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# Investigating Visual Vigilance following Chronic Behavioural Immune System Activation

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# Investigating Visual Vigilance following Chronic Behavioural Immune System Activation

By

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DECLARATION OF ORIGINALITY

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ABSTRACT

The behavioural immune system (BIS) is a coordinated set of cognitive, affective, and behavioural responses that minimize pathogen contact. Prior to the COVID-19 pandemic, the majority of research on the BIS was limited to situations of acute pathogen threat. These studies identified that personal predispositions and environmental stimuli interact and lead to cognitive changes, including perceptual enhancements and attentional biases, as well as sensations of disgust. The cognitive and affective changes that follow pathogen exposure motivate pathogen avoidance behaviours and reduce the risk of infection. The BIS is highly adaptive in the context of acute pathogen threat, but less is known about its responsiveness when the pathogen threat is chronic.

The primary objective of the current study was to explore how chronic BIS activation impacts visual vigilance. Cross-sectional data were collected at four timepoints within the first seven months of the COVID-19 pandemic (i.e., April, June, August, and October 2020). Participants completed two visual discrimination tasks, one with pathogen-relevant stimuli (i.e., faces) and the other with pathogen-irrelevant stimuli (i.e., shapes); accuracy and reaction times were used as objective measures of vigilance. Participants also completed a questionnaire to gather information about their demographics, predispositions toward pathogen avoidance (i.e., disgust sensitivity), and COVID-19 experiences. Participants that enrolled in the study in August and October were also asked to self-report their political affiliation. Only participants currently living in the United States were included in data analyses.

Results indicated that participants with high disgust sensitivity were less vigilant than those with low disgust sensitivity at later timepoints regardless of whether visual discrimination stimuli were pathogen-relevant (Experiment 1) or pathogen-irrelevant (Experiment 2). Discrimination accuracy on trials that required the detection of subtle differences between stimuli was greater at earlier timepoints than later timepoints for both disgust sensitivity groups. Experiment 3 investigated visual vigilance differences between participants with self-reported liberal and conservative political affiliations. Results indicated that liberals displayed greater vigilance on both visual discrimination tasks than conservatives. Disgust sensitivity, conservatism, and anxiety about contracting COVID-19 were positively correlated. Supplementary analyses indicated that participants with high disgust sensitivity and conservative

political values were more likely to be diagnosed with COVID-19 and endorse COVID-19 symptoms than participants with low disgust sensitivity and liberal political values, respectively.

This study demonstrated that BIS responding is dynamic and chronic BIS activation is associated with a decline in vigilance. Importantly, vigilance changes across timepoints did not correspond with the number of active COVID-19 cases, indicating that factors beyond pathogen contact risk influence chronic BIS activation. A comparison of previous literature with the current findings suggests that the personal characteristics that enhance BIS responding in acute settings, may dampen BIS responding following chronic activation (i.e., disgust sensitivity, conservative values). Overall, the results of this study expand current understanding of BIS functioning in the context of prolonged pathogen threat.

# DEDICATION

For my Funky Unky TJ,

With love and tremendous gratitude.

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LIST OF ABBREVIATIONS

**2D** – Two Dimensional

**ANOVA** - Analysis of Variance

**BIS** – Behavioural Immune System

**CNN** – Cable News Network

**COVID-19** – Disease associated with severe acute respiratory syndrome coronavirus 2

**DS** – Disgust Scale

**DS-R** – Disgust Scale – Revised

**HDS** – High Disgust Sensitivity

**LDS** – Low Disgust Sensitivity

**LPS** – Lipopolysaccharide

**MTurk** – Mechanical Turk

**RT** – Reaction Time

**WHO** – World Health Organization

# CHAPTER 1

## Literature Review

### Introduction

Pathogens (e.g., viruses, bacteria) are one of the greatest threats to human survival and cause millions of deaths each year (Hessling et al., 2017). Pathogens are incredibly small; for example, an influenza virus must be magnified 75,000 times its actual size to be visible to the human eye (Drexler, 2010). The microscopic size of pathogens allows them to evade direct detection as they infect a human host, rapidly multiply, and subsequently spread to a new host (Alberts et al., 2002). An infected individual may display symptoms of illness, which reflect damage caused either by the pathogen directly or the immune system's attempt to eliminate it (Balloux & van Dorp, 2017; Drexler, 2010). The coordinated set of bodily responses that protect against the threat of pathogens are part of an integrated immune system. The immune system is comprised of physiological and behavioural subsystems (Murray et al., 2019; Shakhar, 2019).

The physiological immune system, also known as the "classic" or biological immune system, responds to pathogens that have bypassed surface barriers (e.g., skin, mucous membranes, gastric acid) and invaded the body (Shakhar, 2019). The physiological immune system identifies invading pathogens and attempts to eliminate them through various responses including inflammation, fever, and diarrhea (Long, 1996; Nesse, 2005). These responses are critical in eliminating a pathogen threat but come at a high cost. While fighting against an infection, metabolic energy must be redirected from growth and reproduction and shifted toward physiological defenses (Lochmiller & Deerenberg, 2000). Further, prolonged activation of the physiological immune system is associated with additional costs including accelerated aging and chronic disease (Cho & Stout-Delgado, 2020; Hearps et al., 2012). Importantly, these physiological responses do not guarantee survival; they may be insufficient in eliminating a pathogen and the infection may prove fatal (Hessling et al., 2017). Clearly, the heavy costs and high risk associated with pathogens is threatening (Gangestad & Grebe, 2014). Thus, the most efficient and effective way to ensure host survival and optimal energy allocation is to avoid pathogen contact altogether. It appears that humans, along with many other species, have evolved a behavioural immune system (BIS) to minimize the likelihood of initial pathogen contact (Schaller & Park, 2011; Shakhar, 2019).

The BIS functions to reduce the risk of initial pathogen exposure. As pathogens cannot be directly detected by human senses, the BIS appraises pathogen risk using indirect sensory cues (e.g., odour) and environmental context (Drexler, 2010; Stevenson, 2010). If the appraised risk is high, a series of cognitive and affective changes motivate behaviours that reduce the possibility of pathogen contact (Schaller & Park, 2011). When a pathogen is avoided, the physiological immune system does not have to expend resources fighting infection and the pathogen no longer poses a threat to survival.

In summary, humans have evolved a complex immune system to protect them from potentially life-threatening pathogens. This immune system is comprised of two subsystems: the prophylactic BIS and the reactive physiological immune system (Murray et al., 2019; Shakhar, 2019). These systems function to defend against pathogen threat and are activated outside of conscious awareness (Rachman, 2016). Of the two systems, the physiological immune system has been more extensively studied. However, the BIS influences human behaviour and has been receiving increased attention since its initial conceptualization in 2006 (Gangestad & Grebe, 2014; Schaller, 2006).

Research aimed at understanding the BIS and disease avoidance has primarily occurred within laboratory settings and been reliant upon artificial priming (Tybur et al., 2014). Previous studies have provided a theoretical understanding of the BIS, but the generalizability of these findings to more naturalistic settings is largely unknown. Further, laboratory experiments lend themselves well to the study of acute BIS activation but are limited in their ability to explore the effects of chronic pathogen threat on cognition, affect, and behaviour. In March 2020, the danger pathogens pose to humans became palpable within the context of the COVID-19 pandemic (World Health Organization [WHO], 2020a). The pandemic highlighted the importance of understanding human responses to pathogen threat, but laboratory research was halted as social distancing measures came into effect. The present dissertation used the unique opportunity of a global pandemic to further expand understanding of the BIS. Specifically, the experiments sought to investigate the impact of chronic BIS activation on vigilance using an ecologically valid prime (i.e., COVID-19 pandemic).

The overarching objective of this dissertation is to explore the impact of chronic BIS activation on human cognition, particularly visual discrimination. As mentioned above, humans rely on sensory cues to identify pathogen risk within their environment (Stevenson, 2010). Of the five senses, vision is heavily relied upon to identify pathogen-relevant stimuli (Iwasa et al., 2020). Importantly, previous research has demonstrated that the ability to detect and observe differences in sensory stimuli increases following BIS activation (described below; Chan et al., 2016; Nussinson et al., 2018). Therefore, Experiment 1 and Experiment 2 investigate visual discrimination performance following continuous activation of the BIS (i.e., persistent threat of COVID-19). The relationship between personal characteristics known to influence behaviour during the pandemic (i.e., political affiliation) and visual discrimination skills is examined in

Experiment 3. The first chapter of this dissertation reviews relevant literature on the BIS, with particular emphasis on the processes involved in BIS activation, cognitive changes that follow activation, and the personal factors influencing BIS sensitivity.

**Behavioural Immune System**

***Evolution***

Infection is a significant threat to organism survival and pathogen-driven natural selection is believed to be a major pressure in human evolution (Fumagalli et al., 2011; Sironi et al., 2015). As pathogen threat is highly pervasive throughout the animal kingdom, it is not surprising that pathogen-avoidance behaviours are observed across species (Shakhar, 2019). For example, insects, aquatic animals, amphibians, and mammals avoid others that show symptoms of disease (Blacker & LoBue, 2016; Sarabian et al., 2018). This sickness-avoidance behaviour likely functions to reduce the likelihood of pathogen exposure by minimizing contact with an infected host. The diversity of species demonstrating pathogen avoidance behaviours suggests that the BIS has deep evolutionary roots.

Humans and pathogens have always co-existed, though this relationship has changed over time. Humans are social animals and live in groups, which has associated benefits and costs (Eilam et al., 2011). For example, group living provides greater protection against predators and eases the burden of raising offspring. Conversely, group living increases pathogen transmission rates (McCallum et al., 2001). Pathogen transmission in humans was complicated by the shift from hunter-gatherer to agricultural means of food production (Piret & Boivin, 2021) and it is hypothesized that many diseases were initially contracted from domestic animals and then spread through trade routes (e.g., smallpox from cows; Dobson & Carper, 1996). As we look into the future, pathogen spread is expected to accelerate based on current trends in society (Piret &

Boivin, 2021); increased urbanization and the effects of global warming are anticipated to escalate the transmission of pathogens between animals and humans. Further, it is likely that pathogens will also be spread more quickly and across further distances due to technological advances in travel over time. Therefore, it is of upmost importance that research focuses on understanding how individuals respond to pathogen threat in order to minimize disease spread.

***Pathogen Avoidance Motivation***

The way a particular individual responds to a pathogen threat is influenced by intrinsic and environmental factors. Two people exposed to the same pathogen threat within a specific environmental context may behave differently. This is believed to be a consequence of differences in pathogen avoidance motivation. Pathogen avoidance motivation is the term used to describe inter-individual differences in how a pathogen threat is perceived (Tybur et al., 2014). For example, individuals with greater pathogen avoidance motivations are more likely to identify ambiguous stimuli as pathogenic and experience stronger affective reactions when exposed to pathogen cues (Schaller & Park, 2011). These motivations are independent of situational context and thought to remain relatively stable over time (Tybur et al., 2014). The literature identifies two key personal characteristics that make up pathogen avoidance: perceived infectability and emotional responsivity to pathogens (Tybur et al., 2014; Tybur & Lieberman, 2016).

Perceived infectability accounts for an individual's beliefs about their own immunological functioning and susceptibility to infectious diseases (Díaz et al., 2020; Duncan et al., 2009). Individuals who believe themselves to be at a high risk of getting sick following pathogen exposure would be described as having high levels of pathogen avoidance motivation. The second component of pathogen avoidance motivation is an individual's emotional reaction and sensation of discomfort when faced with pathogen-relevant cues (Tybur et al., 2014).

Emotional responsivity includes disgust sensitivity, which is the level of unpleasantness experienced with the feeling of disgust, as well as disgust propensity, which is the likelihood that disgust will be experienced (van Overveld et al., 2006). Individuals who are high in disgust sensitivity and/or disgust propensity are identified as having high levels of pathogen avoidance motivation. Because perceived infectability and emotional responsivity are primarily subjective, self-report instruments have been developed to quantitatively measure these individual qualities. For example, the Perceived Vulnerability to Disease Questionnaire (Duncan et al., 2009) and the Disgust Scale (Haidt et al., 1994) are two tools designed to measure perceived infectability and disgust sensitivity, respectively. These tools have allowed researchers to identify demographic differences in pathogen avoidance motivations.

Certain demographic variables have been correlated with higher levels of pathogen avoidance motivation. For example, women generally score higher on measures of pathogen avoidance motivation than men (Berger & Anaki, 2014; Díaz et al., 2016; Duncan et al., 2009). There is some evidence to suggest these gender differences are age-dependent and no longer present after age 35, but this finding has not yet been replicated (Díaz et al., 2020). There is also evidence that age is predictive of pathogen avoidance motivation, with older individuals reporting higher motivation levels (Díaz et al., 2020). Importantly, pathogen avoidance motivation appears to moderate some aspects of acute BIS activation (examples presented below; Kusche & Barker, 2019). Hypothesized explanations for these moderating effects include increased vigilance in the detection of pathogen cues within the environment, exaggerated biases for regarding ambiguous cues as pathogenic, and/or greater investment in pathogen avoidant responses in individuals with higher motivation levels (Tybur et al., 2014; Tybur & Lieberman, 2016). Regardless of why these inter-individual differences occur, exploring their moderating effects in the context of BIS activation provides a more nuanced understanding of the system.

### ***Threat Identification***

BIS activation begins with the identification of a pathogen threat within the immediate environment. The size of pathogens makes them imperceivable to the human eye (Drexler, 2010) and humans must rely on sensory cues to infer the likelihood pathogens are present (Murray et al., 2019). These cues exist on a continuum with some more likely to indicate pathogen threat (e.g., sneezing, rash) than others (e.g., obesity, deformities; Ainsworth & Maner, 2014; Kusche & Barker, 2019). Information relevant to the cue is retrieved from memory (e.g., reliability of cue in past to identify disease) and used to estimate the probability a pathogen is present (Tybur & Lieberman, 2016). To increase sensitivity to pathogen cues, the BIS minimizes false negative errors by classifying ambiguous cues as pathogenic (Nesse, 2005; Schaller & Park, 2011). Once pathogen risk is identified, cognitive and affective changes motivate avoidance of the possibly pathogenic stimulus (Schaller & Park, 2011).

Theories underlying the BIS are based on the notion that humans are constantly and unconsciously scanning their environment for pathogen-relevant information using all five senses (Murray et al., 2019). Multisensory cues are integrated to estimate pathogen risk and improve the accuracy and speed of pathogen detection (Regenbogen et al., 2017; Stein & Stanford, 2008). The following example illustrates how pathogen cues guide behaviour. Imagine you are given two vegetable sandwiches at lunch. The first sandwich consists of light brown bread and smells of cucumber and tomatoes. In comparison, the bread on the second sandwich is not uniform in colour but includes faint blue patches, the vegetables appear slimy, and the smell is pungent and sour. It is likely that, given the choice, you would select the first sandwich to eat;

this is because the visual and odour properties of the second sandwich are providing cues that pathogens may be present and it might not be safe to ingest. This example highlights the importance of both vision and olfaction in the detection of pathogen cues. However, as vision is particularly relevant to this dissertation, the visual detection of pathogen cues is discussed in more detail throughout the following sections.

**Visual Cues.** Visual cues provide an estimate of pathogen risk. These cues evoke cognitive (e.g., attention, memory) and affective (i.e., disgust) changes that lead to behavioural avoidance (Iwasa et al., 2020). For example, the glossiness (e.g., 'wetness') of food is a visual cue to food safety. When presented with dough of varying levels of water content, participants reported stronger feelings of disgust and greater intentions of avoidance with moist dough compared to dry dough (Iwasa et al., 2020). This study demonstrates how visual cues are used to estimate pathogen risk with objects, but visual cues are also used to estimate pathogen risk in social encounters.

Faces provide insight into an individual's internal experiences. Previous research has demonstrated that pictures of faces can be used to estimate mental health (Kramer & Ward, 2010) and personality characteristics (Kleiman & Rule, 2012). Faces also provide cues related to physical health status. Skin colouration (e.g., redness; Henderson et al., 2017), facial expressions (e.g., negative emotionality; Sarolidou et al., 2019), and other physical attributes including eyelid droop and skin glossiness (Axelsson et al., 2018) differ between healthy individuals and those experiencing mild inflammation; importantly, these changes are detectable by the human eye. Individuals displaying subtle physical attributes associated with a mild and acute inflammatory response are rated as less likeable than controls, which is a predictor of approach/avoidance behaviours (Sarolidou et al., 2020). Regenbogen and colleagues (2017) explored whether subtle visual cues of disease would be sufficient to alter interpersonal interactions. The researchers induced an acute inflammatory response by injecting the bacterial endotoxin lipopolysaccharide (LPS) into otherwise healthy participants. This injection temporarily activates the physiological immune system and leads to an experimentally induced inflammatory response lasting between 4-6 hours post-injection (Gordon et al., 2018). When a separate group of participants viewed photographs of LPS- and placebo-injected individual's faces, they rated the faces of LPS-injected individuals as less attractive and healthy than faces of placebo-injected individuals. Participants also reported being less interested in a social interaction with LPS-injected individuals. The finding that "sick" faces are perceived as less likable than healthy faces has been replicated (Leschak et al., 2022; Sarolidou et al., 2020) and, the level of (dis)likeability is proportionate to an LPS-injected individual's inflammatory response (Leschak et al., 2022). The neural correlates underlying these findings are only beginning to be explored (Leschak et al., 2022; Regenbogen et al., 2017).

The use of faces to predict health status extends beyond acute inflammatory responses to encompass chronic infectious disease as well. Participants were able to identify whether an individual had a chronic infectious illness (i.e., HIV, herpes) above chance levels when presented with their headshot (Tskhay et al., 2016). Notably, the faces of individuals with chronic diseases did not display any obvious physical symptoms in the photographs, which indicates that ambiguous cues are used to infer sickness status.

Not only can humans visually infer sickness status by looking at another's face, but pathogen risk can also be approximated through dynamic visual cues. Many symptoms of illness, such as sneezing and vomiting, can be visually detected. Even more subtle cues, such as gait, provide visual information that can be used to infer a person's health status. When participants viewed videos of LPS- and placebo-injected individuals walking, they rated LPS-injected individuals as less healthy and more tired than placebo-injected walkers (Sundelin et al., 2015). Notably, the dosing of LPS in this study was mild enough that there were no changes in body temperature following injection. Taken together, humans can detect subtle visual cues that are indicative of disease and this detection reduces the likelihood of contact with a sick person (Regenbogen et al., 2017; Sundelin et al., 2015).

Once a pathogen-relevant cue is identified, specific cognitive and affective changes occur to facilitate behavioural avoidance (Schaller & Park, 2011). One of these cognitive changes is heightened perception (Chan et al., 2019). In addition to perceptual changes, attention and memory become biased toward pathogen-relevant cues and ambiguous stimuli are judged to have a greater association with disease-relevant concepts (Chapman et al., 2013; Charash & McKay, 2002; Miller & Maner, 2012). The feeling of disgust is simultaneously experienced and, in conjunction with cognitive changes, motivates the avoidance of pathogen-relevant stimuli. The perceptual, attentional, and affective changes that occur following pathogen identification are described in detail below.

