Mood and Cognition in Context: Affect as Information for Perception and Memory

by

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Abstract

Mood affects both cognitive content and processes. People often attend to and remember information better when it matches their current mood. When in a sad mood they also tend to process information at a more local level and in a happy mood they tend to process information more globally. However, these effects are inconsistent in the literature. The affect as information model was developed to predict when and how mood would influence cognition based on the perceived relevance of the mood and current cognitive focus (Clore, Gasper, & Garvin, 2001; Schwarz & Clore, 1983). The current series of studies tested the affect as information model principles by examining the influence of mood, task demands (judgments), personality factors (measured by the NEO-FFI-3), and their interactions. Hybrid faces were composed of two individual faces with different characteristics including spatial frequency, facial expression, and face gender. In a series of three experiments, participants made judgments about the hybrid faces presented (male/female, happy/sad) and then completed a memory test. I examined biases for content (i.e., facial expression) as well as biases in processing style (i.e., spatial frequency). Across the experiments, the task participants were engaging in was the strongest and most consistent predictor of performance. Affect, both in mood and personality traits, moderated the task effects by either enhancing or suppressing the task biases. A happy mood, high scores on extraversion, and low scores on neuroticism maintained or enhanced the task biases. In contrast, a sad mood, low scores on extraversion, and high scores on neuroticism tended to reduce these biases. Mood congruency was observed in memory discrimination, but was often only present with high spatial frequency faces, which may involve a greater level of conscious or top-down processing. Together, these findings support the role of affect as one piece of information in a constructive cognitive system, consistent with the affects as information model.

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Dedication

To Dr. John Vokey, who introduced me to the field of cognition and perception, the excitement of research, the work of Philip Schyns, the value of syntax, and the Oxford comma. Your passion has inspired me and your critical thinking has provided me with a compass to guide both my research and clinical practice.

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Chapter I: Introduction and Literature Review

Cognition and emotion have often been portrayed as separate and conflicting processes, with cognition being described as rational and emotion being described as irrational. Yet, when emotional functioning is impaired by brain damage (Adolphs & Damasio, 2001; Damasio, 1994), developmental disorders (Ozonoff, Pennington, & Rogers, 1991), or mental disorders (Kiehl, 2006), many "rational" processes are also severely affected. Reduced or impaired emotional functioning will change decision-making and behaviours in ways that can have damaging consequences for one's daily functioning. For example, impaired emotional functioning is associated with riskier choices on a gambling task (Bechara, Damasio, & Damasio, 2000), differences in moral processing and judgment (J. Greene, Sommerville, Nystrom, Darley, & Cohen, 2001), and social difficulties (Beauchamp & Anderson, 2010). Modern perspectives generally acknowledge that cognition and emotion are both important aspects of human experience that are profoundly entwined (Storbeck & Clore, 2007).

There are two primary effects of mood on cognition that have been examined in the literature. The first finding deals with *what* content is processed. Often, individuals show a preference for mood congruent information, which means that they preferentially attend to, perceive, remember, and make judgments regarding materials that have the same emotional content as their current mood (Bouhuys, Bloem, & Groothuis, 1995; Direnfeld & Roberts, 2006; Gotlib, Krasnoperova, Joormann, & Yue, 2004). In the case of individuals who are sad or depressed, this effect has been called both a "negative bias" (often in the clinical psychology literature or with a clinical population), and "depressive realism" (in experimental psychology and organization psychology or with tasks that benefit from more systematic approaches). The second finding relates to *how* individuals process information. Often mood affects one's processing style in terms of the degree of effort and level of focus that occurs. Generally, those in a sad mood tend to process stimuli at a more local or detailed level than those in a happy mood, who may process stimuli more holistically (Gasper & Clore, 2002). Another way that this effect occurs is with the use of heuristics, which are used more when individuals are in a happy as opposed to sad mood (Forgas & East, 2008; Forgas, 1998a). Heuristics are simple rules of thinking that lead to satisfactory (although not optimal) performance in a given situation (Simon, 1990). For example, the correspondence bias is the tendency to assume that individuals behaviour, including facial expressions, correspond to their internal dispositions (Gilbert & Malone, 1995).

Both the mood congruency and processing style effects have been inconsistent in the literature, and various theories have been developed to account for the mixed results. In the remainder of this chapter, I discuss each of the effects in more detail with respect to pertinent cognitive processes, and describe relevant existing theoretical explanations for the results in the literature. In chapters II through IV, I describe a series of studies I conducted to examine each of these effects with respect to different cognitive processes and in the context of other important variables such as task demands and personality. Finally, in chapter V, I present a general discussion of the results of these studies in the context of the broader emotion and cognition literature.

Moods Influences on Cognition and Perception

Our environment contains far more information than we can process. There are a number of different factors that determine what stimuli will be attended to, interpreted, and remembered. The valence (positive or negative content) of a stimulus is one determinant of processing. In general, emotional content tends to be preferentially attended to, perceived[1], and remembered compared to neutral information (Alpers & Gerdes, 2007; Davidson, Luo, & Burden, 2001; Hamann, Ely, Grafton, & Kilts, 1999; Sears, Newman, Ference, & Thomas, 2011). There may be additional benefits specific to negatively valenced material. Stimuli with negative emotional content tend to capture attention (Algom, Chajut, & Lev, 2004; Pratto & John, 1991; N. K. Smith, Cacioppo, Larsen, & Chartrand, 2003), be identified more quickly, and are less affected by capacity demands than neutral or positive stimuli (Ohman, Flykt, & Esteves, 2001; Ohman, Lundqvist, & Esteves, 2001). For example, angry faces can be detected faster (Fox et al., 2000), allowing for rapid threat detection and a quicker response, which could make the difference between life and death. Although negative stimuli seem to enhance processing compared to positive stimuli, these results are conflated by the role of arousal. Threatening stimuli are often used due to their evolutionary significance, which are both negative in valence and highly arousing. Anderson (2005) demonstrated that arousal has a larger influence on enhancement of information processing compared to valence, although there was also an enhancement of processing for valenced stimuli (both positive and negative) compared to neutral stimuli. There appears to be less of a difference between negative and positive stimuli for memory. Both positive and negative stimuli both tend to be remembered better than neutral stimuli, with additional benefits for arousing stimuli (M. Bradley, Greenwald, Petry, & Lang, 1992; Dolcos & Cabeza, 2002).

Stimuli degree of familiarity or typicality, such as being consistent with stereotypes, will also affect cognitive processing. Information that is highly typical may be easier to encode and use for further information processing (Cantor & Mischel, 1979). However, atypical information,

[1] In the context of this thesis, I am using the term perception to refer to the process of organizing,

such as stereotype-incongruent stimuli, tend to be processed with greater elaboration and are remembered better than stereotype-congruent stimuli (Brewer, 1988; Forgas, 1995b; Hilton, Klein, & von Hippel, 1991). This pattern of findings will vary with cognitive strategies or cognitive load. When stimuli are presented at a high pace (Dijksterhuis & vam Knippenberg, 1995) or with a high processing load (Macrae, Hewstone, & Griffiths, 1993) memory will be better for stereotype-consistent than stereotype-inconsistent information.

Mood Congruent Effects

In addition to the effects of stimulus valence or typicality, one's current mood will also affect what and how information is processed. The most common type of mood effect studied is mood congruence, which can occur at different stages of cognitive processing. This effect is specific to the affective content of the stimulus, with increased congruence between mood and stimulus leading to improved performance. For example, being in a sad mood can increase sustained attention to sad stimuli such as frowning faces (Gotlib, Krasnoperova, et al., 2004). Below, I discuss the mood congruent effects seen with different aspects of cognition.

Attention. The most inconsistent results related to mood congruent effects are found in the literature on attention. Although mood-congruent attention biases are commonly found with anxiety, many of the same procedures fail to produce reliable effects with sadness (Mogg & Bradley, 2005). Mood congruent attention biases have been found with long stimulus presentation times (B. P. Bradley, Mogg, & Lee, 1997; Koster, De Raedt, Leyman, & De Lissnyder, 2010), but not when exposure times are short (Gilboa & Gotlib, 1997; Hill & Knowles, 1991). For example, dysphoric individuals in one study had more difficulty disengaging with negative words on an exogenous cuing task involving emotional cues (positive, negative, or neutral) than nondysphoric individuals, but only when longer (1500 ms) stimulus presentations were employed (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005). Studies using more socially relevant stimuli, such as faces, are also more likely to reveal mood-congruent attention biases (Becker & Leinenger, 2011; Gotlib, Krasnoperova, et al., 2004; Leyman, De Raedt, Schacht, & Koster, 2007) than those using words (Chepenik, Cornew, & Farah, 2007; Hill & Knowles, 1991; Mogg, Bradley, Williams, & Mathews, 1993). However, the former studies have tended to incorporate longer presentation times. For example, Gotlib et al. (2004) found an attentional bias towards sad faces at 1000 ms for individuals with major depression, which was not observed in control participants or participants with generalized anxiety disorder. In contrast, Chepenik et al. (2007) used words in an attention-probe task that were presented for 500 ms and did not find any differences in processing between individuals in a neutral or sad mood. Eye-tracking studies have provided evidence that dysphoric mood is associated with slower disengagement from sad or depressive stimuli (Sears, Thomas, LeHuquet, & Johnson, 2010). Overall, presentation time appears to be the strongest predictor of mood congruent attention biases, which are associated with disengagement of attention from negative stimuli (see Mogg & Bradley, 2005 for a review).

Although attention research has often focused on sad or depressive stimuli, differences in attention processing across moods may be more evident with positive stimuli. Newman and Sears (2015) examined effects of mood induction on attention to positive, depressive, anxiety-related, and neutral stimuli among individuals with or without a history of depression symptoms using eye tracking. Mood induction (neutral or sad) did not affect attention among those with a history of depression symptoms. Instead, a sad mood induction led to mood incongruent attention—specifically increased fixation on positive and reduced fixation on anxiety-related stimuli—among those with no history of depression symptoms. This finding was interpreted as a mood regulation mechanism that was absent among individuals with a history of depression. A similar pattern was observed in a study that did not include a mood manipulation. Both currently dysphoric participants and those with a history of depression symptoms had shorter fixation times for positive stimuli than those with no history of depression symptoms (Sears, Newman, et al., 2011; Sears et al., 2010). Participants with a history of depression symptoms also had longer fixation times for anxiety-related stimuli than those with no history of depression symptoms (Sears, Newman, et al., 2011). In summary, among individuals with current or previous depression symptoms, there may be a reduced bias to attend to positive stimuli, as opposed to the more common assumption of an increased bias to attend to negative stimuli.

Perception. Mood not only affects which stimuli get attended to, but also how stimuli are interpreted. Congruence between mood and perception of stimuli has been found for word recognition (Niedenthal & Setterlund, 1994), detection of changing facial expressions (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001), and interpretation of ambiguous sentences (Sears, Bisson, & Nielsen, 2011) and facial expressions (Coupland et al., 2004; Halberstadt, Winkielman, Niedenthal, & Dalle, 2009). For example, when shown drawings of facial expressions, sad individuals are more likely to perceive rejection and less likely to perceive happiness compared to individuals in a positive mood (Bouhuys, Bloem, & Groothuis, 1995). The majority of research in this area has focused on the perception of facial expression due to the high social relevance of the stimuli, and has generally found mood congruency. In general, the more ambiguous the stimulus is, the more perception will be influenced by previous knowledge, expectations, and an individual's emotional state.

Memory. Although mood-congruent biases have been found in a number of different aspects of cognition, the most common research focus is on memory. Mood congruent memory

(MCM) is a bias towards remembering information that matches one's current mood (Eich, 1995). MCM biases have been found with a variety of types of stimuli (Eich et al., 1997; Mayer, McCormick, & Strong, 1995; Ridout, Astell, Reid, Glen, & O' Carroll, 2003) in both naturally dysphoric individuals as well as in those induced into a sad mood with a mood manipulation procedure (Direnfeld & Roberts, 2006; Eich, Macaulay, & Lam, 1997; Ridout, Noreen, & Johal, 2009). For example, Ridout and colleagues (2009) tested memory for expressive faces in individuals with sub-clinical depression and with individuals without dysphoria, as well as with participants induced into a positive or negative mood using music and autobiographical memories. Relative to the control group, both individuals with sub-clinical depression and those induced into a sad mood showed enhanced memory for sad faces compared to happy faces. The effects are generally stronger for naturally dysphoric individuals compared to individuals with an induced mood (Direnfeld & Roberts, 2006).

Despite a number of studies finding MCM under varying conditions, many others report no such effects (Gayle, 1997; Kwiatkowski & Parkinson, 1994) or even mood incongruent effects (Erber & Erber, 1994; Forgas, Burnham, & Trimboli, 1988; Sedikides, 1994). Eich (2000) has described four main factors that seem to account for these inconsistent findings: 1) the nature of the events/stimuli, 2) the nature of the task, 3) the effectiveness of the mood manipulation, and 4) the participants' level of arousal. Mood effects are more likely to occur if the events or stimuli are perceived as related to the mood state. For example, although studies examining memory for lists of words only sometimes find MCM, this bias is quite consistent and robust in studies involving autobiographic memory (Eich et al., 1997). In addition, tasks that involve interpretation or elaborative processing are more effective at producing effects than tasks with clear meanings or answers (Forgas, 1995a; Watkins, Mathews, Williamson, & Fuller, 1992). However, no task would produce these effects if the mood manipulation were not effective. The mood experienced must be strong, stable, and sincere (Eich & Schooler, 2000). Arousal may also influence whether MCM occurs. Mood and arousal are not independent and it is possible that some of the cognitive influence that occurs in different mood states is also related to different levels of arousal. A change in both mood and arousal seems to be more effective than a change in either mood or arousal alone (Eich, Macaulay, & Ryan, 1994). Although these factors were identified with respect to moods influence on memory, there is also some evidence that they are also important to consider in other cognitive processes (Mokhtari & Buttle, 2015).

Another factor that may contribute to the conflicting results with MCM is the influence of response bias. A memory judgment can be influenced both by the ability to distinguish between old and new stimuli (i.e., discrimination) as well as by the threshold that one sets for claiming that stimuli are old or new (i.e., response bias). Previous research has found evidence of both a genuine memory advantage for mood congruent information (Fiedler, Nickel, Muehlfriedel, & Unkelbach, 2001), and a response bias with false memories (Stea, Lee, & Sears, 2013). These findings demonstrate the importance of separating these components of memory responses to clarify the influence of mood on memory.

Behaviour. Mood also has effects on more complex tasks and behaviours, such as how we navigate relationships with others. Forgas (1998) examined negotiation strategies used by participants who were given positive, negative, or no evaluation on a task. The feedback was intended to act as a positive or negative mood induction. Individuals in a positive mood were more likely to use a cooperative strategy and to make and honour deals and were less likely to use a competitive strategy than those in the no evaluation group (Forgas, 1998b). The negative evaluation group showed trends toward the opposite effects, but these did not reach significance.

Interestingly, participants in a positive mood were more effective in obtaining their desired result from the negotiations than participants in the control condition. The strategies that were chosen may have been influenced by people's expectations about the future. Happy people are more likely to believe that good things will happen in a variety of tasks, such as judgments of probabilities, categorization tasks, and personal perceptions (Mayer, 1992).

Interpretation of mood congruency findings. Mood congruent effects have often been discussed in two different ways in the literature. The first and more popular approach is to describe the findings in terms of a negative bias. This explanation focuses on enhanced processing of negative stimuli, which may serve to exacerbate or maintain a sad or depressed mood (Koster et al., 2005; Watkins, 2002). This view has led to examination of the causal role of memory biases in mood disorders. There has been some evidence that negative biases can predict later depressive symptoms (Pury, 2002; Rude, Wenzlaff, Gibbs, Vane, & Whitney, 2002), as well as evidence that treatment of mood disorders can change these biases (Victor, Furey, & Fromm, 2010). However, there have also been studies finding no change in negative bias among individuals who completed treatment for depression (Joormann & Gotlib, 2007).

An alternate interpretation of these findings is that they represent the "Pollyanna principle," which refers to a general tendency for individuals to see themselves as more positive than average, to have unrealistically positive views about the future, and to recall positive information (Matlin & Stang, 1978). This positive bias may be related to individuals' general tendency to be happy (Diener & Diener, 1996). From this perspective, the performance of sad individuals may represent "depressive realism"—that is, more accurate and less biased processing (Alloy & Abramson, 1979). According to this view, "distorted" thinking is associated with happiness, as opposed to sadness.

So the question then becomes, is it sadness or happiness that is associated with cognitive distortion? The answer appears to be both (Schmid & Schmid Mast, 2010). Human cognition will never be perfect; the processing associated with different moods will affect the types of errors that are made in one direction or another. The type of processing that is more accurate will depend upon the specific situation and which bias is more consistent with reality.

Summary of mood congruent effects. Mood congruency has been extensively examined due to the intuitive nature of the effect. Both positive and negative mood congruent effects occur in different aspects of cognition, from attention to complex decision-making. Mood congruent effects are more common when elaborate processing is required and when the mood is meaningfully related to the stimuli. However, the specific task, instructions, and participants will greatly affect whether or not these effects will occur.

Processing Style Effects

The other main cognitive effect of mood in the literature relates to *how* information is processed, regardless of its valence. There are different ways that various sources of information can be integrated in cognition. Processing can begin with the specific data in the environment and then get integrated with prior knowledge structures, which is a bottom-up or accommodating processing style (Bless, 2001). Alternatively, prior knowledge and beliefs can be used to organize and make sense of new data, which is a top-down or assimilating processing style. Bottom-up processing tends to involve greater focus on more detailed, local information, whereas top-down processing tends to involve greater focus on more holistic, global information. Broadly speaking, individuals in a happy mood tend to process information in a more top-down, global manner, whereas individuals in a sad mood tend to process information in a more bottom-up, local manner. These different styles can have implications for every aspect of cognition from how attention is initially allocated to higher level judgments and behaviour.

Attention. There is a constant barrage of stimuli competing for our attention. How our limited cognitive resources get allocated between various stimuli can vary greatly. Attention can be driven by stimulus characteristics or expectations (general knowledge structures) and can be focused on details or more central information. Individuals who are in a happy mood tend to focus their attention on salient aspects of a specific task (Kern, Libkuman, Otani, & Holmes, 2005; von Hecker & Meiser, 2005). What information is salient will be determined by their expectations and previous knowledge (i.e., top-down). In contrast, individuals who are sad tend to exhibit more divided attention. For example, when remembering words that were presented inside different coloured boxes, individuals with depression recalled similar amounts of task-relevant information (words), but exhibited better memory for task-irrelevant information (box colour), compared to non-depressed individuals (von Hecker & Meiser, 2005). Sad individuals tend to spread out their cognitive resources, leading to decreased performance for some information and increased performance for other information. This attention style could be considered bottom-up, in that it is not directed by knowledge and expectations to the same degree as focused attention. However, this division of resources may vary based on the emotional content of the stimuli, and negatively impacts performance for salient, positive information more than for salient, negative information (Kern et al., 2005).

Perception. Mood can also change how you organize, identify, and interpret information. For many situations and tasks there are different levels of information that can be used for perception. For example, when looking at a painting one could examine the details such as the specific colours used and the brush strokes. Alternatively, one could first experience the painting in a more holistic way, seeing the form of the image and overall tone of the painting. For many types of stimuli and tasks, individuals tend to first perceive global information and then go on (perhaps) to perceive local information (Kimchi, 1992; Navon, 1977). A classic task for examining global versus local processing is the Navon task (Navon, 1977). Participants view figures that are composed of small letters (e.g., S) that are arranged to form a larger letter (e.g., H). Participants are generally able to ignore the local level when instructed, but are unable to inhibit perception of the global level. In other words, a global-to-local processing style is often the dominant tendency. This processing style can be affected by various factors (Kimchi, 1992), including mood (Gasper & Clore, 2002; Gasper, 2004). To study this effect, Gasper and Clore used the Kimchi task (Kimchi & Palmer, 1982). This task requires participants to determine which of two objects is more similar to a target object. All objects were small shapes arranged to form larger shapes, such as four triangles arranged in a 2 x 2 array to form a larger square, or three squares arranged in the shape of a triangle. When this task is performed without a mood manipulation (Kimchi & Palmer, 1982) and when participants are happy (Gasper & Clore, 2002; Gasper, 2004) they tend to rate objects as being more similar when they match at a global level. This pattern is reduced or reversed among individuals in a sad mood (Gasper & Clore, 2002). When participants were made aware of the source of the mood, thereby making mood irrelevant for the task, the association between a sad mood and improved local processing disappeared (Gasper, 2004).

The specific processing style (global-to-local or local-to-global) associated with a specific mood can also change depending on which type of processing is primed (Hunsinger, Isbell, & Clore, 2012; Huntsinger, Clore, & Bar-Anan, 2010). Huntsinger and colleagues (2010) found global precedence among happy participants and local precedence among sad participants on the

Navon and Kimchi tasks when a global focus was primed using two different methods. In contrast, when a local focus was primed, they observed a local processing bias among happy participants and a global processing bias among sad participants. Hunsinger and colleagues (2012) found the same pattern of results when exploring participants' use of stereotypes to inform judgments. When a local focus was primed using various methods, the typical relationship between mood and use of stereotypes was reversed. Specifically, a happy mood led to a greater reliance on behaviour than on stereotypes, and a sad mood led to greater reliance on stereotypes than behaviour, when making judgments about personality traits. Together, these studies suggest that a happy mood supported whichever processing style was primed or dominant, and that a sad mood supported non-dominant processing.

Memory. If initial cognitive processes are affected by mood, there should also be effects on memory. If individuals in happy moods process information using more assimilating strategies (i.e., using prior knowledge to organize and making sense of new information) rather than accommodating strategies (i.e., using current information to update or adjust prior theories), then their memories should contain more information related to the overall theme or most important aspects of the event. In contrast, if individuals in a sad mood process information in a more accommodating manner, then their memories should contain more detailed information, which may not be as conceptually consistent with the overall memory. To test this, Gasper and Clore (2002) used a serial reproduction task that requires individuals had to draw previously seen line drawings of items such as a face or a shield. Sad participants produced more detail-based face drawings than happy participants, which resulted in their drawings diverging more from the original. The authors interpreted this finding as demonstrating that happiness is associated with conceptual representation, whereas sadness is associated with focus on specific features.

Similarly, another study found that a positive mood improved facial recognition, which presumably requires greater global processing (Pacheco-Unguetti, Acosta, & Lupiáñez, 2014).

Processing style effects may also influence how misinformation is incorporated into memory. The misinformation effect occurs when information provided post-event changes one's memory for the event (Schooler & Loftus, 1993). Forgas, Laham, and Vargas (2005) compared participants' memories for various scenes after a happy, sad, or neutral mood induction. Some participants received questions that were direct (e.g., "How fast was the truck going on the highway?") and others received questions that contained misleading information that was not a part of the original event (e.g., "How fast was the truck going when it passed the *white house* on the highway?"). Positive mood increased the incorporation of misleading information into later recollections of the original event (leading to worse discrimination than that seen in the neutral condition), whereas negative mood had the opposite effect. These effects were consistent across different types of events, different mood induction procedures, and different lengths of time between encoding and testing.

The nature of the information may also impact how mood and processing style affect memory. There is presumed to be a link between global processing and stereotype consistent information and between local processing and stereotype inconsistent information (Forgas, 1995b; Förster & Dannenberg, 2010). A happy or sad mood may then lead to differences in the type of information remembered. Although atypical stimuli are often recalled better than typical stimuli, this difference is further increased when comparing individuals in a positive and negative mood (Forgas, 1995b). When viewing typical or atypical couples (i.e., either well matched or poorly matched on physical attributes), participants in a positive mood recalled typical couples better than those in a negative mood. Participants in a negative mood recalled atypical couples better than those in a positive mood (Forgas, 1995b). These findings are consistent with a sad mood leading to more systematic and detailed processing compared to a happy mood.

Judgment and behaviour. Processing style effects are also associated with changes in complex judgments and behaviour. Examining data from the bottom-up, which is more common among individuals with a sad mood, can lead to increased accommodation of new information into previous conceptualizations. Individuals will base judgments more on the individual data points that they are currently examining than on their broader understanding of the world, and therefore will tend to make more "accurate" judgments or decisions in many situations (Au, Chan, Wang, & Vertinsky, 2003; Storbeck & Clore, 2005). However, as we saw with the reconstructed drawings, bottom-up processing can also cause one to lose sight of the bigger picture. Top-down processing relies more on previous theories about the world, and new information is assimilated to fit into this conceptualization. For example, individuals who are feeling happy are more likely than those who are feeling sad to use stereotypes and other heuristics (Bodenhausen, Kramer, & Süsser, 1994; Forgas, 1998a). However, being less bound by the individual data also means that those in happy moods will also tend to think more creatively and flexibly than those in sad moods (Baas, De Dreu, & Nijstad, 2008).

Interpretation of processing style findings. As in the mood congruent literature, there are inconsistencies in results described in the processing styles literature. The first inconsistency is seen in the language used to describe the results. The effects are sometimes described as resulting from differences in global or local processing (Gasper & Clore, 2002), assimilating or accommodating processing (Bless, 2000), broadening or narrowing of processing/attention (Fredrickson, 2004), bottom up or top down processing (Schwarz, 2000), or flexible or rigid processing (Baumann & Kuhl, 2005; Tan, Jones, & Watson, 2009). Although there is a great deal of overlap between these different effects, each choice in wording represents a slightly different theoretical explanation for the findings and affects the questions being asked.

Specific processing style effects also do not occur consistently. Although these results are more reliable than mood congruency effects, some studies produce results opposite in direction to what one might predict (Baumann & Kuhl, 2005; Tan et al., 2009). Similar to the mood congruency literature, important factors for determining when the effects will occur include task demands (Baumann & Kuhl, 2005) and participant motivation (Förster & Higgins, 2005). Specifically, there is emerging evidence that positive mood may result in broader or narrower processing style depending upon the approach motivation associated with the mood (Price & Harmon-Jones, 2010). Consider, for example, seeing a delicious meal—an event associated with positive affect. This event should generate high approach motivation if you have not yet eaten, but low approach motivation after you have recently enjoyed a meal. Experiencing high approach motivation should narrow processing to the specific target of the motivation (i.e., the food), while experiencing low approach motivation should broaden one's processing beyond focusing on the attractive food stimuli.

Mood effects on processing style are also *interpreted* in a variety of ways. The biases are sometimes described in ways that, like the depressive realism perspective, emphasize the more accurate processing of sad individuals (Alloy & Abramson, 1979; Forgas, 1998a; Sinclair & Mark, 1995). However, there are also studies that focus on benefits associated with a happy mood including increased creativity and flexibility (Baas et al., 2008; Baumann & Kuhl, 2005; Forgas, 1998b). These differing interpretations are much less prominent than in the mood congruency literature, and the value of each processing style is generally acknowledged. The difference in processing styles is typically discussed as reflecting a strategy for meeting the goals that are indicated by the specific mood. Specifically, a sad mood may indicate that there is a problem and that a more systematic, detailed processing style may be beneficial to identify opportunities to improve the situation. In contrast, a happy mood would indicate that things are going well and that use of a holistic processing style will be more efficient.

Summary of processing style effects. Mood influences both what and how we process information. A happy mood is often associated with global or holistic processing that involves top-down assimilation of information into existing theories about the world. This processing style will emphasize the most salient information at the expense of the finer details. In contrast, a sad mood is often associated with local or detail-oriented processing style that involves bottom-up accommodation of theories to fit with the specific information being presented. These effects may vary with both the informational value and the motivation associated with the mood.

Facial Stimuli

Although a range of emotional stimuli has been used in research on mood effects—including words, stories, pictures, and autobiographical memories—the most widely used stimuli are pictures of human faces. Because this work is of direct relevance to the research described in this dissertation, it is important to review some of the relevant literature here.

Human faces are among the most complex, socially relevant stimuli in our environments. A quick glance at a face can provide information about a person's age, sex, health, mood, fleeting emotions, and possibly even personality (Ekman, Friesen, & Ellsworth, 1982). People have considerable expertise in detecting faces, recognizing faces as familiar, and making judgments based on information obtained from analyzing faces under a wide range of conditions, such as under different lighting conditions and from different viewpoints (Rhodes, Brake, &

Taylor, 1989). These judgments are important to human functioning in terms of sexual selection, self-protection, and communication. Facial expressions are important for reading another's emotional state. These expressed emotions can signal things such as danger, interest, contempt, or love. The expressions observed for the basic emotions are similar across cultures (Bimler & Kirkland, 2001; Yik & Russell, 1999), in non-human primates (Waller & Micheletta, 2013), and in blind and non-blind participants in similar situations (Galati, Miceli, & Sini, 2001). Emotional information presented in faces is processed very quickly and is extremely difficult to ignore (Stenberg, Wiking, & Dahl, 1998). Both the automaticity of processing facial expressions and their social relevance contribute to the fact that mood congruency effects seen with facial stimuli are larger than those seen with other stimuli such as words. Because there are gender-based norms related to facial expressions, it is possible that the processing of stereotype-consistent and stereotype-inconsistent information could also be examined with the use of expressive faces. Although there are beliefs about gender norms for a range of emotions or expressions, the most consistent gender or sex differences occur for smiling. Specifically, females smile more often than men (LaFrance, Hecht, & Paluck, 2003) and smiling faces are viewed as more feminine (Hess, Jr, Grammer, & Kleck, 2009). Therefore, in the context of this thesis, smiling female faces and frowning male faces could be considered to be stereotype consistent and frowning female faces and smiling male faces could be considered to be stereotype inconsistent.

