing elicits greater left amygdala activation in response to incongruent combinations of signals (e.g., direct eye gaze coupled with fearful expression; Adams, Franklin, et al., 2012).

Although partial mediation was found, the results were relatively weak. There were a few limitations that may have lead to this. First, the study had a relatively low sample size. This precluded us for examining gender differences in attentional bias patterns, which may be a potential source of moderation. A post-hoc power analysis revealed that this study was underpowered (power = .536), and that to get adequate power, we would have needed to run 56 participants. Thus, Study 3 was designed to address this. Additionally, it is possible that attentional biases may be more associated with implicit measures of stereotypic associations. Given the automatic nature of visual attention, it is possible that implicit measures will tap into associations that drive attentional biases based on expectations. Additionally, differences in correspondence between explicit and implicit measures can vary greatly across studies (Nosek, 2007). Thus, we went into Study 3 with these limitations in mind in order to better clarify the relationship between attention and expectations.

Study 3

In Study 2, we find evidence that stereotypes about expressive behavior partially mediate the relationship between expression and attentional biases, at least for anger and sadness, in certain conditions (i.e., right visual field at 1000ms). We followed this up with Study 3, which looks to further determine the mechanism that drives differential attention to facial expressions as a function of gender of the face. The current study builds upon Study 2 in the following ways. First, we replace sadness with fearful expressions. As seen in Study 1, fear, like sadness, demonstrates a strong discrepancy in expectations across genders. Demonstrating mediation with fear as well will provide more generalizability to our effects. Additionally, the patterns of attentional biases for sadness found in Study 2 mirror those found in previous research we have conducted (Nelson & Adams, in preparation). Next, we doubled the number of participants to achieve adequate power. Additionally, we ensured that we had an approximately equal number of males and females in order to look at potential differences across gender of participants. Finally, we now include additional potential moderators of the attentional biases, including a measure of implicit associations, which are described in the Method section below.

Method

Participants

Sixty one participants (28 females) with an average age of 18.87 (*SD* = 1.19, range 18-23) from undergraduate psychology courses were recruited to participate for course credit.

Materials

The faces used in Study 3 are the same faces that were used in Study 2, with the exception of fear expressions replacing the sad expressions.

Experience-Express Stereotypes. The same experience-express stereotype measure used in Studies 1 and 2 was used in Study 3, with the exception that the scale was now 1-7 rather than 0-100, to bring it closer in line to the other survey measures to make the betas from the mixed models more interpretable.

Single-Category IAT. The motives of agenticism and communalism, which are dictated by gender roles, likely underlie expression stereotypes. In order to capture this, we administered an implicit measure – an adapted version of the single category IAT (SC-IAT; Karpinski & Steinman, 2006). The SC-IAT is a modification of the original IAT that can measure associations with a single category. The problem with using the more established traditional IAT in the current research is that we cannot break down gender associations with traits (agenticism and communalism) separately. The IAT instead measures relative differences between two attitudes and two attitude objects (Greenwald & Farnham, 2000). Thus, we can only measure the relative extent to which males are associated with agenticism versus females are associated with communalism. We cannot, for instance, look at the relative difference between how much males and females are associated with agenticism, or how much they are associated with communalism. Given our results from Study 1 showing that, at least explicitly, there are much larger differences in how much males and females are believed to express fear, but much smaller differences in the degree to which they are believed to express anger. This is a difference that the traditional IAT cannot take into account, and it is a difference, given our hypotheses that stereotype endorsement may be driving attentional biases, that we need to be able to measure separately.

The number of correct button presses was at a ratio of 58:42, meaning that one button was correct 58% of the time (58% of trials showed either the category or the target that is assigned to the same button press) whereas 42% of trials required the alternative button press (42% of trials show the lone target). This asymmetry was designed to reduce the possibility of a response bias from occurring (see Karpinski & Steinman, 2006).

Ambivalent Sexism Inventory. Participants also completed the Ambivalent Sexism Inventory (Glick & Fiske, 1996). This inventory assesses the degree to which participants endorse two types of sexism: hostile and benevolent sexism. Hostile sexism is often what people think of when they think of sexism. In this case, women have undesirable traits and this justifies the differential treatment of them. Conversely, benevolent sexism refers to a method of sexism whereby women are perceived in a positive light (e.g., "women are wonderful"), however, there are negative ramifications of this. By looking at women with a restricted role defined by gender expectations, this limits their ability to thrive. Both subtypes are rooted in traditional views of gender, and thus, one or both of these subtypes may predict attentional biases.

State-Trait Anxiety Inventory. Participants also completed the state and trait portions of the State-Trait Anxiety Inventory (Spielberger, 1983). Much of the previous research conducted using the dot-probe methodology has done so within the realm of looking at anxiety disorders. As such, it has been demonstrated that anxiety modulates attentional biases to threatening stimuli

(Koster, Verschuere, Crombez, & Van Damme, 2005). Given we use the threatening facial expressions of anger and fear in the current study, it is possible that anxiety may moderate the attentional biases that we found, hence it is included in the current study.

Attentional Control Scale. In addition to the above mentioned measures, participants also completed the Attentional Control Scale (Derryberry & Reed, 2002). This measure was included for exploratory purposes. It measures the extent to which individuals have executive control over their attention. It is possible that individuals who have greater control over their attention may be less susceptible to demonstrating attentional biases given task instructions are to focus solely on the center of the screen and to ignore the faces being presented.

Procedure

Participants completed two sessions in the current study. During session 1, participants completed all of the surveys and the SCIAT. The order of the surveys was randomly presented, with the exception of the experience-express stereotype measure, which always came first. The single-category IAT always was completed after the survey. Approximately 1 week later, participants returned to the lab and completed the dot-probe portion of the task. This session was identical to the dot-probe session in Study 2, with the exception of the survey.

Results

As in Study 2, beta values and standard errors were computed for all models below with raw reaction times for ease of interpretation. Inferential statistics and significance were computed using logarithmic transformed reaction times to correct for normality in the distribution. Then, as before, attentional bias scores were computed by subtracting the reaction time on trials when the dot followed the female face from trials when the dot followed the male face. A bias score was computed for each laterality by expression by stimulus duration condition. The data were then submitted to a 2 (laterality: left = -0.5, right = 0.5) by 3 (emotion: -0.5 = anger, 0 = neutral, 0.5 = fear) by 2 (stimulus duration: 300ms = -0.5, 1000ms = 0.5) linear mixed model analysis with all combinations of main effects and interactions consisting of each of these factors entered as both fixed effects and random effects relative to each participants to account for the within-subjects nature of this design. Note that participant gender was originally included as a fixed factor, however, this yielded no significant effects (all *p*s > .30) and thus has been dropped from all reported analyses below.

First, there was a main effect of emotion (controlling for laterality and stimulus duration), $b = -11.58$ ms, $SE = 4.78$ ms, $F(1,59) = 8.40$, $p = .005$. An examination of the least squares means shows that significant biases are found toward female anger (relative to male anger), $b = 6.29$ ms, $SE = 3.35$ ms, $t(59) = 2.92$, $p = .005$ while fear was in the opposite direction, but nonsignificant, $b = -5.29$ ms, $SE = 3.19$ ms, $t(59) = -1.33$, $p = .189$. Controlling for emotion and laterality, there is a main effect of stimulus duration, $b = -9.64$ ms, $SE = 3.89$ ms, $F(1,59) = 7.61$, $p = .008$. An examination of the least squares means shows that, at 300ms, there is a significant bias toward female faces, $b = 5.32$ ms, $SE = 3.04$ ms, $t(59) = 2.83$, $p = .006$. There was no significant effect at 1000ms, $b = -4.32$ ms, $SE = 2.88$ ms, $t(59) = -0.90$, $p = .374$.

Controlling for stimulus duration, there was a laterality by emotion interaction, $b = -43.58$ ms, $SE = 11.96$ ms, $F(1,59) = 12.51$, $p < .001$. An examination of the least squares means shows that in the right visual field, anger is significantly biased toward female faces, $b = 20.22$ ms, $SE = 5.21$ ms, $t(59) = 3.80$, $p < .001$, while fear is significantly biased toward male faces, $b =$

-13.15 ms, *SE* = 4.41 ms, *t*(59) = -2.93, *p* = .005. There were no significant effects in the left visual field (both *p*s > .31).

Crucially, we found the predicted emotion by stimulus duration interaction (controlling for laterality), *b* = -61.90 ms, *SE* = 11.12 ms, *F*(1,59) = 36.10, *p* < .001. Attention was biased toward female faces expressing fear at 300ms, *b* = 15.00 ms, *SE* = 4.66 ms, *t*(59) = 4.32, *p* < .001, and anger at 1000ms, *b* = 16.94 ms, *SE* = 4.94 ms, *t*(59) = 4.25, *p* < .001. Attention was also biased toward male faces expressing fear at 1000ms, *b* = -25.59 ms, *SE* = 4.52 ms, *t*(59) = -6.09, *p* < .001. No significant effect was found for anger at 300ms (*p* < .66).