***Perceptual Sensitivity***

Perceptual sensitivity is the ability to detect subtle sensory stimuli (Bolders et al., 2017). One way to quantify perceptual sensitivity is to measure an individual's perceptual detection threshold, which is the minimal level of perceptual qualities necessary for conscious detection. As examples, an olfactory detection threshold is the concentration at which a scent can be consciously perceived and a tactile detection threshold is the amount of pressure required for touch to be detected (Chan et al., 2016, 2019; Hunt et al., 2017). Previous research has identified that perceptual detection thresholds are reduced following BIS activation. For instance, participants exposed to a plastic container filled with live maggots (i.e., pathogen cue) had lower tactile detection thresholds than those exposed to a container filled with rice (i.e., neutral cue; Hunt et al., 2017). These results were replicated when the participants were presented with images of the containers rather than the containers themselves. In addition to tactile thresholds, changes in olfaction detection thresholds have been observed following BIS activation (Chan et al., 2016, 2019). More specifically, exposure to pathogen-relevant images lowered olfaction detection thresholds more than neural or happy images (Chan et al., 2019). This effect may be moderated by pathogen avoidance motivation as one study, but not its replication, only observed lowered thresholds in individuals with high disgust sensitivity (Chan et al., 2016, 2019). Reduced perceptual detection thresholds occur in the context of fear- and disgust-relevant primes suggesting both emotions enhance perceptual detection and, presumably, avoidance behaviours (Chan et al., 2016).

In addition to perceptual threshold detection, another component of perceptual sensitivity is perceptual contrast sensitivity. Perceptual contrast sensitivity is the ability to distinguish between two stimuli based on their perceptual properties (e.g., scent, texture, colour). Two studies have explored perceptual contrast sensitivity using subjective ratings by participants. Reid and colleagues (2012) investigated changes in auditory contrast sensitivity following BIS activation. In their study, American participants viewed neutral, pathogen-relevant, or fear-relevant images and then listened to audio-recordings of a male speaker. Participants were asked to rate how similar the recorded accent was to their own and how foreign the recorded speaker sounded. They also completed a self-report measure of pathogen avoidance motivation (i.e., disgust sensitivity). Participants who were primed with disease and reported high levels of pathogen disgust sensitivity rated the non-American speaker as more foreign and having an accent more dissimilar than their own. This suggests a moderating effect of pathogen avoidance motivation as the impact of acute BIS activation on linguistic distance ratings was greater for individuals with higher disgust sensitivity.

In addition to differences in auditory contrast sensitivity, subjective differences in visual contrast sensitivity related to the BIS have also been explored. Participants with higher disgust sensitivity described disfigured faces as more irregular than those with lower disgust sensitivity (Nussinson et al., 2018). The same research group also investigated whether visual contrast changes related to the BIS would be observed in neutral stimuli that contained no pathogen-relevant information (e.g., shapes). They did this by presenting participants with clearly perfect, ambiguously imperfect, and clearly imperfect shapes and asking them to rate the shape's similarity to the concept of that shape (e.g., "is this a square") on a 6-point Likert scale (e.g., "definitely not" to "definitely yes"; Nussinson et al., 2018). They found that participants who were primed with pathogen-relevant images were more likely to rate clearly perfect and imperfect shapes toward to scale extremes. They also observed that participants with higher disgust sensitivity were more exaggerated when asked to rate how similar two images were to each other, compared to participants with lower disgust sensitivity. The authors of this study hypothesized that heightened sensitivity toward morphological differences occurs when participants are predisposed toward pathogen avoidance and/or acutely aware of pathogen threat. Their findings suggest that heightened sensitivity to differences occurs generally, rather than specifically to pathogen relevant information. Both perceptual contrast sensitivity studies were limited by their reliance on subjective ratings of differences and further studies are needed to determine whether automatic and unconscious changes in perception simultaneously occur.

As described in the previous section, humans are able to identify chronic infection (i.e., HIV, Herpes) by looking at faces without any obvious physical indication of disease (Tskhay et al., 2016). In a follow-up study, the researchers investigated whether accuracy of sickness identification would be altered following acute BIS activation (Tskhay et al., 2016). Participants with low pathogen avoidance motivation (e.g., more likely to assume others are healthy) more accurately detected illness when they were primed with pathogen-relevant information than when primed with non-infectious disease information or in the absence of a prime. The infectious disease prime did not enhance performance in individuals with high levels of pathogen motivation (e.g., more likely to assume others are sick). This study provides evidence that acute BIS activation may improve the ability to detect pathogens in individuals that are less concerned about the illness of others.

Information in this section has demonstrated that activation of the BIS enhances the ability to detect sensory stimuli and makes subjective differences between stimuli more pronounced. There is also evidence to suggest that this effect is moderated by pathogen avoidance motivation. After a pathogen-cue is identified, these perceptual changes enhance the likelihood additional cues are detected within the environment. As will be described next, not only are individuals with an activated BIS more likely to perceive pathogen cues, but they are also more likely to attend to these cues.

***Attention***

The successful evasion of an environmental threat requires that the threat be detected, encoded, and monitored to reduce the likelihood of contact (Ackerman et al., 2009). Attention is a limited resource that restricts the amount of information that can be simultaneously processed (Atchley & Lane, 2014). Human cognition appears to be programmed so that threatening stimuli (e.g., weapons) capture and maintain attention (Biggs et al., 2013; Nairne & Pandeirada, 2016). This attentional bias extends beyond physical threat and also applies to pathogen risk.

Attentional bias toward pathogen-relevant cues has been observed in a variety of experimental paradigms. In one study, participants completed the Emotional Stroop Test, which required them to name the colour of ink that words were printed in and not read the word (Charash & McKay, 2002). Participants were slower to name the colour of ink that disgust- (i.e., pathogen-) and fear-relevant words were printed in, as compared to neutral words. This suggests that threat-relevant words held attention longer than neutral words. The attentional bias toward pathogen-relevant words is mirrored with images. When participants viewed a disgust-evoking (i.e., vomit, feces), fear-relevant, or neutral image with a line above or below it, they were slower to indicate the line location when it was paired with a disgust-evoking image (Chapman et al., 2013). This suggests that pathogen-relevant images captured participants attention to a greater extent than fearful or neutral images. Another visual cue that appears to capture attention is facial disfigurement. Facial disfigurement is an ambiguous visual cue that may be misidentified as pathogenic to minimize the risk of false negative errors in pathogen identification (Schaller & Park, 2011). This misperception may be especially likely following acute BIS activation. In a study by Ackerman and colleagues (2009), participants were primed with pathogen-relevant or neutral images. Next, they were presented with a face followed by a shape and asked to identify whether the shape was a circle or a square. The faces were either controls or mildly disfigured in a way that was salient but not related to any visual disease cue (e.g., altered pupil location or added pink colouration to a section of face). In this experiment, participants primed with pathogen-relevant images had more difficulty disengaging from the disfigured faces than those in the control condition. Taken together, these studies suggest that pathogen-relevant cues capture and maintain attention.

There is preliminary evidence to suggest that BIS activation enhances attention. Specifically, participants that viewed a pathogen-relevant video were more accurate during a letter identification task than those that watched a neutral video (Magalhães et al., 2018). The letter identification task paired letters with healthy faces and contained no pathogen-relevant cues suggesting that BIS activation may enhance attention more generally, but further research is needed support this theory. Overall, pathogen-relevant cues enhance perceptual sensitivity and attentional biases. Pathogen cues also lead to the feeling of disgust. Together, these cognitive and affective changes increase avoidance behaviours and minimize pathogen contact (Schaller & Park, 2011).

***Disgust***

Disgust is one of six universal human emotions and the hallmark affective response of BIS activation (Lieberman & Patrick, 2014; Mesquita & Frijda, 1992). Supporting its universality, facial expressions associated with disgust are observed across cultures and in congenitally blind children (Galati et al., 1997, 2003; Mesquita & Frijda, 1992). Prelingually deaf children are also able to identify disgusted facial expressions (Gray et al., 2007; Hosie et al., 1998). Evolutionary accounts hypothesize that disgust is an affective response to revolting stimuli that evolved to protect against pathogen-contaminated foods (Darwin, 1872/1965; Kusche & Barker, 2019). Indeed, many elicitors of disgust are consistent across cultures and associated with pathogen risk (e.g., rotten food, body excretions, and disease-causing animals; Curtis et al., 2004; Curtis & Biran, 2001). Thus, the experience of disgust not only applies to rotting food but is believed to motivate the avoidance of pathogens in general (Oaten et al., 2009; Tybur et al., 2013).

If you were presented with the mouldy, putrid, and damp sandwich described earlier, you would likely feel disgust. Disgust is associated with a variety of uncomfortable bodily sensations including increased salivation, nausea, and autonomic nervous system arousal (Tybur et al., 2009). These sensations are aversive and subsequent avoidance of disgust-evoking stimuli is motivated by relief from them (Shook et al., 2019). The undesirable bodily sensations associated with disgust are key motivators driving pathogen avoidance behaviours.

***Behaviours***

To review, individuals are predisposed toward certain levels of pathogen avoidance motivation. Those with higher levels of pathogen avoidance motivation may perceive themselves as particularly vulnerable to pathogen threat or find the experience of disgust to be intensely uncomfortable. Due to its stability over time, pathogen avoidance motivation allows for the exploration of inter-individual differences to pathogen-relevant behaviours within a particular situation. In comparison, acute BIS activation is context-dependent; it occurs once a pathogen cue has been detected and results in a rapid sequence of cognitive and affective changes. These changes increase awareness of the pathogen threat and lead to pathogen avoidance behaviours.

**Functional Flexibility.** Acute BIS activation and high levels of pathogen avoidance motivation increase pathogen avoidance behaviours. Importantly, the relationship between a pathogen cue and BIS response is complex and marked by functional flexibility (Ackerman et al., 2018). Functional flexibility describes the incorporation of environmental context, competing personal needs, and individual beliefs into a cost-benefit analysis of pathogen avoidance (Ackerman et al., 2018; Schaller & Park, 2011). Pathogen cues are abundant and avoidance of them reduces social network expansion, disrupts learning, and is a barrier to reproduction. Therefore, the costs associated with pathogen avoidance are carefully weighed against the benefits of pathogen approach within a particular context. To illustrate functional flexibility, recall the described tendency to avoid others who are displaying signs of illness (i.e., sickness-avoidance behaviours; Blacker & LoBue, 2016; Sarabian et al., 2018). If the "sick" other is a stranger in a park, there is great benefit and little cost associated with avoiding this person. This cost-benefit ratio changes if the "sick" other is your infant as the cost of pathogen avoidance becomes much higher (e.g., child's inability to complete daily living tasks). The cost-benefit ratio may also be impacted by things like pathogen avoidance motivation (e.g., perceptions of own health, affective reactions to germs), social supports, and the child's age. Clearly, there are many environmental, contextual, and personal factors that may be considered when evaluating a pathogen threat and initiating behavioural responses.

Several experimental studies have demonstrated functionally flexible responding in the context of pathogen cues. In some situations, competing needs dampen the BIS response. For example, hungry individuals display a reduced disgust response when presented disgust-evoking pictures of food, but not disgust-evoking images unrelated to food (Hoefling et al., 2009). This discrepancy was not observed in satiated controls highlighting the role nutritional status plays on disgust responses related to food (i.e., needs-relevant pathogen cues). Additional examples of functionally flexible responding based on competing needs have been reported within the context of reproduction. Sexual encounters require intimate interpersonal interactions, which carry a relatively high risk of pathogen exposure. In keeping with functional flexibility, individuals who are sexually aroused rated sex- and pathogen-relevant tasks (e.g., touching a stranger's underwear) as less disgusting than controls (Borg & de Jong, 2012). As alluded to, caregiving needs can also impact BIS responding. When presented dirty, unidentified diapers, mothers rated the scent of their baby's feces as less disgusting than that of other babies (Case et al., 2006). Taken together, these studies demonstrate the moderating effect of competing needs (e.g., hunger, reproduction, caregiving) on the relationship between stimulus cues and affective responding, which ultimately influences approach/avoidance behaviours.

### *Social Variables*

The BIS has provided a framework to better understand a wide variety of behaviours. The relationship between specific pathogen threats and avoidance behaviours is direct and relatively intuitive (i.e., avoidance of sick others, contaminated food, and dirty animals). However, social sciences research has demonstrated that the BIS is also associated with more distally related variables, such as personality, cultural values, and political preferences (Ackerman et al., 2018).

Personality traits are considered stable and can increase or reduce the likelihood of pathogen contact (Matthews et al., 2003). For example, high levels of extraversion and openness to new experience increases the likelihood of pathogen exposure through increased social contact and a draw to novel experiences, respectively. Therefore, it is not surprising that a meta-analysis identified that pathogen avoidance motivation is negatively correlated with extraversion and openness to experience (Oosterhoff et al., 2018). Similarly, people with higher levels of pathogen avoidance motivation also tend to have decreased affiliative interest, reduced enjoyment interacting with acquaintances, and lower levels of attraction toward others (Sawada et al., 2018). It is interesting to note that the relationship between pathogen avoidance motivation and personality traits is observed at a population level; in regions that are more pathogen-rich, levels of extraversion and openness to experience are lower than regions with fewer pathogens (Schaller & Murray, 2008).

When considering cultural values, high levels of conformity and convergent pathogen-reduction practices minimizes the spread of disease. These collectivist practices may be particularly beneficial in pathogen-rich regions. Conversely, individualistic values (e.g., tolerance of deviation from status quo) fail to safeguard against disease and are expected to negatively correlate with pathogen prevalence. Indeed, geographic regions marked by higher levels of pathogens are more likely to be characterized by collectivist values, while regions with historically lower levels of pathogen prevalence are generally characterized by individualistic values (Fincher et al., 2008). This effect remains significant after controlling for population density, gross domestic product per capita, inequity in the distribution of wealth, and pathogen-irrelevant health threats. Further, pathogen prevalence is also positively correlated with cultural conformity (Murray et al., 2011). Thus, pathogen prevalence appears to uniquely contribute to the endorsement of individualist and collectivist values.

Political preferences and social beliefs also appear to be influenced by pathogen threat. Political orientation is related to threat sensitivity and more socially conservative individuals tend to be more sensitive and reactive to threat-relevant information (Hibbing et al., 2014; Jost et al., 2009). Therefore, it is not surprising that a meta-analysis of 24 studies found pathogen avoidance motivation was positively associated with a variety of socially conservative values (Terrizzi et al., 2013). Socially conservative values and high pathogen avoidance motivations are connected to traditionalism, which includes the drive to maintain existing norms and wariness toward incorporating new progressive ways of doing things (Karinen et al., 2019; Tybur et al., 2016). The association between the BIS and prejudice is believed to occur through a similar connection.

Prejudice has been proposed as a mechanism of pathogen avoidance (Ackerman et al., 2018; Tybur & Lieberman, 2016). Members of outside groups are more likely to carry foreign pathogens and deviate from cultural norms that have been established within a particular region to minimize disease transmission (Murray & Schaller, 2016). When the BIS is acutely activated or an individual has greater pathogen avoidance motivation, the difference between features (e.g., accent, age, race) similar (ingroup member) and different (outgroup member) to oneself are amplified (Makhanova et al., 2014; Reid et al., 2012). Further, experiments using the Implicit Association Test (IAT) have identified an increase in the unconscious association of disease with obesity, mental health, and age, following acute BIS activation (Duncan & Schaller, 2009; Lund & Boggero, 2014; Park et al., 2007). Taken together, the BIS impacts the way that individuals perceive and relate to others, and this can manifest as prejudice.

Pathogen avoidance motivation has been correlated with xenophobic attitudes (Laakasuo et al., 2018; Zakrzewslka et al., 2019). Immigrants from countries linked to disease are perceived as a greater health threat and produce greater feelings of discomfort than those from an unspecified country (Ji et al., 2019). Huang and colleagues (2011) harnessed the relationship between the BIS and prejudice in an attempt to reduce xenophobic attitudes. They observed that individuals not vaccinated against H1N1 expressed more racist beliefs after being exposed to information about H1N1 than those in a control prime condition, while xenophobic attitudes did not differ based on prime in vaccinated participants. In a follow-up study, participants that were instructed to use a handwipe were less likely to report racist beliefs than those in a control condition, regardless of pathogen avoidance motivation. This suggests that perceived protection from disease reduces negative perceptions of outgroups and provides a glimpse into the benefits that understanding the BIS may have on society.

## Research Tools

Most of the studies described in the previous sections were collected in laboratories and reliant upon artificial pathogen primes to induce acute BIS activation. In these studies, participants exposed to a pathogen prime were compared to participants exposed to a control prime in order to delineate the effect of acute BIS activation on a dependent variable (Tybur et al., 2014). Several different primes have been used to artificially induce acute BIS activation and these will be briefly reviewed to facilitate an understanding of the common paradigm used to study the BIS prior to the COVID-19 pandemic.

Experimental primes used to study acute BIS activation include visual images (e.g., vomit, dirty toilet, photograph of someone sneezing; Schaller et al., 2010; Stevenson et al., 2011), vignettes (e.g., reading a short story where a hospital character encounters disgust-evoking events; White et al., 2013), and odours (e.g., spray laboratory room with odour similar to feces; Tybur et al., 2011). Standardized priming tools are being developed to enhance the replicability of BIS studies (e.g., Culpepper Disgust Image Set; Culpepper et al., 2018). In experiments using primes, dependent variable differences between a pathogen-primed group and a control group are compared to draw conclusions.

Experimental controls improve accurate interpretation of results by minimizing the likelihood that variables other than the independent variable(s) contributed to the observed changes (Boring, 1954). Within the context of BIS research, control groups must be carefully selected so that the effects of a pathogen prime may be attributed to disease-relevant processes. For example, when a control prime is simply marked by the absence of disease threat (e.g., clean toilet), it is not possible to differentiate effects that are specific to BIS activation from those associated with increased arousal and/or negative valence emotions more generally (Tybur et al., 2014). Thus, control primes that evoke fear (e.g., image of someone pointing a gun, vignette of a home intrusion) allow for distinctions between disease-specific vs. high arousal outcomes to be made (Schaller et al., 2010; White et al., 2013).

In summary, pathogens pose a threat to humans and avoidance of them increases chances of survival and optimal energy allocation (Hessling et al., 2017; Schaller & Park, 2011; Shakhar, 2019). The BIS is believed to be an integrated system that uses sensory cues within the environment to identify pathogen threat (Drexler, 2010; Stevenson, 2010). Once a threat is identified, changes in perception, attention, and memory, as well as the experience of disgust, result in pathogen avoidant behaviours (Schaller & Park, 2011). How a particular individual responds to a pathogen threat is dependent upon their pathogen avoidance motivation as well as the environmental context that the threat is experienced (Ackerman et al., 2018; Tybur et al., 2014). This understanding of the BIS has largely been developed by laboratory research relying on experimental primes and controls. Due to methodological limitations, it is unclear how generalizable the current theoretical understanding of the BIS is in the face of a real and chronic pathogen threat.

**Global Pandemic**

The term "pandemic" describes a sudden and unforeseeable increase in the number of people with a given condition around the world (Grennan, 2019). Pandemics often occur in waves with intermittent outbreaks that range from months to centuries. Human history is marked with deadly pandemics. One of the most recent pandemics is the Spanish flu pandemic (1918-1919), which resulted in an estimated 50 million deaths worldwide (Piret & Boivin, 2021). Improved public health measures, access to modern medicine, and increased nutrition have reduced pathogen fear in developed countries, but the threat of pathogens remains present (Troisi, 2020).