Studying facial processing also allows for an examination of mood related processing style effects. Faces are typically processed in a holistic, configural manner, but can also be processed at a more local, feature-based level (Marotta, McKeeff, & Behrmann, 2002; Rhodes et al., 1989). Some researchers have even used local processing of facial features as a measure of attention switching (Mokhtari & Buttle, 2015). In this study, disengagement from global stimuli was slower for sad than happy faces, although mood of the participants had few effects. There is also some evidence that a negative emotional state decreases holistic processing of faces (Curby, Johnson, & Tyson, 2012). The processing style one adopts can be manipulated through inverting the faces (Rhodes et al., 1989), asking for a verbal description of the faces (Halberstadt, 2005), or using other-race faces (Rhodes et al., 1989). Facial processing can also be manipulated and studied using spatial filtering—a procedure that impacts early visual processes that extract information from luminance contrasts. Through this filtering process, specific spatial frequencies (sinusoidal grids with varying frequencies and orientations) can be removed from an image (De Valois & De Valois, 1988). The low spatial frequency (LSF) bands carry basic structural, holistic information, whereas the high spatial frequency (HSF) bands carry detailed, local information such as fine lines. Performance on matching faces using configural information is superior for LSF than HSF stimuli and using featural information performance is superior for HSF than LSF stimuli (Goffaux, Hault, Michel, Vuong, & Rossion, 2005). This finding, along with reduced holistic effects for whole-part advantage and composite face procedures (Goffaux & Rossion, 2006), supports the compatibility between HSF and local processing and LSF and global processing. Integration of different spatial frequencies generally functions more effectively by working from LSF to HSF information, but processing can occur in either direction and will depend on the specific task (Oliva & Schyns, 1997; Parker, Lishman, & Hughes, 1996; Schyns & Oliva, 1997).

In parallel to the ideas of a happy mood improving global processing, there seems to be an association between LSF and happy stimuli. Researchers have found increased effects of positive priming when happy faces were presented in LSF as opposed to HSF (Phaf, Wendte, & Rotteveel, 2005), as well as faster and more accurate responding to happy faces presented in LSF as opposed to sad faces in LSF or happy faces in HSF (Kumar & Srinivasan, 2011). Similarly, Srinivasan and Hanif (2010) found improved identification of happy faces after a global prime and improved identification of sad faces after a local prime.

In the studies just described, the amount of LSF and HSF information in the faces was systematically varied. An alternate approach that could be used to explore interactions between processing style and mood effects is to put LSF and HSF information in faces in direct competition with each other. This can be done by taking two face images, filtering them for different spatial frequencies, and then overlaying them to create one hybrid image (Schyns & Oliva, 1999). These images resemble real life stimuli more than those presented in only high of low spatial frequencies (Ruiz-Soler & Beltran, 2006).When presented for a short duration of approximately 30 to 70 ms, viewers tend to perceive only one face consciously. By noting whether the viewer tends to report seeing the LSF or HSF face across trials, one can assess his or her bias to engaging in global or local processing, respectively.

The processing style can be manipulated by changing what facial characteristics are relevant for the task. This procedure can then be used to examine processing when different processing styles would be dominant. Using hybrid facial stimuli, Schyns and Oliva (1999) determined that by changing the judgment task they could alter participants' spatial frequency biases. When the task required determining whether a face was male or female, participants demonstrated no spatial frequency bias; when determining whether a face was expressive or non-expressive, there was an HSF bias; and when determining the specific emotional expression communicated by the face (happy, angry, or neutral) there was an LSF bias (Schyns & Oliva, 1999). Based on the literature reviewed above, these results suggest that the task of identifying whether a face is expressive or not involves local processing, whereas the task of identifying a particular expression relies more on global processing. It is important to note, however, that the majority of the research to date using spatial filtering with faces—particularly using hybrid faces—has incorporated faces displaying angry or frightened facial expressions. Anger and fear are both of high importance to survival and therefore may be processed in a unique manner. LSF information appears to be processed to a greater degree unconsciously and is important for quick responding to threats (Vuilleumier, Armony, Driver, & Dolan, 2003; Winston, Vuilleumier, Dolan, & Winstone, 2003). Angry faces presented in LSF have greater emotional impact (Phaf et al., 2005; Vuilleumier et al., 2003) and LSF information provides better information for categorizing fear in faces compared to HSF information (Mermillod, Vuilleumier, Peyrin, Alleysson, & Marendaz, 2009). Given this, it is unclear whether Schyns and Oliva's (1999) results would generalize to all negative emotions, or how hybrid stimuli not comprised of angry/fearful faces would be processed.

Theories of Mood Influences on Cognition and Perception

A number of theories have been developed to explain the mood effects discussed in the previous section. Most of the theories have focused on the mood congruency effect, although some are beginning to incorporate processing style effects. One of the first theories developed to explain mood congruency was the *associative network theory* (Bower, 1981), which evolved into the *affect priming theory* (Bower & Forgas, 2000). Both theories use the concept of a network composed of nodes that are connected with varying degrees of strength. Activation at one node spreads through the connections and can either activate other nodes directly, or lower the threshold for other nodes to be activated. This architecture can be used to explain mood congruency effects. For example, when a sad mood is present it would activate networks associated with sadness, which would make information that was encoded as being associated with sadness (e.g., frowning faces) easier to retrieve (Bower & Forgas, 2000). Some support for this theory comes from an fMRI study showing that emotionally relevant brain regions activated during encoding predict later mood congruent memories (Lewis, Critchley, Smith, & Dolan, 2005). Specifically, there was increase activation at study and test in the subgenual cingulate for positive words and the right posterior lateral orbitofrontal cortex for negative words with congruent mood and stimuli. These models were developed to explain mood congruency and can provide a parsimonious explanation of positive results that occur in attention, memory, and higher-order decision-making. However, these types of theories have difficulty explaining the inconsistency of mood congruency effects, and the fact that different moods are associated with different processing styles.

Other theories have taken a cognitive construction approach. An example is the *affect as information model* (Clore & Huntsinger, 2009; Schwarz, 2001), which uses an attribution process to explain mood effects. The model is built around the *affective immediacy principle,* which states that affect is experienced as related to current mental content (Clore, Wyer Jr., et al., 2001). Therefore, mood will have different effects depending upon the specific focus, whether it is interpreting a facial expression or determining how satisfied one is with a choice or how one is performing at a task. This model predicts mood effects only when the mood is experienced as being related to the task, and is viewed as a reliable source of information (Clore, Wyer Jr., et al., 2001). For example, individuals in a sad mood will generally give lower ratings for life satisfaction (Schwarz & Clore, 1983) presumably, in part, because being sad can be viewed as a source of information that one is not satisfied with one's life. However, if an alternate explanation for the sad mood is provided—one that is unrelated to overall life satisfaction, such as poor weather—then the mood effect should disappear (Schwarz & Clore, 1983).

According to the affect as information model (Clore & Huntsinger, 2009; Schwarz, 2001), mood will also influence one's processing style when used as information about the current strategy or situation. Based on the *affect processing principle,* a happy mood will support use of the most accessible processing strategy (Clore, Wyer Jr., et al., 2001), namely the more dominant strategy in a specific situation. In contrast, a sad mood will provide information that the most accessible strategy is likely *not* a good fit to the current situation, and will suppress use of this strategy and support the adoption of an alternative way of processing information. Therefore, a specific mood will not cause one to adopt a specific processing style (e.g., global or local), but instead will increase or decrease the use of the default processing strategy in a particular context. For example, as previously discussed, participants typically use more global processing on the Kimchi task (Kimchi & Palmer, 1982). A happy mood supports global processing in this task, whereas a sad mood increases the use of local processing (Gasper & Clore, 2002). However, this finding can be reversed by priming local processing (Huntsinger et al., 2010). When local processing is primed, it becomes the default processing style. In this context, a happy mood increased local processing and a sad mood increased global processing. A more recent term for this approach is the cognitive malleability approach (Isbell, Lair, & Rovenpor, 2013), which focuses on processing style and highlights the flexibility of the relationships between affect and cognition with varying contexts.

One other prominent model, the *affect infusion model,* was developed in an attempt to integrate the network and cognitive construction models in order to explain how affect influences perception, cognition, and executive functioning (Forgas, 1994). Forgas (2001) identifies four main processing strategies that have different susceptibility to affect infusion: 1) direct processing, 2) motivated processing, 3) heuristic processing, and 4) substantive processing. As will be illustrated below, the first two strategies will have relatively low affect infusion and the last two will have high affect infusion.

According to the affect infusion model, a number of factors determine the type of processing that will be used, including stimulus familiarity, complexity, and typicality, personal relevance, specific motivation (e.g., accuracy, mood repair), cognitive capacity, situational pragmatics, and individual differences (Forgas, 2001). If all other factors are held constant, individuals will use the simplest processing strategy possible for the situation, from direct processing up to substantive processing (Forgas, 2000). Direct processing is used when the information needed is stored in knowledge structures, when the task is highly familiar, when there is no specific motivation, and when there is little or no personal involvement (e.g., responding to the question, “Where do you live?”). Motivated processing occurs when there are strong, preexisting motives to process information in a specific way, such as when there is a large incentive for accuracy. Strong personality traits can also lead to motivated processing, as discussed in more detail below. Heuristic processing occurs when knowledge cannot be directly accessed, there is no specific motivation to process the information in a specific manner, the task is relatively simple or typical, there is little personal relevance, and/or cognitive capacity is limited. For example, providing a colleague with an opinion about a restaurant before an important meeting will likely activate heuristic processing. Finally, substantive processing is the most elaborative type of processing, requires the most resources, and occurs when an individual needs to learn or interpret new information. It is more common when the task is novel and complex, there is no specific motivation, there are adequate cognitive resources, and/or there is personal relevance (Forgas, 2000). For example, substantive processing would be engaged when you were interpreting the reaction of your boss during an important presentation.

Forgas (2002) also acknowledges that mood influences processing style, with positive mood leading to more top-down processing and negative mood leading to more bottom-up processing. However, the model does not clarify how and when these effects will occur or how they interact with mood congruency effects. The inclusion of processing style as both a cause and effect of mood biases is problematic and has not been adequately addressed in the affect infusion model. Similarly, research testing the model generally makes assumptions about the type of processing that will be engaged in during a specific task, and results are then used to validate the occurrence of the specific type of processing. Despite claims of parsimony, the affect infusion model makes additional assumptions about processing that do not increase its explanatory value above that of the revised affect as information model. It also fails to provide an adequate explanation of the inconsistencies seen in both mood congruency and processing style effects. However, the affect infusion model does identify a number of factors that affect whether or not mood effects will occur, and these could be reexamined from an affect as information perspective.

Personality and Mood Effects

The influence of personality on cognition has been studied both as an independent factor and as a moderator of mood effects. There is a body of literature parallel to that of mood congruency examining trait-congruent processing (Barrett & Niedenthal, 2004; Mayo, 1989; Rusting & Larsen, 1998; von Hippel, Hawkins, & Narayan, 1994). Trait neuroticism has been linked to increased processing of negative stimuli, and extraversion has been linked to increased processing of positive stimuli (Gomez, Gomez, & Cooper, 2002; Mayo, 1989; Rafienia, Azadfallah, Fathi-Ashtiani, & Rasoulzadeh-Tabatabaiei, 2008; Rusting & Larsen, 1998). Although the focus in the personality literature is more often on trait-congruency, there is some research examining processing style (Basso, Schefft, Ris, & Dember, 1996; Kossowska & Nęcka, 1994; Yovel, Revelle, & Mineka, 2005). It appears that a local or analytical processing style (i.e., systematic and detail oriented) may be more common among individuals with high neuroticism, and a global processing style may be more common among individuals with high extraversion (Kossowska & Nęcka, 1994). However, trait neuroticism and extraversion are also associated with increased experiences of negative and positive affect, respectively (Costa & McCrae, 1980; Zelenski & Larsen, 1999). Therefore, the differences in processing could be due to state mood as opposed to personality traits more broadly.

Rusting (1998) recommended that studies include state and trait measures of affect to better understand the inconsistencies that occur in both the mood congruent and trait congruent literatures. There are a number of different ways that personality and mood could interact to influence cognitive functioning. The most obvious way is that personality could influence mood, which would, in turn, then affect cognition. In support of this, personality does appear to alter the effectiveness of mood induction procedures; thus sad mood inductions are more effective for individuals with high trait neuroticism, and happy mood inductions are more effective for individuals with high trait extraversion (Rusting & Larsen, 1997; Zelenski & Larsen, 1999). However, there are also studies that have found personality effects independent of state mood (Mayo, 1989; Rusting & Larsen, 1998).

An alternate perspective on the interaction between mood and personality comes from the affect infusion model, which includes personality factors as moderators that lead to motivated processing (Forgas & Ciarrochi, 2001; Forgas, 1998b). For example, both individuals high on Machiavellianism (a tendency to manipulate others for personal benefit), and those high on need for social approval, were less influenced by mood than those who were lower on those trait measures when examining negotiation strategies (Forgas, 1998b). Instead, these individuals were consistent in the negotiation strategies (uncooperative and cooperative, respectively) for a given situation across happy and sad moods. In contrast, other traits may lead to greater effects of mood, such as high openness to feelings (Forgas & Ciarrochi, 2001). These traits, and others (e.g., trait anxiety, social desirability, self-monitoring, need for approval, and self esteem; Forgas, Laham, & Vargas, 2005; Li, Zinbarg, Boehm, & Paller, 2008; S. M. Smith & Petty, 1995) have been examined to define the boundary conditions for when mood effects will occur. However, independent effects of the traits or more complex interactions are not addressed within the affect infusion approach.

Other theoretical perspectives have addressed the interactions between mood and personality by focusing either on the congruence or incongruence between mood and trait (Robinson & Clore, 2002; Tamir, Robinson, & Clore, 2002; Tamir & Robinson, 2004). These approaches focus on the traits of neuroticism and extraversion because of the close link to negative and positive affect, respectively. Generally there are larger mood/trait effects when there is mood/trait congruence (Rafienia et al., 2008; Rusting, 1999; Tamir et al., 2002; Tamir & Robinson, 2004). Robinson and Clore (2002) describe the accessibility model that attempts to define when mood effects and when traits effects will occur. Mood effects will occur when there is information available in the form of a state mood that directly relates to the situation, judgment, or task in question. However, when the current mood is not relevant, the individual will rely on beliefs that they hold about the specific situation (e.g., scripts, stereotypes). If situation beliefs are not relevant, then the individual will use identity beliefs (i.e., personality). From this perspective, personality can be viewed as the default processing mode in the absence of more specific and relevant information (Robinson, Solberg, Vargas, & Tamir, 2003).

The affect certainty model takes the idea of both personality and mood as information one step further and explores what it might mean to have state and trait match or mismatch (Tamir et al., 2002). The first assumption is that personality traits could be viewed as beliefs about one's general disposition and interactions with the world. From this perspective, individuals with high extraversion would believe that they are generally happy and social people. In contrast, individuals with high neuroticism would believe that they are often unhappy people. When trait and state affect are incongruent, individuals will experience a sort of dissonance because one of their beliefs is inconsistent with current evidence. This incongruence will therefore require more effortful processing, reducing the efficiency of cognitive processes (Tamir et al., 2002; Tamir & Robinson, 2004). However, there are few predictions of specific biases when trait and state are incongruent, other than less efficient processing. These perspectives offer a valuable starting point for examining trait-state interactions, but have not yet been fully integrated into a more complete framework to explain mood effects.

Work on the affect as information model acknowledges that there will be moderating effects of personality, but to date these effects have not been explicitly incorporated into the model. One possible way that personality could be conceptualized within an affect as information framework is to build on the accessibility model view of personality as a default processing mode, and to view mood as information within that context. From the affect certainty model, congruency between trait and state may signal that the situation is as expected, and that one should therefore continue with the default processing style. However, incongruence may signal that a shift in processing could be warranted. Among individuals with high extraversion, a sad mood may indicate that things are not going as well as expected and that an alternate processing strategy should be considered. The predictions for high neuroticism are less clear; a positive mood may indicate that things are better than expected and that one should either continue with the default processing style, or perhaps relax and explore alternate information or processing styles.

Overview of the Experiments

In the current series of studies, I tested the **affect as information model** for both mood congruency and processing style effects in immediate perception and memory. I also explored how personality variables might fit within the affect as information framework. I used a procedure adapted from Schyns and Oliva (1999) involving hybrid faces because it allowed me to simultaneously assess viewers' bias to perceive faces of a particular sex (male, female) or facial expression (smiling or frowning), or to adopt a particular processing style (local or global) as reflected in a bias for HSF or LSF information. Participants either made a judgment of face gender (female or male) or a judgment of facial expression (happy or sad) for each hybird face. By manipulating the judgments or the task that participants engaged in, I was able to change the default SF bias or dominant processing style. Comparing processing in the different tasks then allowed me to test affect as information claims regarding how mood influences or interacts with viewers' dominant information-processing style (Clore & Huntsinger, 2009).

Experiment 1 provided information about the dominant tendencies for each perceptual judgment task in terms of biases for face gender, facial expression, and spatial frequency. In contast to previous experiments that have including angry or fearful faces, I investigated task effects with smiling and frowning faces in order to examine mood congruency specific to happy and sad moods. A memory task was also added to the procedure and basic findings were noted. Finally, exploratory analyses of unmanipulated mood, arousal, stress, and personality measures were completed. These results were used to guide the analyses and interpretation of the next two studies. Experiment 2 examined the impact of a mood induction on the same procedural tasks. Specifically, mood congruency and processing style biases were examined, as well as an exploratory assessment of stereotype-consistent and stereotype-inconsistent processing. The results were used to compare traditional theoretical approaches that predict specific directional effects with happy and sad moods to the affect infusion model that predicts different effects when there are different dominant tendencies for a specific context. Finally, Experiment 3 examined the impact of longstanding depressive symptoms on perception and memory of faces using the same procedural tasks.

Broadly speaking, I predicted that mood would modify the preexisting effects of stimuli and judgment task rather than leading to a specific type of processing such as mood-congruent processing or global to local processing. I predicted that positive affect, as indicated by baseline high mood, happy mood induction, healthy community members, and high scores on extraversion or low scores on neuroticism, would support preexisting processing effects. In contrast, negative affect, as indicated by baseline low mood, sad mood induction, depression symptom group membership, and low scores of extraversion or high scores on neuroticism, would suppress or reverse preexisting processing effects. This pattern could present in terms of mood congruency, spatial frequency bias, and/or gender stereotype consistent or inconsistent processing. More specific predictions will be detailed in the introduction to each study. A comprehensive discussion of the results was left for the general discussion because the largest implications for the findings and clearest interpretations could be made when examining the three experiments as a set. Because there are a number of different factors associated with mood that were examined in this set of experiments, Table 1 summarized the main findings for happy and sad moods for quick reference.

Table 1

Summary of main findings in the literature for happy and sad moods

	Happy Mood	Sad Mood	Example Reference(s)
Mood Congruency	Quicker disengagement from sad faces compared to sad mood	Sustained attention to sad faces compared to happy mood	(Gotlib, Kasch, et al., 2004)
	Increased perception of positive stimuli	Increased perception of sad stimuli	(Halberstadt et al., 2009; Niedenthal & Setterlund, 1994)
	Better memory for happy stimuli that is socially (faces) or personally (autobiographical) relevant	Better memory for sad stimuli that is socially (faces) or personally (autobiographical) relevant	(Ridout et al., 2009)
Processing Style	Global processing	Local processing	(Gasper & Clore, 2002)
	Top-down processing	Bottom-up processing	(von Hecker & Meiser, 2005)
	Stereotype-consistent processing	Stereotype-inconsistent processing	(Forgas, 1995b)
	Dominant processing	Non-dominant processing	(Hunsinger et al., 2012)
Personality Traits	High Extraversion	High Neuroticism	(Zelenski & Larsen, 1999)

Chapter 2: Experiment 1

Experiment 1 provided an initial examination of the perception and memory procedures with happy and sad faces. The results represent baseline performance and were used to guide the subsequent experiments. There were four main goals for this experiment. The first goal was to examine spatial frequency biases for different tasks with happy and sad faces. There is evidence that the use of spatial frequency information interacts with the task being performed (Ruiz-Soler & Beltran, 2006; Schyns & Oliva, 1999). The procedure for these experiments was based on the research of Schyns and Oliva (1999) that identified an LSF bias for the task of discriminating the specific facial expression being displayed, an HSF bias for the task of distinguishing expressive or neutral, and no advantage for one type of SF information over another for the task of identifying face gender (when there was not previous exposure to a different task). However, the hybrid images used by Schyns and Oliva (1999) included happy, angry, and neutral faces as opposed to happy and sad faces. The majority of studies using these types of stimuli to date have included angry or fearful faces, which may be associated with specific processing strategies. Anger and/or fear displayed in a face are signals for danger, which is important to detect quickly in order to avoid potential threats (Fox et al., 2000). LSF components have been identified as providing the best source of information for categorizing fear in a face (Mermillod et al., 2009).

In the present experiment, I compared three separate hypotheses about the relationship between task and use of spatial frequencies. First, if the task alone determines the use of spatial frequencies, then this experiment would result in an LSF bias for the expression task. However, if the information value of the facial expression affects the use of spatial frequencies, then this experiment could result in an HSF bias as seen in previous research for the task of distinguishing expressive or neutral faces. A third possibility is that there could be an interaction between the spatial frequency and facial expression. There would be two possible directions for this interaction. Based on studies using angry or fearful faces, there could be an LSF bias for frowning faces and an HSF bias for smiling faces. However, based on the literature on affect and processing style, the predicted interaction would be an HSF bias for frowning faces and an LSF bias for happy faces. For the gender task, I expected to find no spatial frequency bias, consistent with previous research (Schyns & Oliva, 1999).

The second goal of this experiment was to examine biases for other stimulus characteristics, particularly facial expressions, which have not been previously tested using this procedure. Although I did not manipulate mood, I expected participants to be in a generally positive mood based on previous studies of baseline mood (Diener & Diener, 1996). Therefore, I expected to find a slight bias towards perceiving smiling faces (Fiedler et al., 2001). I expected this bias to be stronger in the expression task because of the explicit focus on the mood relevant information. Although the examination of gender stereotype congruent and incongruent faces is highly exploratory, it is possible that faces consistent with gender stereotypes (i.e., female smiling and male frowning) would be preferentially perceived.

The third goal of the experiment was to examine recognition memory for the individual faces that comprised the hybrid images. I am not aware of any other study that uses the hybrid perception task along with a memory task. This experiment was designed to test the viability of examining memory for these stimuli; this could be beneficial as mood effects have been more consistently found in research examining memory as opposed to perception and attention (Yiend, 2010). Similar to the expectations for the perception data, I expected participants to be more accurate at discriminating between old and new instances of smiling compared to frowning faces, and possibly to show a liberal response bias towards smiling faces. Due to the fast presentation rate, gender stereotype consistent faces may also be recalled more than faces that are inconsistent with gender stereotypes. I included a passive viewing condition to provide a control group and determine if there were inherent biases for the stimuli. I predicted that the participants in the passive viewing condition would have similar memory responses to those in the gender judgment task group, which I expected would not generate a significant spatial frequency bias.

Finally, the fourth goal of Experiment 1 was to begin exploratory analyses of mood effects and individual difference variables. I examined interactions with mood, arousal, stress and personality measures to identify variables that might moderate the relationships between task and performance on the perception and memory tasks. Because mood was not manipulated or selected for in this experiment, I did not expect large variation in mood scores. Therefore, I expected to find few effects of mood on the results. However, some of the personality measures could potentially act in a similar manner to mood. Because neuroticism represents a vulnerability to negative emotions, I expected higher scores on this measure to be associated with a bias towards perceiving/remembering frowning faces, which would represent trait-congruent processing. Conversely, extraversion has been linked to positive affect (McCrae & John, 1992). With the additional emphasis on social rewards, I expected higher scores on extraversion to be associated with a bias towards perceiving/remembering smiling faces. With respect to the effects of personality on spatial frequency bias, there are two possible directions of effects. Based on traditional views of affect and processing, positive affect could lead to more global processing and a LSF bias and negative affect could lead to more local processing and a HSF bias. This hypothesis would be supported if high extraversion led to a bias towards LSF faces and high neuroticism a bias towards HSF faces, which would be consistent with trait-congruent processing. The affect infusion model would predict that these effects would be more likely to occur in the gender task, which would be unbiased with respect to spatial frequency. Alternatively, the traits could modify the already existing biases in line with the affect as information approach. From this approach, positive affect would support and negative affect would inhibit the dominant processing style. This hypothesis would be supported if high extraversion enhanced existing spatial frequency biases and high neuroticism reduced or even reversed existing biases.

Methods

Participants

A final sample of 62 participants (38 women, 24 men, M_{age} = 19.7 years, age range: 17-26 years) was recruited from the Introduction to Psychology research participant pool at the University of Manitoba. Participants received credit toward an optional course requirement in exchange for their voluntary participation in the study. All participants were required to have normal or corrected-to-normal vision to control for distance effects on spatial frequency processing. Their visual acuity was confirmed at the beginning of the experiment using a near vision testing card (accessed from http://www.i-see.org/block_letter_eye_chart.pdf; Schneider, 2002). Before beginning the experimental trials, participants were screened for possible facial processing impairments using the protocol described below. Participants who did not pass either of the screening measures were told that they had participated in pilot testing for a future set of experiments and were thanked for their time.

Stimuli

The face images were generated from 128 X 128 pixel, grey scale photographs of 104 individuals obtained from the Bosphorus database (Savran, Sankur, & Bilge, 2010). Their expressions were coded with the Facial Action Coding System (Ekman & Friesen, 1978). The images were taken under controlled lighting and at consistent angles. Hair was covered with a headband. Facial hair and identifying marks were digitally removed using the public domain Image J program (http://rsbweb.nih.gov/ij/). Each photograph was converted into a 32-bit black and white image with contrast and brightness levels normalized. The faces were aligned so that the eyes of the individuals in the photographs were in similar positions to make the hybrid images appear as natural as possible, using the public domain JPsychoMorph software (http://cherry.dcs.aber.ac.uk:8080/wiki/jpsychomorph). Pilot testing was used to select 40 male and 40 female faces that could be correctly classified by gender at least 80% of the time after spatial filtering when presented for 50 ms. Each individual face was depicted in one photograph showing either smiling or frowning and was filtered for either HSF information or LSF information using a bandpass filter in Image J (Walker, 1996). Each of the 80 pictures had three different characteristics: gender (male or female), spatial frequency (high or low), and facial expression (smiling or frowning). Table 1 outlines the eight different face types that can be made from combinations of these characteristics. I combined faces that differed with respect to all three characteristics to create 10 of each of the four possible hybrid types (see Table 2), for a total of 40 hybrid images. These images were presented in random order. Example facial stimuli can be found in Figure 1. Face stimuli were presented on a Dell computer system with a 17-inch flat screen monitor, using the narrow screen setting at a viewing distance of approximately 2 feet.

Table 2

Eight individual face types making up four hybrid types

	Hybrid 1	Hybrid 2	Hybrid 3	Hybrid 4
Image 1	**HSF** Female *Frowning*	**HSF** Female *Smiling*	**HSF** Male *Frowning*	**HSF** Male *Smiling*
Image 2	**LSF** Male *Smiling*	**LSF** Male *Frowning*	**LSF** Female *Smiling*	**LSF** Female *Frowning*

Figure 1. Example facial stimuli. Top left is a low spatial frequency sad male. Top right is a high spatial frequency happy female. Bottom is the hybrid image created from merging the above faces.

Measures

Face processing screener. Baron-Cohen, Wheelwright, and Jolliffe (1997) developed the face processing screener for identifying facial processing deficits in individuals with autism spectrum disorders. The task consists of 20 photographs of a single female actor; 10 of the photographs depict *basic* emotional expressions (*happy, surprised, angry, sad, afraid, disgust,* and *distress*; with the first three expressions each being displayed in two different poses) and 10 depict *complex* mental states (*scheming, guilt, thoughtful, admiring, quizzical, flirting, bored, interested,* and *arrogant*; with *interested* being depicted in two different poses). Under each photo, two words are presented: a target word and a foil in the same superordinate semantic category as the target (i.e., if the target was a basic emotion, then so was the foil). Individuals who have an autism spectrum disorder perform significantly worse on this task than individuals without an autism spectrum disorder (Baron-Cohen et al., 1997).

In the current study, participants who incorrectly identified more than two of the expressions did not continue with the experiment (n = 6). This cutoff corresponds to approximately one standard deviation below the mean performance of normal adults and one standard deviation above the mean for individuals with an autism spectrum disorder (Baron-Cohen et al., 1997). In the current sample, the proportion of individuals not meeting the cutoff was approximately average for the task.

Affect Grid. The Affect Grid (Russel, Weiss, & Mendalsohn, 1989) is a visual measure presented in a 9 X 9 grid representing pleasure/displeasure and arousal/sleepiness. Participants mark one square that best represents how they currently feel on both dimensions. The Affect Grid has demonstrated adequate convergent and divergent validity, as well as high split-half reliability (Russel et al., 1989).

NEO Five-Factor Inventory (NEO-FFI-3). The NEO-FFI-3 (McCrae & Costa, 2004) is a 60-item inventory that consists of five scales: neuroticism, agreeableness, conscientiousness, extraversion, and openness. The inventory takes roughly 10-15 minutes to complete. This measure has been shown to provide reliable, valid estimates of five personality factors, and can be used in different cultures and contexts (McCrae & Costa, 2004). The neuroticism and extraversion scales were used for the purpose of this and subsequent studies. The internal consistencies (Cronbach's *a*) of extraversion and neuroticism for this sample were .76 and .69, respectively.