Finally, as expected, the three-way interaction was significant, *b* = -51.74 ms, *SE* = 19.81 ms, *F*(1,59) = 18.45, *p* < .001 (see Figure 8). In the left visual field, the only bias to reach significance was found toward female faces expressing fear at 300ms, *b* = 16.49 ms, *SE* = 6.86 ms, *t*(59) = 3.06, *p* = .003. At 1000ms, fear trended toward male faces, but was nonsignificant, *b* = -11.37 ms, *SE* = 6.93 ms, *t*(59) = -1.61, *p* = .112 (all other left visual field *p*s > .67). In the right visual field, there were biases toward females expressing fear at 300ms, *b* =13.51 ms, *SE* = 6.03 ms, *t*(59) = 3.07, *p* = .003, and anger at 1000ms, *b* = 37.44 ms, *SE* = 6.62 ms, *t*(59) = 5.80, *p* < .001. For males, there was a significant bias for fearful faces at 1000ms, *b* = -39.82 ms, *SE* = 6.32 ms, *t*(59) = -7.18, *p* < .001. No significant bias was found for anger at 300ms (*p* < .81).

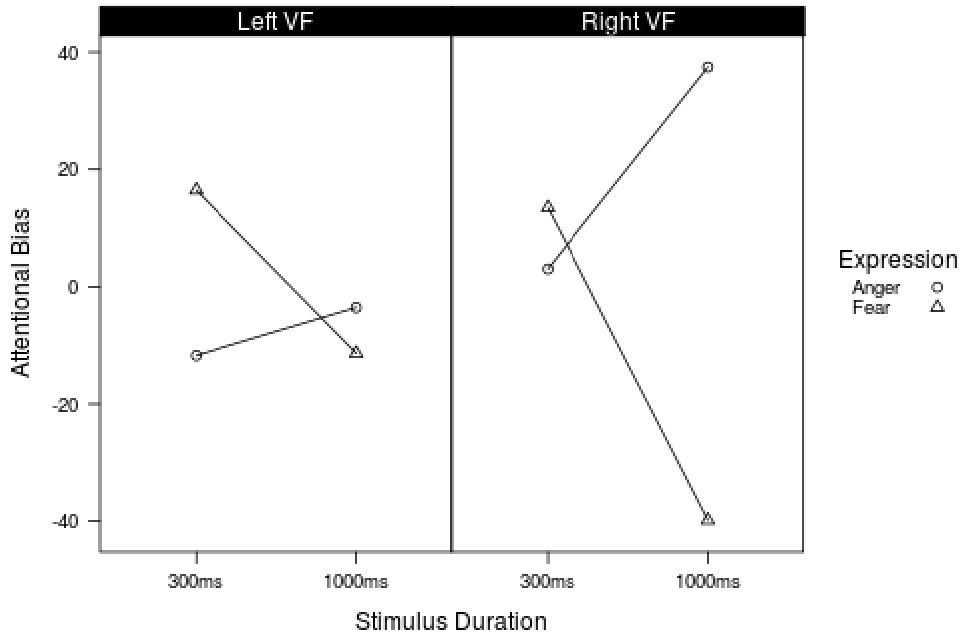

Figure 8. Attentional biases to anger and fear faces (Study 3). VF = visual field. Positive values = female bias, negative values = male bias.

Mediation

Explicit Stereotype. As in Study 2, we followed up these analyses with mediation analyses. First, we examined expressive stereotype endorsement as a mediator. As before, mediation was examined for each combination of laterality and stimulus duration combination. Like Study 2, we find evidence of mediation in the right visual field at 1000ms. First, attentional biases differ as a function of the emotion, b = -77.26 ms, SE = 9.98 ms, F(1,59) = 61.13, $p < .001$. Next, the explicit stereotype differs as function of emotion, b = -4.17, SE = 0.31, F(1,59) = 178.49, $p <$ .001. Then, the explicit stereotype, controlling for the emotion being presented, significantly predicts attentional biases, b = 5.23, SE = 2.69, F(1,168.74) = 12.27, $p < .001$. Finally, controlling for the stereotype, attentional biases still differ as a function of expression, albeit less so, $b = -55.48$ ms, $SE = 14.93$ ms, $F(1,114.16) = 8.12$, $p = .005$. Finally, to confirm that the mediation is significant, bootstrapping analyses were computed (5000 repetitions). The indirect effect was significant, $b = -21.80$ [95% CI: -51.43, -0.30], indicating that the expressive stereotype partially mediates attentional biases to expressive faces.

Implicit Stereotype. We computed D scores on the single-category IAT by subtracting reaction times on female trials from those on male trials and dividing by their pooled standard deviation (see Karpinski & Steinman, 2006) for agentic traits and communal traits separately. As computed, negative values indicate a stronger association with males whereas a positive bias indicates a stronger association with females. A series of one-sample *t*-tests revealed that participants showed strong associations between males and agenticism, $t(59) = -7.61$, $p < .001$, which was expected. Interestingly, participants also showed strong associations between males and communalism, $t(59) = -6.78$, $p < .001$. A direct comparison between the two revealed that participants marginally showed a stronger association between males and agenticism than males and communalism, $t(59) = 1.68$, $p = .099$.

Despite the SCIAT not demonstrating the predicted association between females and communalism, we went ahead and examined the SCIAT measures both as mediators and as moderators. Notably, no evidence of mediation was found, nor did it moderate our 3-way interaction, $p > .48$. Given that the SCIAT seemingly failed to work, we encourage future research to utilize an alternative measure of implicit bias.

Moderation

In addition to the analyses above, we examined the role that different moderators may play in these attentional biases. All individual difference measures outlined below were mean centered (with the exception of the expressive behavior stereotype, which is a bias score of male minus female) and entered into linear mixed model analyses with laterality, expression, and stimulus duration, and all possible interactions between these were entered as fixed variables as well as all main effects and interactions resulting from all combinations of laterality, expression, and stimulus duration as random effects relative to the participant.

Expressive Behavior Stereotype. In addition to examining expressive behavior stereotypes as a mediator, we also entered it into the laterality by expression by stimulus duration linear mixed model as a moderator of the effect. The resulting 4-way interaction was significant, $b =$ -13.21ms, $SE =$ 11.65ms, $F(1,113) = 6.12$, $p = .015$. In order to understand the interaction, we first broke the interaction down by expression and ran two separate linear mixed model analyses. While no effects emerged for fear, $p > .90$, anger demonstrated the three-way interaction, $b =$ -17.27ms, $SE =$ 7.88ms, $F(1,58) = 9.72$, $p = .003$ (see Figure 9). The only bias that differed from zero was found for those who believed men express more anger than women (1 SD) in the right visual field at 1000ms, with a bias toward female anger, $b =$ 28.53ms, $SE =$ 7.77ms, $t(87) = 5.76$, $p < .001$.

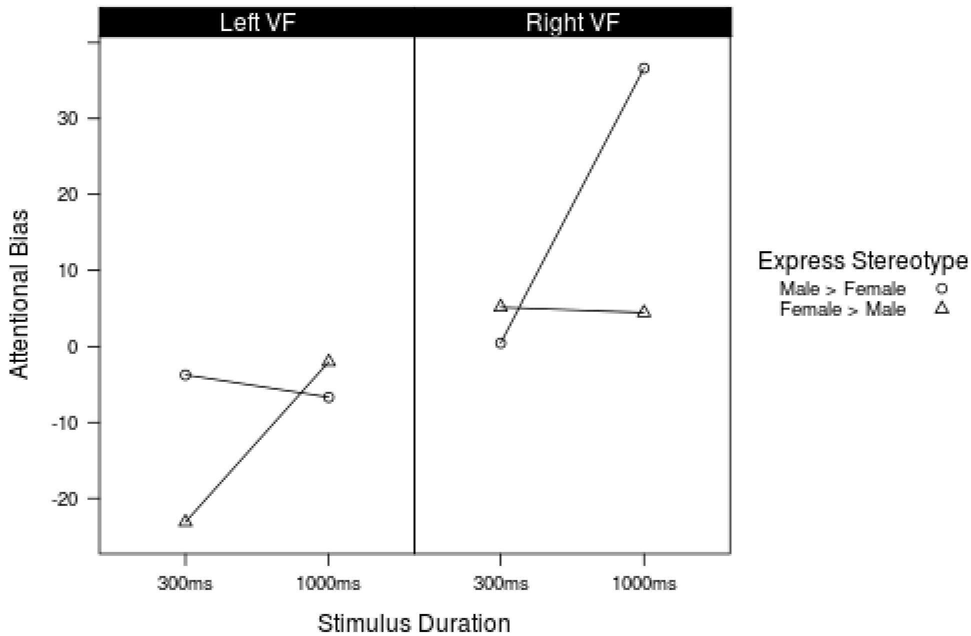

Figure 9. Attentional biases to anger faces (Study 3) as a function of expressive stereotype endorsement. VF = visual field. Positive values = female bias, negative values = male bias. Notably, only the Male > Female condition in the right visual field at 1000ms was significantly different from 0.

Benevolent Sexism. We looked to see if levels of benevolent sexism moderated our effects. Thus, the overall index of benevolent sexism was computed from the ASI and plugged into our original model. Benevolent sexism (controlling for laterality) significantly interacted with emotion and stimulus duration, b = -27.43 ms, SE = 13.08 ms, F(1,58) = 5.28, p = .025 (see Figure 10). Relative to those who are low in benevolent sexism (-1 SD), those high in benevolent sexism (+1 SD) demonstrate stronger biases toward male anger than female anger at 300ms, albeit nonsignificantly, b = -13.46 ms, SE = 9.42 ms, t(58) = -1.55, p = .127. Additionally, they show a stronger bias toward female relative to male anger at 1000ms, b = 15.07 ms, SE = 9.76

ms, $t(58) = 1.70$, $p = .095$. For fear, those higher in benevolent sexism showed a stronger bias toward female faces at 300ms, $b = 13.37$ ms, $SE = 9.23$ ms, $t(58) = 1.69$, $p = .097$. There were no differences found at 1000ms ($p > .63$). Interestingly, this interaction was not moderated by laterality ($p > .86$).