Human vulnerability to infection has been highlighted by the recent global spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the resulting coronavirus disease (COVID-19). When this dissertation was first proposed, nearly 10.2 million cases of COVID-19 had been reported worldwide (statistics reported June 30, 2020; WHO, 2020b). Fast forward to today, over 767.9 million cases of COVID-19 and 6.95 million deaths have been reported, with approximately one in seven deaths occurring in the United States alone (>1.1 million deaths in USA; statistics reported July 12, 2023; Center for Disease Control and Prevention, 2023; WHO, 2023). Clearly, developed nations have not been spared from the deadly nature of the virus nor were they able to escape the day-to-day disruption it caused.

The global pandemic had economic, social, and psychological consequences (Haktanir et al., 2021). Government mandated lockdowns and the suspension of businesses impacted the global economic market and resulted in a macroeconomic recession (Witteveen & Velthorst, 2020). Lifestyle changes were associated with sleep disturbances, increased social media and screen time, and less exercise (Kumar & Dwivedi, 2020). Isolation, loneliness, changes in routine, and mental health difficulties were reported globally (Emir Öksüz et al., 2021; Groarke et al., 2020, Lonergan-Cullum et al., 2022; Özmete & Pak, 2020; Vindegaard & Benros, 2020) and at higher levels than those reported prior to the pandemic (Forte et al., 2020). The pandemic was not experienced equally by all, and some groups were more vulnerable to its negative effects than others including the elderly, women, racial minorities, front line workers, those experiencing loss, and individuals with lower pay and skill levels (Ceri & Cicek, 2021; Kumar & Dwivedi, 2020; Kuy et al., 2020; Mazza et al., 2020; Witteveen & Velthorst, 2020). To prevent the spread of COVID-19, governments encouraged and/or enforced individual protective behaviours including hand washing, mask wearing, and social distancing (Aschwanden et al., 2021). These lifestyle and wellbeing changes, precautionary measures, and influx of social and news media related to the pandemic served as constant reminders of the threat of the SARS-CoV-2 virus.

Research exploring the impact of pandemics on cognitive, affective, and behavioural processes associated with the BIS was minimal prior to 2020 (Schaller et al., 2021). Cross-sectional studies had indicated that predispositions (e.g., perceived vulnerability, outgroup beliefs, individualist values) and heightened disease salience during an outbreak were associated with greater prejudicial attitudes toward outgroups (Kim et al., 2016; Krings et al., 2012). There was also evidence to indicate that intentions to vote conservative increased in the context of pathogen threat (Beall et al., 2016; Schaller et al., 2017). However, to the best of my knowledge, changes in cognition within the context of a pandemic have not yet been explored.

It is likely that the global pandemic would have activated the BIS as information about a pathogen threat (i.e., COVID-19) was highly pervasive. Unlike laboratory studies, government restrictions, media, and individual behaviours provided continuous reminders of pathogen threat for months and years after the pandemic was first declared in March 2020. Over the past three years, social psychology research has explored the personal and interpersonal consequences of the current pandemic, but studies exploring the impact of the pandemic on cognitive processes relating to the BIS have been largely absent within the literature.

**Overview of the Present Study**

The BIS protects against infections; it reduces the likelihood of physiological immune system activation, its associated functional consequences, and the risk of death (Shakhar, 2019).

When a pathogen risk is identified within an environment, cognitive and affective changes motivate behavioural avoidance of that threat (Schaller & Park, 2011). In the months following the onset of the COVID-19 pandemic, numerous cues served as reminders of the risk and deadly consequences of COVID-19 (Haktanir et al., 2021). These cues were different from the manipulated variables included in laboratory studies of the BIS (Tybur et al., 2014). For example, rather than being restricted to a particular location and time, reminders of COVID-19 were universal and persistent. These reminders included constant media converge with case and fatality counts, government-mandated lockdowns, social distancing efforts, and masking (Aschwanden et al., 2021). Many of these cues (e.g., lockdown procedures, media exposure) remained inescapable, even in the absence of imminent pathogen threat (i.e., isolating at home). According to current BIS theory, cues indicating pathogen risk result in cognitive changes that optimize behavioural avoidance of the pathogen threat (Iwasa et al., 2020). However, development of this framework relied on research that examined the effects of <u>acute</u> BIS activation and much less is known about the cognitive changes that occur in the context of <u>chronic</u> pathogen threat. The current dissertation capitalized on the extended threat of the COVID-19 pandemic to address this gap in BIS theory.

When a pathogen risk is present, perception is enhanced (Chan et al., 2019). Enhanced perception, including greater sensitivity to small changes in sensory stimuli, increases the probability that pathogens will be detected and avoided (Chan et al., 2016, 2019; Hunt et al., 2017). Previous research has demonstrated that perceptual abilities related to the detection of tactile, olfactory, auditory, and visual stimuli are enhanced following BIS activation (Chan et al., 2019; Hunt et al., 2017; Nussinson et al., 2018; Reid et al., 2012). These perceptual enhancements are an objective marker of vigilance to pathogen cues within the environment and are believed to, in part, drive the pathogen avoidance behaviours that keep an individual safe from infection. Individuals with greater pathogen avoidance motivation display increased vigilance relative to their less avoidant peers (Chan et al., 2016; Nussinson et al., 2018; Reid et al., 2012). Similarly, people primed with pathogen cues display greater perceptual sensitivity than those primed with pathogen-irrelevant stimuli (Hunt et al., 2017). In sum, individuals who are more pathogen vigilant, either by nature or through environmental forces, demonstrate heightened perceptual abilities compared to their less vigilant counterparts.

The present dissertation is divided into three studies, each exploring vigilance within the context of chronic pathogen threat. Experiment 1 and Experiment 2 investigate whether vigilance differs across timepoints within the first seven months of the pandemic. Vision has been previously identified as particularly influential sense when making decisions about pathogen risk (Tybur et al., 2014). In the present studies, vigilance is operationally defined as visual discrimination skills. In the context of acute BIS activation, an individual can reduce their pathogen risk by avoiding pathogen-relevant stimuli. This contrasts the threat of COVID-19, which is chronic and requires individual- as well as group-level prevention behaviours to minimize its spread. Therefore, Experiment 1 and Experiment 2 have cohorts of participants complete visual discrimination tasks at different timepoints to better understand the impact of chronic BIS activation on vigilance.

The visual discrimination tasks used in Experiment 1 and Experiment 2 differ in terms of their association with pathogens. As described, faces provide cues related to health (Axelsson et al., 2018; Henderson et al., 2017; Sarolidou et al., 2019). For example, skin discolouration and glossiness, as well as eyelid droop are imperfect indicators of an individual's health status (Axelsson et al., 2018; Henderson et al., 2017). Previous research has indicated that humans demonstrate a preference for healthy faces and are more likely to avoid those with facial cues indicative of illness (Gordon et al., 2018; Leschak et al., 2022; Sarolidou et al., 2020). As pathogen-relevant cues are inferred from faces and influence behaviour, it is expected that chronic BIS activation would influence vigilance to these cues. Therefore, Experiment 1 investigates how the ability to discriminate between faces differs at 4 timepoints in the COVID-19 pandemic.

In comparison to Experiment 1, Experiment 2 explores how the ability to discriminate between neutral stimuli (i.e., shapes) differs across the same 4 timepoints in the pandemic. Unlike faces, two-dimensional (2D) shapes provide no information about pathogen risk. Further, the ability to detect small differences in 2D stimuli has no clear evolutionary advantage. Despite this, acute BIS activation has been associated with subjective reports of increased discrimination and identification of neutral stimuli (Magalhães et al., 2018; Nussinson et al., 2018). The purpose of Experiment 2 is to see whether vigilance to pathogen-irrelevant information differs across timepoints in the pandemic and whether this pattern is similar to that of Experiment 1. The combination of Experiment 1 and Experiment 2 will provide insight into the specificity of vigilance to pathogen cues following chronic pathogen threat. If differences across timepoints are only observed in Experiment 1, it would suggest that the impact of chronic BIS activation on visual discrimination is limited to pathogen-relevant stimuli. In comparison, if differences across timepoints are observed in Experiment 1 and Experiment 2, it would provide evidence that chronic BIS activation impacts vigilance in a global and non-specific manner.

Previous research has suggested that inter-individual pathogen avoidance motivations may moderate the relationship between pathogen threat and subsequent BIS reactions (Kusche & Barker, 2019). Individuals predisposed to feel more threatened by pathogens are more likely to show cognitive, emotional, and behavioural responses when exposed to a pathogen threat. It is possible that pathogen avoidance motivation may also impact vigilance in the context of chronic BIS activation. Therefore, Experiment 1 and Experiment 2 compare the visual discrimination abilities between individuals with high and low pathogen avoidance motivation at each timepoint.

The impact of the COVID-19 pandemic was observed at individual, community, and global levels. Government policies and guidelines were put in place to reduce the COVID-19 case count and public information about the seriousness of the disease was made available. Despite this, individual differences in COVID-19 attitudes and prevention behaviours were observed, with some demographic groups being more likely to engage in preventative behaviours than others (Li et al., 2020; Yildirim et al., 2021). One particularly strong predictor of COVID-19 preventative behaviours was political affiliation; liberal individuals were more likely to engage in preventative behaviours than conservative individuals (de Bruin et al., 2020; Kerr et al., 2021; Rabin & Dutra, 2021). According to BIS theory, cognitive and affective changes motivate the avoidance of pathogen threats (Schaller & Park, 2011). Therefore, it is hypothesized that individuals engaging in more COVID-19 preventative behaviours would also demonstrate greater perception and attention skills than those engaging in fewer preventative behaviours. Experiment 3 investigates this hypothesis by comparing vigilance to pathogen-relevant and pathogen-irrelevant stimuli between individuals with liberal, moderate, and conservative political affiliations. An in-depth discussion of the methodologies used is described in the following section.

# CHAPTER 2

## Objectives and Methodology

### Research Objectives

Previous studies have relied upon experimental primes and self-reported pathogen response motivation to study the influence of the BIS on cognitive processing (Tybur et al., 2014). Neither method has allowed for the study of cognitive changes that occur in the face of chronic pathogen threat. The current dissertation used the COVID-19 pandemic as an ecologically valid pathogen prime to investigate the impact chronic BIS activation on cognition (WHO, 2020a).

Previous research has demonstrated that acute BIS activation is accompanied by enhanced olfactory and tactile perceptual sensitivity (Chan et al., 2016; Hunt et al., 2017). Further, subjective ratings suggest that visual and auditory perceptual contrast sensitivity is enhanced following pathogen priming; importantly, these enhancements were reported with pathogen-relevant (i.e., voices, faces) and pathogen-irrelevant (i.e., shapes) stimuli (Nussinson et al., 2018; Reid et al., 2012). The majority of studies exploring sensory changes associated with the BIS have relied on subjective ratings. The visual discrimination tasks used in this dissertation expand upon previous literature by measuring vigilance using objective markers of performance (i.e., accuracy and reaction time [RT]) rather than subjective ratings.

The objectives of Experiment 1 and Experiment 2 are to explore the impact of chronic BIS activation on vigilance. All data were collected within the first seven months of the COVID-19 pandemic and a repeated cross-sectional methodology was used in order to minimize the risk of unforeseen attrition bias/losses in respondents over time. The same participants at each timepoint were included in all three experiments. Each participant was asked to complete two visual discrimination tasks; one discrimination task contained pathogen-relevant stimuli (i.e., faces; Experiment 1), while the other included pathogen-irrelevant, neutral stimuli (i.e., 2D shapes; Experiment 2). Participants were also invited to fill out a questionnaire that included a measure of pathogen avoidance motivation (i.e., disgust sensitivity), which was used to investigate whether pathogen avoidance motivation impacted vigilance at different timepoints. Data were collected at four timepoints (Figure 1) and data collection was completed before any COVID-19 vaccinations were made publicly available (Cable News Network [CNN], 2022).

Political values and affiliations were identified as a predictor of COVID-19 related attitudes and preventative behaviours early in the pandemic (de Bruin et al., 2020; Kerr et al., 2021; Rabin & Dutra, 2021). Prominent political figures and media sources differed dramatically in their depiction of the pandemic; liberals spotlighted the health risk of COVID-19, while conservatives emphasized the economic and personal liberty costs of the pandemic (Samore et al., 2021). These messages were reflected in the behaviour of constituents and conservative individuals were more opposed to COVID-19-related restrictions and less likely to engage in preventative behaviours than their liberal counterparts. Clearly, COVID-19 avoidance behaviours differ across the political spectrum, but it is unclear whether vigilance differences also exist. Experiment 3 aims to investigate the impact of political affiliation on vigilance during the COVID-19 pandemic.

**Hypotheses**

The following hypotheses were tested:

*H1: Participants with high disgust sensitivity will complete visual discrimination tasks faster and more accurately than participants with low disgust sensitivity.*

Previous studies have demonstrated individuals who report greater pathogen avoidance motivation appear to be more sensitive to pathogen-relevant stimuli than those with lower pathogen avoidance motivation (Tybur et al., 2014). When presented with an acute pathogen threat, greater pathogen avoidance motivation is associated with more significant cognitive changes, stronger affective experiences, and increased avoidance behaviours (Kusche & Barker, 2019; Sawada et al., 2018; Schaller & Park, 2011). In the context of chronic pathogen threat, individuals with high pathogen avoidance motivation were expected to outperform those with low pathogen avoidance motivation on visual discrimination tasks at all four timepoints.

*H2: Visual discrimination performance will be faster and more accurate at earlier timepoints than later timepoints.*

Following acute pathogen threat, the short-term enhancement of perceptual abilities leads to greater detection of subsequent pathogen cues (Chan et al., 2019). Changes in perceptual sensitivity and attention are highly adaptive and maximize pathogen avoidance. When presented with a chronic pathogen threat, cognitive enhancements and biases may no longer be an efficient use of mental resources.

As the research on chronic BIS activation is limited, this hypothesis was guided by fear response literature. Fear response systems and the BIS have important similarities; both are "activated" following exposure to a stimulus, have strong affective components (i.e., disgust and fear), and motivate avoidance behaviours (Öhman & Rück, 2007; Schaller & Park, 2011; Steimer, 2002). Additionally, there is evidence to suggest fear-relevant primes enhance some perceptual abilities in a manner similar to disgust-relevant primes (Chan et al., 2016). Exposure to a fear-evoking stimulus leads to desensitization over time, which reduces the fear response to that stimulus (Tyron, 2005). Additional support for this hypothesis comes from literature demonstrating that vigilance decreases during tasks requiring sustained mental effort (Al-Shargie et al., 2019; Atchley & Chan, 2011; Pattyn et al., 2008). Taken together, it is expected that vigilance will decline with chronic exposure to pathogen threat (i.e., COVID-19 pandemic).

*H3: The visual discrimination performance of liberal participants will be faster and more accurate than conservative participants.*

Current BIS theory postulates that pathogen avoidance behaviours are a consequence of cognitive and affective changes (Schaller & Park, 2011). Therefore, individuals less likely to engage in COVID-19 avoidance behaviours, including those with more politically conservative beliefs (de Bruin et al., 2020; Kerr et al., 2021; Rabin & Dutra, 2021), are expected to have reduced cognitive and affective changes following pathogen exposure.

## Methodology

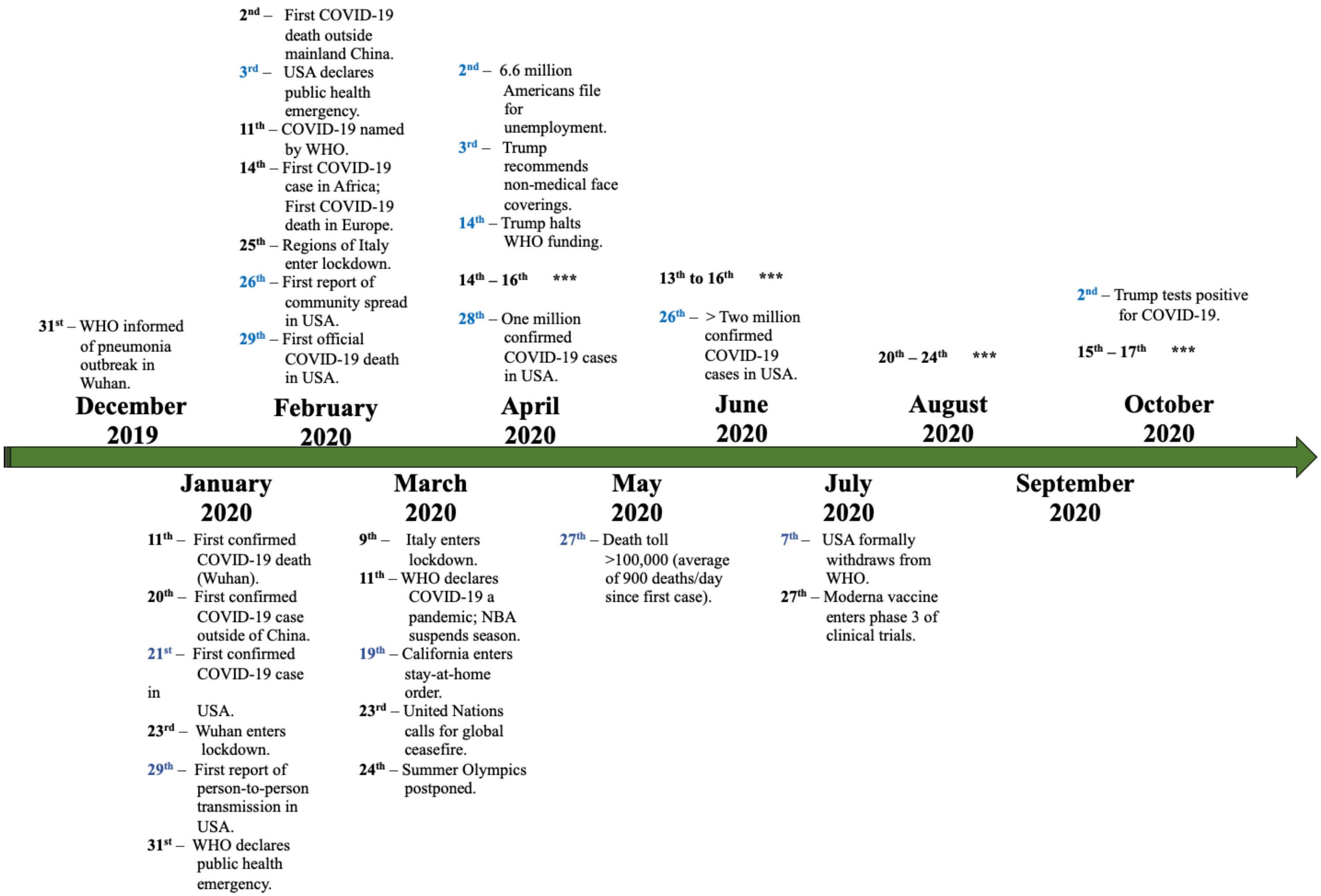
### *Participants*

Participants were recruited through the Mechanical Turk (MTurk) website. The study, titled *Visual discrimination of faces and shapes*, was posted at four different timepoints. The study remained available until 500 participants were recruited and then was taken down until the next timepoint. In total, 2000 participants completed this cross-sectional study. Participants met inclusion criteria if they were older than 18 years of age, currently living in the United States or Canada, and spoke English.