Perceived Stress Scale. The participants answered 10 questions about their thoughts and feelings during the last week to assess their perceived stress with scores that range from 0 to 40. The perceived stress scale (Cohen, Kamarck, & Mermelstein, 1983) is a widely used psychological measure that predicts depressive and physical symptomatology, utilization of health services, and social anxiety. The internal consistency (Cronbach's *a*) of the PSS in this sample was .78.

Procedure

Sixty-two participants (final sample) were randomly assigned to one of three task conditions: passive viewing (n = 20), gender judgment (n = 21), or expression judgment (n = 21). Upon arrival at the laboratory, participants read and signed a consent form (see Appendix A) and then completed the near vision eye test and facial screening test. Participants who passed the screening measures moved on to the experimental procedure, which was administered on the computer.

Experimental sessions began with participants rating their mood and arousal on the Affect Grid, followed by the completion of the NEO-FFI-3 and the PSS. Next, they were given instructions to focus on the centre of the screen and watch for an image of a face. In the judgment test block, 20 hybrid faces (5 of each type) were presented in a random order. A fixation cross was displayed for 1.5 s in the centre of the screen prior to each hybrid face being displayed for 70 ms. This display duration was selected based on pilot testing, which showed that 50 ms was the ideal presentation time for the judgment task and 90 ms was ideal for the memory task. By using a display time of 70 ms, most participants reported seeing only one face, there was variation in the face that they perceived, and the memory task was still possible. A third of the participants responded to each face with a judgment of either male/female, another third made a judgment of happy/sad, and the final third of the participants passively viewed the hybrid faces without making any judgment. When judgments were required, the words male and female (gender task), or happy and sad (expression task) were displayed in the bottom left and right corners of the screen and participants used a key press to indicate their response on each trial. The locations of the words associated with each specific judgment were counterbalanced across participants.

After the first block of hybrid faces was presented, the participants completed a memory task using all 40 of the individual faces used to create the hybrids shown in the judgment phase, along with 20 novel faces. In the former set, the facial expression of the individual depicted was consistent with that used in the hybrid image in the judgment tasks. Each face presented in the memory task was filtered once for low spatial frequencies and once for high spatial frequencies, and the resulting images were then averaged. This process created a face that was more similar to the image seen in the perception task than either a full-frequency or high/low frequency face alone. Each face was presented for 70 ms followed by presentation of the words “old” (i.e., seen during the judgment task) and “new” (i.e., not seen during the judgment task). The participants entered their judgments using a key press; key location was counterbalanced.

Following the memory test, sociodemographic and open-ended questions were asked. Finally, participants were debriefed and provided with a handout containing information about local mental health resources. The Psychology/Sociology Research Ethics Board at the University of Manitoba approved the study protocol.

Results

Perception Task

Each response of male/female or happy/sad was assumed to identify the individual face with the corresponding characteristic. Each identified face was examined with respect to all three facial characteristics (gender, facial expression, and spatial frequency). This interpretation is consistent with how the task has been used in previous research (Schyns & Oliva, 1999; Winston et al., 2003). The dependent variable for the analyses was an SF bias score equal to the difference between perception rates for the HSF and LSF faces for each hybrid type. For this measure, a score of 0 indicates that there was no bias towards seeing one type of face over the other for that particular hybrid, positive values indicate an HSF bias, and negative values indicate an LSF bias. For example, an SF bias score of .20 for Hybrid 1 would indicate that the viewer showed a bias to report seeing the HSF frowning female face, rather than the LSF smiling male face.

To evaluate the role of task on perception, a repeated measures ANOVA was conducted with task (gender judgment, expression judgment) as a between subject factor and facial expression (smiling, frowning) and face gender (male, female) as repeated measures. Here, the repeated measures represent qualities of the HSF images used to create the four types of hybrids (see Table 2). Note that the passive viewing condition was not included in this analysis because there is no way to determine which face the individual perceived in this condition. In this and subsequent studies described in this thesis, Bonferroni adjustments to the significance level were not used. Although the number of comparisons performed increased the probability of a Type I error occurring, a particular pattern of findings was expected, making alpha level adjustments (which would be appropriate for testing an omnibus hypothesis) overly conservative and inappropriate (Perneger, 1998). Rather than relying solely on significance testing, exact *p* values and estimates of effect size (partial eta squared) were presented (Hurlbert & Lombardi, 2012; Nakagawa, 2004).

I first examined the main effect of task to look for evidence of SF effects that would be consistent with those that have been previously described. There was a main effect of task, $F(1,40) = 23.70$, $p < .001$, $\eta_p^2 = .37$. Consistent with previous findings (Schyns & Oliva, 1999) no SF bias was present in the gender task ($M = -.06$) as demonstrated by the intercept of the stratified analysis (below), $F(1,20) = 0.93$, $p = .346$, $\eta_p^2 = .05$. In contrast, an HSF bias was present in the expression task ($M = .35$) as indicated by a significant intercept for the stratified analysis, $F(1,20) = 35.43$, $p < .001$, $\eta_p^2 = .64$. Although this finding runs counter to the LSF bias reported by Schyns and Oliva (1999) for their expression task, the expressions they used were happy, neutral, and angry. It may be important to consider the specific expressions being identified when assessing spatial frequency effects because different expressions may be processed in different ways. Specifically, anger and fear may be processed differently from sadness because of their evolutionary significance or because they are more arousing stimuli compared to either happy or sad faces. Differences in the stimuli change the context of the tasks and could change the value associated with different types of errors.

Spatial frequency bias scores also varied as a function of other facial characteristics, as evidenced by the presence of significant two-way interactions between face gender and facial expression, $F(1,40) = 8.55$, $p = .006$, $\eta_p^2 = .18$, and task and facial expression, $F(1,40) = 15.68$, $p < .001$, $\eta_p^2 = .28$. Both of these interactions had to be interpreted in the context of a significant three-way interaction between task, face gender, and facial expression, $F(1,40) = 5.17$, $p = .028$, $\eta_p^2 = .11$. To explore this interaction I conducted separate repeated measures ANOVAs for each task; these analyses are described below.

Gender judgment task. In the gender task, there was a significant main effect of facial expression, $F(1,20) = 9.37$, $p = .006$, $\eta_p^2 = .32$, which was interpreted in the context of a two-way interaction between face gender and facial expression, $F(1,20) = 9.19$, $p = .007$, $\eta_p^2 = .32$. When the HSF face was male (Hybrid Types 3 and 4), participants were more likely to perceive frowning faces, $F(1,20) = 17.66$, $p < .001$, $\eta_p^2 = .47$ (see Figure 2). There was no significant difference in expressions perceived when the HSF face was female. This result makes sense if one considers that although a frowning face would not indicate immediate danger, it could be perceived as a potential future threat that should be monitored carefully. The bias towards HSF frowning male faces is consistent with gender norms, whereas the bias towards LSF frowning female faces is inconsistent with gender norms. Therefore, the prediction that gender stereotype congrent faces would be perceived more often than stereotype incongruent faces recieves some support for HSF but not LSF faces.

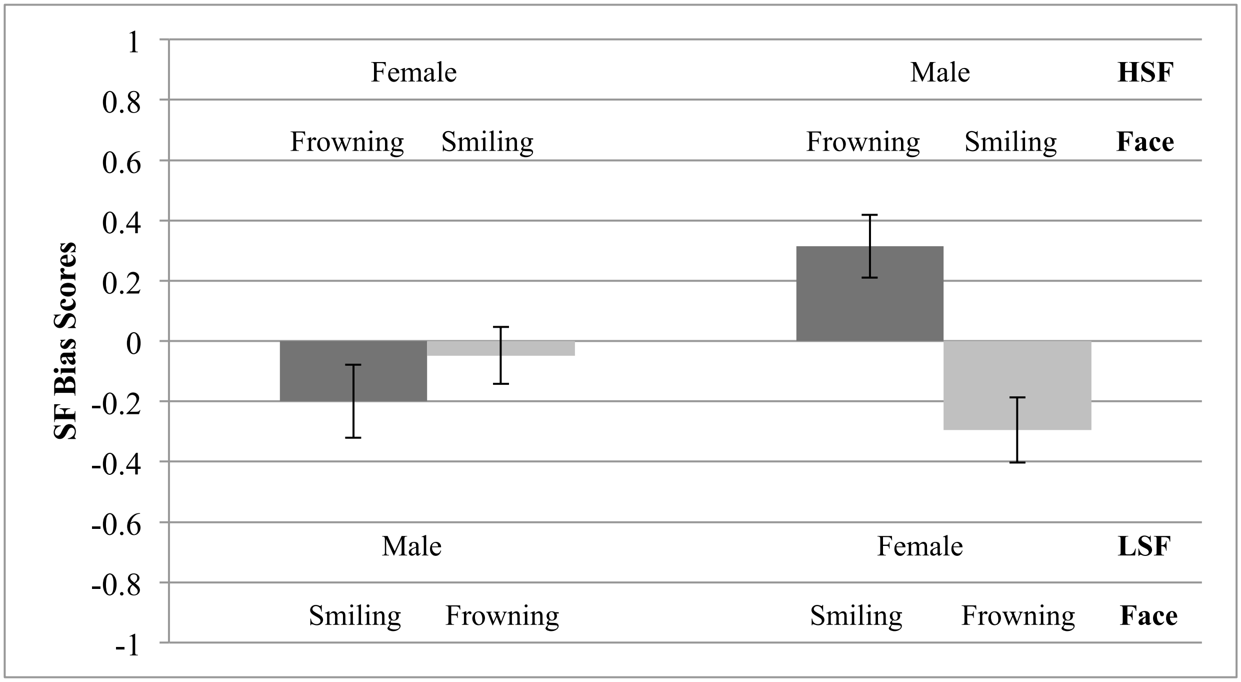

Figure 2. The interaction between face gender and facial expression in the gender perception task. Spatial frequency (SF) bias scores are presented with standard error bars.

Expression judgment task. The data for the expression judgment task are presented in Figure 3. As previously mentioned, this task had an overall HSF bias. There was also a significant main effect of facial expression in the ANOVA conducted on only the data from the expression task, $F(1,20) = 6.82$, $p = .017$, $\eta_p^2 = .25$. Participants perceived more smiling ($M_{Smiling}$ = 0.56) than frowning faces ($M_{Frowing}$ = 0.46), consistent with the Pollyanna Principle (Matlin & Stang, 1978). The fact that this smiling bias occurred only when the emotional information was emphasized by the task requirements is consistent with the prediction that mood congruency will only occur when valance is considered as relevant to the task (Clore et al., 2001; Eich, Macaulay, & Lam, 1997).

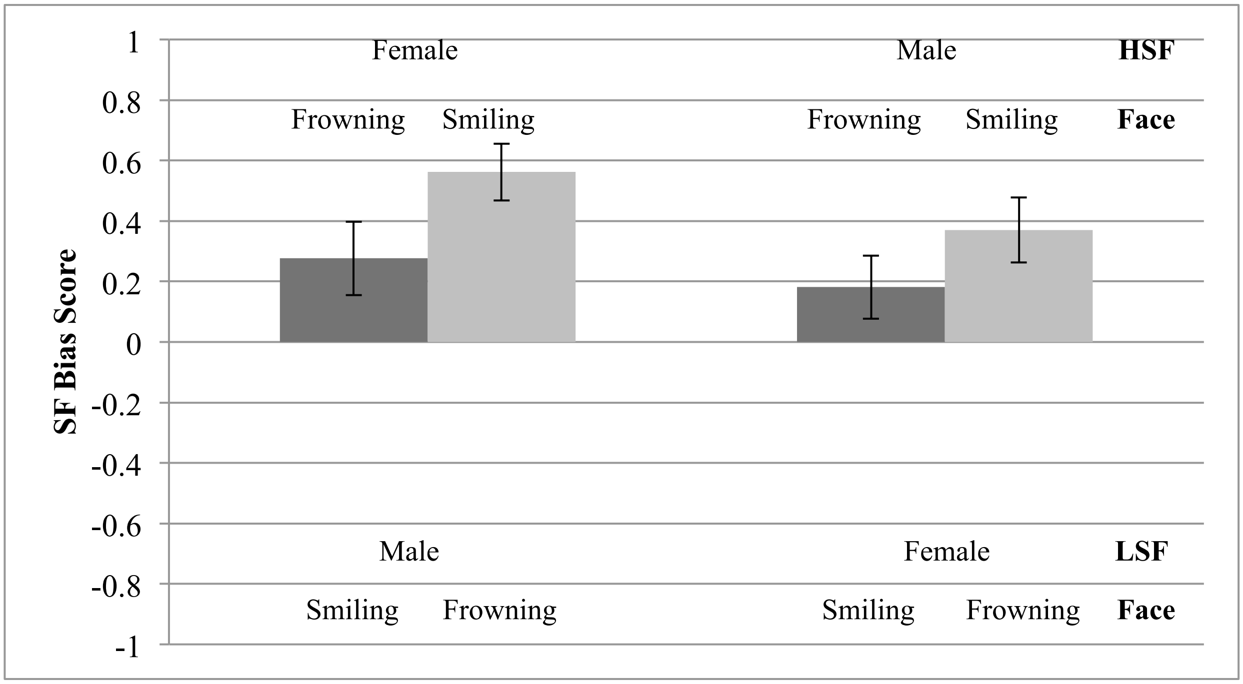

Figure 3. Spatial frequency (SF) bias scores for the expression perception task with standard error bars.

Memory Task

To confirm that participants were able to distinguish old from new faces, I conducted a repeated measures ANOVA examining responses to old and new faces. As expected, participants were more likely to rate a face that had been displayed as a part of a hybrid image in the perception task as being "old" than a face that had never been part of a hybrid image, $F(1,61) = 6.18$, $p = .016$, $\eta_p^2 = .09$.

To evaluate the role of task and facial characteristics on memory responses, two sets of repeated measures ANOVAs were conducted with perception task (gender judgment, expression judgment, passive viewing) as a between subjects factor and spatial frequency (high, low), facial expression (smile, frown), and face gender (male, female) as repeated measures factors. The dependent variable for the first analysis was A', which is a measure of discrimination that can be calculated when there are hit or false alarm rates of 0 or 1. Values of A' range from 0 to 1 with 0.5 representing chance performance (Macmillan & Creelman, 1990). The dependent variable for the second analysis was B''_D, which is a measure of response bias, with values above 0 indicating a conservative bias and values below 0 indicating a liberal bias (Macmillan & Creelman, 1990). These measures were calculated by examining faces that were old (i.e., presented as a part of a hybrid, whether perceived or not) or new. Due to the difficulty of the task and the fact that perceived and non-perceived faces from the perception task were both considered old, participants' discrimination was generally quite poor.[2] For the stimulus set as a whole, performance was just above chance, with performance for some stimuli in some conditions being worse than chance.

Discrimination analysis. For the A' analysis, there was a significant two-way interaction between spatial frequency and face gender, $F(1,59) = 4.61$, $p = .036$, $\eta_p^2 = .07$. This interaction was interpreted in the context of a three-way interaction between task, spatial frequency, and face gender, $F(2,59) = 4.40$, $p = .017$, $\eta_p^2 = .13$, displayed in Figure 4. Follow-up tests examined performance in each task separately.

In the passive viewing task there was an interaction between spatial frequency and face gender, $F(1,19) = 9.42$, $p = .006$, $\eta_p^2 = .33$. Participants showed better discrimination of HSF male ($M = .53$) compared to HSF female ($M = .47$) faces, $F(1,19) = 4.77$, $p = .042$, $\eta_p^2 = .20$. In the gender task, the interaction between spatial frequency and face gender approached significance, $F(1,20) = 4.23$, $p = .053$, $\eta_p^2 = .18$, and showed the same general pattern as that

[2] The same pattern of results emerged when analyses were conducted using only those faces that had been identified in the perception phase, and when examining hits and false alarms separately.

seen in the passive viewing. Finally, in the expression task, the interaction between spatial frequency and face gender was not significant ($p = .344$). The comparability of the passive viewing and gender tasks supports the use of the latter as a relatively neutral task.

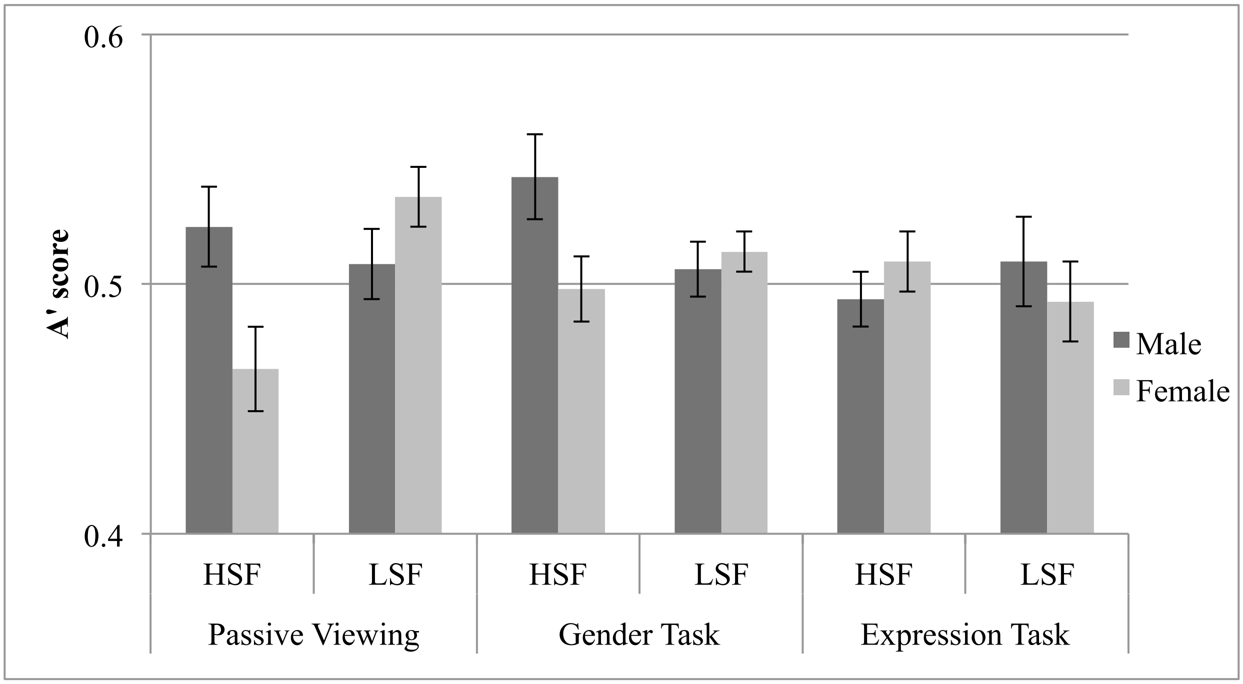

Figure 4. Discrimination by perception task. Three-way interaction between task, spatial frequency, and face gender with standard error bars. Note that an A' score of 0.5 represents chance performance.

Response bias analysis. For the B''_D analyses, there was a two-way interaction between face gender and facial expression, $F(1,59) = 4.75$, $p = .033$, $\eta_p^2 = .07$, which is displayed in Figure 5. Participants' responses were more liberal (i.e., they were more likely to claim that a face had been seen in the previous phase) for frowning male faces and smiling female faces; however, individual contrasts were not significant. This pattern is consistent with gender stereotypes for emotional expression.

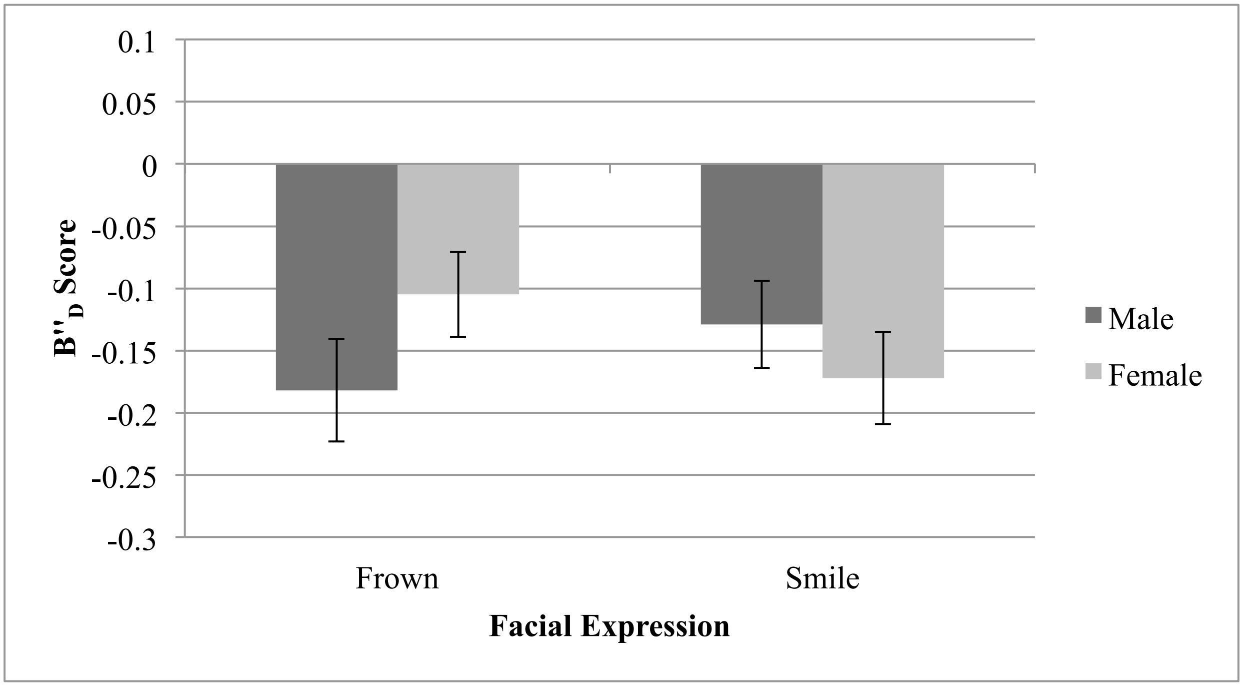

Figure 5. Interaction between face gender and facial expression for response bias with standard error bars.

Mood, Arousal, and Personality Moderation Analyses

The fourth goal of this study was to examine factors that could moderate the relationships between task and perceptual biases based on previous research. I first created a correlation matrix using Spearman correlation coefficients for all the variables to be used in the moderation analyses (see Appendix B). I did not identify any problems with collinearity that would violate the assumptions of the models.

To test moderating effects, I conducted separate repeated measures multiple regressions using the general linear model for each of the variables of interest (Gully, 1994; Park, Bavel, Vasey, Egan, & Thayer, 2012). This procedure produces comparable results to other multivariate modeling techniques for repeated measures for designs that do not include nesting, repeated measures over time, or missing data (Misangyi, LePine, Algina, & Goeddeke Jr., 2006). Each potential moderator was mean-centred and included in the analysis along with interaction terms. Where significant interactions with the variables of interest occurred, the moderation effects were probed with the pick-a-point approach (Hayes & Matthes, 2009). The interactions were examined with linearly independent pairwise comparisons between the estimated marginal means at the mean and one standard deviation below and above the mean of the variable of interest. Line graphs were used to clearly display the complex interactions for the moderation analyses although the x-axis is not a continuum (Kosslyn, 2006; Shah & Freedman, 2011).

Normally distributed variables that are randomly sampled often require large sample sizes to detect moderation effects in multivariate analyses. Therefore, these results should be considered preliminary. In all of the following analyses, the effects described above relating to the perception data remained significant. The variability of participants' perceived stress did not have any critical influence on the dependent variables in this or subsequent studies and therefore will not be discussed further.

Perception moderation analyses.

Neuroticism and extraversion. There were significant main effects for neuroticism, $F(1, 38) = 4.59$, $p = .039$, $\eta_p^2 = .11$, and extraversion, $F(1, 38) = 4.77$, $p = .035$, $\eta_p^2 = .11$. The overall HSF bias was suppressed among individuals with high scores on neuroticism ($M = 0.06$) as well as among those with low scores on extraversion ($M = 0.05$), which both correlate with negative affect (McCrae & John, 1992). In contrast, the HSF bias was enhanced in individuals with high scores on extraversion ($M = 0.22$). This pattern is not consistent with the simple trait specific processing that would predict increased HSF bias for traits associated with negative affect and a LSF bias for traits associated with positive affect. Instead, this pattern is consistent with the view of positive affect as encouraging the dominant processing style and negative affect suppressing the dominant processing style.

Arousal. Arousal had a more complex impact on performance on the perception task than personality variables. There was a significant three-way interactions between arousal, task, and facial expression, $F(1, 37) = 4.74$, $p = .036$, $\eta_p^2 = .11$, and arousal, face gender, and facial expression, $F(1, 37) = 21.66$, $p < .001$, $\eta_p^2 = .37$. Both interactions were interpreted in the context of a four-way interaction between arousal, task, face gender, and facial expression, $F(1, 37) = 6.10$, $p = .018$, $\eta_p^2 = .14$. The analyses were stratified by task to explore the four-way interaction.

For the gender judgment task, there was a three-way interaction between arousal, face gender, and facial expression, $F(1, 18) = 13.18$, $p = .002$, $\eta_p^2 = .42$, which is displayed in Figure 6. Arousal significantly moderated the effect of facial expression when the HSF faces were male, $F(1, 18) = 15.55$, $p = .001$, $\eta_p^2 = .46$, consistent with the bias in the primary ANOVA model. Low arousal increased the bias seen in the primary analyses, whereas high arousal reduced the bias. In this experiment, which did not involve a mood manipulation, participants were university students who were generally in a positive mood. In this sample, low arousal likely indicates a calm state of mind and high arousal may indicate some anxiety or stress. If so, then one interpretation of the present findings would be that feeling calm could signal that there would be no benefit to changing processing strategies, and would therefore support the use of the dominant processing style. In contrast, feelings of mild anxiety could signal that there would be some benefit from inhibiting one's dominant processing tendencies. This pattern is consistent with the prections from the affect as information model.

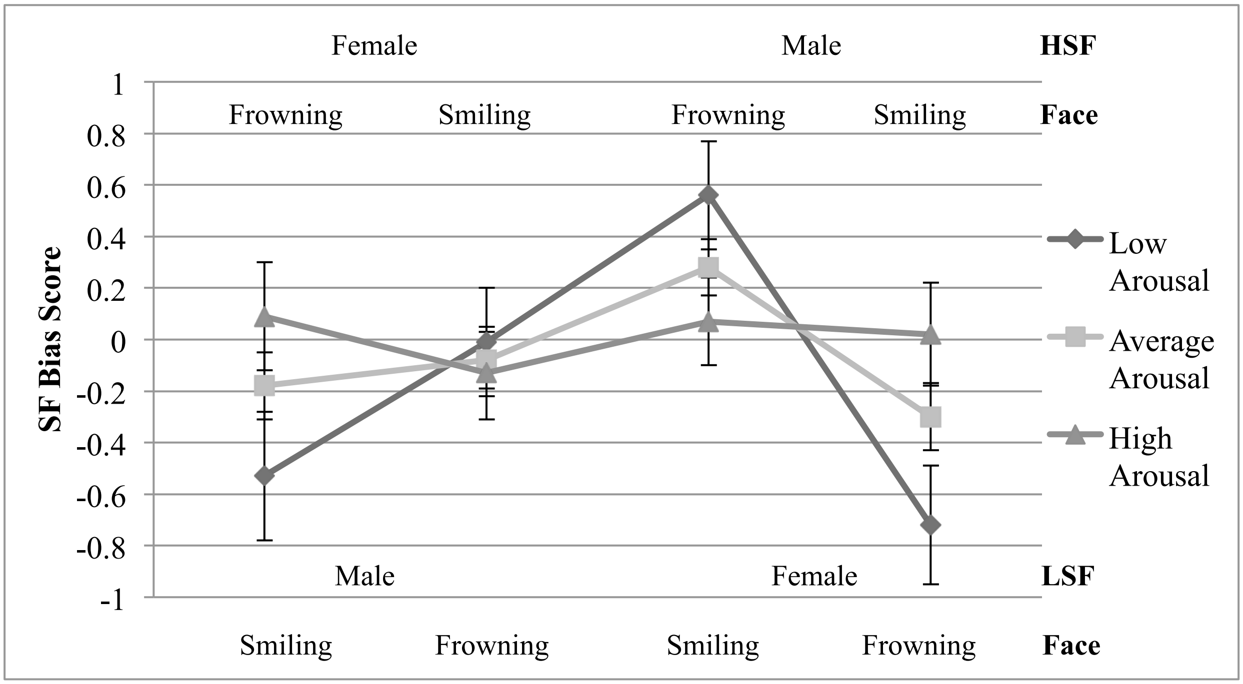

Figure 6. Moderating effect of arousal on perception in the gender task for face gender and facial expression.

For the expression judgment task, there was a two-way interaction between arousal and facial expression, $F(1, 19) = 4.98$, $p = .038$, $\eta_p^2 = .21$, which was interpreted in the context of a three-way interaction between arousal, face gender, and facial expression, $F(1, 19) = 6.23$, $p = .022$, $\eta_p^2 = .25$ (see Figure 7). Arousal only moderated the effect of facial expression when the HSF face was female, $F(1, 19) = 15.66$, $p = .001$, $\eta_p^2 = .45$. Individuals with low arousal ratings displayed a bias towards perceiving smiling compared to frowning faces when the HSF face was female, consistent with the expression bias in the primary analyses. In contrast, individuals with high arousal ratings displayed a consistent bias towards the HSF face, regardless of facial expression. Similar to the effects of arousal for the gender judgment task, low arousal supported the perception pattern seen in the primary analyses, whereas high arousal reduced perceptual biases for facial expression.