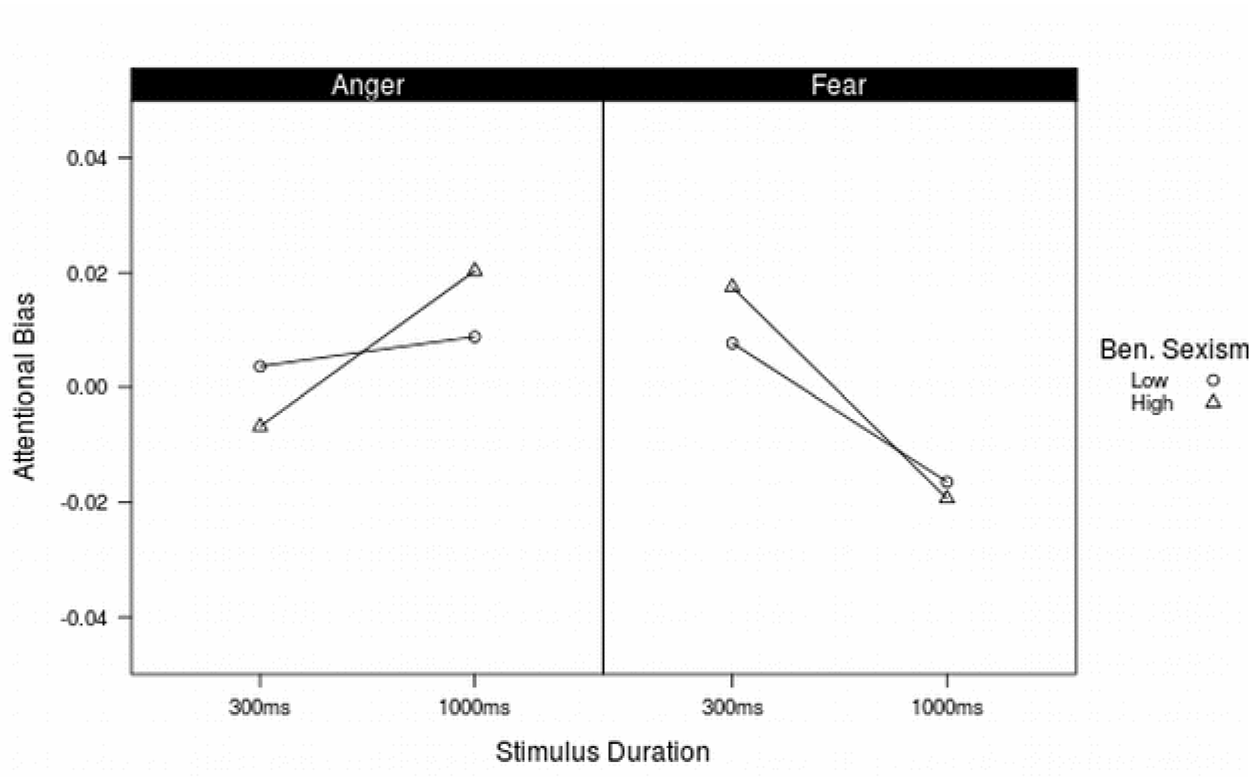

Figure 10. Attentional biases to anger and fear faces as a function of level of Benevolent Sexism endorsed by participants. Positive values = female bias, negative values = male bias.

Other individual differences. Hostile sexism ($p > .40$), trait anxiety ($p > .48$), state anxiety ($p > .30$), and attentional control ($p > .91$) did not moderate the 3-way interaction.

Inhibition of Return

Like Study 2, we wanted to confirm that inhibition of return could not explain the pattern of attentional biases found as we move from the left visual field at 300ms to the right visual field at 1000ms. As before, no significant correlations were found (anger: $r(59) = .024$, $p = .853$; fear: $r(59) = -.081$, $p = .536$), suggesting that inhibition of return cannot account for the attentional biases found at 1000ms.

Discussion

The results of Study 3 are in line with the results of Study 2 in finding partial mediation for attentional biases to facial expressions across time as a function of gender of the face. Specifically, the degree to which individuals believe men and women differentially express anger and fear predicts the extent to which attention is biased toward these faces. Interestingly, as in Study 2, we find evidence for mediation when the face is presented for 1000ms in the right visual field.

With anger/sadness, and now anger/fear, we have shown that expectations about expressive behavior partially drives the pattern of attentional biases we have found. Only one laterality by stimulus duration condition produced this effect across both studies: the right visual field at 1000ms. In this condition, expectations of expressive behavior negatively predicts attentional biases, meaning faces that were least expected elicited larger attentional biases. Additionally, stereotype expectations about anger expressive behavior moderates attentional biases to anger expressions. In particular, individuals who believe men express more anger than women demonstrate a larger attentional bias toward angry female faces in the right visual field at 1000ms.

In addition to stereotypes about expectations of expressive behavior, the level of benevolent sexism endorsed by participants moderates the expression by stimulus duration interaction. Benevolent sexism is a form of sexism that may often be experienced as positive, as it generally promotes positive stereotypes about women as caring and prosocial. However, it perpetuates the dominant role of masculinity in society by viewing women as fragile individuals that need to be taken care of (Glick & Fiske, 1996). These views are steeped in traditional views of the roles that men and women should play in society. As such, it is not surprising that benevolent sexism increases the attentional biases found in the current study. Individuals high in benevolent sexism should see anger on a female face and fear on a male face as especially incongruent given these are at odds with the traditional roles of women as communal and men as agentic (Fiske, Cuddy, & Glick, 2007; Rudman & Kilianski, 2000).

Interestingly, the single-category IAT did not seemingly work as it demonstrated a fairly large effect suggesting that males are both more agentic and more communal than females, despite a vast literature suggesting that women are seen as more communal than men. Given the single-category IAT was always completed after the surveys, it is possible that the task order impacted the outcome. Future research should take this into consideration when designing future studies and/or examine other forms of implicit associations given that these should theoretically be more tied to attentional biases, which presumably reflect more implicit biases given they begin to occur before conscious awareness takes place.

Study 4

In order to draw links between stereotypes and attention to downstream processes, a critical point of examination is to look at the role that attentional biases play in subsequent memory for male and female faces that are expressing either anger or fear. In particular, we are looking to see if faces that receive more attentional biases later in processing (stereotype-inconsistent; male fear, female anger) will be remembered better than those faces that will receive early attentional biases (stereotype-consistent; female fear), due to the additional processing resources that will be applied to such faces (Sherman et al., 2012, 1998). Expecting better memory for stereotype incongruent faces may seem puzzling at first from a stereotyping perspective (but see Strange and Dolan, 2006 for evidence linking amygdala activation and memory for unexpected events), especially since we have collected data showing that memory for fear faces is greater for 1) averted relative to direct gaze, and 2) female relative to male faces (hence showing a congruity effect), but we will explain below.

This study will consist of assigning participants to one of two attentional timing conditions: 300ms or 1000ms. Stimuli would consist of 96 faces of individuals randomly created using FaceGen Modeller (Singular Inversions, Inc.). Of these faces, 48 would be used during the dot-probe task, whereas 48 would be used as foils for the memory task. We will counterbalance whether the stimuli are used during the dot-probe (encoding) or retrieval, and whether they are displaying gender stereotypic or gender non-stereotypic facial expressions. The dot-probe will consist of 192 trials. There will be 12 faces in each of the following cells: expression (2: anger/fear) and face gender (2: male/female), with each trial being repeated 8 times (4 times on each side). The repeated presentations of the same faces has been used in other studies examining dot-probe and memory (LeMoult & Joormann, 2010) and allows us greater reliability on the dot-probe than single presentations of each face while establishing a number of previously seen faces for the memory task that approximates previous face memory research (e.g., Hugenberg, Miller, & Claypool, 2007).

For the memory task, participants would be shown 96 neutrally-expressive faces, a random subset of 48 individuals that were shown during the dot-probe, and 48 new individuals (foils). Using neutral faces at retrieval prevents template matching, which can occur when the exact same faces are used at encoding and retrieval. This can lead to memory effects based on peculiarities in the image rather than remembering the identity (see Bruce, 1982).

Participants responded using a remember-know-new paradigm (Tulving, 1985; Yonelinas, 2002). Participants indicated if they 1) definitely remember seeing the face before (R response), 2) think they may have seen the face before, but do not remember the exact context (i.e., familiarity; K response), or 3) do not remember seeing the face before (N response). Using this paradigm allows us to get differentially at levels of encoding. In our previous research, we used a yes-no paradigm that would conflate R responses with K responses. As such, congruent cues (averted fear; female fear) would appear to be remembered better, however, whether they are remembered with less encoding detail cannot be ascertained. Our current design allows for this distinction.

For R responses, we expected to find better memory for incongruent relative to congruent cues, but only in the 1000ms condition. Because attention has an opportunity to fixate longer on these faces, more details about them will be encoded. For K responses, we expect to find better memory for congruent relative to incongruent pairings across both timing conditions. These are faces that will initially be attended to, encoded and processed to the extent that they fit the current stereotype, and then attentional resources are shifted toward incongruent stimuli, hence preventing a deep encoding of the contextual cues of a face.