As mentioned, the same participants participated in all three experiments at a single timepoint; each participant completed both visual discrimination tasks and the questionnaire portion of the study. The study was posted at four timepoints, each separated by two months. In total, the study spanned six months (i.e., April, June, August, and October 2020) and was

**Figure 1**

*Timeline of Novel COVID-19-Related Events*




*Note.* Visual depiction of novel events related to COVID-19 between December 2019 to October 2020 (CNN, 2021; Global News, 2020). Dates of major international and American (USA) events are denoted in black and blue, respectively. Dates that data were collected for the current dissertation are denoted with three asterisk symbols (***).

completed before COVID-19 vaccinations were publicly available. For the specific dates that data were collected please refer to Figure 1.

### *Materials*

**Visual Discrimination of Faces.** The original images of faces were collected from the Face Research Lab - London Set (DeBruine & Jones, 2017). This dataset includes 102 images of adult faces that are standardized such that photograph brightness and background are consistent across images. All individuals pictured in the dataset are front-oriented, wearing white shirts, and displaying neutral facial expressions. For the current study, each face was matched with a second face of an individual with a similar skin tone in order to seamlessly merge the features of the two images for the ambiguous face trial type. As such, the majority of faces are white; this is also consistent with previous BIS literature involving faces (Jones et al., 2005; Magalhães et al., 2018; Tskhay et al., 2016) and minimizes the impact of any race processing bias on visual discrimination skills (Golarai et al., 2021). There were three types of face combinations: identical, ambiguous, and different (Figure 2). In identical face trials, participants were shown two images that were the same. In ambiguous face trials, a feature of a different face was morphed onto the target face so that the two images were not identical but different versions of the same face. In different face trials, participants were shown faces of two different individuals. A more thorough description of the face discrimination task and all stimuli included within the task (i.e., paired images and ambiguous face trial stimuli) can be found in Appendix A.

**Visual Discrimination of Shapes.** Three shapes were displayed simultaneously (Figure 2). Two of these shapes were identical, while the visual properties of the third shape varied along a single dimension (e.g., colour, size, angle). All stimuli for the shape discrimination task can be found in Appendix B.

**Figure 2**

*Sample Stimuli from the Visual Discrimination Tasks*


A. Identical face trial, same image; B. Ambiguous face trial, lips have been morphed in the second image; C. Different face trial, different faces; D. The third shape is larger than the other two.

### *Post-Session Questionnaire*

Participants completed a questionnaire to collect information on their demographics, pathogen avoidance motivation, and experience with COVID-19. The questionnaire was slightly modified for August and October data collection so that it included additional information related to political affiliation and anxiety (see Appendix C for both versions of the questionnaire).

**Demographics.** A PsychoPy3 survey collected relevant demographic information (e.g. age, gender, country of residence, postal/zip code). The demographic information section was expanded for August and October timepoints to include information about participant's current employment and employment in January 2020, their income, and the makeup of their households.

**Disgust Scale – Revised.** Participants completed the Disgust Scale – Revised (DS-R; Haidt, McCauley & Rozin, 1994, modified by Olatunji et al. 2007; Appendix D) to estimate their baseline disgust sensitivity. Disgust sensitivity is used as a measure of pathogen avoidance motivation. The disgust scale (DS) and its revised version (DS-R; improved psychometric features) are used internationally to study disgust sensitivity and the DS-R has been translated into several languages including Greek, Persian, and Korean (Chalimourdas et al., 2019; Kang et al., 2012; Shams et al., 2013). Scores are associated with a variety of BIS-related variables. For example, DS scores were predictive of neural responses to disgusting stimuli; higher DS scores were associated with greater activation of neural regions associated with disgust and reduced activation of neural regions associated with emotion regulation (Mataix-Cols et al., 2008). Higher DS and DS-R scores have also been positively correlated with health-related anxiety, contamination anxiety, and negative attitudes toward sexually progressive beliefs (Crawford et al., 2014; Fan & Olatunji, 2013; Olatunji et al., 2014).

The DS-R is comprised of 25 items that are divided into two sets. The first set asked participants to rate their agreement with 14 statements (e.g., seeing a cockroach in someone else's home doesn't bother me) on a scale from 0 (strongly disagree) to 4 (strongly agree). The second set asks participants to rate their level of disgust from 0 (not disgusting at all) to 4 (extremely disgusting) in response to 11 scenarios (e.g., you see maggots on a piece of meat in an outdoor garbage pail). Total scores on the DS-R range from 0 to 100. This measure has been previously identified as having good internal consistency ($\alpha = .87$) and moderate to high content validity (van Overveld et al., 2011). Two additional items were embedded within the questionnaire as validity checks (e.g., "please select strongly disagree").

**Political Affiliation.** Participants that completed the study in August and October were asked two questions about their political beliefs. The first question asked them to rate their political identification on a 7-point Likert scale from 1 (strongly liberal) to 7 (strongly conservative). The second question had participants identify which political party best reflects their personal values in short answer format.

**Covid-19 Experience.** All participants were asked about their experience with COVID-19 using items inspired from a study by Dr. Norman Brown at the University of Alberta that was conducted in 2020 but published in 2021 (Brown, 2021). Specifically, participants were asked whether they, their family members, or their friends have tested positive or experienced symptoms that correspond with COVID-19. They were also asked to rate their anxiety about contracting COVID-19 on a 10-point Likert scale. In the initial questionnaire participants were asked to rate their anxiety about their family members or friends contracting COVID-19 on a 10-point Likert scale. When the questionnaire was revised for August and October timepoints, the question related to anxiety about family and friends contracting COVID-19 was split into two separate items.

## Procedure

Adult participants recruited via MTurk signed-up for the study through their worker accounts. Participants consisted of 2000 individuals (i.e., 500 participants/timepoint) and the same procedure was completed with all participants. First, participants completed the visual discrimination tasks on PsychoPy3. Both tasks (i.e., face and shape discrimination) started with a demonstration item followed by practice trials, which provided the participant with feedback on their practice responses. Once the visual discrimination tasks were completed, participants were redirected to Qualtrics to complete a short questionnaire. The questionnaire began with items related to demographics and was followed by the DS-R (Haidt, McCauley & Rozin, 1994, modified by Olatunji et al. 2007). The DS-R was followed by items about participants history with COVID-19 and anxiety related to contracting the virus. Participants in August and October timepoints completed items related to their political beliefs immediately following the DS-R.

Once the tasks and questionnaire were complete, participants were directed to a debriefing form that included information about the study as well as fact sheets on handwashing and coping during the pandemic (Ontario Agency for Health Protection and Promotion, 2020; WHO, 2020c). Once their work was accepted, $2.50 USD was transferred to participants MTurk worker accounts. A visual depiction of the procedure can be found in Figure 3.

Participants across all timepoints were included in Experiment 1 and Experiment 2. As the political affiliation questions were added to the questionnaire in August 2020, only data from participants in August and October timepoints were included within Experiment 3.

## Data Analysis

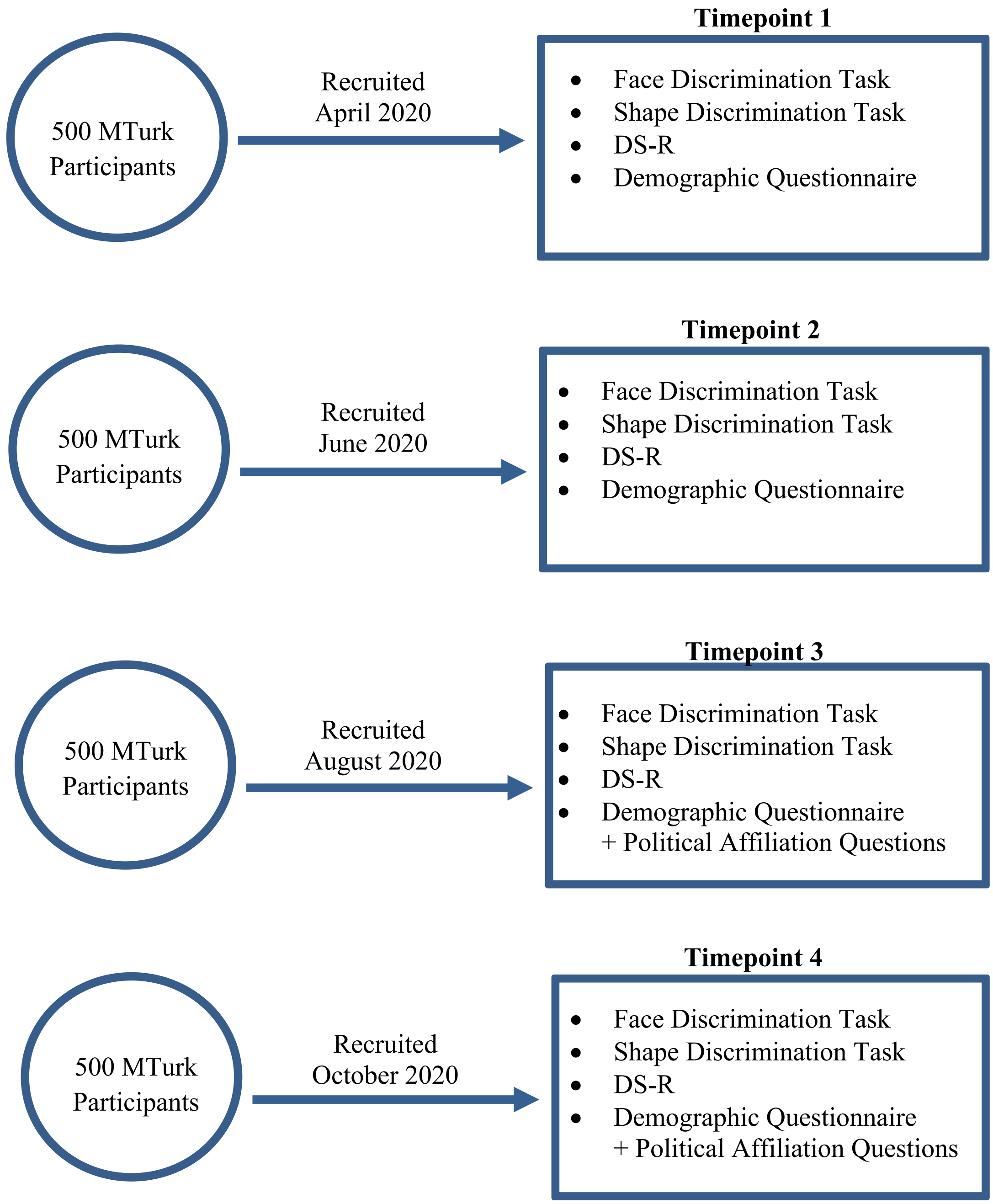
### *Validity Checks*

Participant data were reviewed by timepoint. Data were first reviewed for completion using MTurk IDs and was only considered if the same MTurk ID corresponded to completed PsychoPy3 and Qualtrics files. If the same MTurk ID was associated with multiple experiment attempts, only the first attempt was included within analyses. After participant data were reviewed for completion and multiple attempts, the data were evaluated for validity.

Multiple validity checks were used to increase the likelihood that the retained data reflected good effort. In Experiment 1, participant data were removed if either embedded validity check in the DS-R was failed, mean reaction times were less than .3s or greater than 10s on

**Figure 3**

*Visual Depiction of the Study Procedure*



identical, ambiguous, or different face trials, and/or performance was below chance levels across all face trials (50%). In Experiment 2, participant data were removed if either embedded validity check was failed in the DS-R, mean reaction time was less than .3s or greater than 10s, and/or performance was below chance levels across all shape trials (33%).

Only participants from August and October timepoints were included within Experiment 3 and both timepoints were merged to increase the total number of participants in each political group. Participant data were removed if the data did not include a response to the Likert scale political affiliation item. Additionally, the validity criteria from Experiment 1 and 2 were applied to Experiment 3 (i.e., data were removed if either embedded validity check was failed in the DS-R, mean reaction times were less than .3s or greater than 10s on identical face trials, ambiguous face trials, different face trials, or shape trials, and/or performance was below chance levels on across face or shape trials).

***Experiments 1 and 2***

All data were analyzed using Statistical Package for the Social Sciences (SPSS) Statistics 29.0. Due to the highly novel nature of this study, it was unknown whether vigilance differences would be observed and what the direction of those changes would be. Therefore, disgust sensitivity was categorized into high and low groups because the relationship between the independent and dependent variables was unclear and this categorization would ease interpretation of the results (DeCoster et al., 2011; Farrington & Loeber, 2000). Artificial categorization has also been used to group participants according to their DS-R scores in other studies (Chapman & Anderson, 2014; Silva et al., 2012). A median split was used to divide participants into equally sized high and low disgust sensitivity groups. A t-test was conducted to ensure disgust sensitivity levels between the two groups significantly differed.

The first hypothesis (*H1*) predicted that individuals with greater disgust sensitivity would outperform those with lower disgust sensitivity on visual discrimination tasks. The second hypothesis (*H2*) postulated that participants at earlier timepoints would complete visual discrimination tasks with greater accuracy and more quickly than those at later timepoints. To test *H1* and *H2*, analyses of variance (ANOVAs) were conducted. There were two independent and between-subject variables: disgust sensitivity (2 levels: high or low) and timepoint (4 levels: April 2020, June 2020, August 2020, or October 2020). The dependent variables were accuracy and RT on correct trials. ANOVAs were completed separately for Experiment 1 and Experiment 2. In Experiment 1, separate ANOVAs were completed for each trial type (i.e., identical, ambiguous, different) as well as overall trials (i.e., data from all three trial types combined).

### *Experiment 3*

Data were analyzed using Statistical Package for the Social Sciences (SPSS) Statistics 29.0. Participants were divided into three political affiliation groups based on their self-reported political affiliation on a 7-point Likert scale (1 strongly liberal; 7 strongly conservative). Participants who rated themselves as 1 or 2 on the scale were included in the liberal group, those who rated themselves as 3, 4, or 5 were included in the moderate group, and those who rated themselves as a 6 or 7 were included within the conservative group.

The relationship between visual discrimination skills and political affiliation was explored using ANOVAs (*H3*). The independent variable was political affiliation (3 levels: liberal, moderate, or conservative). The dependent variables were accuracy and RT on correct trials. Data were separately analyzed for overall face trials, identical face trials, ambiguous face trials, different face trials, and shape trials.

Finally, the relationship between political affiliation and DS-R scores were explored using Pearson correlations in order to better understand the connection between these two variables..

# CHAPTER 3

## Experiment 1. Face Discrimination Task

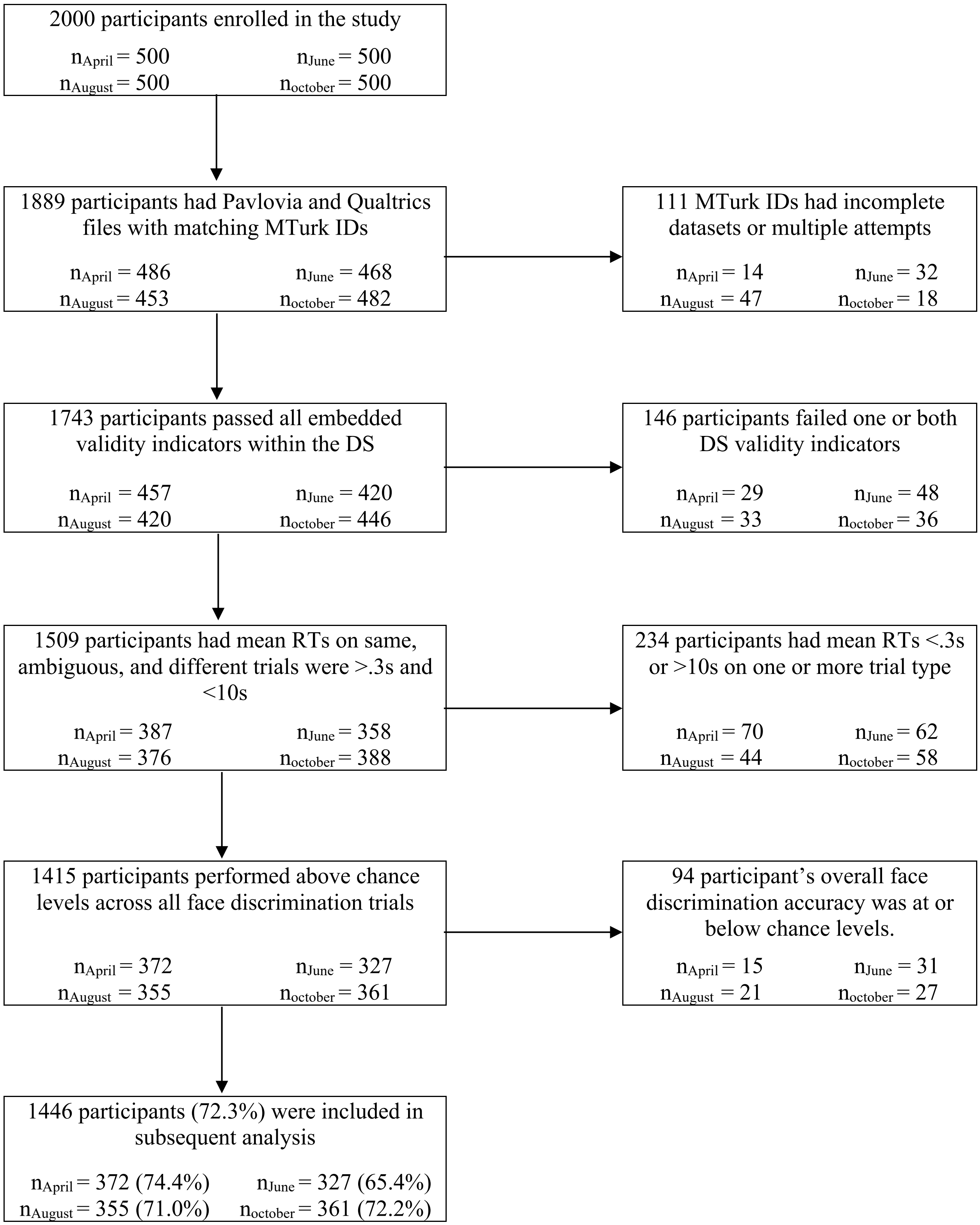
### Results

#### *Data Cleaning*

For a detailed overview of the data cleaning steps, refer to Figure 4. Briefly, participants within each timepoint were removed for having incomplete or multiple datasets (n = 111), failing embedded validity indicators within the DS-R (n = 146), having mean reaction times greater than 10s or less than .3s on identical, ambiguous, or different face discrimination trials (n = 234), and performing at or below chance levels across all trials (n = 94).

**Figure 4**

*Stepwise Application of Exclusion Criteria in Experiment 1*



### *Demographic Information*

A $\chi^2$ test of independence indicated that the proportion of participants in Canada and the United States did not significantly differ across the four timepoints (Table 1). As the political climate and mortality risk of COVID-19 varied between the Canada and the United States, the decision was made to remove participants from Canada (n = 12) as well as participants with missing location information (n=18). Only participants in United States within included within all subsequent analyses.

**Table 1**

*Location of Participants in Experiment 1*

| | n | | | | |
|---|---|---|---|---|---|
| | United States | Canada | $\chi^2$ | *df* | *p* |
| April | 361 | 6 | 4.16 | 3 | .245 |
| June | 322 | 2 | | | |
| August | 348 | 1 | | | |
| October | 354 | 3 | | | |
| Total | 1385 | 12 | | | |

Age differences between timepoints were explored using a one-way ANOVA. Overall, participants who completed the experiment in August were younger than the other timepoints, while participants who completed the experiment in October were older than other timepoints (Table 2).