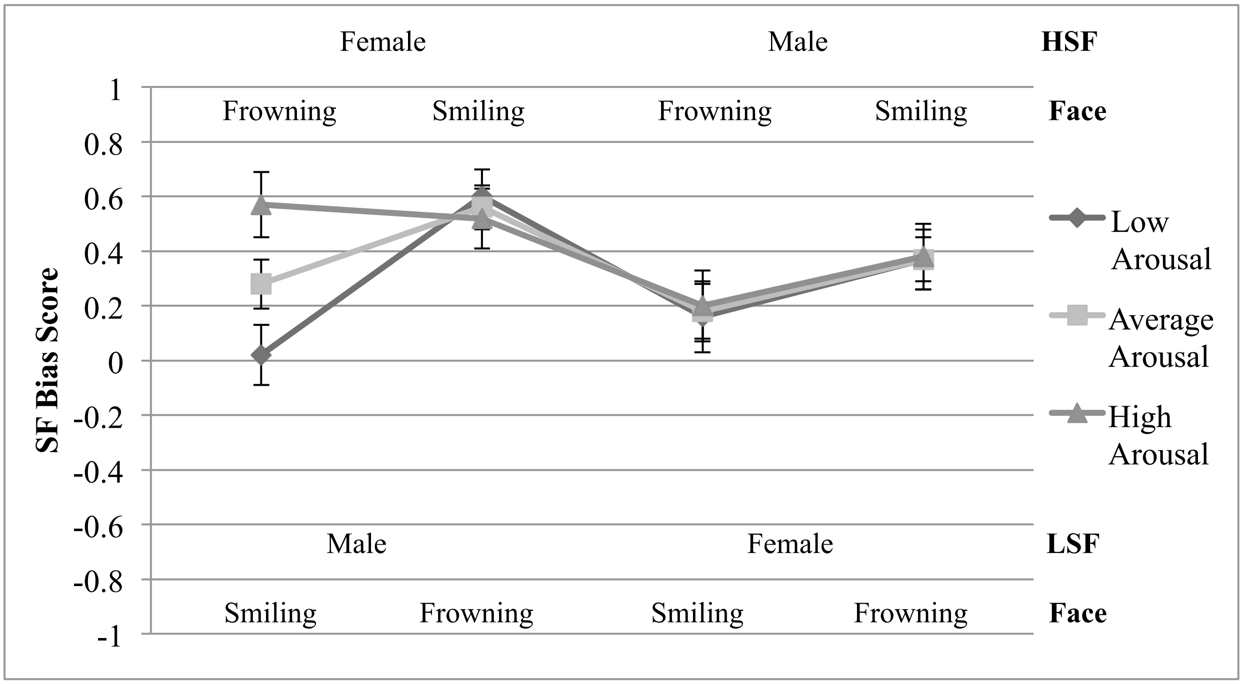

Figure 7. Moderating effect of arousal on perception in the expression task for face gender and facial expression.

Memory moderation analyses.

Mood. With respect to discrimination, there was a significant three-way interaction between mood rating, spatial frequency, and facial expression, $F(1,54) = 4.20$, $p = .045$, $\eta_p^2 = 0.07$ (see Figure 8). For HSF frowning faces, low mood was associated with better discrimination ($M = .53$) compared to high mood ($M = .48$), $F(1,54) = 4.83$, $p = .032$, $\eta_p^2 = .08$. This is consistent with a mood-congruency account. It is interesting to note that the effect only occurred for HSF faces, which tend to be processed more in the ventral areas of the brain and may involve more top-down influence (Vuilleumier et al., 2003).

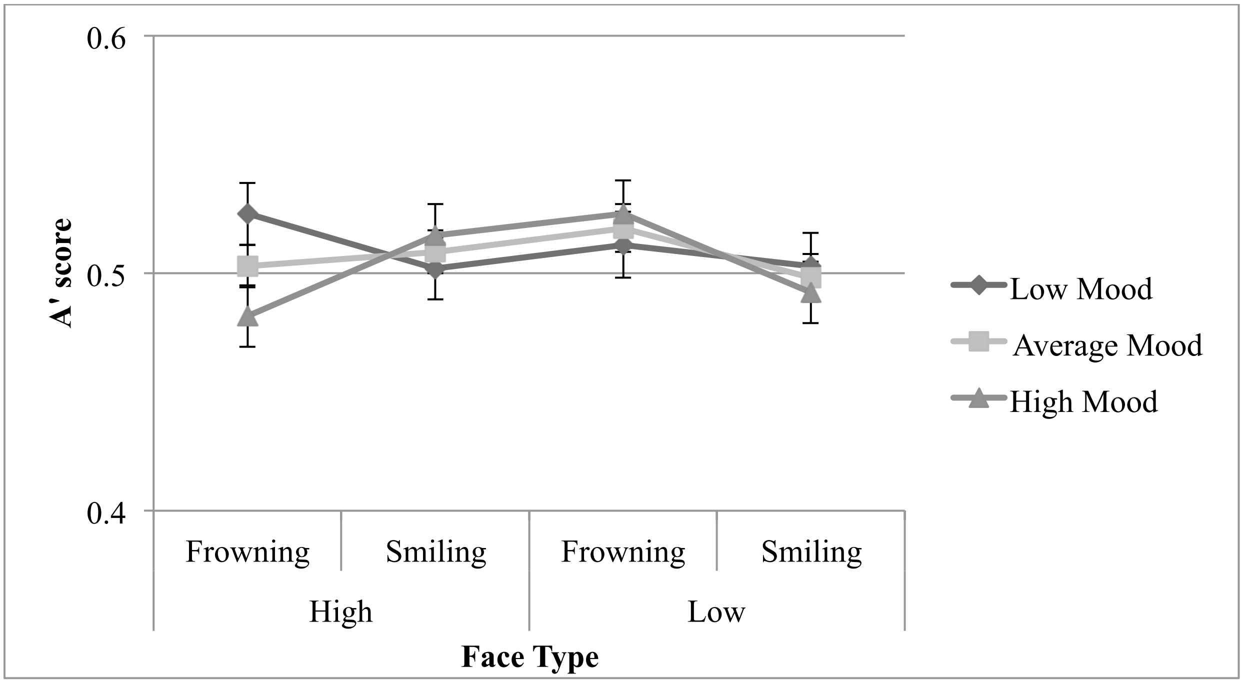

Figure 8. The interaction between mood, spatial frequency, and facial expression for discrimination, presented with standard error bars.

The three-way interaction between mood rating, spatial frequency, and facial expression was also significant in the response bias analyses, $F(1,54) = 4.21$, $p = .045$, $\eta_p^2 = .07$ (see Figure 9). Follow-up analyses did not reveal any two-way interactions or simple effects. Consistent with the discrimination analyses, differences in response bias were greatest for the HSF frowning faces. Participants with higher mood ratings were more willing to claim that these faces were old ($M = -.21$) than those with lower mood ratings ($M = -.11$). Although individuals with low mood ratings showed superior discrimination of frowning faces, they displayed less of a liberal response bias compared to individuals with high mood ratings. These results are in line with previous research that found mood congruent memory to be a genuine effect of memory (i.e., discrimination; Fiedler et al., 2001). This same study also found a more conservative response bias towards mood congruent stimuli.

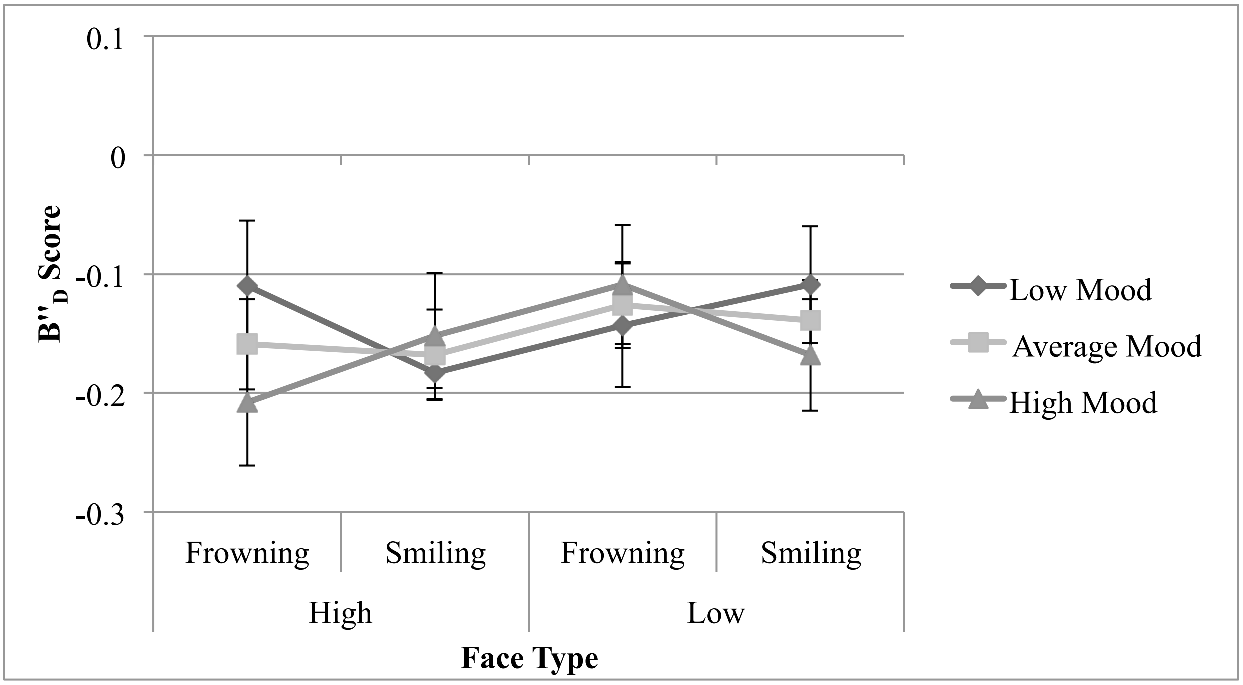

Figure 9. Three-way interaction between mood, facial expression, and spatial frequency for response bias scores with standard error bars.

Extraversion. For response bias there was a four-way interaction between extraversion, task, face gender, and facial expression, $F(1,56) = 6.06$, $p = .004$, $\eta_p^2 = .18$. After stratifying by task, the only significant interaction was a three-way interaction for the gender task between extraversion, face gender, and facial expression, $F(1,19) = 18.21$, $p < .001$, $\eta_p^2 = .49$. Follow-up tests confirmed that the interaction between extraversion and facial expression was only significant for female faces, $F(1,19) = 19.10$, $p < .001$, $\eta_p^2 = .50$. Individuals scoring low on extraversion showed a more conservative response pattern for smiling compared to frowning female faces ($M_{Smiling} = .13$, $M_{Frowning} = -.05$); that is, they were more likely to say that smiling female faces were new compared to frowning female faces. The reverse pattern occurred for individuals with high scores on extraversion who were more likely to say that smiling female faces were old compared to frowning female faces ($M_{Smiling} = -.21$, $M_{Frowning} = -.01$), $F(1,19) =$

14.53, $p = .001$, $\eta_p^2 = .43$. This pattern of results represents trait-congruent responding. Individuals with high trait extraversion (i.e., high tendency for positive affect and responsiveness to social rewards) were more likely to report remembering smiling faces, whereas individuals low on this trait were conservative in their responses to smiling faces. It is interesting to note that extraversion is the only moderator that was related to response bias for facial expressions in a congruent manner. The compatibility of the social stimuli and personality characteristic may have increased the relevance of emotional information on responses.

Arousal. The discrimination analysis revealed a significant three-way interaction between arousal, spatial frequency, and facial expression, $F(1,54) = 4.46$, $p = .039$, $\eta_p^2 = .08$ (see Figure 10). Although the two-way interactions in simpler models were not significant, individuals with high arousal ratings showed slightly better discrimination of frowning than smiling faces presented in LSF and slightly better discrimination of smiling than frowning faces presented in HSF. This pattern indicates that for individuals with high arousal the Pollyanna bias occurred with top-down (i.e., HSF) processing and the reverse pattern for more bottom-up (i.e., LSF) processing. I am not aware of similar findings in the literature, although there has not been a strong focus on examining valance effects and processing style simultaneously to this point. However, this result may relate to research on the role of mood repair in congruency. The chance of observing mood congruent processing varies by self-esteem ratings (S. M. Smith & Petty, 1995) and by the length of time that individuals engage in a task (Sedikides, 1994). Presumably, these findings occur due to the engagement of mood-repair strategies at different points in processing by different individuals. From this perspective, high arousal may indicate motivation to regulate one's mood. Although bottom-up processing may be biased towards negative information (i.e., frowning faces), top-down processing may engage mood-repair or mood maintenance mechanisms, leading to a positive bias (i.e., towards smiling faces).

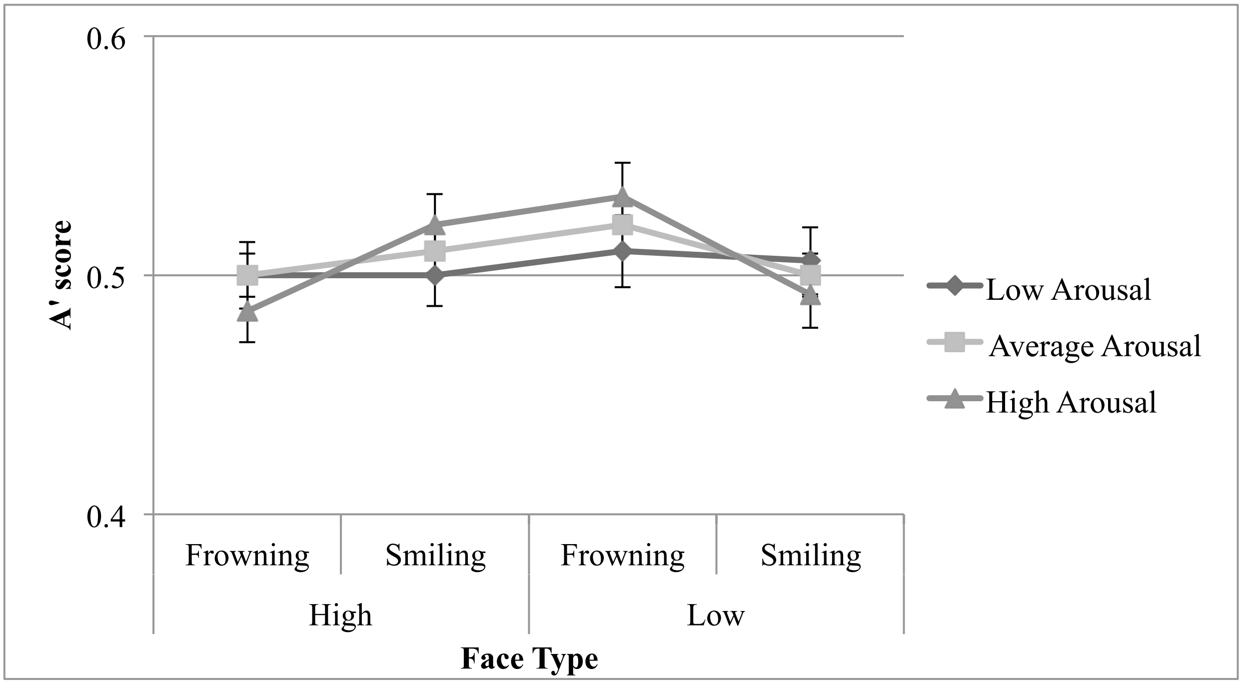

Figure 10. The interaction between arousal, spatial frequency, and facial expression for discrimination.

For response bias, participants' arousal ratings interacted with facial expression, $F(1,54) = 4.41$, $p = .040$, $\eta_p^2 = .08$. There was a more liberal response style for frowning compared to smiling faces for individuals with both low ($M_{Smiling} = -.10$, $M_{Frowning} = -.18$) and high arousal scores ($M_{Smiling} = -.14$, $M_{Frowning} = -.21$). Individuals with average arousal scores showed no difference in response bias based on expression ($M_{Smiling} = -.16$, $M_{Frowning} = -.15$). This result does not directly support or refute any of the hypotheses specific to this study. This pattern may relate to the variation in mood states for each level of arousal. The subsequent studies will help to clarify this relationship.

Discussion

This experiment extends the work of Schyns and Oliva (1999) to smiling and frowning faces. The gender task was unbiased with respect to spatial frequency as indicated by (a) the lack of bias in the perception phase, and (b) the comparable pattern of results in memory performance for individuals in the gender and passive viewing tasks. The spatial frequency bias in the expression task was opposite to that found in studies that included angry faces (Schyns & Oliva, 1999), which highlights the importance of considering both the task and the stimulus when examining cognitive bias. Anger or fear presented on a face has different motivational value than other emotions such as joy or sadness, both in terms of the information conveyed and the amount of arousal generated. The potential implications of detecting anger or fear in another may change the costs and benefits of engaging in particular processing strategies (Fox et al., 2000). Alternatively, it could be the arousal value associated with angry or fearful stimuli that changes the attentional prerequisites for perception and thereby influences processing (Anderson, 2005). With smiling and frowning faces, there is an HSF bias when judging expression and no SF bias when judging gender in the hybrid perception task.

There were also biases identified for other facial characteristics. The expected bias towards smiling faces was found when participants made expression judgments (Figure 3) but not gender judgments (Figure 2). In other words, the Pollyanna bias was only found when affect could have been interpreted as being relevant to the task. This finding mirrors the variable results in the mood literature and is consistent with the suggestion that the informational value of affect will determine whether or not there will be mood effects (Eich, et al., 1997; Clore et al., 2001). Interestingly, when the task focused on determining the gender of the face, a negative (i.e., frowning) bias was found when the HSF face was male (Figure 2, bars on right of graph).

Perhaps the task activated gender norms relating to facial expression and made the combination of gender and expression a relevant source of information.

The memory task was difficult due to the quick presentation rates and the number of faces displayed. However, participants did show some ability to discriminate faces seen during the perception phase from new faces. Discrimination and response biases were generally consistent with the perception results. These findings support the use of a memory test following the hybrid perception task and provided a baseline pattern of results for reference in the subsequent studies.

The final goal of this study was to begin an exploratory analysis of how mood, arousal, and personality measures affect processing during the perception and memory tasks. For each set of analyses, arousal was a significant moderator. This finding is consistent with the work of Eich, Macaulay, and Ryan (1994), who have suggested that arousal plays an important role in cognitive processing and predicting mood effects. For the perception task, individual level characteristics that would lead one to adopt a more cautious approach to situations (low extraversion, high neuroticism, and high arousal) reduced the biases identified in the main analyses. Low extraversion and high neuroticism both suppressed the overall HSF bias, which was driven by the expression task. High ratings of arousal reduced interactions in both perception tasks. In the gender task, high arousal reduced bias towards frowning faces when the HSF face was male (see the triangle vs. diamond points on the right side of Figure 6). In the expression task, high arousal reduced the Pollyanna bias (see triangle point on the left of Figure 7). In other words, for each of the characteristics that could be associated with increased negative affect, heightened arousal was linked to an inhibition of the more dominant processing strategies. These results are in line with the predictions of the affect as information model, which describes mood as a stop-or-go response for relevant tasks, with positive affect supporting or enhancing the dominant tendencies in a given situation (e.g., spatial frequency biases), and negative affect suppressing the dominant tendencies and leading to the adoption of alternative strategies (Clore & Palmer, 2009).

Although there were few primary task effects for the memory task, a number of moderating effects were observed. For HSF faces, mood congruent discrimination (Figure 8) and mood-incongruent response biases (Figure 9) were present. Specifically, low mood was associated with improved discrimination of frowning compared to smiling HSF faces. In contrast, high mood ratings were associated with a more liberal response bias towards frowning faces compared to low mood ratings. These findings are in line with the literature where mood congruency is more commonly observed in memory performance, as opposed to performance on attention and perception tasks. A trait-congruent response bias was also observed with extraversion. Individuals scoring low on extraversion displayed a conservative response bias for smiling compared to frowning faces and those scoring high on extraversion displayed a liberal response bias for smiling compared to frowning faces. It is interesting that the trait-congruency was present in the response bias as opposed to the discrimination findings, in contrast to the mood results. This pattern could be due to the specific link between extraversion and responsiveness to social rewards (Rusting & Larsen, 1998).

This experiment provided basic information about the processing biases present within these experimental tasks. The subsequent experiments focused on the role of mood on task performance and continued to explore the moderating role of individual difference factors.

Chapter 3: Experiment 2

Experiment 2 examined the influence of induced mood on the task effects found in the previous experiment. There were three primary goals for this experiment: 1) to determine if there were mood effects for the tasks, 2) to compare mood effects for perception and memory, and 3) to continue exploratory testing of individual differences as moderators of mood and/or task effects.

Because the affect as information model was consistent with the results from Experiment 1 and offers a parsimonious explanation of conflicting results in the literature, it was used to guide predictions for the final two experiments. I predicted that a positive mood would enhance the task effects from the previous experiment and a negative mood would suppress the effects. Specifically, I expected to find that a sad mood would suppress the HSF bias seen in the expression task. This prediction runs counter to that arising from the affection infusion model, which would predict a mood effect to occur in the gender task because it is naturally unbiased. This effect would present as an HSF bias for sad participants and an LSF bias for happy participants. Both models identify personality as an additional variable that could influence performance, and this study offers a preliminary examination of that possibility. For trait-congruent processing, high extraversion should lead to responses similar to those exhibited by individuals in a happy mood and high neuroticism should lead to responses similar to those exhibited by individuals in a sad mood. Congruence between trait and state affect should strengthen these effects. In contrast, when trait and state affect are incongruent a more complex pattern of results would be expected. Under the assumption that traits represent default processing strategies, the affect infusion model could be extended to predict that a happy mood supports and a sad mood inhibits trait specific processing. From this perspective, I predicted that among individuals with high extraversion, a sad mood would lead to trait-incongruent processing, which would present as preferential processing of frowning faces.

Methods

Participants

Participants (*N* = 192) were recruited from the Introduction to Psychology research participant pool at the University of Manitoba. They received credit toward an optional course requirement in exchange for their voluntary participation in the study. They were required to have normal or corrected-to-normal vision to control for distance effects on spatial frequency processing and were screened for facial processing impairments.

Fifteen participants did not pass the facial processing screener and were excluded, consistent with test norms. An additional 46 participants were excused because the mood induction procedure was ineffective (i.e., these participants did not reached the criterion mood ratings described below that were needed to continue on with the rest of the experiment in the time allotted for the experiment). This rate of mood induction failure (26%) is slightly higher than the typical rate of 19% after 20 minutes that has been reported in the literature (Eich, Ng, Macaulay, Percy, & Grebneva, 2007). Data from four of the remaining participants were excluded from the analyses; two produced patterned responses on the memory task, and two had invalid NEO-FFI-3 profiles. This left a final sample of 127 participants (61 male, 66 female, M_{age} = 19.9 years, age range: 17-53 years); 32 were assigned to the happy condition of the gender task, 37 to the happy condition of the expression task, 31 to the sad condition of the gender task, and 27 to the sad condition of the expression task.

Stimuli and Measures

All the stimuli and measures used in Experiment 1 were included. The internal consistencies (Cronbach's *a*) of the PSS, extraversion, and neuroticism for this sample were .86, .73, and .83, respectively. An additional question was added to the end of the experiment that asked participants to rate the effectiveness of the mood manipulation on a Likert-type scale from one to five.

Mood induction stimuli. The music used during the happy mood induction included selections from Beethoven's *Minuet in G*, Boccherini's *Minuet in E*, Mozart's *Divertimento No.136*, Pachelbel's *Canon in D*, and Vivaldi's *Four Seasons: Spring, Summer, and Fall*. The music used during the sad mood induction included selections from Albinoni's *Adagio in G Minor*, Barber's *Adagio pout Cordes*, Grieg's *Peer Gynt: The Death of Ase*, and Sibelius' *Violin Concerto: Second Movement.* This music has been effective in mood induction procedures in other studies (Eich et al., 1994). Music stimuli were presented via headphones connected to the computer used to present the face stimuli. Seventy-four percent of the participants who completed the experiment rated the effectiveness of the mood manipulation as three or higher out of five.

Procedure

As in Experiment 1, participants were given a consent form to read and sign, and then completed a near vision eye test and the facial screening task. After this stage the examiner provided the participant with the rest of the instructions and left the room. The participants completed the affect grid, NEO-FFI-3, and PSS. They then moved on to the mood induction phase. The continuous music technique (CMT) was used, as recommended by Eich (1995) because it produces strong and stable results. Participants were asked to think about the last situation in their lives that made them very happy/sad while listening to happy/sad music. Periodically, the participants rated their current level of mood and arousal using the affect grid. The participants began the testing phase of the experiment when they reached a critical level of mood, which was the lowest or highest two scores out of nine. The music continued to play in the background throughout the entire experiment.

Following the mood manipulation, the test phase began with the hybrid judgment task followed by the memory task. Next, the participants answered the sociodemographic and open-ended questions. Participants in the sad mood condition were then presented with the happy mood manipulation to counteract the sad mood. Finally, the participants were debriefed and provided with information on mental health resources.

Results

Perception Task

To evaluate the role of task and mood on perception, a repeated measures ANOVA was conducted on SF bias scores with task (gender judgment, expression judgment) and mood (happy, sad) as between subject factors and face gender (male, female) and facial expression (smile, frown) as repeated measures factors. The repeated measures factors represented the qualities of the HSF images that made up the hybrids. There was a large main effect of task, $F(1,123) = 78.30$, $p < .001$, $\eta_p^2 = .39$. As in Experiment 1, there was an HSF bias for the expression task ($M = .35$), demonstrated by the significant intercept in a stratified analysis, $F(1,62) = 90.51$, $p < .001$, $\eta_p^2 = .59$. In this experiment there was also a slight LSF bias in the gender task ($M = -.09$), $F(1,61) = 6.91$, $p = .011$, $\eta_p^2 = .10$. The current experiment included more participants than any previous study involving this type of task, which may have allowed for the detection of this small SF bias.

There were three separate interactions with face gender. The two-way interaction seen in Experiment 1 between face gender and facial expression was also significant in this experiment, $F(1,123) = 5.33$, $p = .023$, $\eta_p^2 = .04$. Viewers showed a bias towards seeing the HSF male faces when frowning (*M* = .22) rather than smiling (*M* = .09), and a tendency to perceive more HSF female faces when smiling (*M* = .14) rather than frowning (*M* = .08). This pattern of results matches the gender stereotype that females express more positive affect and males may express more negative affect (Hess et al., 2009; LaFrance et al., 2003). There was also a significant interaction between participant mood and face gender, $F(1,123) = 4.77$, $p = 0.031$, $\eta_p^2 = .04$. Happy participants showed a bias towards perceiving male (*M* = .22) over female (*M* = .07) faces, whereas sad participants showed a slight tendency to perceive female (*M* = .15) over male (*M* = .08) faces. The final interaction with face gender occurred with task, $F(1,123) = 7.78$, $p = .006$, $\eta_p^2 = .06$. This interaction, presented in Figure 11, shows a bias towards female as opposed to male faces in the expression task, and a small bias towards male over female faces in the gender task. These findings are consistent with the general pattern of results from Experiment 1.

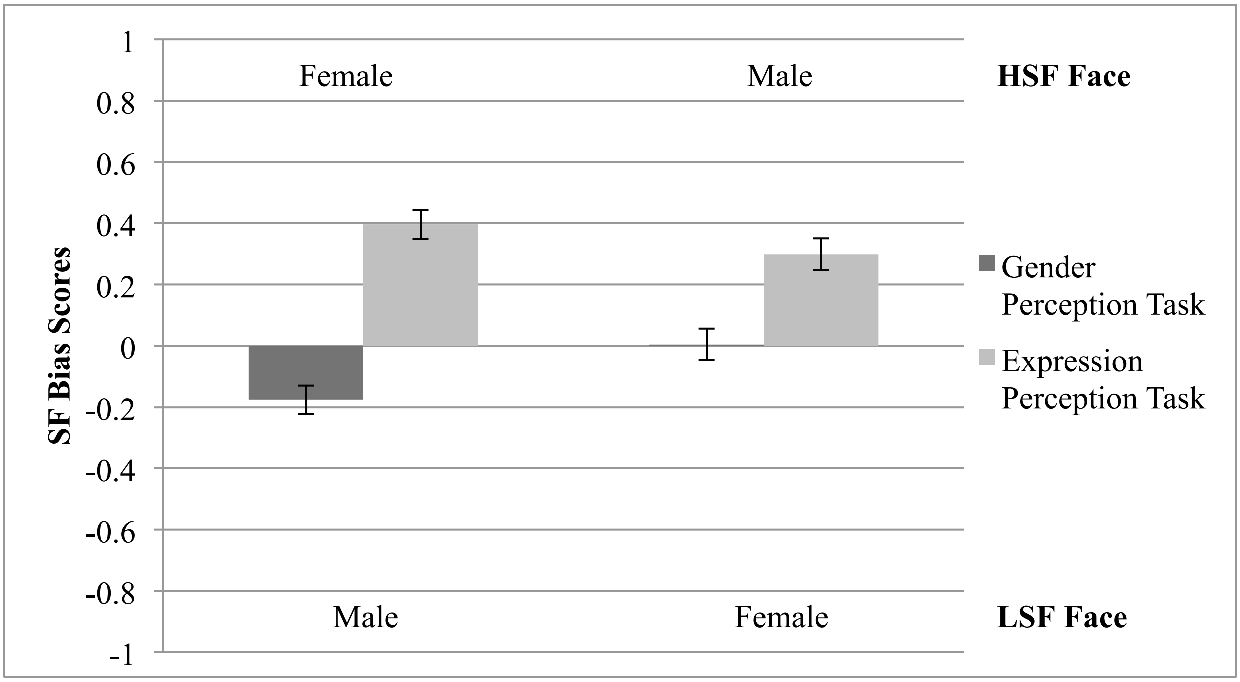

Figure 11. Task and face gender interaction in the perception task. Spatial frequency (SF) bias scores are presented with standard error bars.