If hypotheses are supported, this could lay the groundwork for an explanation of how attention and memory interact to influence how stereotypes are stored and maintained. For instance, if male faces that express fear are recollected (i.e., memory of the identity and expression they were displaying), this could lead to subtyping (Kunda & Oleson, 1995), where individuals who defy stereotypes are re-categorized into a subgroup that can have this new stereotype attributed to it while maintaining the overall group stereotype. However, if a female is expressing fear, thus confirming the stereotype, this face will be attended to early in attention but will quickly be disengaged from. Because of this, the face may not be encoded deeply. If this is the case, contextual cues (such as expression) will be lost, which should be reflected in more familiar responses for these faces. As such, biases from stereotypes may be able to sway the more fragile memory from stereotype expectations.

Method

Participants

Eighty participants from undergraduate psychology courses participated for course credit. Ultimately, 3 participants were dropped for having attentional biases that were beyond 2.5 times the median absolute deviation (see Leys, Ley, Klein, Bernard, & Licata, 2013 for justification of this criteria). An additional 4 participants were dropped for having extremely low hit rates on the memory portion of the study (all < 8%). This left us with 36 females and 37 males, with a mean age of 18.9 years (*SD* = 1.27; range 18-24).

Materials

Faces from a total of 80 avatar individuals (40 females, 40 males) were created using FaceGen Modeller software (Singular Inversions, Inc.). For each face, a neutrally-expressive avatar was randomly created, and from this face, two additional faces were created: one displaying a full anger expression, and one displaying a full fear expression. Each face was cropped with an oval mask so that only the face appeared.

Design and Procedure

Participants first completed a dot-probe task. In this task, each trial began with a fixation cross in the middle of the monitor that appeared for 1000ms, followed by the presentation of two faces, one female face and one male face, matched for expression (i.e., either angry or fearful) for either 300ms or 1000ms (between-subjects). After this, one or two dots appeared in one of the locations a face previously occupied. Via mouse click, participants indicated whether they saw one or two dots. Accuracy and reaction times were recorded for these responses.

The dot-probe consisted of 160 trials total. This included 40 unique faces (20 females), each of which was repeated 8 times across the course of the experiment. Each face identity was shown with one facial expression, either anger or fear, across all of the trials.

After the dot-probe was completed, participants completed a filler task for 5 minutes which consisted of labeling the states on a map of the United States. After this, participants received a surprise memory recognition task. In this, each identity shown in the dot-probe (40 faces) along with 40 new foils, were shown to each participant. All faces were displayed with neutral expressions for this task. Participants were asked “Do you remember seeing this face before?” Via keyboard response, participants had to indicate whether they 1) *Definitely saw*, 2) *Maybe saw*, or 3) *Did not see* the face before.

Upon completion of the memory portion, participants completed several surveys. First, participants filled out the experience/express measure from the previous studies. Participants also completed the Masculine Gender Role Stress scale (Eisler & Skidmore, 1987) and the Feminine Gender Role Stress scale (Gillespie & Eisler, 1992) in order to examine whether participants who may feel threatened by violations of gender roles would demonstrate different patterns of attentional biases and memory biases. However these measures did not moderate our results and therefore are not discussed any further. At the very end, participants completed a manipulation check to ensure that they were able to identify the gender of the faces appropriately. Because gender categorization was potentially more difficult to do given gender-congruent hairstyles were not included, we included this manipulation check to ensure that participants could categorize each face accurately.

Results

First, the manipulation check revealed that participants were accurate overall in identifying the gender of the faces (92.4%). The data were cleaned by dropping dot-probe and memory recognition trials that included faces that the participant was not able to identify the gender of correctly.

Dot-Probe

First, the laterality by expression by stimulus duration interaction found in the previous two studies was not found in this study ($p > .25$). Additionally, no other effects reached significance. It is important to note that this dot-probe differed from the previous iterations in some critical ways. First, the stimulus duration was included as a between-subjects variable, while the previous studies included it as within-subjects. Although many studies use stimulus onset asynchrony (SOA) as a method of teasing apart early versus late attentional processes, SOA also serves the purpose of making the onset of a stimulus difficult to predict. Without this, participants can anticipate when stimuli will appear, and thus may engage in strategies that inhibit visual orienting (e.g., by maintaining attention toward the central fixation).

Additionally, while the previous studies used stimuli that were controlled for visual appearance cues (i.e., FaceGen generated faces), the current study presented 40 different individuals, which vary naturally in appearance. This likely adds a lot of noise to the attentional biases as factors such as attractiveness, unique facial appearance, and dominance can impact attention. As such, it is not entirely unsurprising that this dot-probe does not match previous results. With that said, given the role that attention plays in memory, any attentional bias differences found on the individual level should still predict subsequent memory for faces. These analyses will be presented below.

Memory

The hit rates (i.e., memory accuracy) for each gender by expression condition are presented in Table 5. These data were submitted to a 2 (stimulus duration – 300/1000ms) by 2 (expression – anger/fear) by 2 (face gender – male/female) mixed factorial ANOVA. The only effect that reaches significance is a main effect of expression, $F(1,70) = 13.35$, $p < .001$, $\eta^2_p = .160$, with better overall memory for fearful faces than angry faces . No other effects approach significance (all *p*s < .15).

	300 ms		1000 ms	
	Male	Female	Male	Female
Anger	.646***	.635**	.581#	.560
Fear	.715***	.683***	.640***	.595*
False Alarms	.624**	.619**	.596*	.528

Table 5: Memory hit rates for each condition. Significance determined by one-sample t-tests versus chance performance (0.5). *** = p < .001; ** = p < .01; * = p <.05; # = p < .10

As noted from the data, the rate of false alarms was nearly as high as that of hits, suggesting that participants had poor memory performance overall. In order to assess memory sensitivity, we chose the nonparametric *A′* index of sensitivity over the more commonly used *d′*. *A′* is on a scale of 0-1, which allows all positive values to compute male-female bias scores in memory that mirror the biases computed for the dot-probe. A 2 (stimulus duration) by 2 (expression) by 2 (face gender) mixed factorial ANOVA, like the hit rates, yielded only a main effect of expression, $F(1,70) = 10.62$, $p = .002$, $\eta^2_p = .132$, with better memory overall for fear faces relative to anger faces. Table 6 shows the *A′* values for each condition, with significance determined as one-sample t-tests against chance level of memory (*A′* = 0.5).

	300ms		1000ms	
	Male	Female	Male	Female
Anger	.525	.519	.486	.559#
Fear	.630***	.582**	.542#	.560#

Table 6: *A′* sensitivity rates for each condition. Significance determined by one-sample *t*-tests versus chance performance (0.5). *** = p < .001; ** = p < .01; * = p <.05; # = p < .10

To prepare the *A′* data for the linear mixed model analyses, bias scores were computed as they have been with the dot-probe and stereotype data (male – female). Next, a linear mixed model analysis was conducted with expression (-0.5 = anger, 0.5 = fear), stimulus duration (-0.5 = 300ms, 0.5 = 1000ms), hit type (-0.5 = K-hit A', 0.5 = R-hit A'), and all combinations of their interactions as fixed factors and expression along with hit type, as well as their interaction, as random effects relative to each participant. Once again, participant gender was initially entered into the model but yielded no significant effects and was therefore dropped.

First, there was a marginal interaction between hit type and stimulus duration (controlling for expression), $b = -.126$, $SE = .071$, $F(1,73) = 3.13$, $p = .081$. While no significant differences emerged for R hit sensitivity ($p > .36$), K hit sensitivity was biased toward male faces at 300ms and female faces at 1000ms, $b = -.088$, $SE = .041$, $t(120) = -2.12$, $p = .036$. This interaction was qualified by a marginal three-way interaction between expression, hit type, and stimulus duration, $b = -.190$, $SE = .103$, $F(1,73) = 3.41$, $p = .069$. For K hits, participants demonstrated greater sensitivity for male fear relative to female fear at 300ms, $b = -.068$, $SE = .035$, $t(88) = -1.95$, $p = .055$, and greater sensitivity for female fear relative to male fear at 1000ms, $b = .063$, $SE = .036$, $t(87) = 1.78$, $p = .079$. For R hits, memory for male fear was more sensitive than memory for female fear at 1000ms, $b = -.064$, $SE = .035$, $t(88) = -1.81$, $p = .073$. No effects emerged for R hits at 300ms (ps > .47), and no effects emerged for anger across all conditions (ps > .39).

Dot-Probe and Memory Combined

The following factors were entered into a linear mixed model as fixed effects: expression (-0.5 = anger; 0.5 = fear), hit type (HT; -0.5 = familiar; 0.5 = recollect), attentional bias (AB; negative values = male bias; positive values = female bias), and stimulus duration (-0.5 = 300ms; 0.5 = 1000ms). Note that participant sex was originally entered in as a fixed factor, but it did not moderate any of our effects of interest, thus it has been dropped from all reported analyses. Because expression and hit type were within-subjects factors, both main effects and their interaction were entered into the model as random effects relative to each participant.