**Table 2**

*Age of Participants in Experiment 1*

| | Age | | | n | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | $F(3, 1379)$ | $\eta_p^2$ |
| April | 361 | 37.20 | 11.28 | $12.88^{***}$ | .027 |
| June | 321 | 37.38 | 10.56 | | |
| August | 347 | 34.96 | 10.14 | | |
| October | 354 | 40.11 | 11.95 | | |
| Total | 1383 | 37.43 | 11.16 | | |

$^{***}p < .001$

$\chi^2$ tests of independence were planned for categorical variables (i.e., gender, ethnicity). However, due to an imbalance between cells (i.e., expected cell counts <5 for greater than 20%

of cells), these analyses were not completed but descriptive information can be found in Tables 3 and 4.

**Table 3**

*Gender of Participants in Experiment 1*

| | n | | |
|---|---|---|---|
| | Man | Woman | Non-binary |
| April | 199 | 162 | 0 |
| June | 209 | 113 | 0 |
| August | 205 | 142 | 1 |
| October | 208 | 144 | 2 |
| Total | 821 | 561 | 3 |

*Note. Non-binary and other cultural identity responses were collapsed into single measure due to low n.*

**Table 4**

*Ethnicity of Participants in Experiment 1*

| | n | | | |
|---|---|---|---|---|
| | April | June | August | October |
| African American | 38 | 39 | 45 | 30 |
| Asian American | 19 | 17 | 16 | 21 |
| Latino/a | 22 | 17 | 24 | 24 |
| American Indian | 5 | 9 | 9 | 6 |
| European Origin | 268 | 222 | 245 | 266 |
| Middle Eastern | 1 | 3 | 2 | 0 |
| Bi-racial | 8 | 9 | 1 | 7 |
| Other | 0 | 6 | 4 | 0 |
| Total | 361 | 322 | 346 | 354 |

### ***Disgust Sensitivity***

The mean of the total DS-R score was 59.06 (SD = 13.04) and the median was 59. These scores are similar (i.e., mean within one standard deviation) to those obtained in previous studies using the DS-R (Chalimourdas et al., 2019; Kang et al., 2012; Shams et al., 2013; van Overveld et al., 2011). Participants were divided into disgust sensitivity groups such that participants with a total score of 58 or lower were placed in the low disgust sensitivity (LDS) group and those with total scores greater than 58 were placed in the high disgust sensitivity (HDS) group. An independent samples t-test indicated that the total DS-R scores between the low (n = 682, $M$ =

46.16, *SD* = 10.01) and high (n = 703, *M* = 69.99, *SD* = 7.62) disgust sensitivity groups were significantly different, t(1272.23) = 43.28, $p < .001$, *d* = 2.68. The DS-R total scores did not differ over time when looking at the HDS (*p*= .658) and LDS (*p* = .276) groups separately (Table 5).

**Table 5**

*DS-R Total Scores for HDS and LDS Groups in Experiment 1*

| | LDS Group | | | HDS Group | | |
|---|---|---|---|---|---|---|
| | n | *M* | *SD* | n | *M* | *SD* |
| April | 198 | 45.76 | 9.66 | 163 | 70.20 | 8.70 |
| June | 176 | 46.69 | 10.45 | 146 | 69.34 | 7.10 |
| August | 150 | 47.14 | 9.61 | 198 | 69.94 | 7.58 |
| October | 158 | 45.15 | 10.26 | 196 | 70.34 | 7.11 |
| Total | 682 | 46.16 | 10.01 | 703 | 69.99 | 7.62 |

### *All Trials*

**Accuracy.** A between-subjects ANOVA identified a significant interaction between the effect of timepoint and disgust sensitivity on overall face discrimination accuracy ($F(3, 1377) = 5.95$, $p < .001$, $\eta_p^2 = .013$; Table 6). Post-hoc analysis indicated that there were no significant differences in overall face discrimination accuracy in April. However, the LDS group was more accurate than the HDS group in June, August, and October. Participants in the HDS group that completed the study in April were significantly more accurate than those that completed the study in June, August, and October. In comparison, no differences were observed in the LDS group across timepoints (Figure 5).

**Table 6**

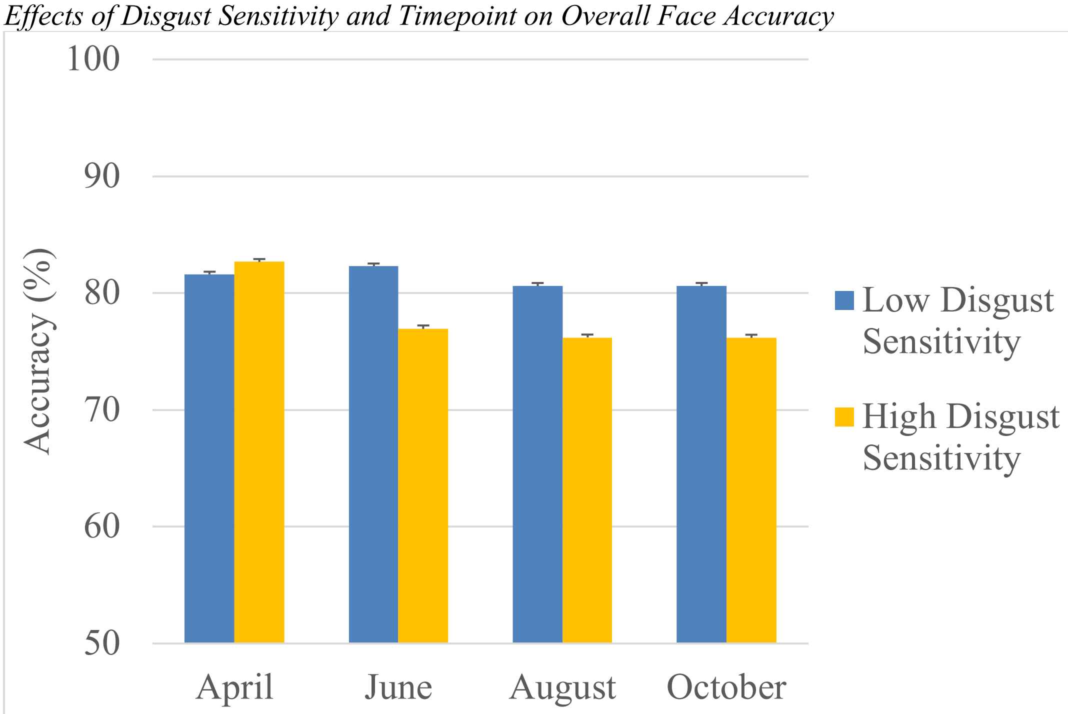
*Overall Face Discrimination Accuracy by Disgust Sensitivity Group and Timepoint*

| | Disgust Sensitivity | Overall Accuracy n | *M* | *SD* | *F*(3, 1377) | $\eta_p^2$ |
|---|---|---|---|---|---|---|
| April | Low | 198 | 24.48 | 3.20 | 5.95*** | .013 |
| | High | 163 | 24.80 | 3.13 | | |
| | Total | 361 | 24.63 | 3.17 | | |
| June | Low | 176 | 24.71 | 3.09 | | |
| | High | 146 | 23.10 | 3.55 | | |
| | Total | 322 | 23.98 | 3.40 | | |
| August | Low | 150 | 24.11 | 3.35 | | |
| | High | 198 | 22.82 | 3.54 | | |
| | Total | 348 | 23.38 | 3.51 | | |
| October | Low | 158 | 24.18 | 3.31 | | |
| | High | 196 | 22.85 | 3.70 | | |
| | Total | 354 | 23.44 | 3.59 | | |
| Total | Low | 682 | 24.39 | 3.23 | | |
| | High | 703 | 23.35 | 3.58 | | |
| | Total | 1385 | 23.86 | 3.45 | | |

***$p < .001$

**Figure 5**

*Effects of Disgust Sensitivity and Timepoint on Overall Face Accuracy*




*Note.* Participants in April performed similarly regardless of disgust sensitivity, but the LDS group was more accurate at all other timepoints. Individuals with HDS were more accurate in April than the other three timepoints. No differences were observed across timepoints in the LDS group. Accuracy is displayed as percentage of correct responses.

**Reaction Time.** Means and standard deviations of RT on correct trials are reported in Table 7. A between subjects ANOVA indicated that there were no significant main effects of wave ($p$ = .58) or disgust sensitivity ($p$ = .28), nor was there a significant interaction between those two variables ($p$ = .15).

**Table 7**

*Overall Face Discrimination RT by Disgust Sensitivity and Timepoint*

| | | RT (s) | | |
|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* |
| April | Low | 198 | 2.17 | .886 |
| | High | 162 | 2.27 | .864 |
| | Total | 360 | 2.21 | .876 |
| June | Low | 176 | 2.37 | .984 |
| | High | 145 | 2.29 | 1.07 |
| | Total | 321 | 2.33 | 1.02 |
| August | Low | 148 | 2.43 | 1.05 |
| | High | 197 | 2.26 | .974 |
| | Total | 345 | 2.33 | 1.01 |
| October | Low | 157 | 2.36 | .962 |
| | High | 195 | 2.14 | .967 |
| | Total | 352 | 2.24 | .969 |
| Total | Low | 679 | 2.32 | .970 |
| | High | 699 | 2.23 | .970 |
| | Total | 1378 | 2.28 | .971 |

### *Identical Face Trials*

**Accuracy.** There was no interaction ($p$ = .40) or significant main effects of timepoint ($p$ = .22) or disgust sensitivity ($p$ = .66) on accuracy scores for identical face trials. Means and standard deviations can be found in Table 8.

**Table 8**

*Identical Face Trial Accuracy by Disgust Sensitivity and Timepoint*

| | | Identical Face Trial Accuracy | | |
|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* |
| April | Low | 198 | 8.24 | 1.81 |
| | High | 163 | 8.46 | 1.57 |
| | Total | 361 | 8.34 | 1.71 |
| June | Low | 176 | 8.44 | 1.50 |
| | High | 146 | 8.40 | 1.67 |
| | Total | 322 | 8.43 | 1.58 |
| August | Low | 150 | 8.69 | 1.39 |
| | High | 198 | 8.53 | 1.81 |
| | Total | 348 | 8.59 | 1.64 |
| October | Low | 158 | 8.58 | 1.48 |
| | High | 196 | 8.72 | 1.77 |
| | Total | 354 | 8.66 | 1.65 |
| Total | Low | 682 | 8.47 | 1.57 |
| | High | 703 | 8.54 | 1.72 |
| | Total | 1385 | 8.50 | 1.65 |

**Reaction Time.** A between-subjects ANOVA identified a significant interaction between disgust sensitivity and timepoint on RT during identical face trials ($p$ = .047; Table 9). Post hoc analysis indicated that participants with LDS performed similarly across all timepoints. In comparison, participants with HDS were significantly slower if they completed the study in April compared to August and October. The LDS and HDS groups did not differ from each other in April, but the HDS group completed identical face trials quicker than the LDS group in June, August, and October (Figure 6).

**Table 9**

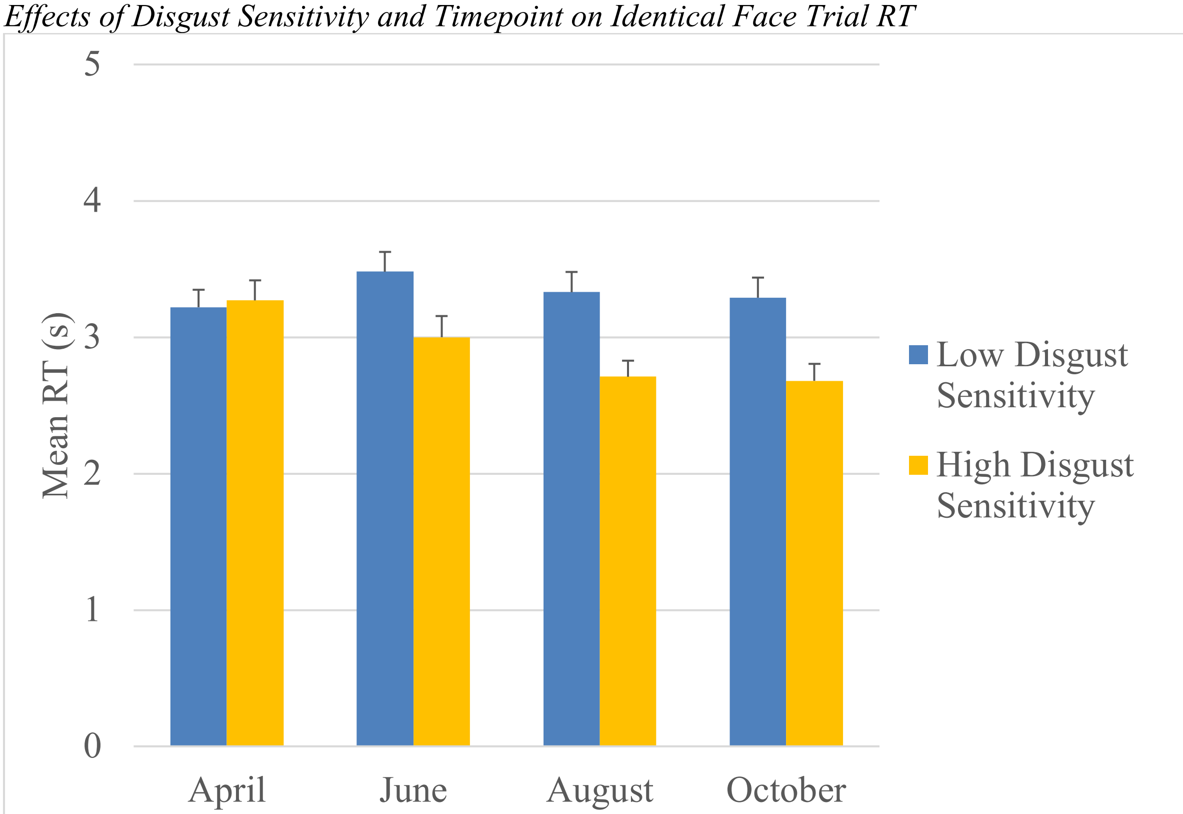
*Identical Face Trial RT by Disgust Sensitivity and Timepoint*

| | Disgust Sensitivity | RT (s) n | *M* | *SD* | $F(3, 1374)$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|
| April | Low | 198 | 3.22 | 1.80 | 2.65* | .006 |
| | High | 162 | 3.27 | 1.87 | | |
| | Total | 360 | 3.24 | 1.83 | | |
| June | Low | 176 | 3.48 | 1.93 | | |
| | High | 145 | 3.00 | 1.87 | | |
| | Total | 321 | 3.26 | 1.91 | | |
| August | Low | 150 | 3.33 | 1.82 | | |
| | High | 198 | 2.71 | 1.66 | | |
| | Total | 348 | 3.29 | 1.75 | | |
| October | Low | 158 | 3.29 | 1.85 | | |
| | High | 195 | 2.68 | 1.74 | | |
| | Total | 353 | 2.96 | 1.81 | | |
| Total | Low | 682 | 3.33 | 1.85 | | |
| | High | 700 | 2.89 | 1.79 | | |
| | Total | 1382 | 3.11 | 1.83 | | |

*$p < .05$

**Figure 6**

*Effects of Disgust Sensitivity and Timepoint on Identical Face Trial RT*




*Note.* LDS and HDS groups performed similarly in April. HDS groups responded quicker than LDS groups at all remaining timepoints. No group differences were observed across timepoints in the LDS group, but the HDS group was faster in August and October than in April.

## Ambiguous Face Trials

**Accuracy.** A statistically significant interaction between the effects of timepoint and disgust sensitivity was observed on accuracy scores of ambiguous face trials ($p$ = .002; Table 10). No group differences were observed at the April timepoint, but the LDS group was more accurate than the HDS group in June, August, and October. Amongst LDS participants, those who completed the study at the earlier two timepoints (i.e., April or June) were more accurate than those who completed the study at the latter two timepoints (i.e., August or October). In the HDS group, participants who completed the study in April were more accurate than those who completed the study in June, August, or October (Figure 7).

**Table 10**

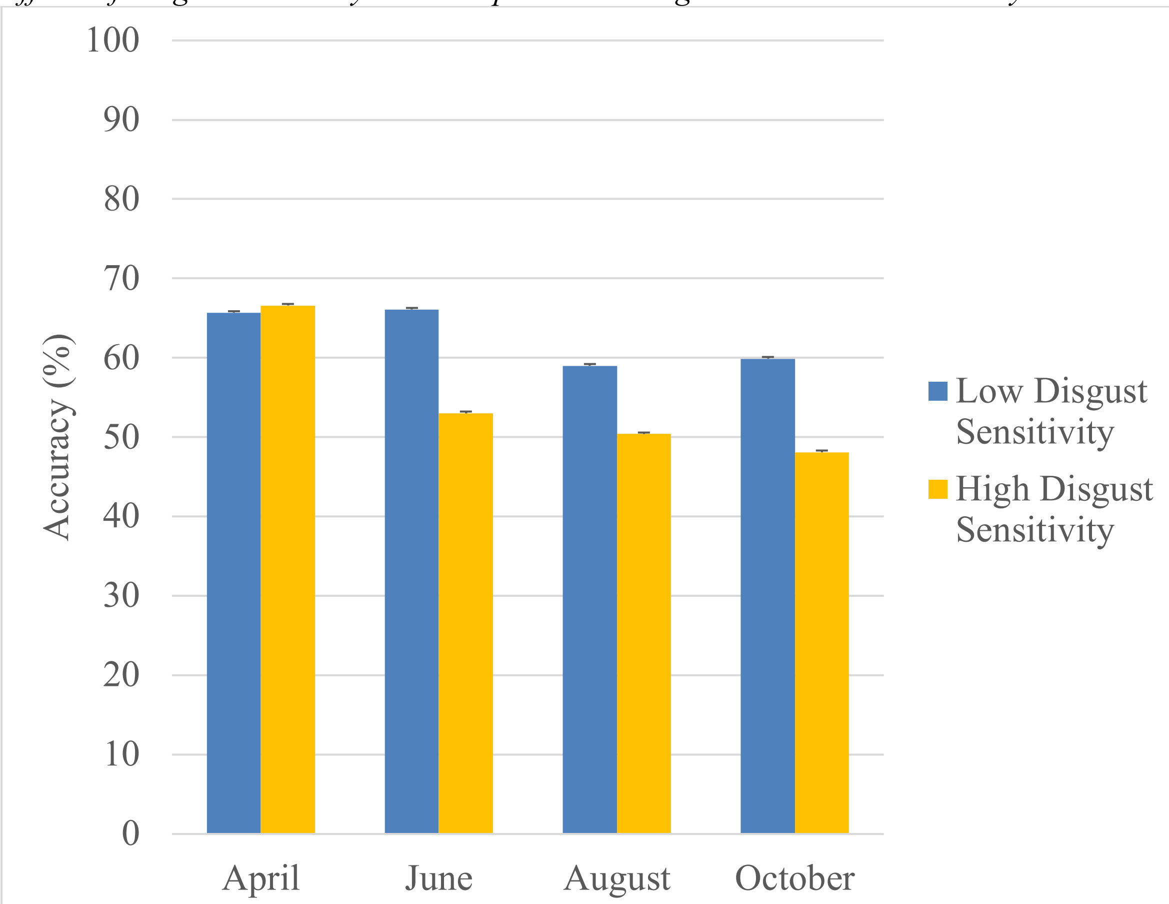
*Ambiguous Face Trial Accuracy by Disgust Sensitivity and Timepoint*

| | | Ambiguous Face Trial Accuracy | | | | |
|---|---|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* | $F(3, 1377)$ | $\eta_p^2$ |
| April | Low | 198 | 6.57 | 2.49 | 5.11* | .011 |
| | High | 163 | 6.68 | 2.45 | | |
| | Total | 361 | 6.62 | 2.47 | | |
| June | Low | 176 | 6.66 | 2.53 | | |
| | High | 146 | 5.31 | 2.86 | | |
| | Total | 322 | 6.05 | 2.77 | | |
| August | Low | 150 | 5.85 | 2.82 | | |
| | High | 198 | 5.05 | 2.66 | | |
| | Total | 348 | 5.40 | 2.76 | | |
| October | Low | 158 | 5.99 | 2.64 | | |
| | High | 196 | 4.81 | 3.11 | | |
| | Total | 354 | 5.34 | 2.96 | | |
| Total | Low | 682 | 6.30 | 2.63 | | |
| | High | 703 | 5.42 | 2.87 | | |
| | Total | 1385 | 5.85 | 2.79 | | |

*$p < .005$

**Figure 7**

*Effects of Disgust Sensitivity and Timepoint on Ambiguous Face Trial Accuracy*




*Note.* In the LDS group, April and June participants were more accurate than August and October participants. In the HDS group, April participants were more accurate than June, August, and October participants. The LDS group was more accurate than the HDS group in June, August, and October. Accuracy is displayed as percentage of correct responses.