Patterns of responses were generally quite comparable for happy and sad participants, although less variation was observed in the responses of sad participants. This slight suppression of perceptual bias is consistent with the results of the moderation analysis from Experiment 1 that found reduced biases among individuals with high arousal, high neuroticism, and low extraversion.

Memory Task

Preliminary tests indicated that there was a main effect of perception status on memory responses, $F(1,125) = 5.04$, $p = .008$, $\eta_p^2 = .08$. Post-hoc contrasts specified that faces that had been identified in the perception task were judged as old more often than either faces that were not identified during perceptual testing, $p = .003$, or those that were new, $p = .014$. For this reason, the signal detection analyses were conducted with the faces that had been idendified in the perception task and those that were new.

Discrimination analysis. Discrimination performance was influenced by task, mood, and each of the facial characteristics. Mood and task interacted with facial expression in the gender task, and face gender and SF in the expression task. Performance for each task was examined separately to explore the following three-way interactions between: task, mood, and spatial frequency, $F(1, 123) = 5.94$, $p = .016$, $\eta_p^2 = .05$; task, mood, and face gender, $F(1, 123) = 4.94$, $p = .028$, $\eta_p^2 = .04$; and task, mood, and facial expression (approached significance), $F(1, 123) = 3.35$, $p = .069$, $\eta_p^2 = .03$.

Mood congruent discrimination was observed in the gender judgment task, as evidenced by an interaction between mood and facial expression, $F(1, 61) = 5.15$, $p = .027$, $\eta_p^2 = .08$. Sad participants had better discrimination of frowning ($M = .53$) compared to smiling ($M = .50$) faces, and happy participants showed the reverse trend ($M_{frowning} = .50$, $M_{smiling} = .52$).

Among individuals who completed the expression perception task, there were two-way interactions between mood and face gender, $F(1, 62) = 4.02$, $p = .049$, $\eta_p^2 = .06$, and mood and spatial frequency, $F(1, 62) = 4.81$, $p = .032$, $\eta_p^2 = .07$. Happy participants were not affected by manipulations of face gender or spatial frequency. In contrast, sad participants showed slightly superior discrimination of female ($M = .53$) compared to male ($M = .50$) faces, and LSF ($M = .53$) compared to HSF ($M = .50$) faces. The difference between female and male faces may be due to the slight bias towards perceiving female faces among sad participants in the perception phase. However, the superior performance seen with LSF faces occurred despite the fact that participants generally showed a HSF bias during perception testing.

In summary, it was sad participants who showed larger effects for discrimination. A mood-congruent pattern was seen in the gender task but not in the expression task. This pattern is the opposite to that seen in the first experiment, where mood was not manipulated. From the affect as information perspective, people rely on their current mood when it may be judged to provide information relevant to the judgment. With a natural mood state it may be reasonable to use that information to guide perception of facial expressions. However, in Experiment 2, mood was manipulated using a procedure that participants would easily identify as a contributor to their current affect. When making affect-related judgments in this experiment, participants may have identified the source of the mood as being unrelated to the facial expressions, thereby removing the mood congruency effect. In contrast, when judging face gender, participants may not have considered the connection between the judgment and their mood, leaving the source of the mood unidentified and allowing affect to influence perception.

Response bias analysis. There were a number of task interactions for the response bias analysis that were explored in each task separately, including: a two-way interaction between task and face gender, $F(1, 123) = 7.64$, $p = .007$, $\eta_p^2 = .06$; a three-way interaction between task, mood, and face gender, $F(1, 123) = 4.44$, $p = .037$, $\eta_p^2 = .04$; and a four-way interaction between task, mood, spatial frequency, and facial expression, $F(1, 123) = 4.74$, $p = .031$, $\eta_p^2 = .04$.

***Gender judgment task*.** The main effect of face gender, $F(1, 61) = 7.82$, $p = .007$, $\eta_p^2 = .11$, was interpreted in the context of significant interactions between mood and face gender, $F(1, 61) = 4.50$, $p = .038$, $\eta_p^2 = .07$, and between facial expression and face gender, $F(1, 61) = 4.24$, $p = .044$, $\eta_p^2 = .07$. Participants exhibited a more liberal bias for male compared to female faces, particularly if they were in a happy mood (see Figure 12) and or if the faces were smiling (see Figure 13). This finding is consistent with the results of the perception analyses in this experiment where happy participants were more likely to perceive male than female faces. Although this pattern is inconsistent with gender stereotypes, it is consistent with positive affect supporting or enhancing dominant processing styles for a particular task.

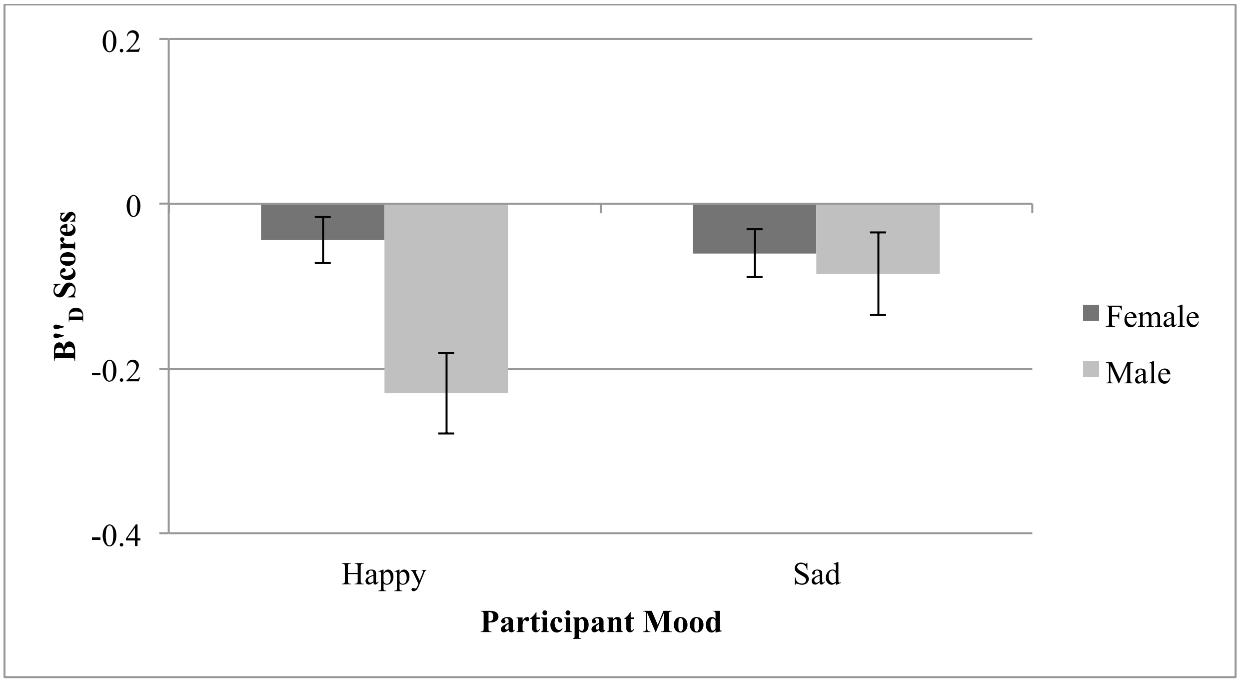

Figure 12. Mood and face gender interaction in the gender task for response bias scores with standard error bars.

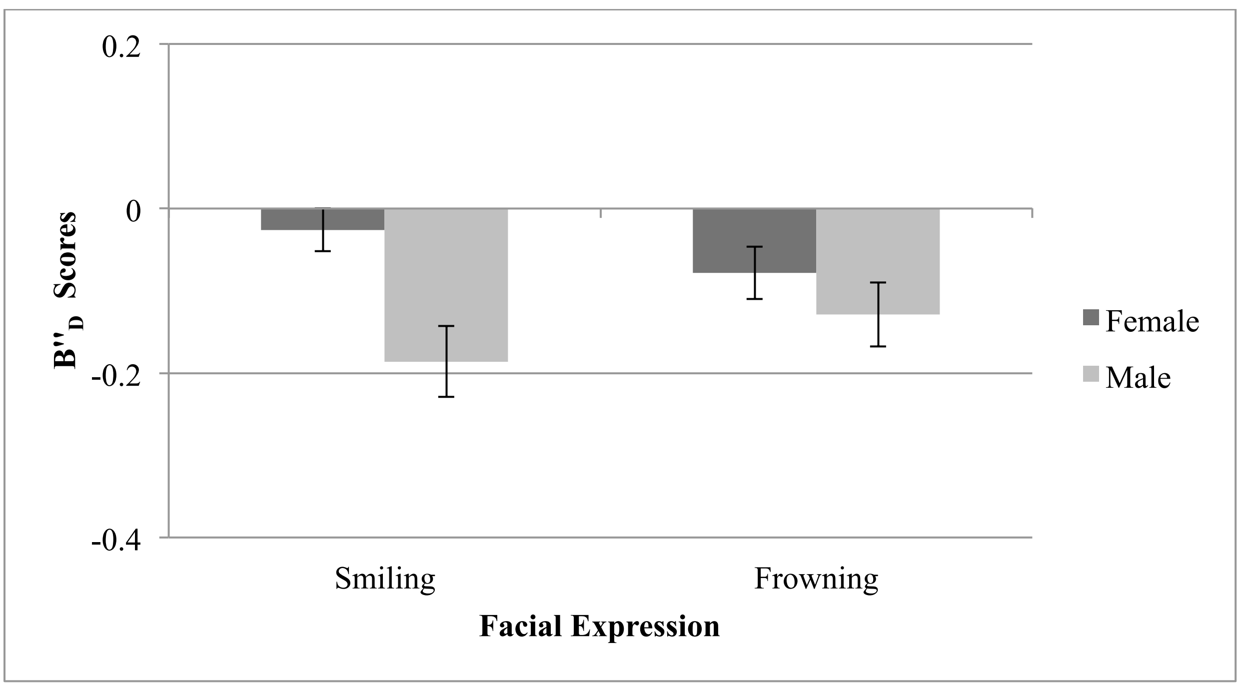

Figure 13. Facial expression and face gender interaction in the gender task for response bias scores with standard error bars.

Expression judgment task. In the expression task participants were more willing to claim that HSF faces were old when they were mood congruent and to claim that LSF faces were old when they were mood-incongruent. There was a three-way interaction between mood, spatial frequency, and facial expression, $F(1, 62) = 3.98$, $p = .050$, $\eta_p^2 = .06$ (see Figure 14). Happy participants showed a more liberal response style to HSF smiling faces and LSF frowning faces compared to HSF frowning and LSF smiling faces. Sad participants displayed the opposite pattern with slightly more liberal response biases for HSF frowning and LSF smiling faces compared to HSF smiling and LSF frowning faces. The pattern of affect congruent responding for HSF and affect incongruent responding for LSF has emerged in a number of analyses in this set of experiments.

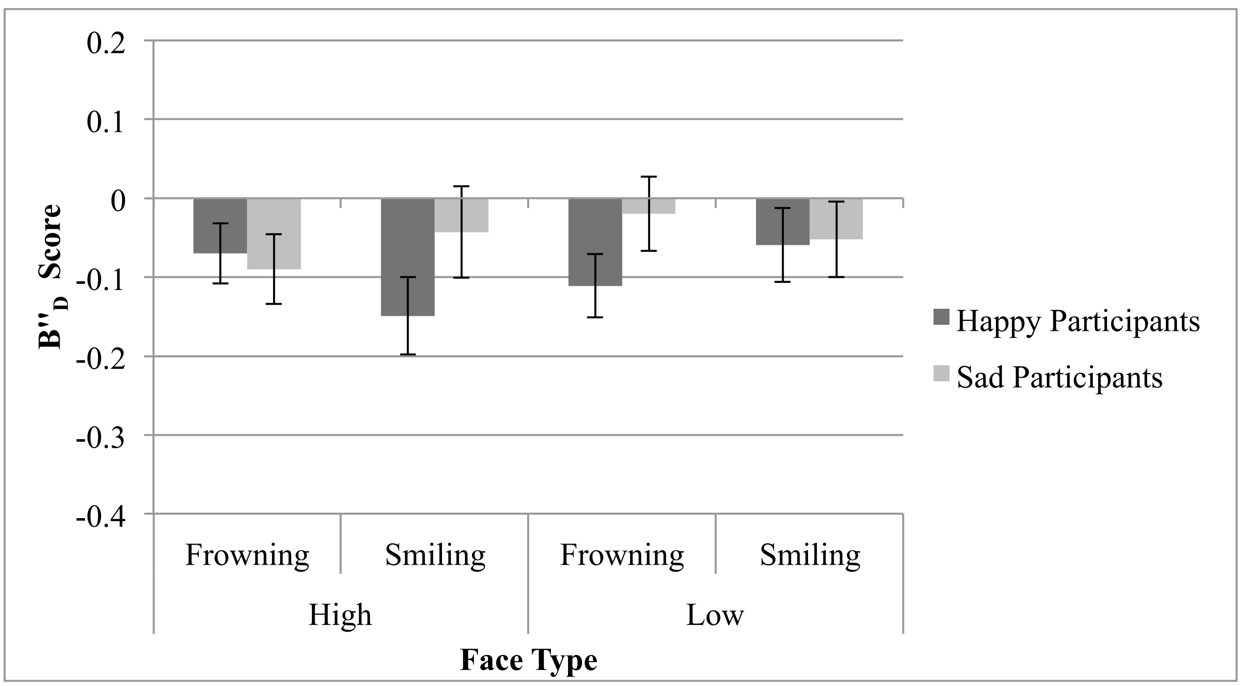

Figure 14. Three-way interaction between mood, facial expression, and spatial frequency for response bias scores with standard error bars.

In the response bias analyses it was the happy participants whose responses were more affected by task and facial characteristics. These participants had a more liberal response style to male faces in the gender task and HSF smiling and LSF frowning faces in the expression task. Notably, the characteristics being judged in the perception task were the same characeteristics that had differences in response biases in the memory task. For example, when participants made gender judgments in the perception task, there were differences in response bias for male and female faces. The nature of the perception judgments may have had an impact on how participants conceptualized the faces and, therefore, affected their response bias.

In this experiment, discrimination followed a mood congruent pattern in the gender task and response bias followed a mood congruent pattern (for HSF faces) in the expression task. These conflicting patterns highlight the importance of separating discrimination and response bias for examinations of mood congruent memory. Although an affect-relevant task may influence willingness to rate faces as old, a seemingly unrelated task may have a more genuine affect on memory accuracy when the source of the mood is easily identifable.

Moderation Analyses

I created a correlation matrix using Spearman correlation coefficients for all the variables to be used in the moderation analyses (see Appendix C). I did not identify any problems with collinearity that would violate the assumptions of the models.

Perception moderation analyses. As in Experiment 1, there was an effect of extraversion on SF bias, $F(1, 117) = 7.44$, $p = .007$, $\eta_p^2 = .06$. Participants with low scores on extraversion showed less of an HSF bias ($M = .06$) than those with average ($M = .13$) or high extraversion scores ($M = .20$). This pattern again represents a reduction in the default processing style with reduced positive affect. A four-way interaction was also observed between neuroticism, mood, face gender, and facial expression, $F(1, 117) = 4.16$, $p = .044$, $\eta_p^2 = .03$. Happy participants with high scores on neuroticism (i.e., incongruent state and trait affect) were more likely to perceive smiling male HSF faces (*M* = .28) compared to smiling female HSF faces (*M* = -.03), $F(1, 65) = 5.23$, $p = .026$, $\eta_p^2 = .07$. The pattern of findings is opposite of that seen in the primary analyses and counter to typical gender stereotypes. If local or analytical processing is more common among those with high trait neuroticism (Kossowska & Nęcka, 1994), these individuals may rely less on heuristic processing and therefore may challenge processing stereotype-consistent information. Being in a happy mood may act to reinforce this tendency, leading to stereotype-inconsistent processing.

Memory moderation analyses.

Arousal. Arousal affected response bias as evidenced by a number of significant interactions, including: a three-way interaction between arousal, task, and mood, $F(1, 119) = 4.73$, $p = .049$, $\eta_p^2 = .03$; a four-way interaction between arousal, mood, face gender, and facial expression, $F(1, 119) = 4.60$, $p = .034$, $\eta_p^2 = .04$; and a five-way interaction between arousal, mood, task, face gender, and spatial frequency, $F(1, 119) = 5.12$, $p = .026$, $\eta_p^2 = .04$. All of these interactions were contained in a six-way interaction between arousal, mood, task, face gender, facial expression, and spatial frequency, $F(1, 119) = 5.20$, $p = .024$, $\eta_p^2 = .04$, which was examined by stratifying by task.

In the gender judgment task there was a significant four-way interaction between arousal, mood, facial gender, and facial expression, $F(1, 59) = 4.73$, $p = .034$, $\eta_p^2 = .07$. The three-way interaction was only significant for happy participants, $F(1, 30) = 4.64$, $p = .039$, $\eta_p^2 = .13$ (see Figure 15). Happy participants with high levels of arousal had a more liberal response bias for male than faces, regardless of the facial expression. In contrast, those with low levels of arousal had more variation in their response bias depending on both the face gender and facial expression.

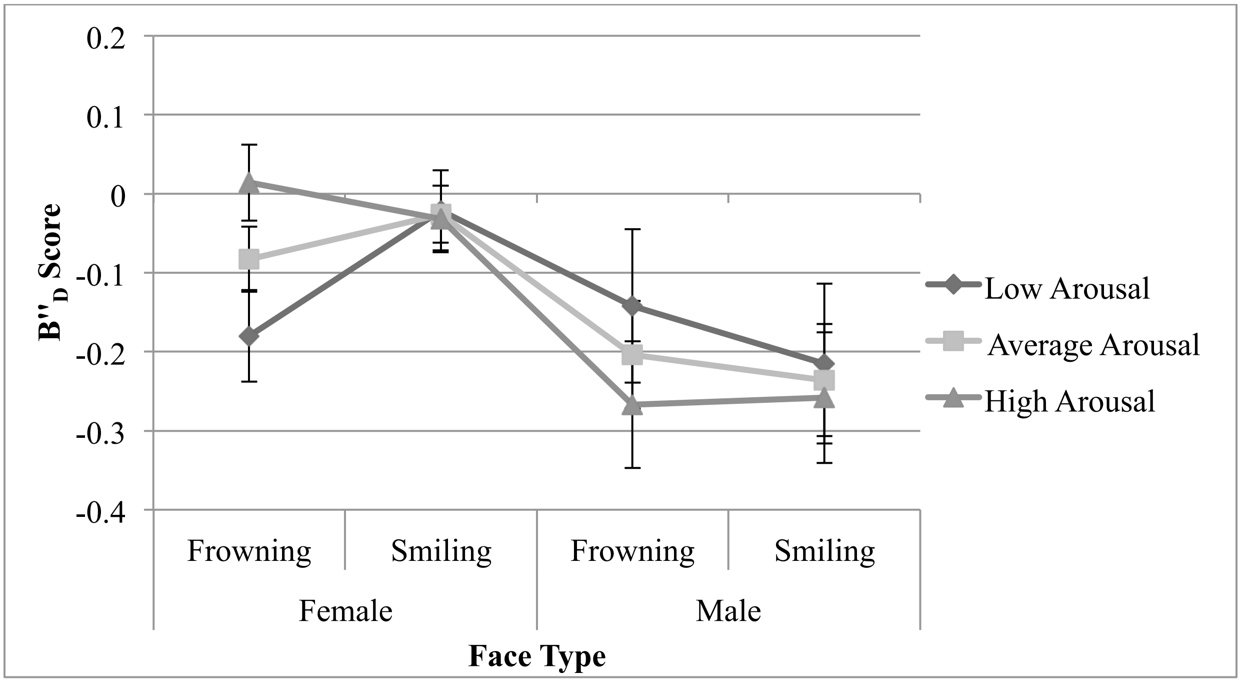

Figure 15. Three-way interaction between arousal, face gender, and facial expression for happy participants in the gender task. Response bias scores with standard error bars.

In the expression judgment task there was a four-way interaction between arousal, mood, face gender, and spatial frequency, $F(1, 59) = 4.49$, $p = .038$, $\eta_p^2 = .07$. The three-way interaction approached significance for sad participants, $F(1, 25) = 3.64$, $p = .068$, $\eta_p^2 = .13$ (see Figure 16). Sad participants with high arousal ratings gave more conservative responses for LSF female and HSF male faces than those with low arousal ratings, who were more likely to claim that these faces were old.

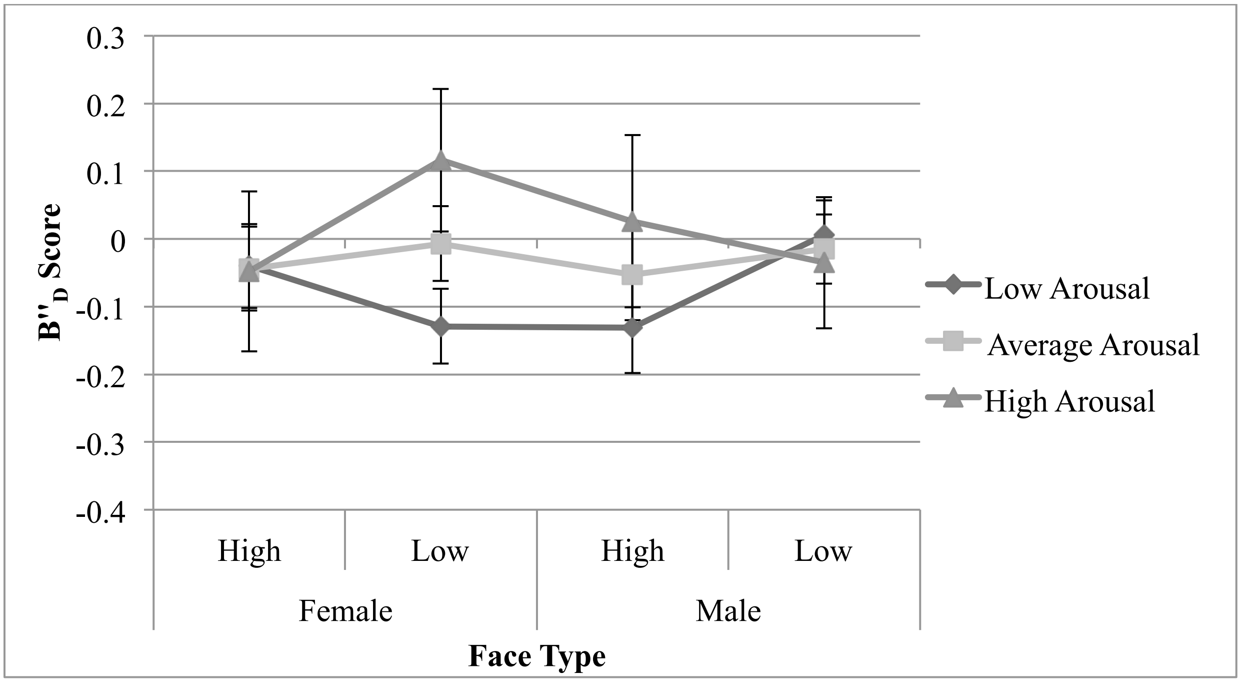

Figure 16. Moderating effect of arousal on face gender and spatial frequency for sad participants in the expression task. Response bias scores with standard error bars.

In summary, in contrast to Experiment 1, when mood was manipulated arousal did not significantly influence perception or discrimination. Arousal did play a role in how willing participants were to claim that a face was old. However, arousal's influence was limited to specific mood, task, and stimulus conditions, rather than having a broad effect. In particular, for happy participants in the gender task and sad participants in the expression task, high levels of arousal reduced the liberal response style participants exhibited for specific stimuli. Although these results should be interpreted very cautiously due to the highly complex nature of the interactions, the tendency for more conservative (as opposed to liberal) response criteria could be considered within a motivational framework. Arousal can be thought of as a signal of how important or urgent something is to one's current goals or needs (Storbeck & Clore, 2008). In the context of a memory judgment, high levels of arousal may signal the importance of avoiding mistakes in claiming that a face was previously seen, and in this way lead participants to adopt a more conservative response style.

Neuroticism.

In the discrimination analysis, there was a significant three-way interaction between neuroticism, face gender, and facial expression, $F(1, 117) = 5.33$, $p = .023$, $\eta_p^2 = .04$, which was interpreted in the context of a five-way interaction between neuroticism, mood, face gender, facial expression, and spatial frequency, $F(1, 117) = 4.36$, $p = .039$, $\eta_p^2 = .04$. The interaction was first explored by separately examining the different mood conditions. There were no significant effects in the sad condition ($p > .05$).

The three-way interaction between neuroticism, face gender, and facial expression was significant among the happy participants, $F(1, 65) = 5.48$, $p = .022$, $\eta_p^2 = .08$, which was interpreted in the context of a four-way interaction between neuroticism, face gender, facial expression, and spatial frequency, $F(1, 65) = 4.45$, $p = .039$, $\eta_p^2 = .06$. There was no influence of neuroticism with HSF faces ($p > .05$). For LSF faces, neuroticism interacted with face gender and facial expression, $F(1, 65) = 10.45$, $p = .002$, $\eta_p^2 = .14$, which was interpreted in the context of a four-way interaction between neuroticism, judgment task, face gender, and facial expression, $F(1, 65) = 6.08$, $p = .016$, $\eta_p^2 = .09$.

In the expression judgment task, the interaction between neuroticism, face gender, and facial expression remained significant, $F(1, 35) = 12.48$, $p = .001$, $\eta_p^2 = .26$ (See Figure 17). Among participants in the happy condition, those with low neuroticism scores had better discrimination for LSF faces that were not consistent with gender stereotypes (frowning females and smiling males) compared to faces consistent with gender stereotypes (smiling females and frowning males), whereas those with high neuroticism scores performed poorly for these faces. It is interesting to note that this pattern would be in opposition to trait-specific processing for stereotypical information and occurred only for LSF faces.

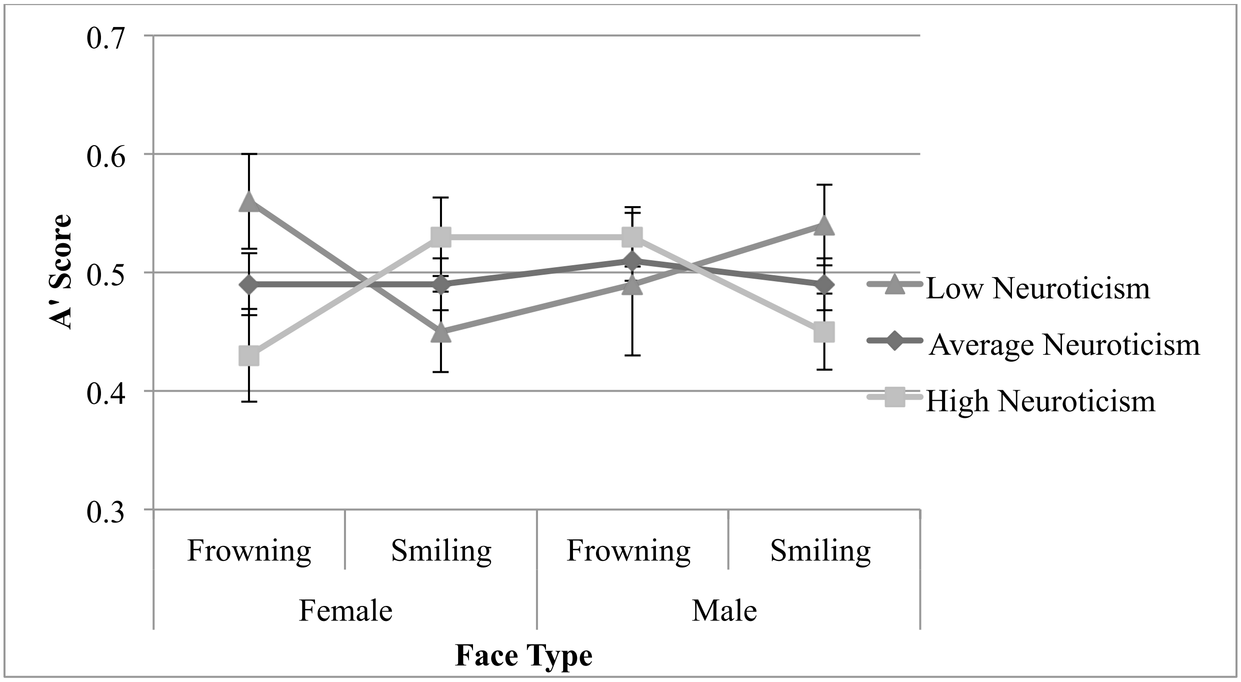

Figure 17: The interaction between neuroticism, face gender, and facial expression on discrimination with standard error bars.