First, the expression by hit type by stimulus duration interaction found previously was strengthened after controlling for AB, $b = -.305$, $SE = .116$, $F(1,76) = 6.80$, $p = .011$. Critically, this interaction was qualified by a marginal four way interaction with AB, $b = .011$, $SE = .006$, $F(1,125) = 3.42$, $p = .067$. To explicate the interaction, we broke it down by stimulus duration and computed two separate three way interactions. At 300ms, no effects were significant, however an expression by AB interaction (controlling for hit type) approached marginal significance, $b = .002$, $SE = .001$, $F(1,72) = 2.54$, $p = .115$. Participants seemed to remember fearful faces that they were paying more attention to, whereas they tended to remember angry faces that they were not paying attention to. However, none of these simple effects approached significance, (ps > .26).

At 1000ms, the only effect that emerged as significant was an interaction between expression and hit type (controlling for AB), $b = -.197$, $SE = .091$, $F(1,40) = 4.57$, $p = .039$. For fear, K hit sensitivity was greater for female faces relative to male faces, $b = .074$, $SE = .036$, $t(33) = 2.05$, $p = .049$, and R hit sensitivity was greater for male relative to female faces, $b = -.079$, $SE = .037$, $t(34) = -2.13$, $p = .041$. No effects emerged for anger (ps > .90).

Explicit Stereotypes and Memory Combined

To determine whether memory for faces is moderated by the explicit expectations of how women and men differentially express emotions independently of AB, separate linear mixed models were computed, this time with AB replaced with the explicit stereotype bias score (negative values = belief that men express more, positive values = belief that women express more). Notably, the median bias score for the anger expression stereotype endorsement was exactly 0. Thus, participants were nearly identically split between saying that men and women express anger more. Because the range for stereotype endorsement of anger (i.e., mean bias = -0.33, SD = 1.47) was not restricted to one gender, but fear however was strongly biased toward women expressing more (mean bias = 3.54, SD = 1.44), we computed separate models for each emotion. Fear ultimately did not produce any significant results, so the focus of the following analyses is on anger.

For anger, controlling for stimulus duration, there was a hit type by stereotype endorsement interaction, $b = -.076$, $SE = .031$, $F(1,63.8) = 5.95$, $p = .018$ (see Figure 11). Examination of the least squares means suggests that for participants who indicate that men express more anger than women (-1 SD), they demonstrate greater K hit sensitivity for expected faces (i.e., male faces expressing anger) relative to unexpected faces (i.e., female anger), $b = -.101$, $SE = .051$, $t(126) = -2.00$, $p = .047$, and more R hit sensitivity for unexpected faces (i.e., female anger) relative to expected faces (i.e., male anger), albeit non-significantly, $b = .068$, $SE = .051$, $t(127) = 1.33$, $p = .188$. For participants who indicated that women express more anger than men (+1 SD), they demonstrate the opposite pattern of findings, with greater K hit sensitivity for female anger relative to male anger, $b = .115$, $SE = .057$, $t(116) = 2.03$, $p = .044$. As before, the R hit sensitivity effect was in the opposite direction as the K hit sensitivity effect, albeit nonsignificantly, $b = -.081$, $SE = .058$, $t(117) = -1.42$, $p = .160$.

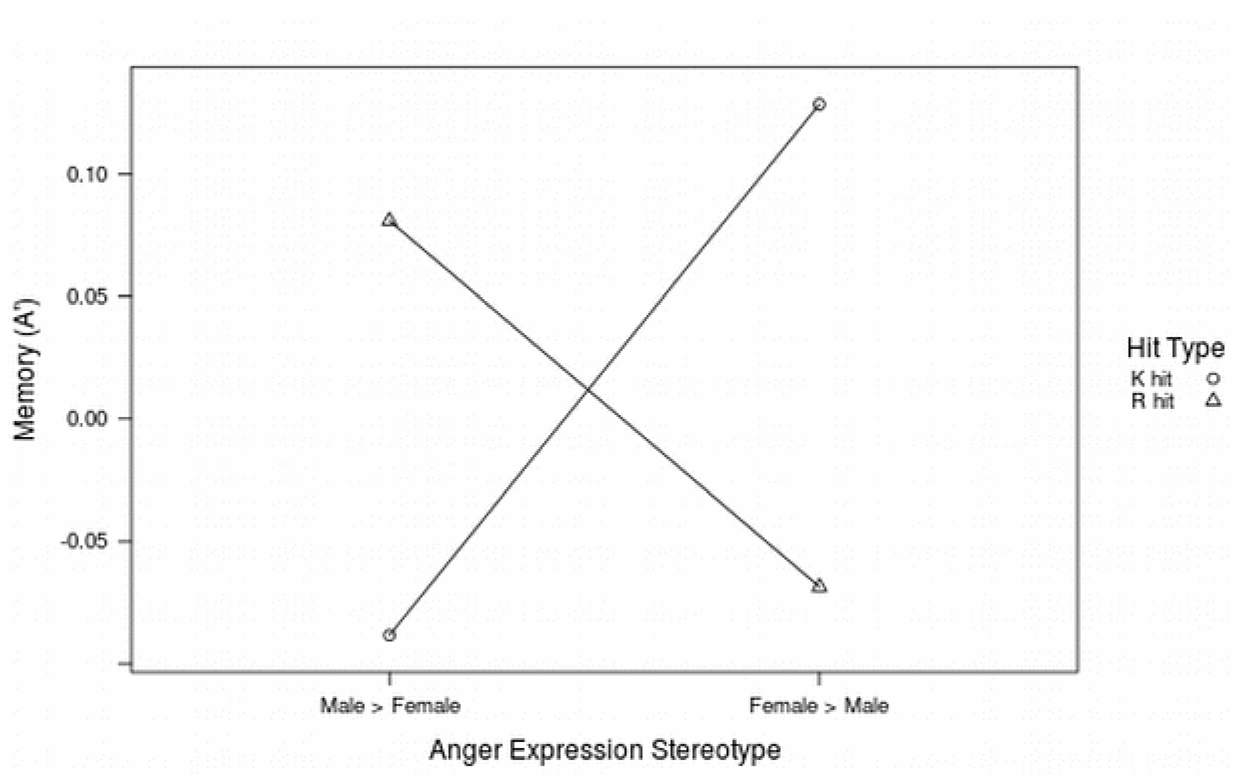

Figure 11. Memory for angry faces as a function of gender expression stereotype endorsement and hit type. Negative A' values indicate that male faces were remembered better than female faces and vice versa for positive values.

The interaction between hit type and stereotype endorsement for anger was subsumed by a marginal three-way interaction with stimulus duration, $b = -.116$, $SE = .062$, $F(1,64) = 3.50$, $p = .066$ (see Figure 12). While no effects at 300ms approached significance (all *p*s > .33), all of the simple effects at 1000ms were either significant or marginally significant (male > female: greater K hit sensitivity for male relative to female anger, $b = -.145$, $SE = .082$, $t(127) = -1.76$, $p = .081$, and greater R hit sensitivity for female relative to male anger, $b = .148$, $SE = .084$, $t(128) = 1.77$, $p = .080$; female > male: greater K hit sensitivity for female relative to male anger, $b = .092$, *SE*

= .087, *t*(126) = 2.19, *p* = .030, and greater R hit sensitivity for male relative to female anger, *b* = -.166, *SE* = .089, *t*(127) = -1.87, *p* = .065).

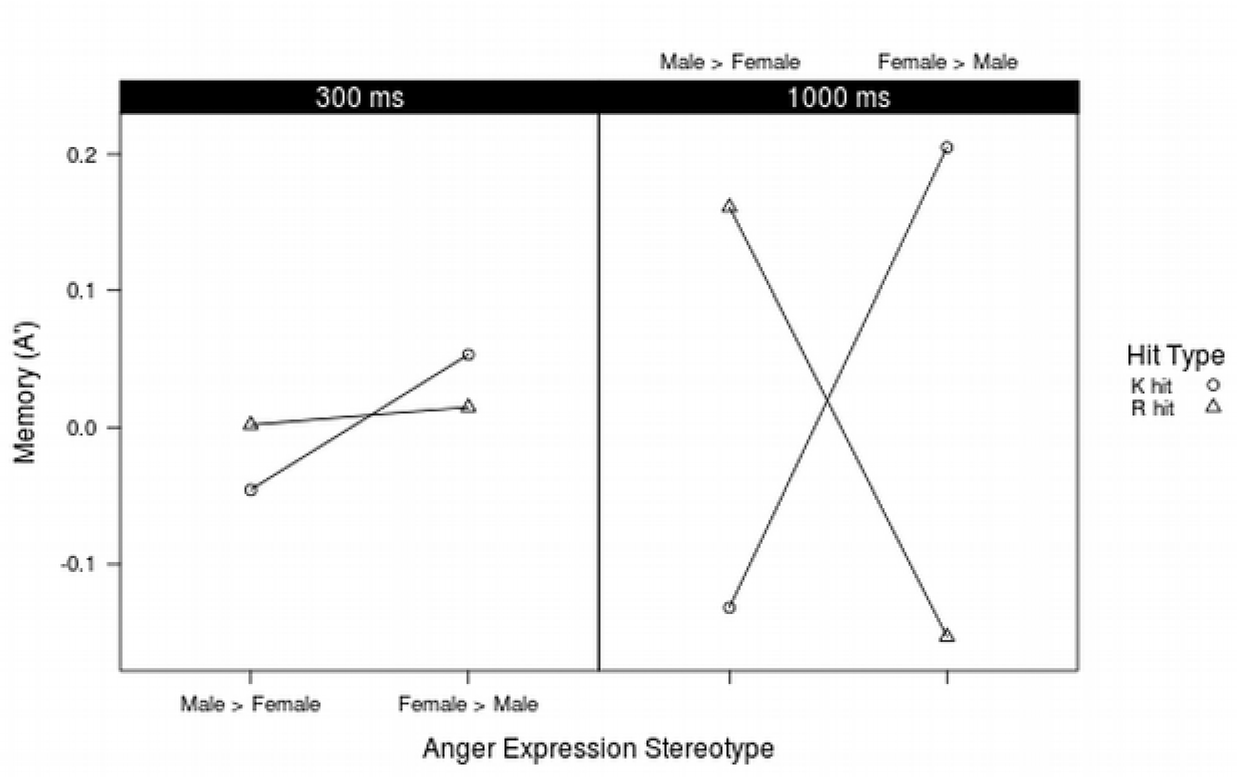

Figure 12. Memory for angry faces as a function of stimulus duration, gender expression stereotype endorsement, and hit type. Negative A' values indicate that male faces were remembered better than female faces and vice versa for positive values.