**Reaction Time.** No significant main effects of timepoint ($p$ = .65) or disgust sensitivity ($p$ = .53) were observed on ambiguous face trial RT and the interaction between these two variables was nonsignificant ($p$ = .17). Means and standard deviations can be found in Table 11.

**Table 11**

*Ambiguous Face Trial RT by Disgust Sensitivity and Timepoint*

| | | Reaction Time (s) | | |
|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* |
| April | Low | 198 | 2.26 | 1.05 |
| | High | 162 | 2.39 | 1.09 |
| | Total | 360 | 2.32 | 1.07 |
| June | Low | 176 | 2.53 | 1.27 |
| | High | 145 | 2.41 | 1.42 |
| | Total | 321 | 2.76 | 1.34 |
| August | Low | 148 | 2.46 | 1.32 |
| | High | 197 | 2.48 | 1.33 |
| | Total | 345 | 2.48 | 1.33 |
| October | Low | 157 | 2.57 | 1.34 |
| | High | 195 | 2.29 | 1.43 |
| | Total | 352 | 2.42 | 1.40 |
| Total | Low | 679 | 2.45 | 1.24 |
| | High | 699 | 2.39 | 1.33 |
| | Total | 1378 | 2.42 | 1.29 |

### *Different Face Trials*

**Accuracy.** Means and standard deviations are reported in Table 12. No significant main effects of timepoint ($p = .23$) or disgust sensitivity ($p = .057$) were observed for different face trials. The interaction between the two independent variables was not significant ($p = .17$).

**Table 12**

*Different Face Trial Accuracy by Disgust Sensitivity and Timepoint*

| | | Different Face Trial Accuracy | | |
|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* |
| April | Low | 198 | 9.68 | 0.82 |
| | High | 163 | 9.66 | 0.79 |
| | Total | 361 | 9.67 | 0.81 |
| June | Low | 176 | 9.61 | 1.00 |
| | High | 146 | 9.38 | 1.05 |
| | Total | 322 | 9.51 | 1.03 |
| August | Low | 150 | 9.57 | 0.92 |
| | High | 198 | 9.24 | 1.33 |
| | Total | 348 | 9.39 | 1.18 |
| October | Low | 158 | 9.61 | 0.85 |
| | High | 196 | 9.32 | 1.22 |
| | Total | 354 | 9.45 | 1.08 |
| Total | Low | 682 | 9.62 | 0.90 |
| | High | 703 | 9.39 | 1.14 |
| | Total | 1385 | 9.50 | 1.04 |

**Reaction Time.** The final analysis in Experiment 1 explored the relationship between timepoint, disgust sensitivity, and RT during different face trials (see Table 13 for means and standard deviations). There was no significant interaction between timepoint and disgust sensitivity ($p$ = .26) nor a significant effect of disgust sensitivity ($p$ = .06) on RT but there was a significant effect of timepoint (F(3, 1370) = 1.35, $p$ = .031, $\eta_p^2$ = .003; Figure 8). Post-hoc analysis revealed that participants in the April timepoint were significantly faster at completing different trials than all other timepoints, while participants in August were significantly slower than all other timepoints.

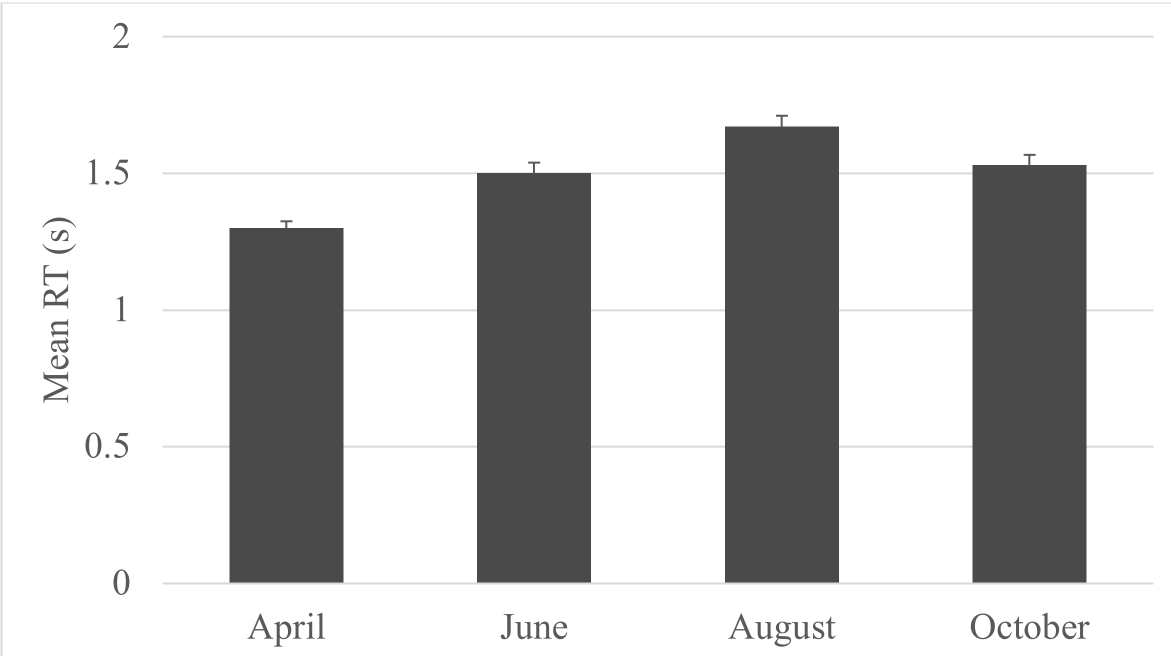
**Table 13**

*Different Face Trial RT by Disgust Sensitivity and Timepoint*

| | | Reaction Time (s) | | |
|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* |
| April | Low | 198 | 1.29 | .501 |
| | High | 162 | 1.31 | .424 |
| | Total | 360 | 1.30 | .467 |
| June | Low | 176 | 1.41 | .637 |
| | High | 145 | 1.62 | .763 |
| | Total | 321 | 1.50 | .703 |
| August | Low | 148 | 1.57 | .790 |
| | High | 197 | 1.74 | .721 |
| | Total | 345 | 1.67 | .755 |
| October | Low | 157 | 1.48 | .646 |
| | High | 195 | 1.57 | .750 |
| | Total | 352 | 1.53 | .706 |
| Total | Low | 679 | 1.42 | .648 |
| | High | 699 | 1.57 | .699 |
| | Total | 1378 | 1.50 | .678 |

**Figure 8**

*Effect of Timepoint on Different Face Trial RT*




*Note: Participants in April were significantly faster than all other timepoints on different face trials, while participants in August were significantly slower than all other timepoints.*

***Supplementary Analysis: Exposure to COVID-19***

An additional exploratory analysis was conducted to explore whether exposure to COVID-19 differed across disgust sensitivity groups. Two $\chi^2$ tests of independence were run to compare the number of participants who tested positive for COVID-19 and the number of participants suspected to have COVID-19 (i.e., presented with symptoms but were not tested). Results indicated that a greater proportion of participants were confirmed or suspected to have COVID-19 in the HDS group than the LDS group (Table 14 and Table 15).

**Table 14**

*Number of participants indicating they tested positive for COVID-19*

| Disgust Sensitivity | Tested positive for COVID-19 (n) No | Yes | $\chi^2$ | *df* | *p* |
|---|---|---|---|---|---|
| Low | 673 | 27 | 14.06 | 1 | <.001 |
| High | 650 | 62 | | | |
| Total | 1323 | 89 | | | |

**Table 15**

*Number of participants that suspected they had COVID-19*

| Disgust Sensitivity | Tested positive for COVID-19 (n) No | Yes | $\chi^2$ | *df* | *p* |
|---|---|---|---|---|---|
| Low | 616 | 81 | 28.72 | 1 | <.001 |
| High | 548 | 158 | | | |
| Total | 1164 | 239 | | | |

## Discussion

The impact of disgust sensitivity and pandemic length on visual discrimination skills was examined using face stimuli. A month after the pandemic was declared (April 2020), participants performed similarly on a face discrimination task regardless of their self-reported disgust sensitivity. However, differences between LDS and HDS groups emerged as the pandemic persisted. At timepoints between June and October 2020, participants with LDS consistently completed the task more accurately than those with HDS; separate analysis of each trial type indicated that this difference was driven by performance on ambiguous face trials. When comparing performance within each group, the overall accuracy of participants with LDS did not differ across timepoints but the LDS group was less accurate on ambiguous face trials in August and October than in May and June. In comparison, differences in accuracy were observed earlier in the HDS group and participants were less accurate across all trials and ambiguous face trials in June, August, and October than in April. No differences in accuracy were observed on identical or different face trials.

The influence of disgust sensitivity and timepoint on RT directly contrasted the accuracy findings and neither variable significantly impacted RT across all trials or ambiguous face trials. However, significant effects were observed on identical and different face trials. On identical face trials, LDS and HDS groups performed similarly in April, but the HDS group completed identical trials faster than the LDS group at the three other timepoints. Participants in April were slower than participants in June, August, and October in the HDS group, while reaction time did not change across timepoints in the LDS group. On different face trials, no differences between disgust sensitivity groups were observed. However, different face trials were completed quickest in the April timepoint and slowest in the August timepoint.

Overall, the LDS group demonstrated greater visual vigilance on a face discrimination task than participants with HDS at later timepoints. This corresponds with findings from the supplementary analyses that indicated a greater proportion of HDS participants tested positive for COVID than LDS participants.

# CHAPTER 4

## Experiment 2. Shape Discrimination Task

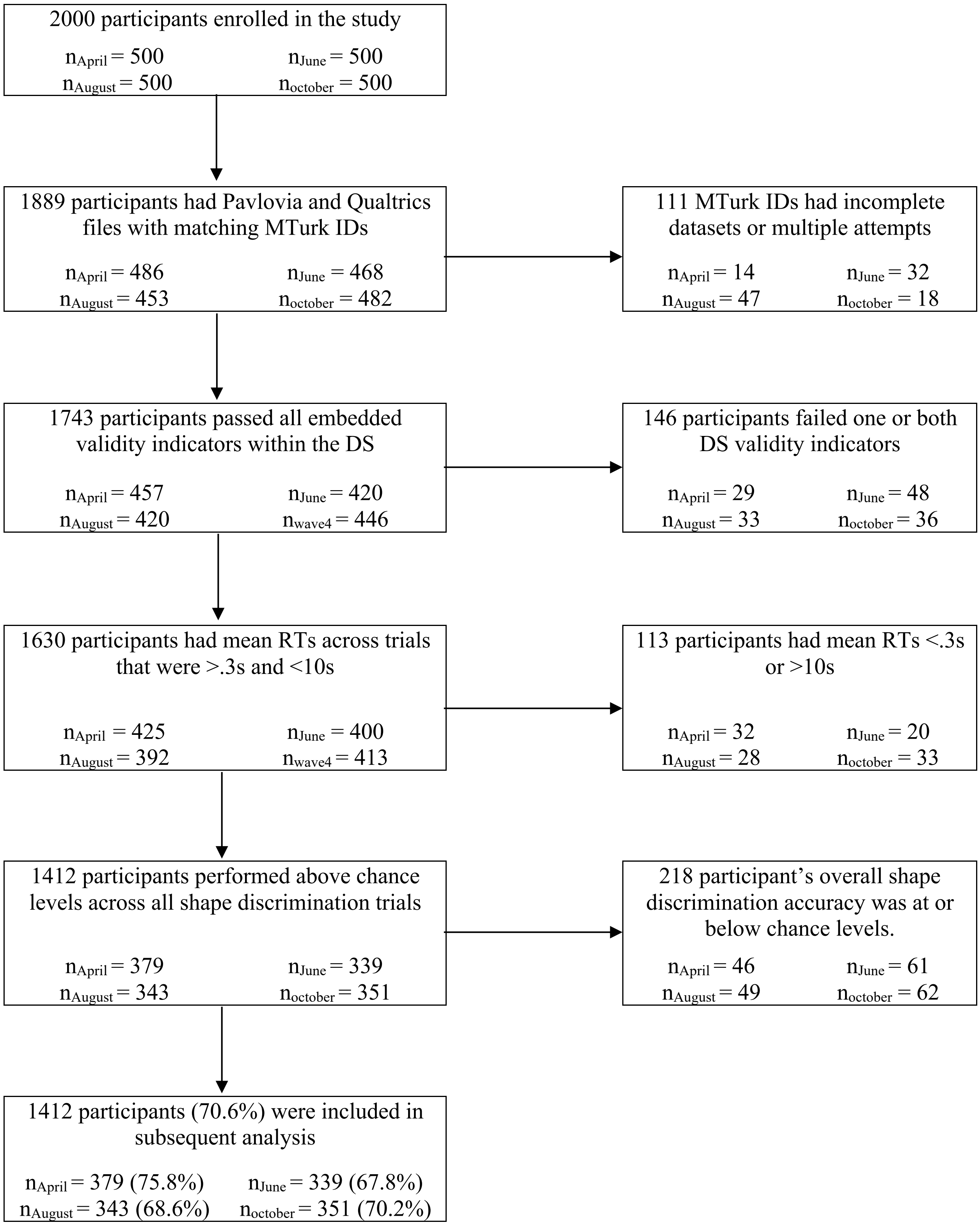
### Results

#### *Data Cleaning*

Figure 9 provides a detailed stepwise description of the applied exclusion criteria in the shape discrimination task. Although the same participants completed the face and shape discrimination tasks, exclusion criteria were applied separately in each experiment to retain a greater number of participants. A total of 1442 participants remained in the final analysis. One hundred and eleven participants were removed due to incomplete/repeated datasets, 146 for failing a validity indicator within the DS-R, 234 participants had reaction times outside of the predetermined acceptable range, and 194 participants performed below chance levels.

**Figure 9**

*Stepwise Application of Exclusion Criteria in Experiment 2*



***Demographic Information***

A total of 12 Canadian participants and 1380 American participants remained within the dataset after data cleaning was completed. Twenty participants did not report their current location. A $\chi^2$ test of independence indicated that the proportion of participants completing the study in Canada and the United States did not significantly differ across timepoints (Table 16). Similar to Experiment 1, only participants who reported being in the United States were included in the data analyses that are described below.

**Table 16**

*Location of Participants in Experiment 2*

| | n | | | | |
|---|---|---|---|---|---|
| | United States | Canada | $\chi^2$ | *df* | *p* |
| April | 368 | 6 | 4.01 | 3 | .261 |
| June | 331 | 3 | | | |
| August | 336 | 1 | | | |
| October | 345 | 2 | | | |
| Total | 1380 | 12 | | | |

A one-way ANOVA indicated that mean age significantly differed across timepoints (Table 17); participants in October were older than all other timepoints and participants in August were younger than all other timepoints.

**Table 17**

*Age of Participants in Experiment 2*

| | Age | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(3, 1374) | $\eta_p^2$ |
| April | 368 | 37.40 | 11.52 | 8.46** | .018 |
| June | 330 | 37.78 | 10.94 | | |
| August | 335 | 35.66 | 10.56 | | |
| October | 345 | 39.94 | 11.57 | | |
| Total | 1378 | 37.70 | 11.26 | | |

$^{***}p < .001$.

Descriptive information about gender and ethnicity can be found in Tables 18 and 19, respectively. Similar to Experiment 1, $\chi^2$ tests of independence were planned but not executed as the cells were unbalanced.

**Table 18**

*Gender of Participants in Experiment 2*

| | n | | |
|---|---|---|---|
| | Man | Woman | Non-binary |
| April | 213 | 155 | 0 |
| June | 211 | 120 | 0 |
| August | 192 | 143 | 1 |
| October | 206 | 137 | 2 |
| Total | 822 | 555 | 3 |

*Note. Non-binary and other cultural identity responses were collapsed into single measure due to low n.*

**Table 19**

*Ethnicity of Participants in Experiment 2*

| | n | | | | |
|---|---|---|---|---|---|
| | Total | April | June | August | October |
| African American | 147 | 39 | 34 | 46 | 28 |
| Asian American | 80 | 22 | 19 | 16 | 23 |
| Latino/a | 86 | 17 | 22 | 21 | 26 |
| American Indian | 26 | 5 | 8 | 6 | 7 |
| European Origin | 1002 | 276 | 233 | 239 | 254 |
| Middle Eastern | 4 | 1 | 2 | 1 | 0 |
| Bi-racial | 26 | 8 | 10 | 1 | 7 |
| Other | 7 | 0 | 3 | 4 | 0 |

### *Disgust Sensitivity*

The mean DS-R total score was 58.77 (SD = 13.28) and the median was 59. Similar to Experiment 1, participants were divided into HDS and LDS groups at the DS-R total score of 59. Participants with a DS-R total score of 59 or above were placed in the HDS group, while all other participants were placed in the LDS group. A t-test indicated that the total score on the DS-R was significantly different between the LDS (n = 691, $M$ = 45.66, $SD$ = 10.29) and HDS (n =

689, *M* = 70.09, *SD* = 7.79), t(1285.86) = 49.75, $p < .001$, $d = 2.68$) groups. The DS-R total score did not differ across timepoints for HDS ($p = .575$) or LDS ($p = .312$) groups (Table 20).

**Table 20**

*DS-R Total Scores for HDS and LDS Groups in Experiment 2*

| | LDS Group | | | HDS Group | | |
|---|---|---|---|---|---|---|
| | n | *M* | *SD* | n | *M* | *SD* |
| April | 205 | 45.41 | 9.90 | 163 | 70.26 | 8.79 |
| June | 185 | 45.84 | 10.86 | 146 | 69.42 | 7.44 |
| August | 145 | 46.85 | 9.86 | 191 | 70.04 | 7.60 |
| October | 156 | 44.67 | 10.45 | 189 | 70.51 | 7.36 |
| Total | 691 | 45.66 | 10.28 | 689 | 70.09 | 7.79 |

***Accuracy***

Raw score means and standard deviations are reported in Table 21. A two-way ANOVA identified a significant interaction between disgust sensitivity and timepoint on shape discrimination accuracy ($p = .013$). Post-hoc analysis indicated that accuracy of the LDS group did not differ across timepoints. In comparison, the HDS group was more accurate in April than it was in August or October. Overall, both disgust sensitivity groups performed similarly in April but the LDS group was more accurate than the HDS group in June, August, and October (Figure 10).