In the response bias analysis, follow-up tests performed on a significant four-way interaction between neuroticism, face gender, facial expression, and spatial frequency, $F(1 ,117) = 9.02$, $p = .003$, $\eta_p^2 = .07$, provided evidence of trait congruent response biases for HSF faces and affect incongruent response biases for LSF faces. Responses for female (but not male) faces varied slightly as a function of neuroticism scores, $F(1, 117) = 5.33$, $p < .001$, $\eta_p^2 = .12$. As seen in Figure 18, low scores on neuroticism were associated with a more liberal response bias for HSF smiling and LSF frowning female faces. This finding parallels the interaction between mood, facial expression, and spatial frequency in this experiment. Specifically, happy participants displayed a more liberal response bias to HSF smiling and LSF frowning faces, and sad participants displayed a weaker response bias to these same faces. As predicted, low scores on neuroticism appears to act in a similar manner as a happy mood.

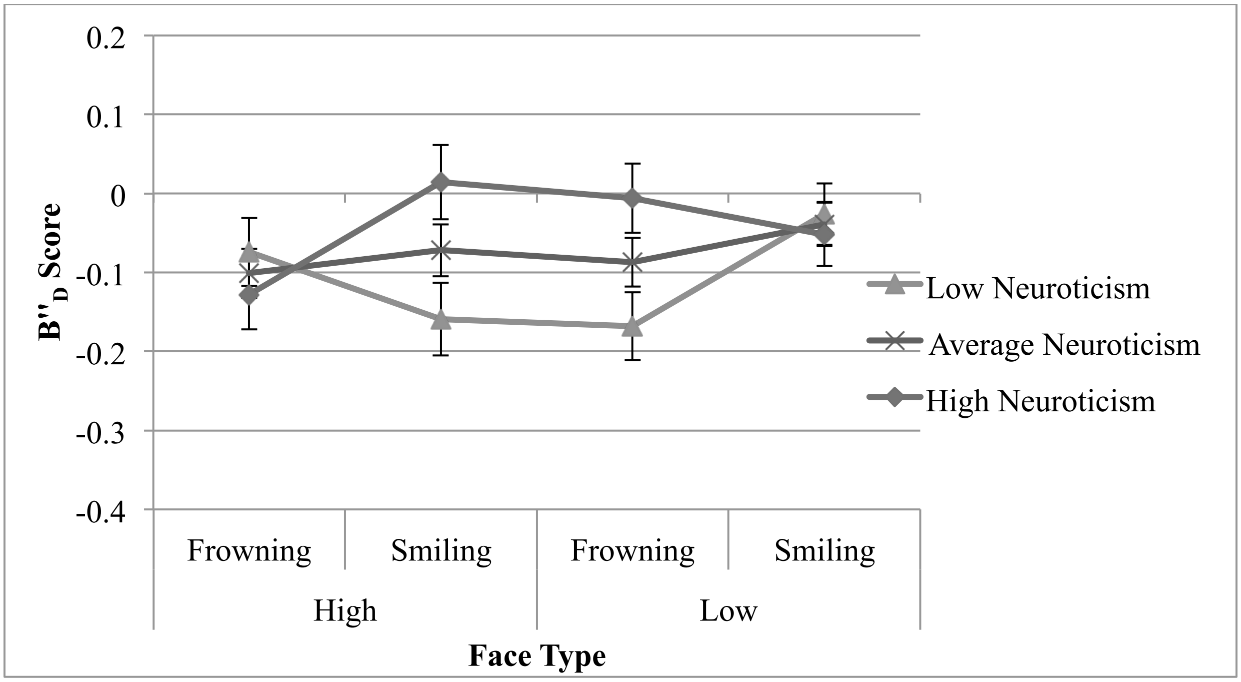

Figure 18. Moderating effect of neuroticism on response bias for female faces by spatial frequency and facial expression with standard error bars.

There was also a significant five-way interaction between neuroticism, participant mood, judgment task, facial expression, and spatial frequency, $F(1, 117) = 4.06$, $p = .046$, $\eta_p^2 = .03$. There were no further effects among sad participants who completed the gender judgment task. The interaction between neuroticism, facial expression, and spatial frequency was only significant for happy participants who completed the expression judgment task, $F(1, 35) = 5.97$, $p = .020$, $\eta_p^2 = .15$. As seen in Figure 19, the pattern of response bias among participants in the happy condition who completed the expression judgment task was consistent with the previous interaction. These participants who also had low neuroticism scores displayed more liberal response biases for trait-congruent HSF faces and trait-incongruent LSF faces. As predicted, for happy participants, neuroticism acted in a similar manner to state affect.

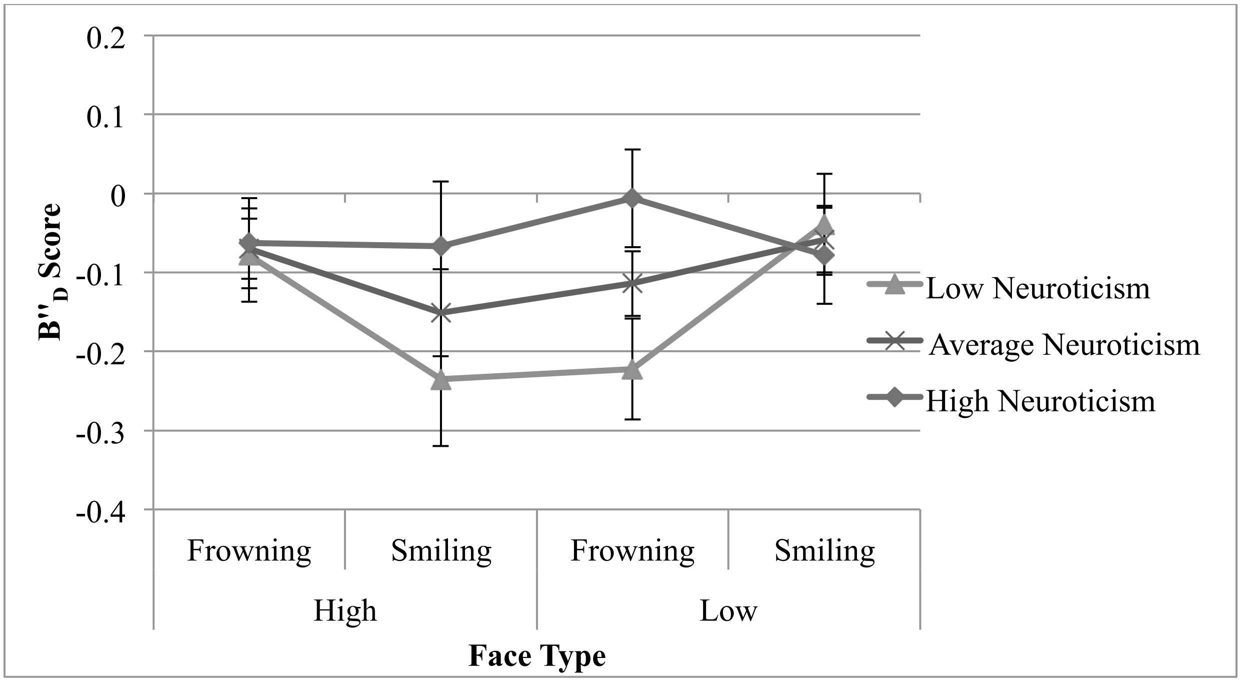

Figure 19: Moderating effect of neuroticism on response bias by facial expression and spatial frequency for happy participants who completed the expression judgment task with standard error bars.

After stratifying the analysis by mood and judgment task, two additional interactions emerged with face gender. For happy participants in the gender judgment task condition, neuroticism interacted with face gender and spatial frequency, $F(1, 30) = 4.61$, $p = .040$, $\eta_p^2 = .13$ (See Figure 20). Those with low scores on neuroticism had more liberal response styles, with the exception of for LSF female faces. And finally, for sad participants in the expression task condition, neuroticism interacted with face gender and facial expression, $F(1, 23) = 8.524$, $p = .008$, $\eta_p^2 = .27$ (See Figure 21). Those with high scores on neuroticism (state and trait congruent affect) displayed a more liberal response style for gender stereotype inconsistent faces, which is consistent with predictions of negative affect leading to greater stereotype-inconsistent responding. By examining Figures 19, 20, and 21 together, we can see that for participants in the happy condition, those with low scores on neuroticism had greater variability in response bias, whereas for participants in the sad condition, high scores on neuroticism were associated with greater variability in response bias. Consistent with previous research, the largest effects occur with there is trait and state congruence (Rafienia et al., 2008; Rusting, 1999).

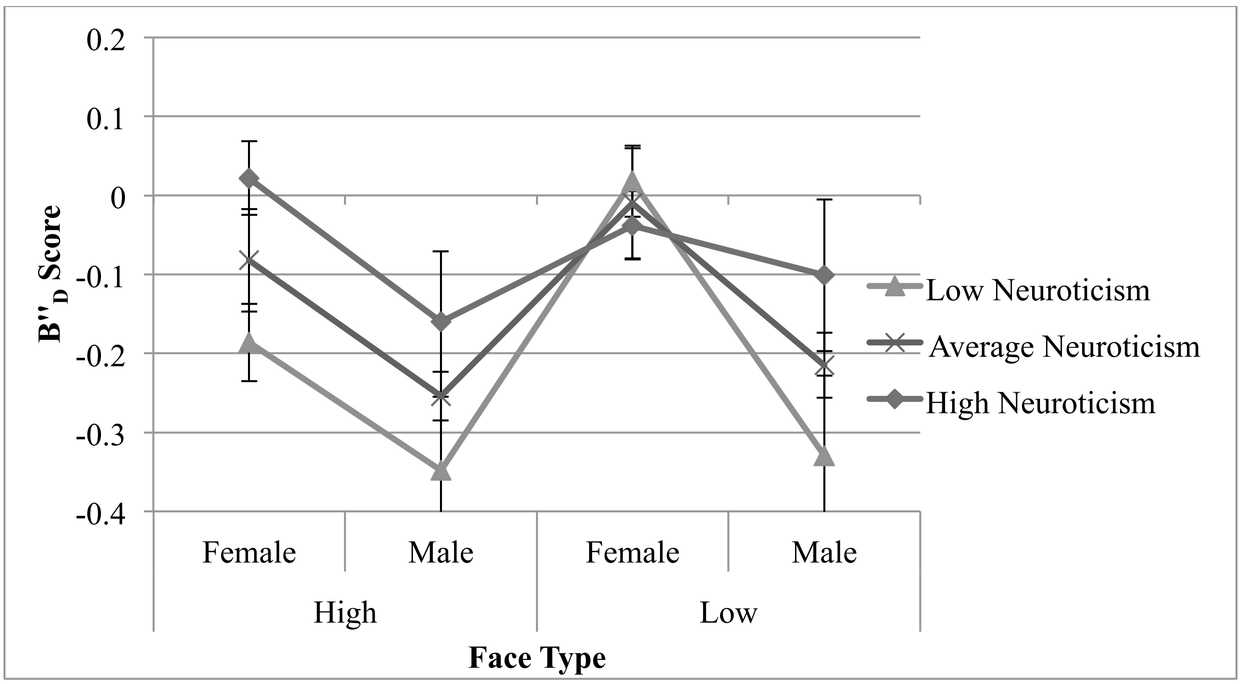

Figure 20: Response bias scores for happy participants who completed the gender judgment task; interaction between neuroticism, face gender, and spatial frequency with standard error bars.

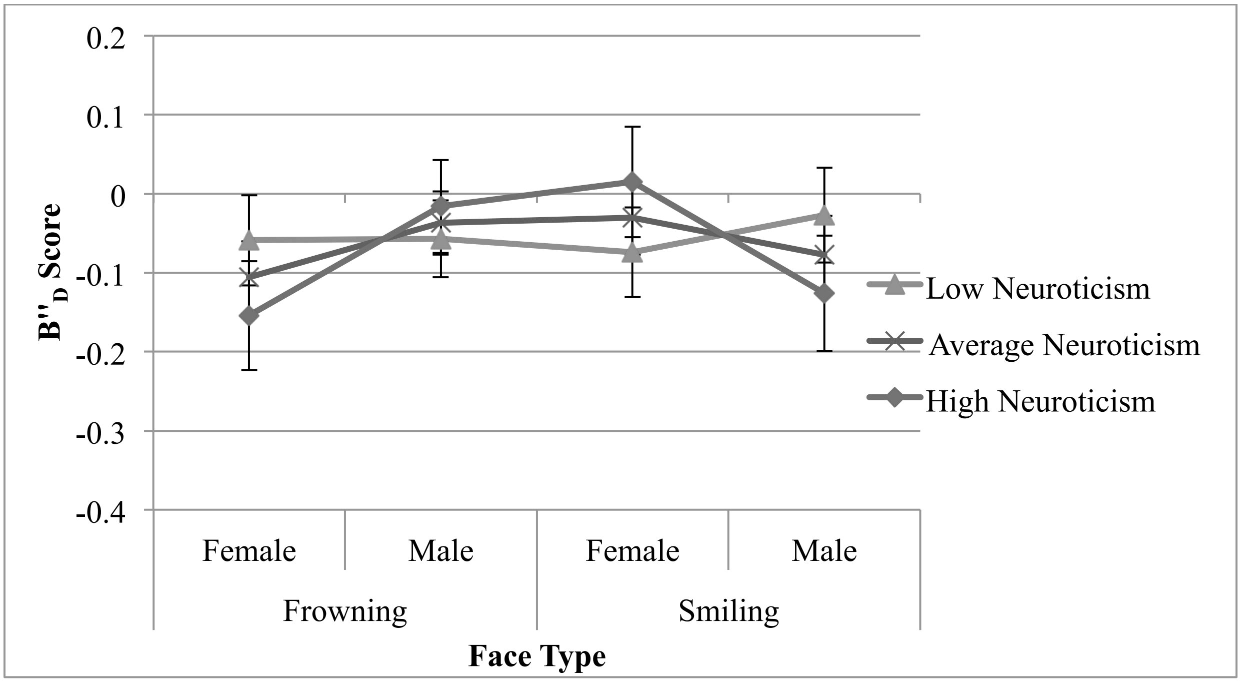

Figure 21: Response bias scores for sad participants who completed the expression judgment task; interaction between neuroticism, face gender, and facial expression with standard error bars.

Discussion

This study provides the first examination of mood biases for these tasks. The main hypothesis was that a sad mood would suppress, and a happy mood would enhance, task-related SF biases in the perception task. Although the results were in this general direction, the mood manipulation did not have a significant effect on the task effect. Indeed, task was the strongest, and most consistent predictor of performance. The absence of a mood effect on SF bias is noteworthy. Perhaps the task effects were so strong that mood was not considered a relevant source of information. Mood must be considered as situated within a specific context (Clore & Huntsinger, 2009). If there were a large advantage for approaching a task in a specific way, it would be ineffective to change that approach entirely in response to a shift in mood. Mood does impact performance, but is not the only, or the most important factor in many situations (Forgas, 1995a).

Mood had a larger impact on performance in the memory task, which is consistent with the literature on mood effects (Chepenik et al., 2007). The pattern of perception responses was consistent for both mood groups, with less variation for sad compared to happy participants. However, during memory testing there were a number of differences in response patterns for happy and sad participants in each of the tasks. For discrimination, it was the sad participants whose performance varied as a function of facial characteristics, but with response bias I found that the performance of happy participants varied across different face types. Discrimination of old from new faces followed a mood congruent pattern in the gender, but not the expression task. This pattern is the exact opposite of that seen in Experiment 1, but is comparable to that described in a classic experiment examining the influence of a sunny day on judgments of life satisfaction (Schwarz & Clore, 1983). In this experiment, participants reported more happiness and greater life satisfaction on sunny than raining days. However, this effect did not occur when the weather was discussed earlier in the conversation. Presumably, discussing the weather allowed the participant to identify the potential influence of the weather on their mood and this reduced their tendency to attribute a positive mood to more general life satisfaction. In the current experiment, the mood manipulation was likely easily identifiable as the source of the current mood state. When making judgments of facial expression after the manipulation, participants would have been less likely to use their current mood to inform their judgments because it was seen as irrelevant. In contrast, a source for a happy or sad mood in Experiment 1 would not have been obvious, thereby increasing the likelihood of affect influencing cognition for affect relevant tasks (Clore, Wyer Jr., et al., 2001).

The third goal of the study was to continue to explore if and how individual level variables affected mood biases. It should be noted again that, with random sampling, effects of these types of variables are difficult to detect reliably without a very large sample. Arousal played less of a role in this experiment than in Experiment 1, only affecting response bias when interacting with mood. The mood manipulation in the present experiment also affected arousal scores, with participants in the happy condition having higher arousal scores ($M = 4.97$) than those in the sad condition ($M = 3.74$). Additionally, happy and sad are both relatively moderate arousal states in comparison to anger and surprise (high arousal states), or calm and sleepy (low arousal states) (Feldman, 1995). The reduced variation in arousal may have made it more difficult to detect effects.

Extraversion and neuroticism both influenced perception, whereas only neuroticism influenced memory performance. During the perception phase, low extraversion was associated with a reduction in the overall HSF bias. High neuroticism was also associated with a change in the perception biases seen in the primary analyses. Among those in the happy mood condition, high scores of neuroticism were associated with a reversal in the bias towards HSF frowning males and HSF smiling females. Both of these findings provide support for claims that trait negative affect can influence perception by reducing or reversing default processing strategies. The fact that the reversal of the gender and expression interaction occurred only for individuals in the happy condition is of particular relevance. To date there has been little examining or theoretical predictions about incongruent trait and state affect, particularly for the combination of negative trait affect and positive state affect. For research examining response time data, incongruence typically leads to slower response times (Tamir et al., 2002; Tamir & Robinson, 2004), although biases in perception are relatively unexamined. The current finding could support an extended application of the affect as information model that views trait affect as a default processing style and a positive mood would act as a go signal to enhance that processing style.

In the memory task, happy participants with low scores on neuroticism—which represents congruence between trait and state affect—led to superior discrimination for LSF faces that were inconsistent with traditional gender stereotypes. Specifically, these participants showed superior performance of frowning female and smiling male faces compared to happy participants with high neuroticism scores (Triangle data points in Figure 17). This finding adds to previous results in this set of experiments linking untraditional processing styles, such as increased processing of mood incongruent or stereotype incongruent faces, to LSF faces, in contrast to more congruent processing with HSF faces.

In contrast to the gender stereotype consistent discrimination among those with high neuroticism scores, the response bias analyses showed increase willingness among those with high neuroticism to report faces as old when they were gender stereotype inconsistent (Diamond data points in Figure 21). The key factor may be the match with mood. Stereotype consistent processing occurred among individuals in the happy condition for the discrimination analyses and those in the sad condition for the response bias analyses.

The analyses examining response bias found the greatest number of moderating effects of neuroticism. Participants' willingness to rate a face as old was influenced by a combination of factors including neuroticism scores, the mood condition, and the perception judgment task that they completed. In two separate interactions (Figures 18 and 19), participants were more liberal for trait-congruent than trait-incongruent HSF faces (e.g., frowning faces for those with high neuroticism) and more liberal for trait-incongruent than trait-congruent LSF faces. Specifically, this pattern was seen for female faces and for happy participants who completed the expression task.

Traditional approaches to mood biases would predict that negative affect would lead to preferential processing of negative stimuli and information presented in HSF. In contrast, the affect as information approach views being in a positive mood as an indication to continue using the default processing strategy, and experiencing a sad mood as an indication to switch to a different strategy (Clore & Huntsinger, 2009). If negative affect was associated with a specific processing style it would be most easily observed in an otherwise unbiased task (Forgas, 1995a). Because the gender task was not associated with an SF bias in the previous experiment it would provide an opportunity to observe this effect. However, no such bias was present in the current experiment. Instead, negative affect as measured by low scores on extraversion reduced the strong HSF bias that was driven by the expression task. This finding provides evidence in opposition to traditional approaches and appears to be more consistent with the affect as information model as opposed to the affect infusion model.

Memory performance results were also inconsistent with theories predicting widespread affect congruent responding, and particularly network models that presume selective sensitivity to information congruent with one's current mood state. Instead, there were both congruent and incongruent results. The direction of the effects depended on personality, task, and the exact nature of the stimuli (e.g., HSF or LSF). These results suggest that there is a much more complex relationship between affect and memory than network models can accommodate. Although the affect infusion model and the affect as information model both identify personality as a factor that moderates mood effects, personality has not been fully integrated into either model in a way that allows for accurate prediction of effects when there is mismatch between state and trait affect. The affect certainty model predicts overall impairment of processing when state and trait conflict, but does not speak to specific biases in recall for affective stimuli (Tamir et al., 2002). Integrating the affect certainty model and the affect as information model, incongruence between one's general disposition and current mood could create affective incoherence (Centerbar, Schnall, Clore, & Garvin, 2008). Affect incoherence would signal the need to shift from one's typical information processing style, thereby leading to trait-incongruent memory effects.

Together, these results support the use of mood as one source of information to either support or suppress one's baseline processing style. However, the current experiment was conducted with psychology students who were induced into a happy or sad mood. The mood conditions may not adequately represent the processing of individuals who would naturally be in a positive or negative mood or be suffering from more severe mood disturbance. Therefore, the present findings may not generalize to a more clinical population. The next experiment addressed this concern by comparing the performance of participants with mood disorder symptoms to that of participants with no history of mental health problems.

Chapter 4: Experiment 3

Experiment 3 examined the influence of natural mood disturbance on the task biases found in the previous experiments. The primary goal of this study was to determine if depression symptoms affect task performance and, if so, whether the effects are consistent with those from the previous study examining induced mood. Although much of the literature on mood effects shows similar patterns of findings among individuals with induced mood and clinical symptoms of depression, there may be some differences, particularly with respect to facial processing. Depression has been associated with atypical neural activation during face processing. For example, compared to non-depressed samples, individuals with depression show reduced right posterior activity when viewing affective faces (Deldin, Keller, Gergen, & Miller, 2000) as well as greater amygdala reactivity for sad faces and lower reactivity to happy faces (Dannlowski et al., 2007; Suslow et al., 2010). In terms of performance, there are studies showing normal facial processing among those with depression, others demonstrate more global impairment, and many show valance-specific impairments or biases (Bistricky, Ingram, & Atchley, 2011). Studies with inpatient samples are more likely to show deficits in the perception of facial affect among those with depression compared to studies using participants with less severe depressive symptoms (Csukly et al., 2011). Moderate levels of depression may lead to more accurate discrimination of sadness (Gollan, McCloskey, Hoxha, & Coccaro, 2010), whereas more acute levels of depression may lead to less accurate discrimination of sadness (Gur et al., 1992). Specifically, severity of depression may increase perception of sadness in faces displaying a range of different negative facial expressions, causing decreased specificity in expression perception (van Marle, Hermans, Qin, & Fernandez, 2009) as well as lower sensitivity to subtle signs of happiness conveyed through facial affect (LeMoult, Joormann, Sherdell, Wright, & Gotlib, 2009). There is some evidence that in some cases, induced negative mood and naturally occurring depressive symptoms produce opposite patterns of biases, with induced negative mood leading to improved recognition of sadness and natural depressive symptoms leading to impaired recognition of sadness, although MCM may be more comparable across the groups (Ridout et al., 2009).

Overall, I predicted a similar pattern of results as the previous two experiments. Specifically, I predicted that the depression group would show less evidence of the stimuli and task effects identified in the first experiment. Given the aforementioned differences in facial processing between non-depressed and depressed samples, it is possible that a mood congruent bias could emerge in the perception task in this sample. The second goal was to compare mood effects for perception and memory. I predicted that mood congruency would be more evident in the memory than perception results. The final goal was to continue exploring the role of personality traits for cognition, particularly when interacting with mood. The depression symptom group represents a different personality profile than the general population and these traits may interact with clinical depression symptoms differently than they do with a temporary mood state. Because the mood is not temporally related to the experimental tasks, personality traits may drive the effects more in this experiment compared to Experiment 2. I predict that the pattern of personality effects will be more consistent with those of Experiment 1 than Experiment 2.

Methods

Participants

Sixty-three participants (16 male, 47 female, M_{age} = 29.7 years, age range: 17-58 years) were recruited from the community. All participants were required to have no problems with substance abuse due to potential effects of chronic substance use on cognitive functioning

(Lundqvist, 2005; Meyerhoff et al., 2005) and high rates of comorbidity between mood and substance use disorders, which could be a confounding factor (Currie et al., 2005). They were given a vision test to control for distance effects on spatial frequency processing and were screened for facial processing impairments. Participants received a $25 gift card to a local grocery or department store in exchange for their voluntary participation in the study.

The depression symptom group (*N* = 31, 23 female) was recruited from treatment programs in Winnipeg, Manitoba including the Mood Disorders Clinic at the Health Sciences Centre, the Mood Disorders Association of Manitoba, the Psychological Service Centre and the Student Counseling Centre at the University of Manitoba, private counseling centres, the Men's Resource Centre, and the Fort Garry Women's Resource Centre. These participants were required to have current symptoms of depression. All participants reported some contact with mental health professionals and all but one had received a formal mood disorder diagnosis. Approximately 84% of the depression group reported also having problems with anxiety symptoms. Roughly 81% were on medication related to their mood symptoms, 52% were currently seeing a therapist, and 94% had been suffering from depressive symptoms for over three years. Although this was not a "clean" sample in terms of comorbidity or exposure to intervention, the group was quite representative of the population of individuals with depression seen in clinical settings. They were also a chronic sample, with many reporting having suffered from depression for most of their lives.

The control group (*N* = 32, 24 female) was recruited through various community bulletin boards located at the University of Manitoba, grocery stores, and community centres. They were required to have no problems with mood, anxiety, or substance abuse in the past five years.

Stimuli and Measures

All the stimuli and measures used in Experiment 1 were included and one additional measure was added. The internal consistencies (Cronbach's *a*) of the PSS, extraversion, and neuroticism for this sample were .92, .88, and .91, respectively.

The Beck Depression Inventory – Second Edition (BDI-II). The BDI-II (Beck, Steer, & Brown, 1996) is a 21-item self-report measures of depression severity that corresponds to the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV; American Psychiatric Association, 1994). This measure has high internal consistency and test-retest reliability, good convergent validity with the Beck Hopelessness Scale, Scale for Suicidal Ideation, and Hamilton Psychiatric Rating Scale for Depression, and good divergent validity with the Beck Anxiety Inventory and Hamilton Psychiatric Rating Scale for Anxiety (Beck et al., 1996). The internal consistency (Cronbach's *a*) of the BDI-II for this sample was .95.

Procedure

Participants were randomly assigned to a task condition (gender judgment, expression judgment), blocked by depression status. Participants read and signed a consent form, completed a near vision eye test, and the facial screening task. The participants then completed the affect grid, NEO-FFI-3, PSS, and the BDI-II. The test phase began with the hybrid judgment perception task followed by the memory task. The experiment ended with the sociodemographic and open-ended questions. Finally, the participants were debriefed and provided with a handout that provided information on local mental health resources.

Results

As expected, the depression group had a significantly higher mean BDI-II score (M = 28.77) than the control group (M = 5.66), $t(60) = -10.968$, $p < .001$. The depression group also had a significantly higher mean age ($M = 38$) than the control group ($M = 21$), $t(61) = -8.143$, $p < .001$.

Perception Task

To evaluate the role of task and mood on perception, a repeated measures ANOVA was conducted on SF bias scores, with task (gender judgment, expression judgment) and mood (control, depression) as between subject factors and face gender (male, female) and facial expression (smile, frown) as repeated measures. The repeated measures represented the qualities of the HSF image used to create each hybrid type. There was a main effect of task, $F(1,59) = 14.12$, $p < .001$, $\eta_p^2 = .19$. As in the previous two experiments, there was an HSF bias for the expression task ($M = .16$), $F(1,30) = 15.32$, $p < .001$, $\eta_p^2 = .34$. In this experiment no SF bias was observed in the gender task ($M = -.08$), $F(1,29) = 2.45$, $p = .13$, $\eta_p^2 = .08$.

There was a significant three-way interaction between mood, face gender, and facial expression, $F(1,59) = 4.47$, $p = 0.039$, $\eta_p^2 = .07$. The control group showed the same pattern seen in the previous experiments, namely a bias towards perceiving HSF frowning male faces ($M = .19$) and away from perceiving HSF frowning female faces ($M = -.14$), $F(1,30) = 6.70$, $p = 0.015$, $\eta_p^2 = .18$. This interaction was not significant for participants with depression symptoms. This finding supports the prediction that a sad mood suppresses the dominant processing biases for a given task.

In this experiment there was also an interaction between task and facial expression, $F(1,59) = 4.32$, $p = 0.042$, $\eta_p^2 = .07$, which is comparable to the direction of results in Experiment 1. In the expression task there was a slight bias towards perceiving HSF smiling ($M = .20$) over HSF frowning faces ($M = .13$). In the gender task there was a bias towards perceiving LSF frowning ($M = -.15$) compared to LSF smiling faces ($M = -.01$).

The task effects were consistent with those described in Experiments 1 and 2. When stratified by mood, all effects reported in the current model were significant for the control group and were not significant ($p > .10$) for the depression group. This pattern is consistent with a sad mood suppressing the dominant tendency. However, this was a slight suppression and the task effects were again the strongest predictors of performance.

Memory Task

In the next set of analyses I examined the influence of mood on memory bias. As expected, preliminary tests indicated that there was a main effect of perception status (i.e., whether the face was perceived or not during perceptual testing) on memory responses, $F(1,58) = 2.77$, $p = .048$, $\eta_p^2 = .10$. Post-hoc contrasts specified that faces identified in the perception task were judged as being old more often than faces that were new, $p = .020$. Recognition rates for faces that were presented but not identified in the perception task were similar to those of new faces, $p = .941$. Signal detection analyses were conducted with the faces that were perceived being classified as old, and foils being classified as new.