Mediation

Next, we examined the extent to which attentional biases may mediate the relationship between express stereotypes and face memory. We examined the four steps of mediation, as outlined by Baron and Kenny (1986) and utilized in Studies 2 and 3. For the current study, we examined eight separate mediation analyses, one for anger and one for fear for each of the following: 1) familiar (K) hits at 300ms, 2) remember (R) hits at 300ms, 3) K hits at 1000ms, and 4) R hits at 1000ms. None of these analyses yielded significant results, which is unsurprising given we found minimal evidence of AB being associated with subsequent memory of faces.

Discussion

The results of Study 4 suggest that stereotypes play a role in memory for expressive faces as a function of gender. For fearful expressions, R hit memory was greater for male faces in the 1000ms stimulus duration condition, whereas no effects emerged at 300ms. Effects for anger, on the other hand, appear to be moderated by levels of stereotype endorsement. Participants that believe men express more anger than women demonstrate better R hit sensitivity to female faces expressing anger, whereas they demonstrate better K hit sensitivity to male faces expressing anger. The reverse pattern is found for participants who believe women express more anger than men.

It is interesting that stereotype endorsement appears to be more related to anger than fear in the current study. One likely explanation for this may be a restricted range for beliefs about expressing fear. While participants showed a relatively even split in terms of their expectations of the expression of anger (median bias score = 0), no participants indicated that they expected men to express more fear than women. As stated previously, stereotypes for women have been changing in recent years while stereotypes for men remain unchanged (Diekman & Eagly, 2000). Thus, although women are restricted in their expressions of anger and power-oriented emotions depending on the context (Rudman & Glick, 2001; Rudman & Phelan, 2008), men are universally not allowed to express fear, an expression of weakness.

Attentional biases in the current study did not yield strong evidence of an association with subsequent memory. If anything, controlling for attentional biases seemed to help clean up the results. Although this is the case, the overall pattern of memory effects nicely parallels those found in the dot-probes of the previous studies. This is true for R hits, while K hits tended to be biased toward stereotype-consistent faces. The only effect that did not follow this pattern was fear at 300ms, which demonstrated greater K hit sensitivity toward male fear. It is possible that due to the fast nature of the stimulus presentations, participants adjusted their cognitive resources to deal with the restricted visual information. According to the encoding flexibility model (Sherman et al., 2004, 1998), when resources are limited, individuals will allocate more cognitive resources toward stereotype-inconsistent cues in an effort to maximize the limited resources they have available. Given that one stimulus duration was given to these participants, this strategy would not be disrupted by a failure to anticipate the onset of the stimuli.

Previous research conducted in our lab (Adams et al., in preparation) examining the impact of intersectionality in social visual cues found evidence that memory is enhanced for faces demonstrating congruent cues of eye gaze and emotion (i.e., averted eye gaze coupled with fear). One key difference between this study and the current study is the method of retrieval used. In the previous study, participants were simply asked to make an old/new distinction, whereas we find differences as a function of the hit type indicated. Future research looking at face memory should break down retrieval hits as either R or K because these serve distinctive forms of memory which each have different potential ramifications for person perception (i.e., categorization versus individuation).

Overall, the pattern of attentional biases demonstrated much weaker effects than previous studies. There are a few potential explanations for this. Most dot-probe studies use a limited number of highly-controlled stimuli. The faces used in the current study were allowed to vary naturally. As we know from Studies 2 and 3, controlling facial appearance leads to clear attentional bias patterns that replicate our previous findings (Nelson & Adams, in preparation). Additionally, participants were assigned to either the 300ms or 1000ms stimulus duration condition, which makes the ability to predict when faces will appear much easier. We cannot rule out strategic influences as a result of anticipating when a stimulus will appear. Also, laterality was not included as a factor in the memory portion of the study. Faces were presented multiple times on both the left and the right sides during the dot-probe task. This was a trade-off made in order to limit the number of stimuli participants would be exposed to while maintaining enough stimuli per condition.

Previous attempts to link dot-probe attentional biases with subsequent memory have yielded mixed results (Beck, Stanley, Averill, Baldwin, & Deagle III, 1992; LeMoult & Joormann, 2010; Watts & Weems, 2006). Unfortunately, our study does not do much to clarify this literature. In our current study, while far from clear, the evidence suggests that differences are found as a function of hit type. It is possible that failure to differentiate between R hits and K hits has led to researchers failing to find consistent links between attention and memory. The RKN paradigm was introduced by Tulving (1985) to differentiate between memory events where specific details are recollected versus those of familiarity, where the specifics are not recalled but the individual believes she/he has encountered the stimulus before. Indeed, some research has shown that disrupting attention impacts R hits while having no impact on K hits (Parkin, Gardiner, & Rosser, 1995), thus future research should continue to utilize the RKN paradigm.

Remember responses are more associated with perceptual memory (i.e., the visual features of a stimulus) whereas familiarity has been associated with semantic memory (i.e., memory for the meaning of a stimulus; Yonelinas, 2002). Thus, it is possible that the memory for stereotype-incongruent faces is more perceptual than semantic. This is interesting in that a recipe for individuation is created, whereby individuals can remember the perceptual features of the stimulus without addressing the semantic mismatching. Because the stimulus is not being processed semantically, the stereotype does not receive a challenge, hence it can be maintained. Because attention and memory are theorized to be highly linked (Chun & Turk-Browne, 2007), researchers should continue to focus on differences in hit types as these seem to be differentially influenced by attention.

Chapter 3: GENERAL DISCUSSION

Across four studies, we have begun to elucidate the role that gender stereotypes of emotional behavior has on attentional biases to, and subsequent memory of, faces. Gender stereotypes about emotionality are highly pervasive in our culture (Shields, 2002). As such, it is not surprising that we find lower-level cognitive outcomes that arise from these higher-level patterns. Within one second of processing, we are already processing stimuli much differently depending on whether they fit with our expectations or not.

As we see in Study 1, beliefs about emotional behavior in men and women differ, with women expected to experience and express more emotion than men, with the notable exception of anger, a power-oriented emotion. The pattern of findings matches previous research (Fabes & Martin, 1991), and the differences are particularly pronounced for fear and sadness, both expressions that convey weakness (Knutson, 1996; Tiedens, 2001). This is in line with research suggesting that stereotypes are changing for women, whom are being seen as more agentic, but not for men, who are still not allowed to show signs of weakness (Diekman & Eagly, 2000). Studies 2 and 3 demonstrate that the larger discrepancy between expectations of sadness and fear between women and men is also found in attentional biases as a function of 1) the timing and 2) the visual field of presentation. Sadness (Study 2) and fear (Study 3) elicit attentional biases toward female relative to male faces in the left visual field when the stimuli are presented for 300ms. By 1000ms, this flips toward a bias toward male faces in the right visual field. For anger (Studies 2 and 3), while no significant attentional biases were found at 300ms, biases at 1000ms, primarily in the right visual field, were toward female relative to male faces.

Gender stereotypes in the current study provide a contextual cue by which to understand how face processing works. By varying the signal value of facial expressions with gender cues, the pattern of findings in the current dissertation fit into a broader examination of the role that social cues in the face contextualize one another. That is, the perception of cues on the face is not done in isolation, but rather, the meaning of one cue is influenced by other cues in the face. Facial expressions, such as anger and fear, are both outward displays of basic threat-related emotions. Although processing of emotions such as these is presumed to be hardwired and conducted at very crude, "low road" areas of processing, we see from the current research that social cues such as gender modulate visual attention to and memory of these faces.

The findings presented here help clarify discrepancies in the literature on attention to stereotypes that have been demonstrated by past research (Sherman et al., 2012). A key factor that must be taken into consideration is the temporal dynamics of the attentional biases. When probing attention early in the temporal stream (i.e., 300ms), biases are more likely to be found toward stereotype-consistent cues (at least for sadness/fear), whereas probes later in the stream (i.e., 1000ms) will reveal biases toward stereotype-inconsistent cues.

The spatiotemporal dynamics that we find are consistent with previous research on the processing of compound social cues. For instance, congruent combinations of eye gaze and expression (i.e., a fearful expression with averted eye gaze) elicit greater amygdala activation in the right hemisphere at 300ms, whereas ambiguous combinations of cues (i.e., a fearful expression with direct gaze) elicit greater amygdala activation on the left side when the stimuli are presented for 1000ms (Adams, Franklin, et al., 2012). We will discuss this in further detail below.