**Table 21**

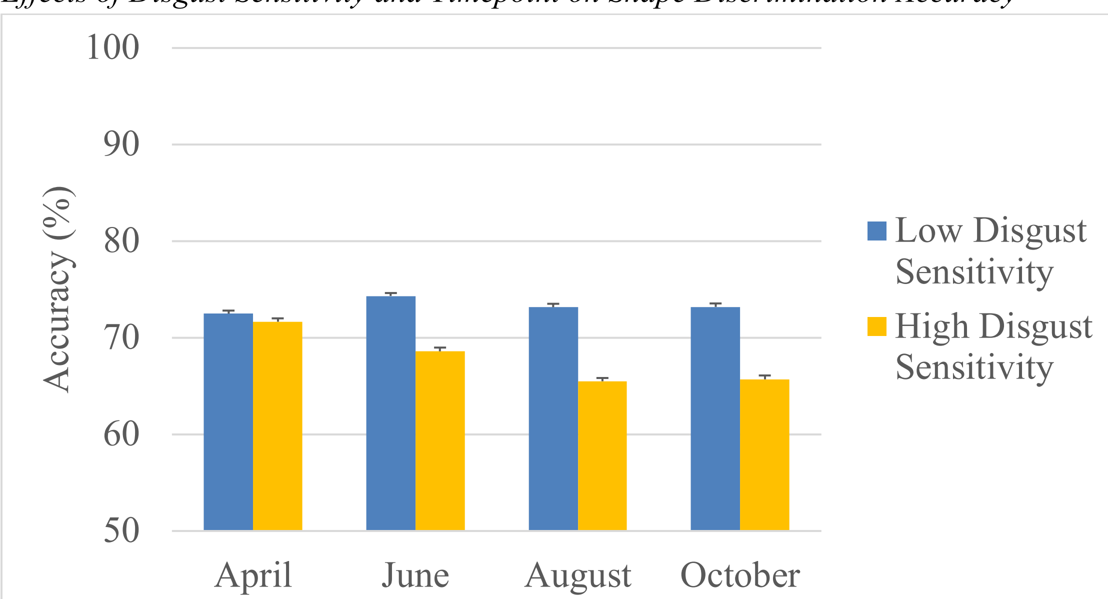
*Shape Discrimination Accuracy by Disgust Sensitivity and Timepoint*

| | Disgust Sensitivity | Overall Accuracy n | *M* | *SD* | *F*(3, 1372) | $\eta_p^2$ |
|---|---|---|---|---|---|---|
| April | Low | 205 | 21.75 | 4.54 | 3.58* | .008 |
| | High | 163 | 21.50 | 4.45 | | |
| | Total | 368 | 21.64 | 4.49 | | |
| June | Low | 185 | 22.35 | 4.09 | | |
| | High | 146 | 20.58 | 4.69 | | |
| | Total | 331 | 21.57 | 4.45 | | |
| August | Low | 145 | 21.87 | 4.62 | | |
| | High | 191 | 19.65 | 4.84 | | |
| | Total | 336 | 20.61 | 4.87 | | |
| October | Low | 156 | 21.96 | 4.47 | | |
| | High | 189 | 19.71 | 5.53 | | |
| | Total | 345 | 20.72 | 5.19 | | |
| Total | Low | 691 | 21.98 | 4.42 | | |
| | High | 689 | 20.30 | 4.97 | | |
| | Total | 1380 | 21.14 | 4.78 | | |

$^{*}p < .05$

**Figure 10**

*Effects of Disgust Sensitivity and Timepoint on Shape Discrimination Accuracy*




*Note.* Individuals in the LDS group were more accurate than the HDS group in June, August, and October. Within the HDS group, participants in April outperformed those in August and October. Performance within the LDS group did not differ across timepoints. Accuracy is displayed as percentage of correct responses.

### *Reaction Time*

A two-way ANOVA indicated no significant differences between timepoint ($p$ = .373) or disgust sensitivity groups ($p$ = .833) on shape discrimination RT. There was also no significant interaction between these variables ($p$ = .094; Table 22).

**Table 22**

*Shape Discrimination RT by Disgust Sensitivity and Timepoint*

| | | Reaction Time (s) | | |
|---|---|---|---|---|
| | Disgust Sensitivity | n | *M* | *SD* |
| April | Low | 205 | 2.58 | .838 |
| | High | 162 | 2.59 | .869 |
| | Total | 367 | 2.58 | .851 |
| June | Low | 185 | 2.79 | .873 |
| | High | 146 | 2.69 | .907 |
| | Total | 331 | 2.75 | .888 |
| August | Low | 145 | 2.47 | 1.31 |
| | High | 191 | 2.74 | 1.19 |
| | Total | 336 | 2.62 | 1.25 |
| October | Low | 156 | 2.53 | 1.27 |
| | High | 189 | 2.42 | 1.40 |
| | Total | 345 | 2.47 | 1.34 |
| Total | Low | 691 | 2.60 | 1.07 |
| | High | 688 | 2.61 | 1.14 |
| | Total | 1379 | 2.60 | 1.10 |

### *Supplementary Analysis: Exposure to COVID-19*

$\chi^2$ tests of independence were run to compare the number of participants with confirmed and suspected COVID-19 in HDS and LDS groups. A greater number of participants in the HDS group reported confirmed or suspected COVID-19 than in the LDS group (Tables 23 and 24).

**Table 23**

*Number of Participants in Experiment 2 that Tested Positive for COVID-19*

| Disgust | Tested positive for COVID-19 (n) | | | | |
|---|---|---|---|---|---|
| Sensitivity | No | Yes | $\chi^2$ | *df* | *p* |
| Low | 683 | 26 | 17.84 | 1 | <.001 |
| High | 633 | 64 | | | |
| Total | 1316 | 90 | | | |

**Table 24**

*Number of Participants in Experiment 2 Suspected of having COVID-19*

| Disgust Sensitivity | Tested positive for COVID-19 (n) No | Yes | $\chi^2$ | *df* | *p* |
|---|---|---|---|---|---|
| Low | 613 | 76 | 35.31 | 1 | <.001 |
| High | 535 | 156 | | | |
| Total | 1166 | 232 | | | |

## Discussion

To investigate the impact of disgust sensitivity and pandemic length on the visual discrimination of disease-irrelevant stimuli, accuracy and RT on a shape discrimination task were analyzed. Similar to the face discrimination task, accuracy of shape discrimination did not differ between disgusts sensitivity groups in April. This level of accuracy was maintained across timepoints in the LDS group, but participants with HDS were less accurate in August and October than in April. Participants in the HDS group were also more likely to test positive for COVID-19 or experience COVID-19 symptoms than the LDS group. No differences in reaction time were observed across disgust sensitivity groups or timepoints.

# Chapter 5

## Experiment 3. Political Affiliation on Visual Discrimination

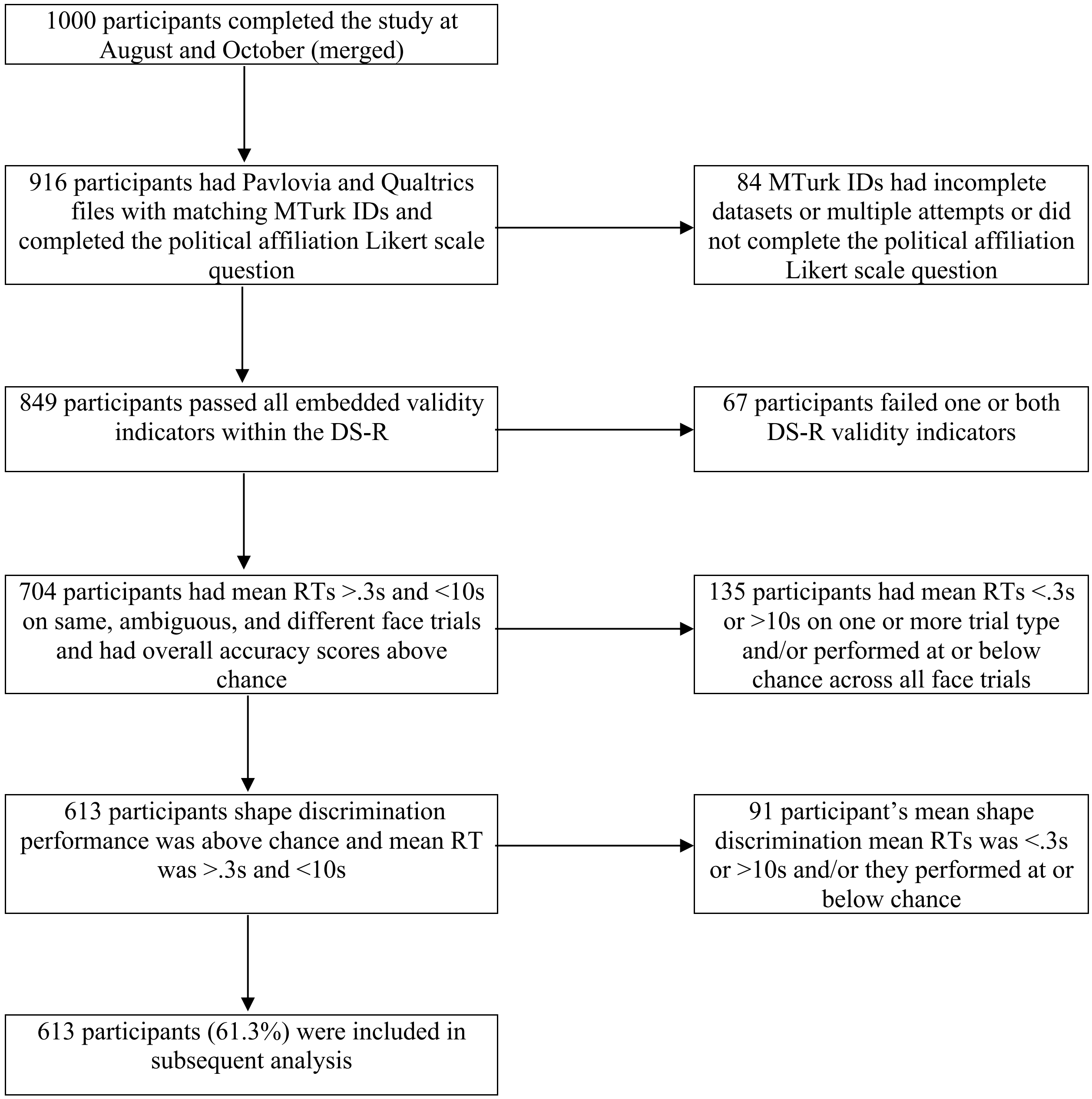
### Results

#### *Data Cleaning*

Please refer to Figure 11 for a visual depiction of the stepwise exclusion process for Experiment 3. Data from August and October timepoints were merged in Experiment 3 to increase the total n. Participants were excluded from the experiment if they had incomplete or multiple data (n = 65), did not complete the Likert scale question regarding political affiliation (n = 19), failed one or both DS-R validity indicators (n = 67), had reaction times outside of the inclusion window on one or more face trial subtypes (n=99), performed at or below chance across all face discrimination trials (n=46), performed at or below chance across all shape discrimination trials (n = 83), or had mean reaction times outside of the inclusion window on the shape discrimination task (n = 8). A total of 613 participants were included in statistical analysis for Experiment 3.

**Figure 11**

*Stepwise Application of Exclusion Criteria in Experiment 3*



***Political Grouping***

Participants were grouped according to their self-reported political affiliation on a 7-point Likert scale. In total, 135 participants identified as liberal (rated 1 or 2; 22.0%), 267 were moderate (rated 3, 4, or 5; 43.6%), and 211 were conservative (rated 6 or 7; 34.4%). $\chi^2$ test of independence identified no significant proportion differences between the location of participants across political groups (Table 25). A total of 2 Canadian participants (1 moderate, 1 conservative) and 5 participants with unknown locations (3 moderate, 2 conservative) were removed so that the final analyses only included participants within the United States.

**Table 25**

*Location of Participants in Experiment 3*

| | n | | | | |
|---|---|---|---|---|---|
| | United States | Canada | $\chi^2$ | *df* | *p* |
| Liberal | 135 | 0 | .608 | 2 | .738 |
| Moderate | 263 | 1 | | | |
| Conservative | 208 | 1 | | | |
| Total | 606 | 2 | | | |

***Demographics.***

Demographic differences and secondary variables across political groups were explored using one-way ANOVAs (i.e., age, disgust sensitivity). Overall, the conservative group was significantly older and had higher DS-R total scores than the moderate and liberal groups (Table 26 and 27). [1]

[1] Analyses of covariance were conducted for Experiment 3 that included the independent variable of political affiliation, covariates of disgust sensitivity and age, and dependent variables of accuracy and reaction time for each visual discrimination trial type. The interested reader can find the results of these analyses in Appendix E.

**Table 26**

*Age of Participants in Experiment 3*

| | Age | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(2, 602) | $\eta_p^2$ |
| Liberal | 135 | 36.4 | 11.12 | 4.25* | .014 |
| Moderate | 263 | 37.0 | 10.50 | | |
| Conservative | 207 | 39.6 | 12.21 | | |
| Total | 605 | 37.7 | 11.31 | | |

*$p$ =.015

**Table 27**

*Disgust Sensitivity of Participants in Experiment 3*

| | DS-R Total Score | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(2, 601) | $\eta_p^2$ |
| Liberal | 135 | 54.56 | 16.89 | 24.42** | .075 |
| Moderate | 263 | 57.13 | 13.89 | | |
| Conservative | 206 | 64.64 | 13.21 | | |
| Total | 604 | 59.11 | 14.94 | | |

**$p < .001$

$\chi^2$ tests of independence were planned to explore group differences in gender, ethnicity, income, and employment (pre-pandemic and current). Due to low cell counts, analyses could not be completed for gender, ethnicity, pre-pandemic employment, or current employment. Descriptive information for these variables can be found in Table 28 to 30. Cell counts were sufficient to compare the income across political groups and the proportion of participants within each income bracket did not significantly differ ($p$ = .20; Table 31).

**Table 28**

*Gender of Participants in Experiment 3*

| | n | | |
|---|---|---|---|
| | Man | Woman | Non-binary |
| Liberal | 78 | 54 | 3 |
| Moderate | 151 | 112 | 0 |
| Conservative | 116 | 92 | 0 |
| Total | 345 | 258 | 3 |

*Note.* Non-binary and other cultural identity responses were collapsed into single measure due to low n.

**Table 29**

*Ethnicity of Participants in Experiment 3*

| | n | | | |
|---|---|---|---|---|
| | Total | Liberal | Moderate | Conservative |
| African American | 62 | 15 | 17 | 30 |
| Asian American | 34 | 6 | 22 | 6 |
| Latino/a | 40 | 10 | 18 | 12 |
| American Indian | 12 | 2 | 6 | 4 |
| European Origin | 443 | 98 | 192 | 153 |
| Middle Eastern | 1 | 0 | 1 | 0 |
| Bi-racial | 8 | 4 | 4 | 0 |
| Other | 4 | 0 | 1 | 3 |

**Table 30**

*Current and Historical (Jan 2020) Employment of Participants in Experiment 3*

| | n | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Status at Time of Data Collection | | | | Status in January 2020 | | | |
| Employment | Total | Liberal | Moderate | Conservative | Total | Liberal | Moderate | Conservative |
| Employed | 579 | 118 | 255 | 206 | 580 | 117 | 256 | 207 |
| Caregiver/ Homemaker | 8 | 3 | 4 | 1 | 8 | 3 | 3 | 2 |
| Student | 7 | 3 | 3 | 1 | 6 | 3 | 3 | 0 |
| Other | 33 | 13 | 14 | 6 | 33 | 15 | 13 | 5 |

*Note.* Full and part time employment were merged into the 'employed' category, full time and part time students were merged into the 'student' category, and not employed for pay and other were merged into the 'other' category.

**Table 31**

*Income of Participants in Experiment 3*

| | n | | | | | | |
|---|---|---|---|---|---|---|---|
| Income | Total | Liberal | Moderate | Conservative | $\chi^2$ | *df* | *p* |
| $0 to $24,999 | 134 | 34 | 62 | 38 | 13.38 | 10 | .203 |
| $25,000 to $49,999 | 178 | 45 | 82 | 51 | | | |
| $50,000 to $74,999 | 184 | 38 | 77 | 69 | | | |
| $75,000 to $99,999 | 81 | 11 | 32 | 38 | | | |
| $100,000 or greater | 46 | 8 | 22 | 16 | | | |
| Prefer not to answer | 4 | 1 | 2 | 1 | | | |

### *Face Discrimination Task Performance*

***All Trials.*** A one-way ANOVA indicated that accuracy on the face discrimination task differed significantly between each political group ($p < .001$; Table 32). The liberal group was more accurate than the moderate group, who was more accurate than the conservative group (Figure 12). The effect of political group on overall face discrimination RT was not significant ($p = 0.51$; Table 33).

**Table 32**

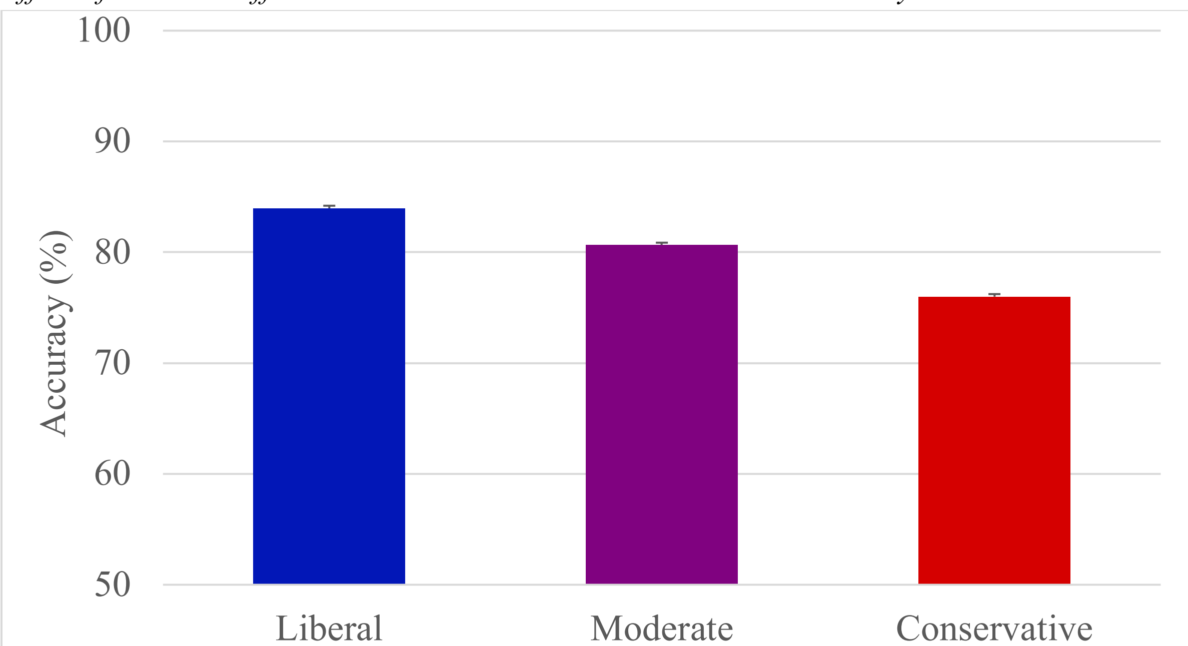
*Overall Face Discrimination Accuracy by Political Affiliation*

| | Overall Accuracy | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | $F(2, 603)$ | $\eta_p^2$ |
| Liberal | 135 | 25.19 | 2.77 | $23.84^{***}$ | .073 |
| Moderate | 263 | 24.15 | 3.34 | | |
| Conservative | 208 | 22.79 | 3.35 | | |
| Total | 606 | 23.91 | 3.35 | | |

$^{*}p < .001$

**Figure 12**

*Effect of Political Affiliation on Overall Face Discrimination Accuracy*




*Note.* Participants in the liberal group were more accurate than the moderate and conservative groups. The moderate group was more accurate than the conservative group. Accuracy is displayed as percentage of correct responses.