Discrimination analysis. Discrimination was influenced by face gender and facial expression, $F(1, 59) = 7.17$, $p = .010$, $\eta_p^2 = .11$. Discrimination was better for female frowning ($M = .52$) and male smiling faces ($M = .52$) compared to female smiling ($M = .50$) and male frowning faces ($M = .48$). This pattern is consistent with results in the liturature of superiour memory performance for stereotype incongruent stimuli (Brewer, 1988; Forgas, 1995b; Hilton et al., 1991).

Participants with symptoms of depression showed better discrimination for mood congruent HSF faces and mood-incongruent LSF faces. This finding presented as a significant three-way interaction between mood, facial expression, and spatial frequency, $F(1, 59) = 5.14$, *p*

= .027, η_p^2 = .08. Facial expression and spatial frequency interacted with the performance of depressed participants, *F*(1, 29) = 7.69, *p* = .010, η_p^2 = .21, but not the control group (*p* =.603). Participants in the depression group were slightly worse at discriminating between old and new HSF smiling (*M* = .49) and LSF frowning faces (*M* = .46) compared to HSF frowning (*M* = .52) and LSF smiling (*M* = .52) faces. Variation in discrimination in relation to stimulus characteristics was more common with those in a sad mood than those in a happy mood. This result supports the prediction that mood congruent processing would be more common in memory than perception tasks. This results is also another example of congruent (mood or stereotype-consistent) processing for HSF and incongruent processsing for LSF stimuli, which has been an ongoing pattern throughout this series of experiments.

Response bias analysis. There was a two-way interaction between facial expression and spatial frequency, *F*(1, 59) = 5.13, *p* = .027, η_p^2 = .08. The faces that were identified as being harder to discriminate between (HSF smiling and LSF frowning) were the faces that showed a more liberal response bias. Although the interaction with mood was not significant, when stratifying by mood group this pattern was somewhat stronger in the control group than in the depression symptoms group.

Moderation Analyses

In this experiment, neuroticism scores were highly correlated with mood group, r_s (63) = .86, *p* <.01. As this relationship led to problems with collinearity, neuroticism was not examined further in this experiment. The remaining correlations can be seen in Appendix D.

Perception moderation analyses. There was a three-way interaction between extraversion, mood, and facial expression, *F*(1, 55) = 10.34, *p* = .002, η_p^2 = .16. Among the depression symptoms group, high extraversion was associated with a trait-congruent (and mood-incongruent) bias for HSF faces. Thus, for the depression symptom group, $F(1, 27) = 10.89$, $p = .003$, $\eta_p^2 = .29$, but not for the control group, $p = .216$, higher extraversion scores were associated with a bias towards perceiving smiling HSF faces ($M = .40$), and low scores were not associated with an SF bias ($M = -.05$). Individuals with average scores on extraversion fell in the middle ($M = .18$). This finding supports the prediction that traits may be more relevant in this experiment than Experiment 2 where mood was manipulated due to the temporal relationship between the experienced affect and the tasks.

A significant three-way interaction between extraversion, face gender, and facial expression, $F(1, 55) = 6.22$, $p = .016$, $\eta_p^2 = .10$, was contained within a four-way interaction between extraversion, task, face gender, and facial expression, $F(1, 55) = 4.24$, $p = .044$, $\eta_p^2 = .07$. The three-way interaction was evident in the gender task, $F(1, 27) = 9.81$, $p = .004$, $\eta_p^2 = .27$, but not in the expression task, $p = .743$. The face gender and facial expression interaction was moderated by extraversion. Specifically, individuals with high scores on extraversion showed a bias towards perceiving HSF male smiling faces ($M = .30$), whereas individuals with low scores on extraversion showed a bias away from perceiving these faces ($M = -.17$) and those with average scores exhibited little bias in either direction ($M = .07$). This pattern is opposite of that seen in the primary analyses for these experiments, which provides some evidence against the prediction that traits associated with positive affect would enhance baseline processing. However, further exploration of this finding revealed very different patterns in the control group and the depression symptoms group, as well as wide confidence intervals, making this specific finding difficult to interpret. Further examination of this pattern would be necessary in future research to clarify the implications.

Memory moderation analyses.

Arousal. Arousal had a significant effect on response bias in this experiment. There was a five-way interaction between arousal, mood, task, face gender, and facial expression, $F(1, 55) = 5.74$, $p = .020$, $\eta_p^2 = .09$, contained in a six-way interaction between arousal, mood, task, face gender, facial expression, and spatial frequency, $F(1, 55) = 5.983$, $p = .018$, $\eta_p^2 = .10$. These effects were examined separately by mood and task.

Control group. In the expression task, individuals in the control group with high scores on arousal were more liberal in their responses to frowning faces and those with low scores were conservative in their responses, $F(1, 14) = 6.49$, $p = .023$, $\eta_p^2 = .32$. Individuals in the control group with high scores on arousal were biased towards identifying frowning faces as being old ($M = -.19$) and those with low scores were biased towards identifying these faces as new ($M = .13$). By contrast, in Experiment 1 both low and high arousal levels were associated with a more liberal response bias to frowning faces. In the present experiment there were no significant effects of arousal in the gender task among the control group.

Depression symptoms group. In the gender task, the interaction between arousal, face gender, facial expression, and spatial frequency was significant for the depression group, $F(1, 13) = 5.11$, $p = .042$, $\eta_p^2 = .28$. Here, low arousal was associated with more liberal response bias towards HSF female smiling and LSF male smiling faces compared to high arousal. The three-way interaction displayed in Figure 22 between arousal, face gender, and spatial frequency had a medium effect size but did not reach significance for smiling faces, $p = .087$, $\eta_p^2 = .21$, likely due to limited power in the stratified sample. There was no effect for frowning faces, $p = .461$. This results demonstrates more gender stereotype consistent processing of HSF than LSF stimuli among those with low scores on arousal. In this specific population, the meaning of high or low arousal is more difficult to interpret. Low arousal could either indicate lower levels of anxiety, or alternatively, more severe depression symptoms.

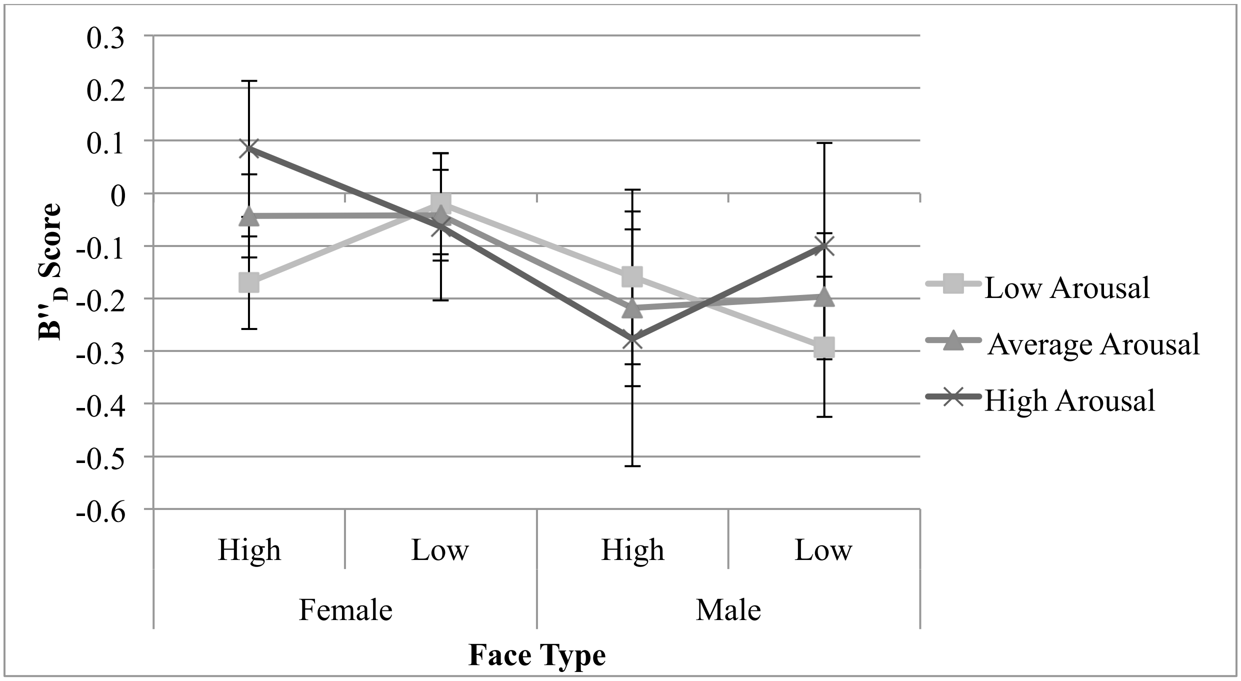

Figure 22. Moderating effect of arousal on face gender and spatial frequency for depressed participants in the gender task for smiling faces. Response bias scores with standard error bars.

Extraversion**.** In the gender task, individuals with lower extraversion scores had better discrimination (M = .52) than those with high scores (M = .48), as indicated by a two-way interaction between extraversion and task, $F(1, 55) = 4.29$, $p = .043$, $\eta_p^2 = .07$. There was also a three-way interaction between extraversion, mood, and spatial frequency, $F(1, 55) = 4.52$, $p = .038$, $\eta_p^2 = .08$. In the control group, individuals with lower extraversion scores (M = .56) had better discrimination than those with high scores (M = .48) for HSF faces.

Extraversion was also involved in a number of complex interactions in the response bias analysis. There were three-way interactions between extraversion, mood, and facial expression, $F(1, 55) = 11.15$, $p = .002$, $\eta_p^2 = .17$; extraversion, face gender, and spatial frequency, $F(1, 55) =$

4.24, $p = .044$, $\eta_p^2 = .07$, and extraversion, facial expression, and spatial frequency, $F(1, 55) = 5.96$, $p = .018$, $\eta_p^2 = .10$. There was also a five-way interaction between extraversion, task, mood, face gender, and facial expression, $F(1, 55) = 6.49$, $p = .014$, $\eta_p^2 = .11$. All of these were contained within a six-way interaction between extraversion, task, mood, face gender, facial expression, and spatial frequency, $F(1, 55) = 4.54$, $p = .038$, $\eta_p^2 = .08$. The interactions were explored by first examining the depression symptoms and control groups separately.

In the depression group, those with high scores on extraversion were more liberal in their responses to smiling faces ($M = -.35$) than those with low scores ($M = -.09$), $F(1, 28) = 7.57$, $p = .010$, $\eta_p^2 = .22$. This finding represents trait-congruence and mood incongruence. This finding supports the prediction that traits may drive results more in this experiment than mood, which is temporally unrelated to the tasks.

In the control group, those with low scores on extraversion showed greater variation in their response bias for different types of stimuli in the expression task. The five-way interaction between extraversion, task, face gender, spatial frequency, and facial expression was significant, $F(1, 28) = 4.69$, $p = .039$, $\eta_p^2 = .14$. After stratifying by task, there were no significant moderation effects in the gender task. In the expression task, however, the four-way interaction between extraversion, face gender, facial expression, and spatial frequency was significant, $F(1, 14) = 6.87$, $p = .020$, $\eta_p^2 = .33$. Further post-hoc analyses indicated that the effect was significant for HSF, $F(1, 14) = 10.32$, $p = .006$, $\eta_p^2 = .42$, but not LSF faces, $p = .430$. As seen in Figure 23, individuals with low scores on extraversion showed the greatest variation in response bias, exhibiting a liberal bias for smiling female faces and a slightly conservative bias for frowning female and smiling male faces. This pattern represents gender stereotype consistent reponding with reduced trait positive affect, only when gender was not the focus of the perception task.

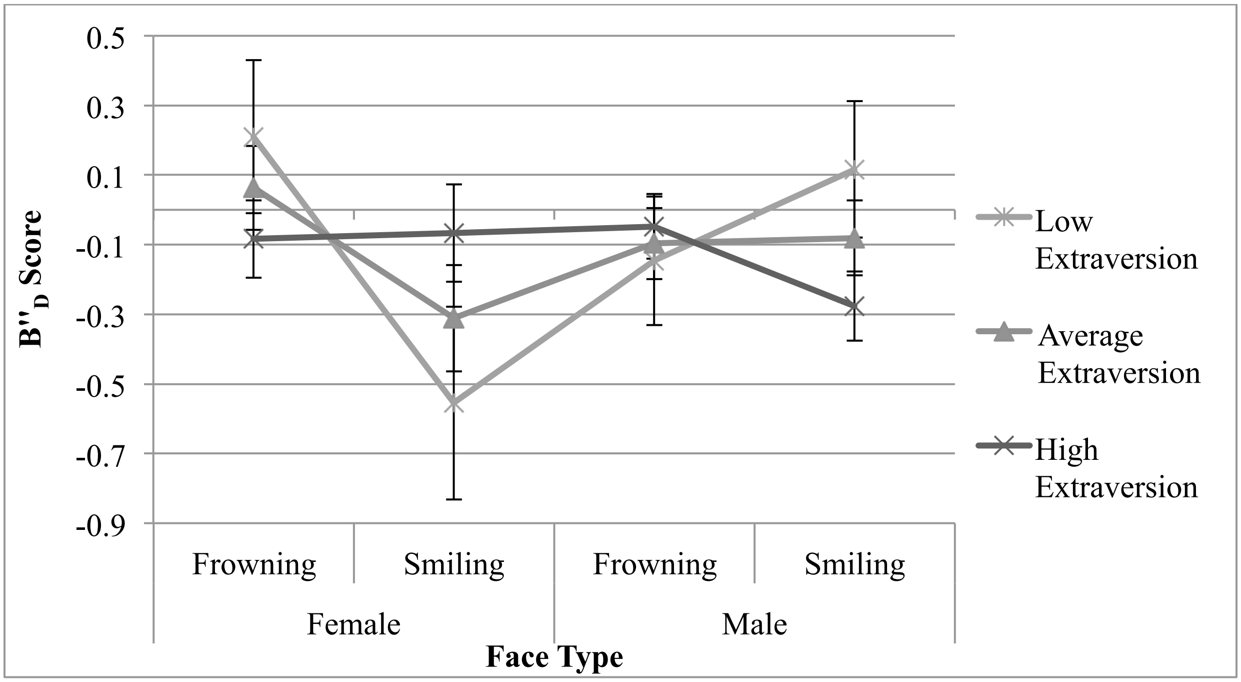

Figure 23. Moderating effects of extraversion on face gender and facial expression for HSF faces in the expression task for the control group.

Discussion

This study extends the previous examination of mood biases to a clinical population. Results for the primary analyses across the three experiments were very similar, indicating reliable task effects. Similarly, there was a slight suppression of these biases in the depression symptom group. This pattern of reduced biases with negative affect was again observed in all three experiments in some form. These results contradict the idea that a specific processing style is associated with sad mood (Fredrickson, 2004; Gasper & Clore, 2002). Instead, the results provide support for the affect as information assumption that experiencing a happy mood supports or enhances, and experiencing a sad mood inhibits, the dominant processing style (Clore & Huntsinger, 2009). Yet the mood effects were quite small in comparison to the overall task effects, emphasizing the importance of context. In recent years, there has been increasing interest in embodied cognition (Willems & Francken, 2012; Wilson, 2002) and embodied emotion (Foroni & Semin, 2009; Halberstadt et al., 2009; Niedenthal, 2007). These perspectives consider cognition/emotion as situated in a specific context, including the body. Theories of mood effects on cognitive functioning have also been moving towards more integration of contextual factors (Clore & Huntsinger, 2009; Forgas, 1995a). This trend is driven by data, like those presented here that show effects that vary widely depending on the specific task, population, and individual differences.

In the memory task, mood congruent discrimination was evident in the depression symptom group for HSF, but not LSF, faces. This same pattern of mood congruency with HSF stimuli was observed in some form in each of the three experiments. Although both HSF and LSF information can be perceived consciously very quickly, LSF information tends to be processed somewhat faster and can have a greater influence on cognitive processing when not consciously perceived (de Gardelle & Kouider, 2010). It is possible that HSF information is then more susceptible to influence from top-down processes, allowing mood to have a greater influence.

Mood affected different aspects of memory performance in happy and sad participants. Sad participants showed more variation in discrimination performance based on stimulus characteristics, whereas happy participants showed more variation in response bias. The finding of variation in discrimination for sad participants is consistent with previous research (Fiedler et al., 2001; Forgas, 2002). I am not aware of any studies finding variable response bias for happy participants; however, the focus in this type of study is generally discrimination and the effects of a sad mood. This change in response bias among happy and discrimination among sad participants is consistent with the broader findings that a happy mood tends to lead to more heuristic processing and decision making, whereas a sad mood tend to lead to more systematic processing (Forgas & East, 2008).

Extraversion emerged as an important moderating variable in each set of analyses. Within the depression symptom group, high extraversion scores were associated with a smiling bias in the perception task, and a liberal response bias for smiling faces in the memory task. Within this clinical group, extraversion could be an important factor in determining the relevant goals, and therefore biases. Extraversion could be a useful factor for clinicians to consider assessing to help guide treatment planning for individuals with mood disorders. It is also possible that high scores on extraversion could be associated with bipolar rather than unipolar depression, which may impact cognitive performance (Bagby et al., 1996; Sauer et al., 1997). Because these analyses are considered preliminary, further study of this effect would be warranted.

In this experiment, as in Experiment 2, arousal only played a significant role in the response bias analysis. The specific effects of arousal varied greatly in the different participant groups, different perception tasks, and with different facial stimuli. The pattern of results is not directly comparable to the results from Experiment 2 and the specific pattern is quite complex. More research would be beneficial for clarifying the role of arousal in cognitive processing biases for different populations.

The current experiment replicates many of the main findings from the previous two experiments, and extends the evidence on the role of mood in these tasks to a clinical population. The results provide some support for the affect as information model, and highlight areas that would be valuable to explore further. Specifically, the role of individual differences in relation to mood and cognition provides a rich ground for improving the predictive power of mood theories and developing a more complete understanding of cognition.

Chapter 5: General Discussion

Mood affects the content and process of cognition in complex ways. These results have typically been examined from the perspective that specific moods are associated with specific processing styles. In particular, a happy mood is associated with preferential processing of positive and global stimuli, and a sad mood is associated with preferential processing of negative and local stimuli (Direnfeld & Roberts, 2006; Gasper & Clore, 2002; Gasper, 2004; Gotlib, Krasnoperova, et al., 2004). However, as conflicting results increase in the literature, models have begun to incorporate other important individual and situational variables in order to more accurately define the conditions that will produce mood effects and predict the direction of those effects. Table 3 is provided to help organize and highlight the most important findings across the three experiments and relate each finding to how much support it provides for the affect as information model.

Table 3

Summary of main finds from Experiments 1, 2, and 3, with level of support for affect as information model

	Perception	AAI Support	Discrimination	AAI Support	Response Bias	AAI Support
Ex. 1	ExpressTask - HSF bias	☐	Mood congruence for HSF faces	☐	Mood incongruence for HSF faces	☐
	High neuroticism suppress	☑				
	Low extraversion suppress	☑				
	High extraversion enhance	☑			Female faces - trait congruence with extraversion	☐
Ex. 2	ExpressTask - HSF bias	☐	GenderTask - mood congruence	☑	ExpressTask - HSF mood congruence, LSF mood incongruence	☐
	Low extraversion suppress	☑				
					Female faces - HSF trait congruence, LSF trait incongruence	☐
Ex. 3	ExpressTask - HSF bias	☐	DepressionSx - HSF mood congruence, LSF incongruence	☐	DepressionSx - trait congruence with extraversion	☐
	Trait congruence with extraversion	☐				

☑ Support for the affect as information (AAI) model
☐ No strong support for or against the affect as information (AAI) model
☒ Support against the affect as information (AAI) model

The affect as information model predicts that mood will affect cognition when it is determined to be a relevant source of information. The specific effects that occur will depend upon the "object" and implications of the mood. If the mood is seen as being relevant for a judgment, then valence effects may occur. If the mood may be providing information about a cognitive strategy, then differences in global/local processing may occur. Importantly, the direction of the effect will depend upon the information value of the mood. With respect to valence effects, often mood will be used directly as information about a judgment (e.g., did you like that movie), about one's overall life satisfaction, or the past, and in these cases one will generally see mood congruent results (Forgas & Ciarrochi, 2001; Mayer, 1992; Schwarz & Clore, 1983). Mood incongruence can occur when there is motivation to repair one's mood (Erber & Erber, 1994; Sedikides, 1994) or when the context is associated with expectations of negative affect (e.g., a funeral; Martin, 2001). When the object of the mood relates to performance (i.e., how the individual is approaching the task rather than the content of the task), then a happy mood will support or enhance one's personal preference or dominant style whereas a sad mood will indicate that an alternate approach is needed (Hunsinger et al., 2012; Huntsinger et al., 2010). Therefore, the specific processing style (e.g., global/local) will depend upon the strategy that is most activated in a specific context, as well as an individual's dominant tendencies.

The current research simultaneously examined mood congruency and global/local processing with different task demands. Importantly, the results were compared between individuals with different personality traits, which could be considered as different default processing styles (Robinson et al., 2003). Three different approaches to studying mood effects were also taken, including examining natural mood states in university students, inducing a happy or sad mood, and examining individuals with or without current symptoms of depression. The pattern of results was complex, highlighting the fact that there are many factors that influence cognition and specific combinations of those factors are important. Mood is not the only, or the most important, factor in cognitive biases. Overall, the studies presented here provide support for the affect as information model. However, the interplay between mood and personality need to be further integrated into the model to fully account for the variable effects of mood.

Mood Congruency

From the affect as information perspective, mood congruent processing is more likely to occur when the mood is relevant for the current task (Clore & Huntsinger, 2009). For the perception task, there were both conflicting valence content and different levels of analysis available. The facial expressions depicted (frowning and smiling) did not have the immediate implications for personal safety that would be conveyed by anger or fear. Therefore, the valence of the expression would only be relevant when the task specifically involved the facial expression. This pattern was seen in both the first and third experiments, where mood was not manipulated. In these experiments, there was a bias towards perceiving smiling faces when making facial expression judgments, but not when making gender judgments. This finding indicates that the facial expression only influenced perception when it was directly relevant to the judgment. A smiling bias is common in experiments that do not have a specific mood manipulation, and represents the Pollyanna principle (Matlin & Stang, 1978). This pattern could in some respects, be considered to reflect mood congruent perception. In Experiment 1, without a mood manipulation, participants were in a generally positive mood with an average mood rating of six on a nine-point scale. Other studies have indicated that people tend to be relatively happy

(Diener & Diener, 1996). The smiling bias in the expression task could be explained as mood congruence in that relatively happy participants were more likely to perceive smiling faces. However, mood ratings were not significantly associated with an expression bias in any of the three experiments. Perhaps for perception tasks with such brief presentations, stimulus valence is more relevant than a temporary mood state. Attention studies require longer stimulus presentation times to obtain mood congruent results (Koster et al., 2005). However, mood did affect perception of different spatial frequencies, as discussed in detail in the next section. Therefore, the absence of mood congruent perception does not mean that mood is unable to influence perception so early in processing. Rather, stimulus valence was not specifically influenced by mood in this perception task. For the perception task broadly, but most prominently for the expression task, spatial frequency had a much stronger and more consistent influence on the results than valence.

In contrast to the perception task, in the memory task there was a stronger influence of facial expression than spatial frequency. In the literature, mood congruence is more commonly found in memory than other cognitive processes (Chepenik et al., 2007). Mood congruent discrimination was observed in all three experiments presented here. In some cases mood congruent memory was only present for HSF faces or observed in sad as opposed to happy participants. Although discrimination of faces followed a mood congruent pattern, there were some incongruent findings with response bias. In some cases, happy participants were more willing to claim that frowning faces were previously seen. This pattern of results is consistent with previous research showing increased discrimination for mood congruent stimuli and a mood incongruent response bias (Fiedler et al., 2001). Nevertheless, the interpretation of these findings in the literature has focused more on the discrimination results, and it has been concluded that mood congruence is a genuine memory effect rather than the result of heuristic processing (Fiedler et al., 2001). The meaning of the mood incongruent response bias has not been explored in detail and the implications of this pattern of results is unclear. These contrasting results may explain some of the confusion in the mood congruency literature. Although participants may be more accurate with mood congruent stimuli, they may be more willing to report remembering incongruent stimuli.

In daily life, these results may inform how our regular variation in mood affects our cognition. Our perception, memory, and therefore judgments, may be influenced in a mood-congruent manner at many times. Often mood will be used as a valid source of information to help guide decisions and behaviour, such as rejecting a dating partner after a bad date. Other times we may discount the influence of our mood for a specific task. For example, if one recognizes that their sad mood is related to the ending of a relationship they may not grade essays in a more critical manner than if they were in a happy mood. However, at other times we may use mood to guide cognition when it is not appropriate to do so. Being unaware of the source of a specific mood may allow the unconstrained affect to influence cognition in a mood-congruent way. For example, a long period of time with poor weather may lead to a negative mood without awareness of the cause of the mood and could therefore cause negative evaluations of a wide range of daily experiences. Mood-congruent processing may also be more likely to influence memory than immediate processing. Perhaps we should be especially considerate of the source of a current mood when making judgments about past events.

Processing Style

The traditional view on the relationship between processing style and mood is that being in a happy mood leads to more global, assimilating, top-down processing, whereas being in a sad mood leads to more local, accommodating, bottom-up processing (Bless, 2000; Fredrickson, 2004; Gasper & Clore, 2002). In contrast, the affect as information model predicts that different processing styles will be adopted depending upon the baseline strategy employed for a particular situation and/or by a particular person (Clore & Huntsinger, 2009). From this latter perspective, being in a happy mood should facilitate or enhance the dominant baseline tendency, whereas being in a sad mood should inhibit or suppress this tendency and lead to the adoption of an alternate processing strategy.

The first experiment provided baseline information about processing biases in the perception and memory tasks without any manipulation of, or selection for, mood. In the perception task, there was no spatial frequency bias in the gender judgment task and an HSF bias in the expression judgment task. This same pattern was evident in all three experiments and had a larger effect size than any influence of mood. In fact, there were no direct effects of mood on spatial frequency bias. Thus, even in the gender task (where there were no dominant SF bias in Experiment 1), individuals experiencing either an induced or chronic sad mood did not show an HSF bias, and those experiencing a happy mood did not show an LSF bias. This finding contradicts traditional, fixed approaches to mood and processing style, as well as predictions from the affect infusion model. The affect infusion model would predict a spatial frequency bias related to mood in the gender judgment task where there was not a specific baseline bias. Instead, there was a slight (non-statistically significant) suppression of the primary task effect among sad participants.

In each experiment, this suppression of primary task effects was significantly linked to personality traits associated with negative affect or reduced positive affect, such as high neuroticism and low extraversion. This pattern parallels research that found mood effects in different directions depending on what type of processing is more accessible (Hunsinger et al., 2012; Huntsinger et al., 2010; Koo, Clore, Kim, & Choi, 2012). For the majority of people, in many different contexts, global processing is more dominant and easily accessible (Kimchi, 1992; Navon, 1977). The association between a happy mood and global processing could therefore be due to the relative frequency of this type of processing rather than a causal link.

Clore and Palmer (2009) even suggest that typical studies of cognitive phenomenon represent effects in a positive mood and would be reduced or eliminated among those in a sad mood. For example, a sad mood reduces false memory effects (Storbeck & Clore, 2005), the use of stereotypes (Bodenhausen et al., 1994), and the outcome-density effect (Allan, Siegel, & Hannah, 2007). When studying mood and cognition, it will be increasingly important to consider results in context. Specifically, considering what type of processing would be most accessible during a specific task may help predict direction of effects.

These results mean that how a mood will change processing in daily life will vary based on the specific task and how an individual would usually approach such as task. For a detail-oriented person, a sad mood may help them to understand a problem from a more global perspective. In contrast, someone who typically thinks big-picture may benefit from a sad mood when memorizing details for a test. In order to maximize performance on a task, it may be beneficial to consider one's natural strategies and use mood to either enhance or suppress these strategies to suit the task demands.

There were few effects of spatial frequency in the memory task. This may be because the test stimuli for this task were made of one face, as opposed to being hybrid images, and this may have reduced the importance of spatial frequency on memory judgments. There was one main effect of mood on SF bias: in the second experiment, participants induced into a sad mood showed better discrimination of LSF than HSF faces in the expression task—a result that runs counter to the perceptual bias for that task. Again, this finding may link sad mood to non-dominant processing. There were also several significant interactions between mood, spatial frequency, and other facial characteristics. In the first experiment, mood effects occurred for HSF faces only; individuals with low mood showed better discrimination of frowning faces, whereas individuals with elevated mood showed a more liberal response bias to these faces. A similar pattern occurred in the third experiment. HSF information tends to be processed more by ventral areas in the brain and LSF information more by dorsal areas (Vuilleumier et al., 2003), possibly associated with more top-down and bottom-up processing, respectively. It is possible that mood congruency requires the activation of higher-level cognition. This possibility may explain why mood congruency is rarely found in early attention processes, but is more common with longer stimulus presentations and in memory studies. This finding provides more support for cognitive construction explanations of mood congruency than for priming models.