Memory

Although a pattern of attentional biases has been uncovered by the current research, the downstream implications are only now beginning to be uncovered. In Study 4, we provide evidence that stereotype-consistent faces elicit more shallow encoding than stereotype-inconsistent faces, and this is moderated by the strength of the stereotype endorsement, particularly for anger. To understand how attention can mediate memory, we now turn to the perceptual processes that underlie face processing. Faces, in general, are perceived configurally (Maurer, Grand, & Mondloch, 2002). There are three components in configural processing: 1) processing of first-order features (i.e., two eyes and a mouth), 2) holistic processing (i.e., seeing a face as a whole, single stimulus), and 3) processing of second-order features (i.e., distances between facial landmarks). The processing of first-order features is the important first step in detecting that a face is present. Even newborn infants, who have underdeveloped visual systems, can detect orbs that are face like and follow them (Goren, Sarty, & Wu, 1975; Johnson et al., 1991; Morton & Johnson, 1991). Once a face has been detected, processing then occurs holistically in most cases. Notably, this step is disrupted when processing out-group faces (i.e., cross-race), where attention is allocated to group identifying characteristics of the face (Hugenberg, Young, Bernstein, & Sacco, 2010). Finally, the second-order processing of the landmark differences allows us to determine if the face has been encountered before.

It is at this last phase that face memory occurs. However, the extent to which an individual engages in this last component of configural processing is dependent upon motivational factors. Rodin (1987) put forth a model of “cognitive disregard” whereby attentional resources are only allocated toward individuals that have significance to us. In the case of gender and emotion, faces that are stereotypically congruent are processed rapidly, and given they offer no additional benefit to us, they are quickly disengaged from. Resources are then made available to process additional environmental stimuli. In this case, faces that are stereotypically-incongruent require those extra resources in order to make sense of the inconsistencies. However, it is interesting that attention to these faces negatively predicts memory, at least for angry faces. It is possible that there is an optimal level of attention to be allocated to these faces, with too much attention leading to a shift toward piecemeal processing. This makes sense when we examine it with regard to lateralization of brain activation, particularly if much of the attentional biases are being driven by the left hemisphere, which favors piecemeal processing. With this, we now turn to a discussion of laterality.

Laterality and Potential Neural Underpinnings

Within the framework of the biased competition model, information in the left and right visual fields are likely being processed simultaneously in a pre-attention stage. Because stereotype-consistent stimuli are easier to process because they are expectancy-congruent, the attentional spotlight becomes greater on this stimulus first. Interestingly, we find that this happens primarily in the left visual field. There are a few potential explanations for this. First, this may simply be due to a left-to-right bias in attention that is found in cultures where reading occurs from left-to-right (Pollatsek et al., 1981; Spalek & Hammad, 2005). Under this explanation, initial attention shifts are biased toward the left visual field regardless of the stimulus. However, the content of the stimuli could also provide a separate, simultaneous modulating of attention. When the stereotype-consistent cue is in the right visual field, the left-to-right bias may cancel out the bias toward this stimulus. When the visual field bias and the stereotype-consistence match, the attentional bias would presumably be enhanced. Essentially, this argument would suggest that our laterality effects are simply a product of the task and not a laterality effect of particular interest. However, the analyses in Studies 2 and 3 included neutral faces as a baseline from which the factors of interest were compared to. Thus, differences as a function of visual field are statistically controlled for. In order to properly test this possibility, these studies should be replicated within a culture that reads from right-to-left. However, we turn to another, perhaps more likely, explanation of the laterality effects by looking at the neuroscience of lateralized processing.

The amygdala is a likely source of the early detection and trigger of subsequent processing of the stimuli presented. The amygdala sits at the crossroads of cognition and emotion with extensive connections to attentional, visual, and executive control networks (Adolphs, 2003; Pessoa & Adolphs, 2010). The amygdala has been implicated in the processing of emotional stimuli (Adolphs, 2001, 2003; Adolphs & Tranel, 2000) and is implicated in stimulus evaluation more broadly (Phan, Wager, Taylor, & Liberzon, 2002). Some evidence suggests that the amygdala is implicated in stereotype processing. For instance, amygdala activation in response to black faces among white participants is found to be associated with implicit associations those participants have regarding black and white individuals (Cunningham, Raye, & Johnson, 2004; Phelps et al., 2000). Additionally, when making a black stimulus more relevant to white participant by directing eye gaze toward that participant, white participants showed greater amygdala activation, demonstrating that this may be a threat response (Richeson, Todd, Trawalter, & Baird, 2008). More recently, the amygdala has been implicated in gender stereotyping. Specifically, the right amygdala activation has been associated with strength of explicit and implicit gender stereotype associations, while bilateral amygdala activation is found for gender stereotyping behavior in general (Quadflieg et al., 2009).

Some evidence has also been found for the lateralization of amygdala activation in response to combinations of social cues. Neuroimaging work examining processing of faces that vary on the social cues of eye gaze and expression, both cues to the behavioral intentions of others, has shown patterns of lateralization as a function of the 1) congruency of the signals of the cues and 2) the timing of presentation of the stimuli. Adams, Gordon, Baird, Ambady, and Kleck (2003) found greater left amygdala activation to ambiguous combinations of threat cues (i.e., fearful face with direct gaze) at long stimulus durations (i.e., 2.5 seconds). Following up on this, work by Adams, Franklin, et al. (2012) found that fearful faces with averted eye gaze elicited greater right amygdala activation at 300ms stimulus presentations, while fearful faces with direct gaze, being a more ambiguous signal of threat, activate the left amygdala more at 1000ms stimulus presentations. Additionally, similar research on eye gaze and emotion has evidenced more overall activation in the left hemisphere for ambiguous threat cues whereas more activation is found for clear threat in the right hemisphere (Adams et al., 2011). These results follow a dual-processing path by which the right amygdala appears to be more sensitive to clear, reflexive threat responses, whereas the left amygdala appears to be more sensitive to ambiguous, more reflective threat responses (e.g., Morris et al., 1998).

This idea that congruent combinations of social cues elicit more right amygdala activation while incongruent cues elicit more left amygdala activation requires further research, but we can begin to speculate as to why this may be the case. Previous research has suggested that the right amygdala may play a more important role in evaluative processing based on experience, whereas the left amygdala appears to be more active in response to instruction (Dolan & Morris, 2000; Phelps et al., 2001; Quadflieg et al., 2009). Numerous studies have implicated media biases in the acquisition and strength of stereotypes (Arendt, Steindl, & Vitouch, 2014; Mastro & Tukachinsky, 2012; Weisbuch & Ambady, 2009) and stereotypes can create a self-fulfilling prophecy whereby a stereotyped individual will act in ways that confirm the stereotype due to how they are interacted with (Snyder, Tanke, & Berscheid, 1977), hence strengthening the stereotype via experience.

Given that we may have less experience with stereotype-inconsistent exemplars, the ability to process and represent these instances requires greater elaboration and more cognitive resources. Indeed, when cognitive resources are low, we are likely to devote them solely to stereotype-inconsistent information and ignore stereotype-consistent information in an effort to maximize our cognitive resources (Sherman et al., 2004). This processing, at least attentionally, appears to come on later, and stimuli that are stereotype-inconsistent appear to be remembered better. While this would seemingly help to reduce stereotypes by providing a salient disconfirming example, encoding into memory differs for these stimuli. We provide evidence suggesting these instances are recollected more, given the greater R hit sensitivity we found for these stimuli relative to K hits. As stated before, R hits have been associated with perceptual memory, whereas K hits have been associated with semantic memory (Yonelinas, 2002). Thus, while these stereotype-inconsistent faces are being remembered perceptually, they are not being integrated into the semantic associations that make up the stereotype. One potential consequence of this is subtyping, where stereotype-inconsistent individuals will be categorized into a subtype that does not conform to the overall group stereotypes (Kunda & Oleson, 1995; Weber & Crocker, 1983).

Social Cue Intersectionality: The Processing of Compound Social Cues

The current work provides additional evidence that the processing of social cues in a face, even as rapidly as 300ms post-stimulus, is heavily moderated by the signal value being conveyed by the combination of cues. Previous models of face processing have purported a separation of features that are static in the face, such as facial appearance, and features that are dynamic, such as eye gaze and facial expressions (Bruce & Young, 1986; Haxby et al., 2000, 2002). While not inaccurate, these models are missing an important piece of integration between these sources of cues. As social creatures, we have evolved to extract predictive social information from others rapidly. To not do so could have had deadly consequences in our ancestral past. Thus, not only was it important to detect friend from foe, it was also essential to understand the behavioral intentions of the individual. Signals, such as facial expressions and eye gaze, provide such intentions.

Gender is clearly a social cue that significantly moderates the perception of facial expressions. In addition to the stereotypes that we have discussed in great detail, there are also sexual dimorphic differences in facial appearance that overlap with the appearance of facial expressions (Adams et al., 2015). Female faces tend to be lower in maturity, appearing more round and babyish in appearance. These faces tend to appear more fearful naturally because features such as larger eyes and raised eyebrows, both low maturity signals, are also characteristic of fearful expressions. Conversely, anger, noted by lowered brows, smaller eyes, and more angularity in the face, are also signals of higher facial maturity, which tends to be found in male faces (Friedman & Zebrowitz, 1992; Marsh et al., 2005). Facial maturity was controlled for in Studies 2 and 3 of the current dissertation, while being allowed to vary naturally in Study 4. Given the lack of dot-probe findings in Study 4, it is possible that the lack of control over this factor may have added a significant source of error to our study. Future research should look to see if the dot-probe could be even strengthened by examining highly gender-prototypical faces (i.e., low mature female, high mature male).