Arousal

Arousal has often been identified as an important moderator of mood effects (C. M. Greene, Bahri, & Soto, 2010; Jefferies, Smilek, Eich, & Enns, 2008). Although a mood defines whether an experience is positive or negative, arousal indicates the relative immediate importance of that experience. Therefore, arousal has strong implications for motivation. However, mood and arousal are not independent. Indeed, a sad mood is typically less arousing than a happy mood and both are moderately arousing in comparison to other specific moods/emotions (Feldman, 1995). The moderating role of arousal may be more evident when examining positive or negative valence more broadly, as many studies in this area have done (e.g., Forgas, 1998; Spering, Frensch, & Funke, 2005), as opposed to examining specific mood states. In the first experiment of the present series, where mood was not manipulated, arousal had a significant influence on performance in all three sets of analyses. In contrast, in the second and third experiments, where mood was manipulated or selected for, arousal only had an influence in the response bias analyses, where an interaction between arousal and mood was observed. These results indicate that arousal might have an important role in clarifying the effects of general positive and negative affect, but may not add additional relevant information when specific mood states are being examined. Even so, it would be worth examining the impact of arousal level on individuals experiencing other, more intense states such as anxiety, fear, and anger. It may be that larger effects would be evident when participants are in states of heightened arousal.

Personality

Personality has been shown to influence processing, and to act as a moderator of mood effects (Rusting, 1998). The results presented in this series of studies provide some support for this statement and highlight the need for further study. Trait-congruent processing would be evident if individuals high on trait extraversion showed a bias to perceive or recall more smiling faces, or if those with high levels of neuroticism showed a bias for frowning faces. In the first experiment, extraversion scores did relate to response bias in the expected manner. Thus, individuals with low trait extraversion had a conservative response bias for smiling faces, whereas those with high trait extraversion had a liberal response bias for smiling faces. However, in the second and third experiments personality interacted with other variables to predict performance in a way that did not fit within a straightforward trait-congruency framework. In the first experiment—as opposed to experiments two and three—there was no specific focus on mood. With no particular relevance of mood, participants may have relied on their more general identity beliefs to inform their judgments, as described in the accessibility model (Robinson &

Clore, 2002). Experiments 2 and 3 involved moods that were presumably more intense than those in Experiment 1, and in the case of Experiment 2, were unrelated to their personality or identity beliefs. These experiments provided an opportunity to examine congruence and incongruence between state and trait affect, but should be consider exploratory. The results indicate that the effects of each factor cannot be fully understood in isolation. The interaction between state and trait offer important insights into developing a comprehensive model of the role of affect on cognitive processing, which will be discussed in more detail shortly.

Trait-specific processing style could also be examined in terms of spatial frequency biases. Here, the expectation would be for increased global processing (i.e., an LSF bias) among individuals with high trait extraversion, and increased local processing (i.e., an HSF bias) among individuals with high trait neuroticism. In contrast to previous research showing this pattern (Basso et al., 1996; Kossowska & Nęcka, 1994), there were no specific SF effects associated with personality traits in the present experiments. Instead, high neuroticism and low extraversion acted in a similar fashion to low mood, reducing the task effects on spatial frequency. The affect as information model does not specifically address trait effects. However, one could extend the model by suggesting that positive affect or associated personality traits (such as high extraversion) operate as a "go" signal, whereas negative affect or associated personality traits (such as high neuroticism) operate as a "stop or proceed with caution" signal, which may override default processing biases. From this perspective, the present results are more consistent with the affect as information model than with the view that a specific processing style is linked to a specific mood or trait. I am unaware of any literature that examines cognitive biases and personality from this perspective. Therefore, these results should be considered preliminary and further research is necessary.

Examining the independent role of personality traits in processing does not explain the full range of results in the current experiments. For example, the role of personality differed depending upon whether mood was natural or induced. Robinson and Clore (2002) propose that when state information is viewed as relevant to the current task, it will be the preferred source of information. When relevant state information is not present people should default to a trait-specific style of processing. In line with this thinking, previous research has found stronger effects of personality in studies without mood manipulations, and stronger effects of state mood in studies with mood manipulations (Rusting, 1999). In those studies with mood manipulations, personality acted as a moderator to either enhance or downplay mood effects. The results discussed here generally support this view. When mood was not manipulated there were more effects from traits than mood. The trait results in the first and third experiments were largely consistent with the mood effects in that high neuroticism and low extraversion had similar effects as low mood.

Although the findings related to personality are preliminary, it is likely not surprising that a mood can affect different individuals in a variety of ways. The combination of trait affect and/or affect related beliefs will determine what a specific emotional experience will mean to an individual in terms of their specific goals and priorities. That experience will therefore guide their cognitive processing in different ways to maximize the likelihood of achieving their most important goals. For example, someone with high trait neuroticism may care more about minimizing risks than accessing rewards, whereas someone with high trait extraversion may care more about social rewards than risking rejection. These different individuals would then seek positive affect or respond to negative and positive affect to different degrees.

Theoretical Implications

Together, the results presented here clearly indicate that one type of mood does not lead to one type of cognitive bias. Instead, mood needs to be considered as part of a system of interacting variables that affect performance in different ways depending on the present conditions. Within this system, the task being performed is the strongest and most consistent predictor of how people perform and how mood influences cognition. Theoretical approaches to mood effects need to be grounded in this context.

The results from the present studies provide some support for the affect as information model. Specifically, the affect as information model is based on the idea that feelings are unconscious evaluations about current mental content (Clore, Gasper, et al., 2001). Mood will affect cognition when it is experienced as being relevant to a judgment/task. In daily life, mood is often a relevant source of information about whether experiences are good or bad, or how we are performing at a task. In the current series of experiments, the majority of main effects of mood occurred in Experiment 2, where mood was manipulated and therefore more temporally related to the judgment and memory tasks. There were also more main effects of mood on the memory results than the perception results. Memory tasks inherently require some reflection on one's internal experience, which may increase the relevance of mood. Mood can be used as information directly about a judgment, but can also be used as information about one's own performance or strategies for completing a task. When mood is considered to be information about processes, the affect as information model predicts that a happy mood will support the strategies that are most accessible and a sad mood will suppress these strategies and increase non-dominant processing styles (Clore, Gasper, et al., 2001). In the perception task, the spatial frequency bias was the strongest predictor of performance. Traits linked to negative affect were associated with a reduction in the spatial frequency bias. In other words, these traits led to a suppression of the more dominant processing style for the task. These results support the notion that sad mood can act as a signal to stop the most dominant processing tendencies (Clore & Palmer, 2009).

Consistent with previous research, the findings presented here show similar patterns of cognitive performance among individuals with induced sad moods and those with depression symptoms (Direnfeld & Roberts, 2006; Ridout et al., 2009). These effects likely reflect an appropriate and efficient mechanism for tuning the cognitive processing of individuals showing normal variation in mood states (Neese, 1990). In daily life, mood is generally a good indicator about the match between the current situation and one's goals. However, among individuals with long lasting depressive symptoms, mood may become unconstrained and the informative value of mood may be overgeneralized (Clore, 2011). For example, rather than a sad mood being an indication that a valued relationship has ended, it becomes an indication that you are not a good person or that the world is not a kind place. These overgeneralizations will reduce the fit between the situation and the mood thereby reducing the benefit of the mood effects.

Mood congruent effects have obvious associations with depression and other mood disorders, and have been implicated in both the development and maintenance of depression and other mood disorders (Koster et al., 2005; Watkins, 2002). Preferential processing of negative information could lead to an overly negative view of the world and maintain depression symptoms. Rumination, a common depression symptom, could also be viewed as a local (i.e., more analytic or less associative) processing strategy (Andrews & Thomson, 2009; Bar, 2009). Similarly, other mental disorders are also characterized by biases to adopt either a global or local processing style. For example, obsessive compulsive traits are associated with difficulty ignoring irrelevant local aspects of stimuli (Yovel et al., 2005). In contrast, an exaggerated global processing advantage has been found in individuals with schizotypal personality disorder (Granholm, Cadenhead, Shafer, & Filoteo, 2002) and schizophrenia (Granholm, Perry, Filoteo, & Braff, 1999). Although these cognitive effects can be valuable for specific situations, broad application of them across situations is problematic.

Overgeneralized cognitive effects due to unconstrained affect could also be considered cognitive distortions (Beck, 1963). Cognitive distortions are a core concept in cognitive behavioural therapy, which is one of the most popular current theoretical orientations among clinicians. This therapy involves psychoeducation about how cognition, behaviour, and emotions interact and influence one another, as well as the completion of cognitive and behaviour exercises designed to change these interactions. Cognitive restructuring is a technique that involves repeatedly challenging cognitive distortions to develop more balanced thoughts. This process could help reduce the reach of the mood by constraining the mood to a specific object (Clore & Colcombe, 2003) and/or by increasing flexibility in thinking (Baumann & Kuhl, 2005). Many other popular treatment modalities, such as acceptance and commitment therapy and dialectical behaviour therapy, also include techniques that are also based on the idea that individuals with these disorders have abnormal patterns of cognitive functioning. Building a more detailed understanding of these patterns is important for improving treatments and identifying key components across treatments.

Limitations and Future Research

Although the research presented here provides new evidence for understanding mood effects, there are limitations that are important to acknowledge, and areas where more research is needed. The hybrid perception task allowed for simultaneous comparison of two different mood effects with varying task demands. However, the judgments that participants made for the faces do not provide a perfect measure of what they perceived. Although both the individual and hybrid faces were tested in pilot studies, there may have been some trials where the female face was identified as male, the sad face was identified as happy, and so on. However, as there is no reason to assume that these errors would be systematic, they should be balanced across stimuli and conditions through random variation. The perception procedure also tests processing preference rather than ability. If the two types of stimuli (happy/sad, global/local) were not in direct competition with each other, then it is possible that different results could have emerged. Future studies could explore accuracy and response time with individual faces as opposed to hybrid faces. In addition to the above, the memory task was made very challenging with the fast presentation of the facial stimuli, resulting in performance that was at chance levels for certain stimuli. Future researchers could modify the memory task to make it easier and see if the same pattern of results emerges.

The mood manipulation in Experiment 2 was a between subjects factor, limiting my ability to detect changes in performance for individuals. Comparing performance within subjects following neutral and happy/sad mood inductions could strengthen future studies. The inclusion of a baseline processing measure, such as performance on the same task prior to mood induction, would also help to clarify causality and strengthen future research designs.

Participants were not selected based on personality scores, and therefore relatively normal distributions of these characteristics were observed and most participants had scores within the normal range. When few participants have extreme scores effects and complex interactions are difficult to reliably obtain. Therefore, these findings should be viewed as initial information to inform areas of future investigation rather than strong evidence of specific effects.

The experiments in this thesis involved different populations, including two convenience samples and one clinical sample. Results were quite consistent across the experiments. However, further exploration of these effects with other populations and other mood measures is important. With respect to the mood manipulation, participants were likely aware of the purpose of the manipulation and that they were being asked to get into a happy/sad mood. Their responses on the affect grid may have been based on the demand characteristics of the manipulation in addition to their genuine mood state. Replicating the results with other mood manipulations or real world variations in mood would be beneficial. The clinical sample experienced high rates of comorbidity. Although this made the sample quite representative of individuals typically presenting for mental health treatment, it also limited my ability to directly study the impact of depressive symptoms, as opposed to symptoms of anxiety. Previous research has identified some differences in cognitive biases between those with only depression symptoms compared to depression and anxiety symptoms (Kircanski & Gotlib, 2015). Specifically, anxiety and depression biases may conflict with each other, making it more difficult to detect significant biases. It would be beneficial to repeat Experiment 3 in a depression group with no comorbidity. The majority of participants in the depression symptom group in Experiment 3 was also on psychotropic medication and engaging in some type of counseling; these confounding variables may have reduced my ability to detect differences in cognitive processes between clinical and control samples. Previous research has found that depression treatment can lead to reductions in mood effects (Victor et al., 2010). Moreover, there could be cognitive effects of the medication itself, which could confound the results. Given these factors, replication in a pre-treatment sample would be warranted. Although the mood effects studied here are clearly relevant to depression, there are many other mental disorders characterized by disturbances in mood and cognition. A rich area of future research would be to compare biases across different disorders such as generalized anxiety disorder, obsessive-compulsive disorder, and personality disorders.

This research examined mood effects in different contexts (tasks) and among individuals differing in personality traits. An interesting extension of this research would be to examine the influence of mood in different cultural contexts. Although there are generally greater similarities than differences in emotions across cultures, valuation of different emotions does differ by cultural background (Chentsova-Dutton, Choi, & Ryder, 2014; Tsai, Knutson, & Fung, 2006). These differences influence how individuals express their emotions on their own and with others, and they also influence how disorders such as depression are expressed (Chentsova-Dutton et al., 2007; Chentsova-Dutton, Tsai, & Gotlib, 2010). North American culture emphasizes expression of high arousal positive emotions, such as excitement and enthusiasm. In North America, depression is often evidenced by reduced affect, especially positive affect. In contrast, East Asian culture emphasizes expression of less arousing emotions such as relaxation, and inhibition of highly arousing emotions. Among individuals with an East Asian background, depression is often expressed as increased affect, especially negative affect (Chentsova-Dutton et al., 2007, 2010). It is possible that these differences in depression presentation could be conceptualized within the affect as information framework. Different cultures have different valuations of specific kinds of emotions, and perhaps different dominant tendencies for expressing such emotions. Depression, or sadness, is then expressed by inhibiting the dominant tendencies for expressing or experiencing emotion. In North American culture, this effect would present as suppression in high arousal positive emotions, and in East Asian culture, this effect would present as inhibition of low arousal positive emotions and enhanced high arousal emotions.

Conclusions

The findings reported here suggest that theoretical frameworks for mood and cognition need to be broadened to address both context and individual differences. Although these results are preliminary and require further verification, they provide general support the affect as information approach. However, further consideration and incorporation of individual differences into the model would be warranted. Mood is just one part of a larger system of variables that tune cognition towards information or strategies that may be more likely to meet goals. The specific task or context will have the largest influence on cognition because it will have the largest influence on the goals. Individual differences will play a role in weighting various goals; some individuals will place greater value on social rewards or on avoiding negative affect than others. A happy mood will then support those thoughts or strategies that are most readily accessed, and a sad mood will reduce the use of these strategies or support alternative strategies.

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Appendix A

Informed Consent

[TYPED ON INSITUTIONAL LETTERHEAD]

Research Project Title: Cognitive Processes in Facial Perception

Researcher (P.I): D. Jolene Kinley, M.A., Doctoral candidate
Department of Psychology, University of Manitoba

Research Supervisors: Dr. Jason Leboe, PhD, Associate Professor, Psychology
P404 Duff Roblin Building

Dr. Lorna Jakobson, PhD, Professor, Psychology
P413 Duff Roblin Building

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The first phase of the experiment will involve looking at a series of facial expressions and distinguishing between two possible emotions that the expression is conveying. Based on the results of this phase, some individuals may continue on to a second phase of the experiment.

The second phase of this study will involve a number of different tasks. The first task involves listening to a selection of music and imagining a recent event in your life. More specific instructions about what to imagine will be presented on the computer. Throughout this phase you will be periodically asked to make a rating of your mood and arousal level by placing an X on a grid. The second task of this phase involves viewing a series of faces and making numerous judgments about each face such as gender, age, facial expression, or previously seen/new (specific judgments will be described on the computer). Finally, participants will be asked to answer a number of questions about themselves including sociodemographic variables and personality items. You will receive a total of 2 experimental credits.

Participation in this experiment does not involve any risks or benefits beyond those experienced in everyday life. It is possible that there may be an emotional reaction to the music and imagery component of the experiment and participants may choose to withdraw from the study if this becomes distressing.

Any information that you provide will be completely confidential and anonymous. The computer program will assign your data a code number so that your information will be in no way linked to your name. The information that you provide will be kept in a secured office to which only researchers and designated research assistances will have access. Information such as your name and email or surface mail address (optional) are being collected to the ends of acquiring your consent to participate and in order to communicate a summary of research findings if you wish to receive them. Raw data (experimental data) will be destroyed 5 years after the publication of the results, as stipulated by general funding guidelines. Information with personal identifies (consent forms) will be destroyed following the dissemination of the summary of results to all participants who requested such information.

If you have any questions or concerns about your participation, either before we begin or at any time during or after your participation, please feel free to discuss them with Jolene Kinley, Dr. Jakobson, or Dr. Leboe.

Participation in this study is voluntary and you have the right to discontinue your participation at any time, both during and following the experiment, without penalty. As a thank you for your time, experimental credits will be provided for PSYC 1200. To obtain the results of the study you can leave a regular mail or e-mail address at the end of the study and a summary of the results will be sent to you approximately one month following the completion of data collection.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba Research Ethics Board(s) and a representative(s) of the University of Manitoba Research Quality Management / Assurance office may also require access to your research records for safety and quality assurance purposes.

This research is being conducted by Jolene Kinley under the supervision of Drs. Jason Leboe and Lorna Jakobson and has been approved by the Psychology/Sociology Research Ethics Board at the University of Manitoba. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator (HEC) at 474-7122. A copy of this consent form has been given to you to keep for your records and reference.

Jolene Kinley, MA	Jason Leboe, PhD	Lorna Jakobson, PhD
Doctoral Candidate	Associate Professor	Professor

Appendix B

Table A1

Spearman correlations between covariates, independent, and dependent variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Task	-																								
Hybrid																									
2. 1	.43**	-																							
3. 2	.59***	.46**	-																						
4. 3	-.14	-.14	.16	-																					
5. 4	.54***	.13	.22	.08	-																				
A' Face Type																									
6. HSF Frown Fem	-.06	-.29	-.11	.11	-.19	-																			
7. HSF Smile Fem	.30*	-.01	.10	.06	.07	.16	-																		
8. LSF Frown Fem	.29*	.07	-.01	.26	-.36*	.03	.04	-																	
9. LSF Smile Fem	.02	.07	-.03	-.16	-.31*	-.28*	.06	-.05	-																
10. HSF Frown Mal	-.12	.11	.08	.27	-.04	.05	-.06	.14	.09	-															
11. HSF Smile Mal	.14	-.02	-.19	-.04	-.12	-.21	.20	.16	.14	-.01	-														
12. LSF Frown Mal	.24	-.02	-.12	-.23	-.06	.06	-.12	-.08	-.10	-.13	.22	-													
13. LSF Smile Mal	-.01	-.26	-.08	-.01	-.06	.03	-.11	-.08	.01	.08	-.06	.19	-												
B''$_D$ Face Type																									
14. HSF Frown Fem	.08	-.23	-.27	.07	-.06	.33**	.20	.05	.06	-.13	-.02	-.01	.12	-											
15. HSF Smile Fem	.09	-.18	-.11	.36*	.09	-.11	.20	.17	.09	-.08	.27*	-.10	-.03	.34**	-										
16. LSF Frown Fem	-.17	-.12	-.22	.16	-.16	.07	.12	.70**	.10	.10	.31*	-.20	.10	.34**	.32*	-									
17. LSF Smile Fem	.16	.09	-.30	-.12	-.23	-.10	-.01	.05	.51**	-.17	.30*	-.04	-.02	.29*	.36**	.32*	-								
18. HSF Frown Mal	.12	-.06	.23	.08	-.05	.10	-.25	.08	.09	.37**	.09	-.04	.23	-.01	.01	.09	.09	-							
19. HSF Smile Mal	.17	.14	.14	-.01	-.10	-.18	.00	.22	.26*	.12	.66**	.03	-.01	-.06	.18	.29*	.37**	.38**	-						
20. LSF Frown Mal	.06	-.03	-.05	.16	.15	.16	-.12	.09	-.11	-.08	.10	.14	.03	.37**	.20	.25	.17	.38**	.26*	-					
21. LSF Smile Mal	-.08	.00	-.17	-.06	-.20	.10	-.19	.11	-.08	.04	.15	.10	.11	.11	.06	.19	.18	.37**	.33**	.48**	-				
22. Mood	-.17	.05	.06	-.01	.05	-.09	-.00	.06	.03	-.19	.02	.03	-.19	-.10	.09	.14	-.10	-.15	-.01	.07	-.16	-			
23. Arousal	-.01	.38*	-.15	-.14	.18	-.12	.02	.10	-.13	-.08	.02	.23	-.03	-.11	.01	.13	.06	-.29*	-.10	-.05	.11	.09	-		
24. Neuroticism	.02	-.29	-.14	-.05	-.08	.07	.03	.01	-.12	.03	-.01	-.09	.26*	-.12	-.28*	.03	-.15	.15	-.04	-.00	.00	-.23	-.12	-	
25. Extraversion	.02	.03	.17	.13	.08	-.12	-.03	.09	-.08	.08	-.03	-.09	.03	-.03	-.02	.02	-.15	-.12	-.09	-.11	-.14	.20	.32	-.19	-
Mean	-	.04	.26	.25	.04	.48	.50	.54	.49	.52	.52	.51	.51	-.18	-.18	-.03	-.16	-.16	-.14	-.20	-.12	5.70	4.93	54.26	52.71
SD	-	.60	.53	.48	.59	.09	.10	.12	.07	.10	.10	.08	.11	.33	.35	.32	.36	.43	.38	.35	.33	1.54	1.96	8.13	10.05

Notes. * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$.

HSF = high spatial frequency. LSF = low spatial frequency. Fem = female face. Mal = male face. Hybrid 1: HSF frowning female and LSF smiling male. Hybrid 2: HSF smiling female and LSF frowning male. Hybrid 3: HSF frowning male and LSF smiling female. Hybrid 4: HSF

Appendix C

Table B1

Spearman correlations between covariates, independent, and dependent variables for Experiment 2.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Task	-																								
2. Mood	-.07	-																							
Hybrid																									
3. 1	.46**	-.02	-																						
4. 2	.60**	.05	.42**	-																					
5. 3	.27**	-.16	.15	.16	-																				
6. 4	.27**	-.12	.10	.12	.22*	-																			
A' Face Type																									
7. HSF Frown Fem	-.11	.16	.01	.05	-.05	-.16	-																		
8. HSF Smile Fem	.08	-04	.05	.03	.05	-.17	-.01	-																	
9. LSF Frown Fem	.06	-.03	.02	.02	-.01	-.14	.18*	.05	-																
10. LSF Smile Fem	.05	.01	.13	.13	.07	-.05	-.01	.16	.17	-															
11. HSF Frown Mal	-.03	.03	-.03	-.01	.03	-.23**	.07	.09	.07	.01	-														
12. HSF Smile Mal	-.11	-.02	-.09	-.03	-.01	-.05	.01	-.02	-.02	.07	.08	-													
13. LSF Frown Mal	-.13	.11	.03	-.03	-.09	.02	.03	-.16	-.03	-.04	-.09	-.17	-												
14. LSF Smile Mal	-.06	.01	-.03	.06	.09	-.13	-.17	.16	.09	-.07	-.14	-.06	.02	-											
B''$_D$ Face Type																									
15. HSF Frown Fem	-.02	-.02	.05	.06	.01	-.04	.16	.27**	-.14	.19*	-.21*	.17	-.03	.06	-										
16. HSF Smile Fem	-.02	.13	-.01	-.17	.06	-.03	.15	.15	-.05	.10	.02	-.16	.01	-.09	.15	-									
17. LSF Frown Fem	-.01	-.04	.13	-.01	.05	.09	-.02	.12	-.21	.16	.06	.07	-.11	-.14	.14	-.06	-								
18. LSF Smile Fem	-.17	.04	-.08	-.14	.01	.02	.09	-.23**	-.05	-.24**	-.10	-.02	-23**	-.03	-.05	.06	.11	-							
19. HSF Frown Mal	.06	.08	.07	.09	.07	-.08	-.06	.09	-.07	.02	.22*	.10	-.19*	.07	-.03	.05	.09	-.02	-						
20. HSF Smile Mal	.12	.05	.14	.18*	.06	-.11	.02	.14	.09	.14	.01	.15	-.01	.09	.23*	.02	.04	-.06	.28**	-					
21. LSF Frown Mal	.08	.11	.30**	.24**	.13	-.25**	-.04	.02	.07	.16	.13	.08	-.12	.12	-.03	-.16	.23**	.03	.25**	.17	-				
22. LSF Smile Mal	.15	.06	.21*	.19*	-.06	-.05	.17	.12	.07	.13	.03	.07	-.05	-.07	.07	.12	.08	-.01	.26**	.07	.23*	-			
23. Arousal	-.01	-.31**	-.01	-.04	.02	-.01	-04	-.02	-.18*	-.14	-.06	-.03	-.02	-.09	.05	-.07	.11	.03	-.14	-.13	.01	-.07	-		
24. Neuroticism	-.09	-.04	-.04	-.24**	.01	-.02	-.13	-.05	-.26**	.01	-.01	-.01	.06	.02	-.05	.11	.16	-.09	.16	.01	.05	.05	.22*	-	
25. Extraversion	-.05	.08	.06	.11	.03	.16	.16	-.04	.13	.08	.02	-.12	-.01	.09	-.16	.07	-.07	.15	-.06	-.02	-.06	-.09	-.13	-.24**	-
Mean	-	-	.08	.14	.22	.10	.52	.50	.50	.51	.51	.52	.51	.51	-.09	-.08	-.09	-.04	-.11	-.18	-.08	-.07	4.41	56.43	53.43
SD	-	-	.57	.54	.48	.64	.11	.11	.14	.14	.10	.12	.11	.12	.34	.36	.34	.31	.36	.43	.36	.36	2.11	8.78	9.70

Note. * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$.

HSF = high spatial frequency. LSF = low spatial frequency. Fem = female face. Mal = male face.

Hybrid 1: HSF frowning female and LSF smiling male. Hybrid 2: HSF smiling female and LSF frowning male. Hybrid 3: HSF frowning male and LSF smiling female. Hybrid 4: HSF smiling male and LSF frowning female.

Appendix D

Table C1

Spearman correlations between covariates, independent, and dependent variables for Experiment 3.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Task	-																							
2. Mood	.02	-																						
Hybrid																								
3. 1	.16	.26*	-																					
4. 2	.47**	.02	.36**	-																				
5. 3	.17	-.13	-.13	.01	-																			
6. 4	.15	.07	-.13	.07	.26*	-																		
A' Face Type																								
7. HSF Frown Fem	.01	.16	.24	.01	-.24	-.12	-																	
8. HSF Smile Fem	-.05	-05	.09	-.10	-.11	-.27*	.05	-																
9. LSF Frown Fem	.21	-.06	-.12	.20	-.02	.07	-.10	-.14	-															
10. LSF Smile Fem	-.03	.03	.21	.15	-.19	-.18	.16	-.28*	-.09	-														
11. HSF Frown Mal	-.27*	.10	.06	-.04	.01	-.01	-.04	-.22	-.07	.05	-													
12. HSF Smile Mal	.20	-.11	-.18	.37**	.08	-.07	.10	-.01	.06	-.02	-.23	-												
13. LSF Frown Mal	-.08	-.35**	-.17	.00	.15	-.01	-.28*	.00	-.15	-.09	.07	-.09	-											
14. LSF Smile Mal	.03	-.24	-.06	-.10	.06	-.08	-.07	.05	-.18	.02	-.26*	.02	.28*	-										
B''$_D$ Face Type																								
15. HSF Frown Fem	.03	.01	.04	.16	-.16	.14	.31*	-.19	.06	.06	-.03	.05	.00	-.05	-									
16. HSF Smile Fem	-.04	-.14	.08	,02	-.11	-.14	.12	-.08	.24	.12	.04	.10	-.10	-.05	-.10	-								
17. LSF Frown Fem	-.12	-.10	-.12	-.07	.17	.18	-.17	.16	-.09	.22	-.01	-.15	-.03	.00	-.01	-.17	-							
18. LSF Smile Fem	.00	-.18	.06	.03	.14	.20	-.10	-.10	-.13	.08	.11	-.12	.11	.15	.02	.02	.13	-						
19. HSF Frown Mal	-.20	-.03	-.31*	-.06	-.15	.01	.08	.03	.12	-.03	.30*	.14	.09	-.07	.07	-.04	.27*	.17	-					
20. HSF Smile Mal	-.16	-.01	-.16	-.02	-.11	-.13	.06	.11	-.05	.23	.06	-.06	-.13	-.15	.11	-.06	.33*	.04	.26*	-				
21. LSF Frown Mal	.11	.22	.07	.09	.04	.12	.17	.09	-.14	.01	.25	-.01	-.18	-.18	.17	-.10	.05	.15	.31*	.19	-			
22. LSF Smile Mal	.10	-.05	-.08	-.05	-.03	-.11	.09	.17	.03	-.20	-.06	.09	.11	-.14	.03	.07	-.12	.18	.32*	.11	.10	-		
23. Arousal	.14	-.35**	-.22	.09	-.14	.11	-.10	-.11	.18	-.07	-.06	.01	.24	-.08	.24	.02	-.10	-.05	.01	-.04	-.16	09	-	
24. Extraversion	.05	-.52**	.03	.07	-.07	.20	.02	-.01	.10	-.03	-.15	.05	.31*	-.02	.26*	.00	.01	.13	-.05	-.28*	-.22	.11	-.44**	-
Mean	-	-	-.01	.05	.13	.01	.52	.48	.52	.52	.48	.52	.46	.52	-.02	-.11	-.16	-.03	-.09	-.16	-.14	-.16	5.13	46.87
SD	-	-	.51	.57	.34	.55	.11	.13	.15	.14	.14	.14	.13	.09	.33	.37	.39	.27	.42	.42	.41	.39	1.93	14.07

Note. * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$.

HSF = high spatial frequency. LSF = low spatial frequency. Fem = female face. Mal = male face.

Hybrid 1: HSF frowning female and LSF smiling male. Hybrid 2: HSF smiling female and LSF frowning male. Hybrid 3: HSF frowning male and LSF smiling female. Hybrid 4: HSF smiling male and LSF frowning female.