Indeed, previous research from our lab (Adams, 2009), has shown that when male and female faces are controlled for facial maturity, benefits for identifying anger on a male face and fear on a female face disappear. In light of this, the current findings from Studies 2 and 3 with androgynous faces that did not differ on facial maturity, are particularly interesting given that they are entirely driven by top-down stereotypes. In our previous dot-probe research (Nelson & Adams, in preparation), we studied the role of facial maturity independent of gender. That is, each dot-probe trial consisted of two same-gender faces, one high and one low in maturity, displaying the same expression. Ultimately, this study did not reveal any interactions of significance, suggesting that bottom-up visual factors alone do not drive attentional biases. However, it is possible that gender typicality in facial appearance can enhance between-gender differences.

Alternative Explanations

Given the design of the dot-probe used in Studies 2 and 3, some alternative explanations of what is driving attentional biases do exist. Perhaps the biggest issue with the current design of the dot-probe is the allowance of inhibition of return effects driving attentional biases at 1000ms. Inhibition of return is a phenomenon where, after attention has been allocated to a stimulus and this stimulus has been sufficiently processed, attention will be inhibited from returning to this location for a brief period of time (Posner & Cohen, 1984). Because of this, it could be argued that our attentional biases at 1000ms are simply a result of this process. There are some indications that this cannot account for the entirety of the biases at 1000ms. First, we find no negative correlations between attentional biases moving from the left visual field at 300ms to the right visual field at 1000ms. Additionally, while we consistently find larger effects for sadness (Study 2) and fear (Study 3) across time from 300ms to 1000ms, anger does not show a similar pattern. Notably, the anger bias at 300ms is mostly absent, indicating that attention is not significantly biased toward one gender over the other. However, the expected stereotype-incongruent bias is found at 1000ms. If inhibition of return were the sole force at play, we would not expect a bias at 1000ms.

As stated earlier, pitting gendered faces against one another within each trial is the only test that allows us to examine biased competition in attentional deployment. Using an expressive face along with a neutral face, as is the norm in dot-probe studies, requires an assumption that the neutral face is serving as a baseline by which comparison of reaction times will either demonstrate a facilitation of attention toward the expressive face, or an avoidance of the expressive face if reaction times are faster to the neutral face. Although this is likely the closest approximation to a baseline in order to be able to determine facilitation versus avoidance, it is not without its drawbacks. Neutral faces are rarely perceived as strictly neutral. For instance, facial appearance cues can alter impressions to the extent that their faces naturally resemble emotional expressions, known as emotion overgeneralization (Adams, Nelson, Soto, Hess, & Kleck, 2012; Said, Sebe, & Todorov, 2009; Zebrowitz & Collins, 1997). Additionally, perceptions of expressions are influenced by the context in which they are perceived. When displayed alongside expressive faces, the perception of neutral expressions are altered in the direction opposite of the anchor expression on a circumplex model of emotions (Russell & Fehr, 1987). As the authors summarized, “We can think of no privileged context that could serve as the unarguable standard for an absolute judgment” (Russell & Fehr, 1987, p. 236). Finally, from an ecological standpoint, it is common that when encountering multiple individuals in an environment that they will be reacting to the same emotion eliciting effect similarly. The extent to which we may differentially process the otherwise exact same nonverbal behaviors of others as a function of their identity is a major point to be made by the current dissertation.

It is interesting that the attentional biases in the left visual field at 300ms do not correlate with those in the right visual field at 1000ms. This suggests that these attentional processes are relatively independent of one another. This leaves open the possibility that there are individual differences that have been unaccounted for in the current research that differentiate those who tend to have earlier biases from those who tend to have later biases. While we examined likely moderators, such as anxiety and attentional control, we found no effects with these measures. Future research should continue to focus on potential moderators.

Future Directions

The implications of these findings, namely, that low-level differences in attentional biases are associated with gender stereotypes, have the potential to be quite important and informative to the stereotyping literature. For instance, this opens up avenues that have not been thoroughly examined, particularly at such granular levels.

Social psychology, as a field, understands the insidious role that stereotypes play in our society. As such, many have tried to engage in efforts to reduce stereotyping, often to mixed and disappointing results (Paluck & Green, 2009). Efforts to reduce stereotyping could potentially be more effective if focused on efforts to change attentional patterns, particularly because they lie at the core of social information processing. In general, most efforts focus on "normalization" by exposure to counterstereotypic behavior in an effort to reduce the perceived veracity of the stereotype. However, we know that simply showing counterstereotypic information can lead to individuation and subtyping (Kunda & Oleson, 1995; Weber & Crocker, 1983).

We know from theories about stereotyping and prejudice that these factors are mediated by implicit and explicit processes (Devine, 1989). While the explicit level may be quite subject to motivational factors to reduce stereotyping, implicit activation of stereotypes are much less controllable. However, despite this, there are individual differences in the degree to which stereotypes automatically become activated (Kawakami, Dion, & Dovidio, 1998; Lepore & Brown, 1997). Kawakami, Dovidio, Moll, Hermsen, and Russin (2000) argue that practice with attempting to suppress stereotype activations and applications may lead to changes in automatic processing. As such, they designed a task to modulate the associative strengths of stereotypes by responding with "no" when they encountered stereotype pairings (i.e., elderly face with elderly stereotypic trait). Later work suggests, however, that it is not the suppression of stereotypes via negation that is driving these effects but rather the affirmation of counterstereotypic information (Gawronski, Deutsch, Mbirkou, Seibt, & Strack, 2008). If we, however, begin to pair this type of remediation with re-training of the attentional pathways, or *attentional bias modification*, we may begin to see progress.

Attentional bias modification is a recent intervention that has stemmed from clinical efforts to reduce psychopathological symptoms in patients (mostly patients that suffer from anxiety). In psychological disorders like anxiety, attention has been pegged as a major cognitive process that helps to maintain, or even strengthen, the disorder. Although attention to threatening stimuli is highly adaptive for survival, individuals high in anxiety tend to have much larger biases towards these stimuli that interferes with everyday functioning and is maladaptive. Thus, by allocating an excessive amount of attention toward threatening stimuli, anxious individuals consistently detect more threat in the environment than others, and this keeps them on high alert. Because of this, efforts have been made to reduce anxiety by breaking the cycle of attentional biases and threat perception by re-training attention in these participants to avoid threatening stimuli.

Attentional bias modification was initially introduced as a way to establish causality between attentional biases and anxiety. For instance, several studies reported that attentional biases are greatly reduced, or even completely disappear, when an anxiety disorder is successfully treated or is at least managed by the individual (Lavy, van den Hout, & Arntz, 1993; Mathews, Mogg, Kentish, & Eysenck, 1995; Mattia, Heimberg, & Hope, 1993). From this, some concluded that attentional biases may simply be a byproduct of the anxiety. Mathews and MacLeod (2002) noted, however, that causal relationships between attention and anxiety had not been sufficiently addressed empirically because no studies had directly manipulated attention. MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) sought to examine this by using a modified version of a dot-probe task. In this task, they presented participants with negative and neutral word pairings. After these pairings would disappear, a probe would appear at the location of either the negative or neutral word. Reaction times in identifying the probe are used as a proxy of the amount of attention allocated to one of those words. After establishing a baseline (probe appears at previous location of threatening and neutral words at a 50-50 ratio), participants were either subjected to a bias modification toward threat (the probe appears behind the negative word most of the time) or a bias modification away from threat (the probe appears behind the neutral word most of the time). The location of the impending probe is implicitly learned as being behind either the threatening or neutral word, depending on the bias modification condition. Indeed, in a subsequent dot-probe task (the unmodified, 50-50 task), participants showed biases toward their corresponding modification condition.

Notably, MacLeod et al. (2002) did not find differences in subsequent levels of anxiety. However, when stress was induced in participants, those trained to attend to threat words experienced more negative feelings. This suggests that participants in the threat training condition may have become more vigilant to threatening stimuli, hence the increased negative emotional experience in response to threat. Mathews and MacLeod (2002) conducted an attentional bias modification treatment with individuals high in trait anxiety. In this case, those in the trait anxiety condition actually showed reduced levels of trait anxiety on post-training measures when exposed to an attentional retraining away from threat. Similar evidence has been found in children as well (Eldar, Ricon, & Bar-Haim, 2008).

Conclusion

Within the realm of social perception, the role that attention plays in selecting information for further processing is undoubtedly tied to the maintenance of our perceptions of members of a social category. In the current dissertation, we provide evidence that attention differs across time and visual field when encountering emotionally expressive faces as a function of gender, and we find evidence that these biases are partially mediated by stereotypic expectations of how much women and men express these emotions. Additionally, memory for faces is partially moderated by these stereotypes as well. Overall, this suggests that attention sets the stage for differential downstream processing of faces that can perpetuate stereotypes. Although much additional research is needed, we believe these findings set the groundwork for understanding, and ultimately manipulating, visual attention in order to break the insidious cycle of stereotyping. In this regard, we encourage social justice researchers to address these lower-level cognitive biases that, within 1 second, have major impacts on subsequent processing.

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