**Table 33**

*Overall Face Discrimination RT by Political Affiliation*

| | | RT (s) | |
|---|---|---|---|
| | n | *M* | *SD* |
| Liberal | 134 | 2.29 | .90 |
| Moderate | 262 | 2.46 | 1.03 |
| Conservative | 205 | 2.26 | .94 |
| Total | 601 | 2.35 | .98 |

***Identical Face Trials.*** Means and standard deviations are reported in Table 34 and Table 35. A one-way ANOVA investigating the effects of political group on identical face trial accuracy was non-significant ($p = .354$). In comparison, a one-way ANOVA investigating the effects of political group on RT of correct identical face trials was significant ($p < .001$; Figure 13). The conservative participants completed identical face trials quicker than liberal and moderate participants.

**Table 34**

*Identical Face Trial Accuracy by Political Affiliation*

| | Identical Trial Accuracy | | |
|---|---|---|---|
| | n | *M* | *SD* |
| Liberal | 135 | 8.57 | 1.32 |
| Moderate | 263 | 8.77 | 1.46 |
| Conservative | 208 | 8.79 | 1.63 |
| Total | 606 | 8.73 | 1.49 |

**Table 35**

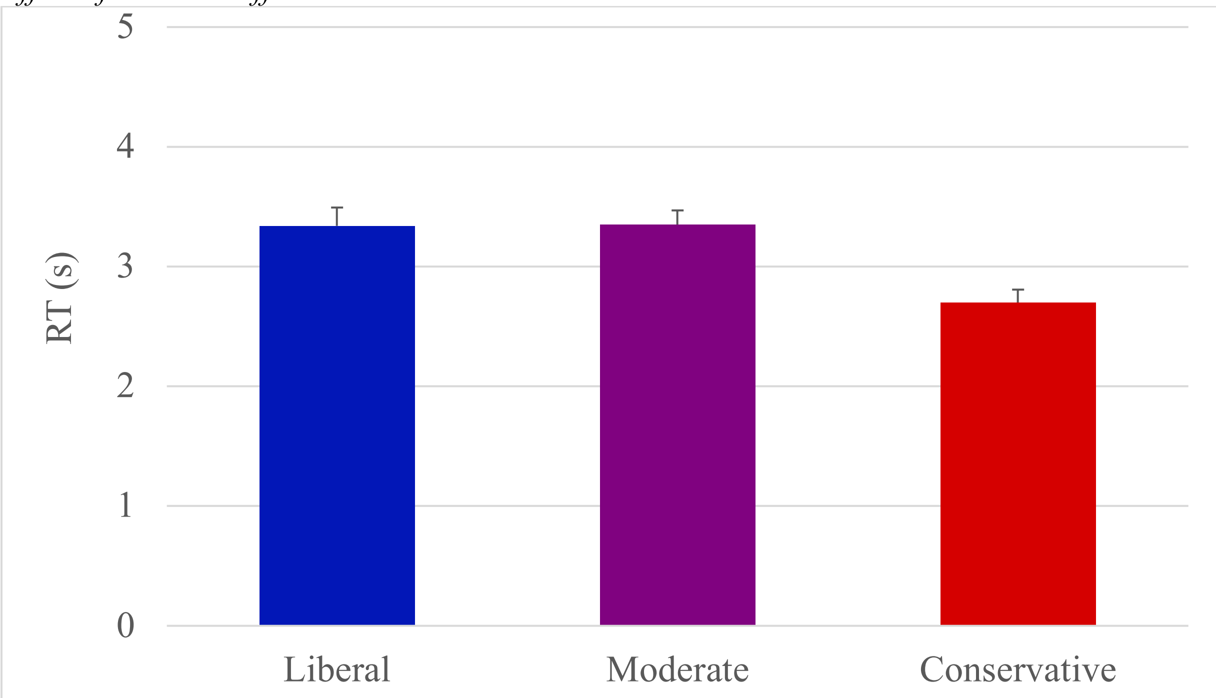
*Identical Face Trial RT by Political Affiliation*

| | | RT (s) | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | $F(2, 602)$ | $\eta_p^2$ |
| Liberal | 134 | 3.34 | 1.77 | *9.07*** | *.029* |
| Moderate | 263 | 3.35 | 1.93 | | |
| Conservative | 208 | 2.70 | 1.55 | | |
| Total | 605 | 3.12 | 1.79 | | |

$^{**}p < .001$

**Figure 13**

*Effect of Political Affiliation on Identical Face Discrimination RT*




*Note:* Conservative participants completed identical face trials faster than liberal or moderate participants.

***Ambiguous Trials.*** A one-way ANOVA indicated a significant effect of political affiliation on ambiguous face trial accuracy (Table 36). All groups differed significantly, with the liberal group being the most accurate and the conservative group being the least accurate (Figure 14). In comparison, there was no significant effect of political group on ambiguous face trial RT ($p$ = .054; Table 37).

**Table 36**

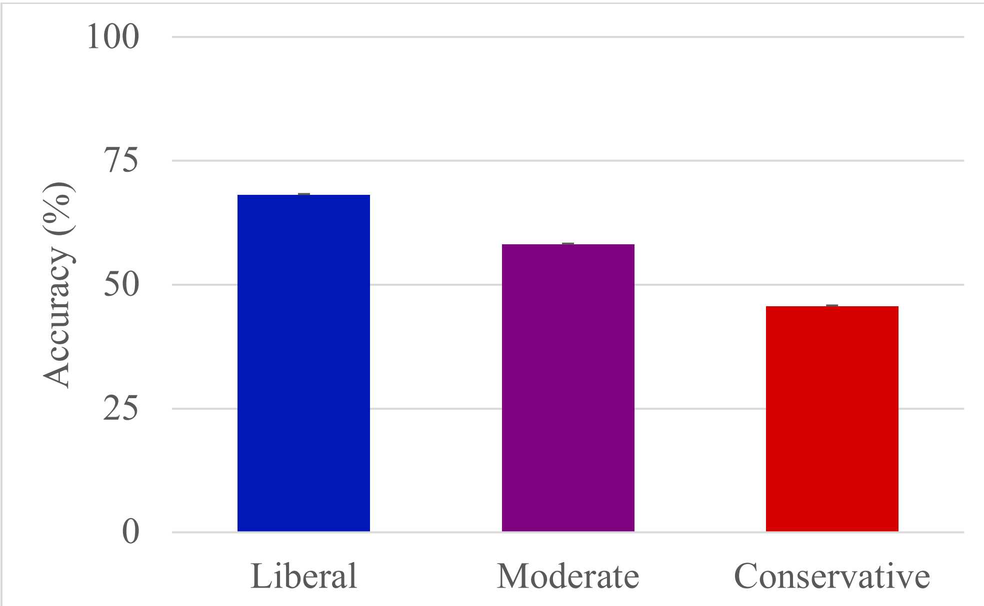
*Ambiguous Face Trial Accuracy by Political Affiliation*

| | Ambiguous Trial Accuracy | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | $F(2, 626)$ | $\eta_p^2$ |
| Liberal | 135 | 6.82 | 2.12 | 28.31** | .086 |
| Moderate | 263 | 5.75 | 2.87 | | |
| Conservative | 208 | 4.61 | 2.80 | | |
| Total | 606 | 5.60 | 2.81 | | |

**$p$ <.001

**Figure 14**

*Effect of Political Affiliation on Ambiguous Face Trial Accuracy*




*Note.* Participants in the liberal group were more accurate than the moderate and conservative groups. The moderate group was more accurate than the conservative group. Accuracy is displayed as percentage of correct responses.

**Table 37**

*Ambiguous Face Trial Reaction Time by Political Affiliation*

| | | Reaction Time (s) | |
|---|---|---|---|
| | n | *M* | *SD* |
| Liberal | 134 | 2.44 | .99 |
| Moderate | 262 | 2.68 | 1.39 |
| Conservative | 205 | 2.48 | 1.50 |
| Total | 601 | 2.56 | 1.35 |

***Different Trials.*** One-way ANOVAs indicated significant effects of political affiliation on different face trial accuracy (Table 38) and RT (Table 39). The conservative group was significantly less accurate than the liberal and moderate groups on different face trials ($p < .001$; Figure 15). The mean RTs of all three groups significantly differed from each other; the conservative group was also slower than the liberal and moderate groups when completing different face trials, and the moderate group was slower than the liberal group (Figure 16).

**Table 38**

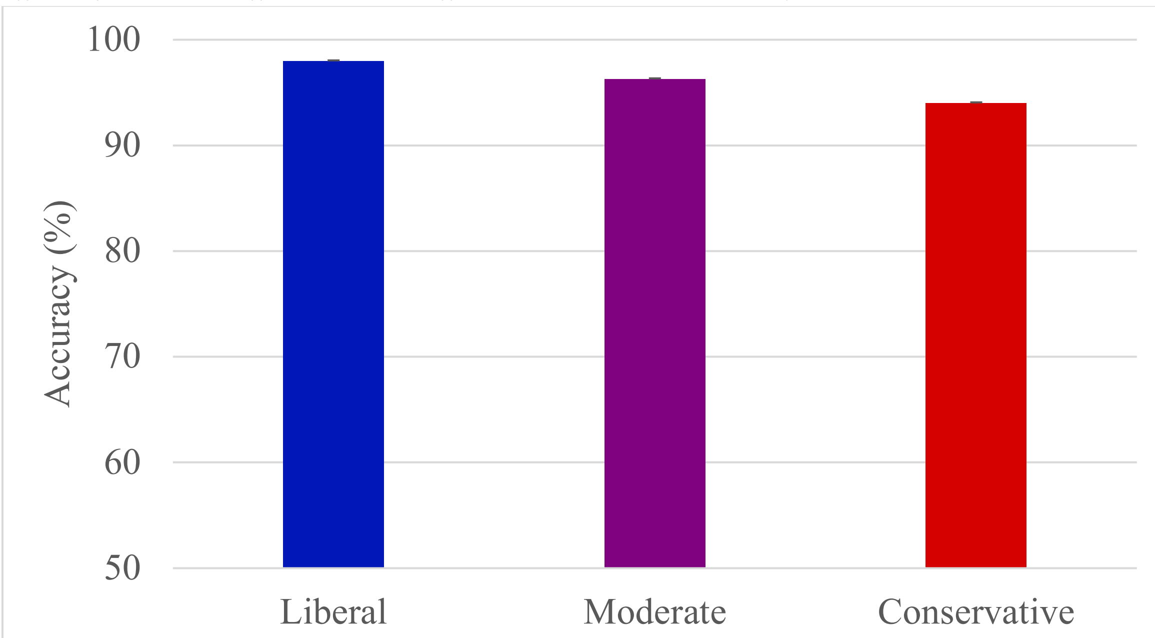
*Different Face Trial Accuracy by Political Affiliation*

| | Different Trial Accuracy | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(2, 603) | $\eta_p^2$ |
| Liberal | 135 | 9.79 | .548 | 8.89** | .029 |
| Moderate | 263 | 9.63 | .814 | | |
| Conservative | 208 | 9.39 | 1.14 | | |
| Total | 606 | 9.58 | .907 | | |

**$p < .001$

**Figure 15**

*Effect of Political Affiliation on Different Face Trial Accuracy*




*Note.* The liberal and moderate groups were more accurate than the conservative group. Accuracy is displayed as percentage of correct responses.

**Table 39**

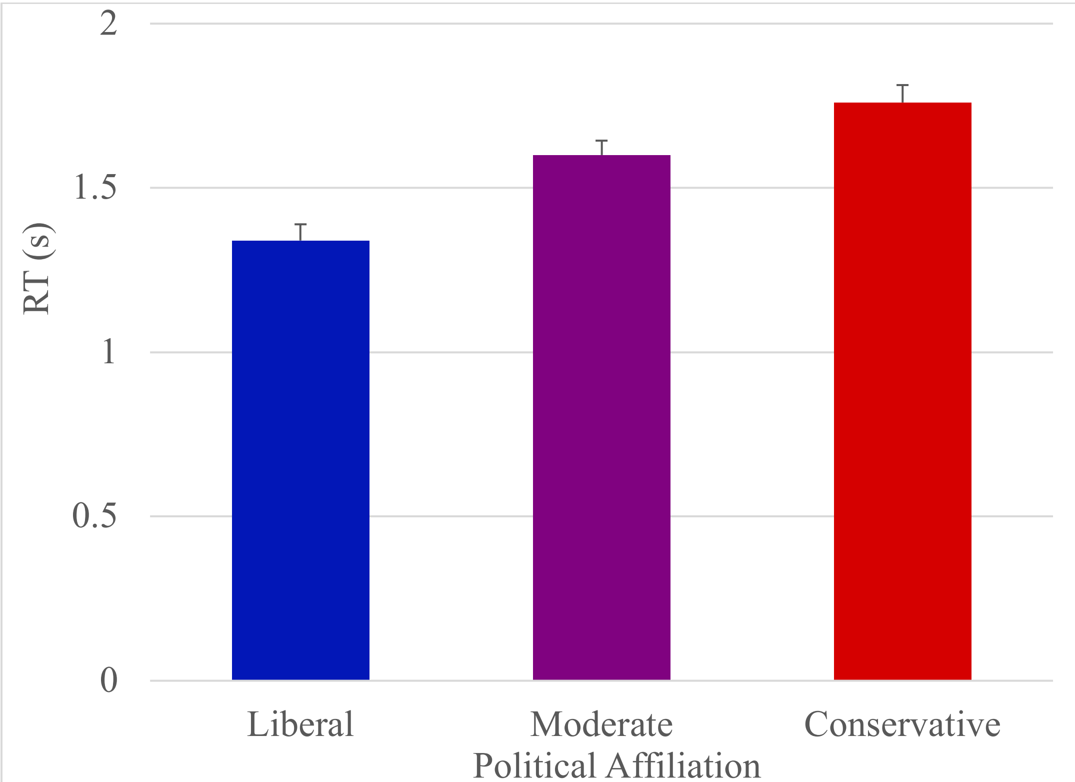
*Different Face Trial RT by Political Affiliation*

| | | RT (s) | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(2, 602) | $\eta_p^2$ |
| Liberal | 134 | 1.34 | .57 | *14.36*** | *.046* |
| Moderate | 262 | 1.60 | .71 | | |
| Conservative | 205 | 1.76 | .76 | | |
| Total | 601 | 1.60 | .71 | | |

**$p < .001$

**Figure 16**

*Effect of Political Affiliation on Different Face Trial RT*




*Note.* The liberal group accurately discriminated different faces faster than the moderate and conservative groups. The moderate group was also faster than the conservative group on these trials.

***Shape Discrimination Task Performance***

A one-way ANOVA indicated significant effects of political affiliation on shape discrimination accuracy (Table 40) and RT (Table 41). All groups significantly differed from each other, with the liberal group being most accurate and the conservative group being least accurate ($p < .001$; Figure 17). The liberal group was significantly faster than the moderate and conservative groups on the shape discrimination task ($p = .015$; Figure 18).

**Table 40**

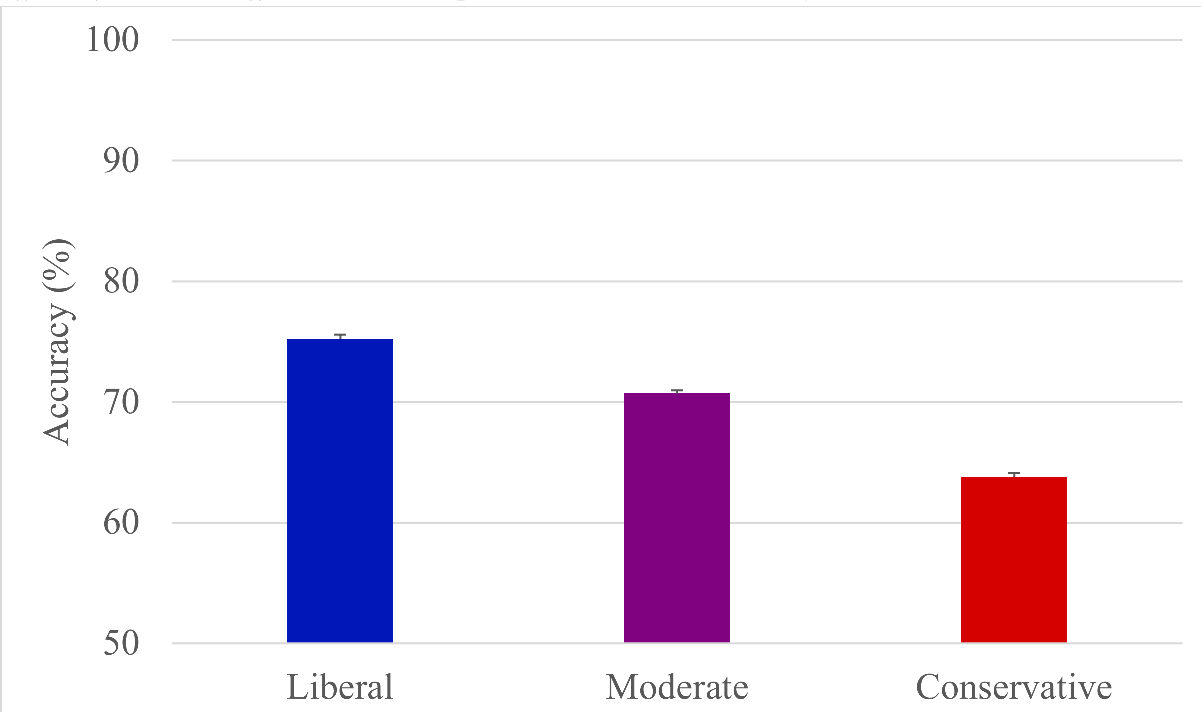
*Shape Discrimination Accuracy by Political Affiliation*

| | Overall Accuracy | | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(2, 603) | $\eta_p^2$ |
| Liberal | 135 | 22.56 | 4.20 | 23.40** | .072 |
| Moderate | 263 | 21.13 | 4.47 | | |
| Conservative | 208 | 19.13 | 5.20 | | |
| Total | 606 | 20.76 | 4.85 | | |

** $p < .001$

**Figure 17**

*Effect of Political Affiliation on Shape Discrimination Accuracy*




*Note.* The liberal was more accurate than the moderate and conservative groups. The moderate group was more accurate than the conservative group. Accuracy is displayed as percentage of correct responses.

**Table 41**

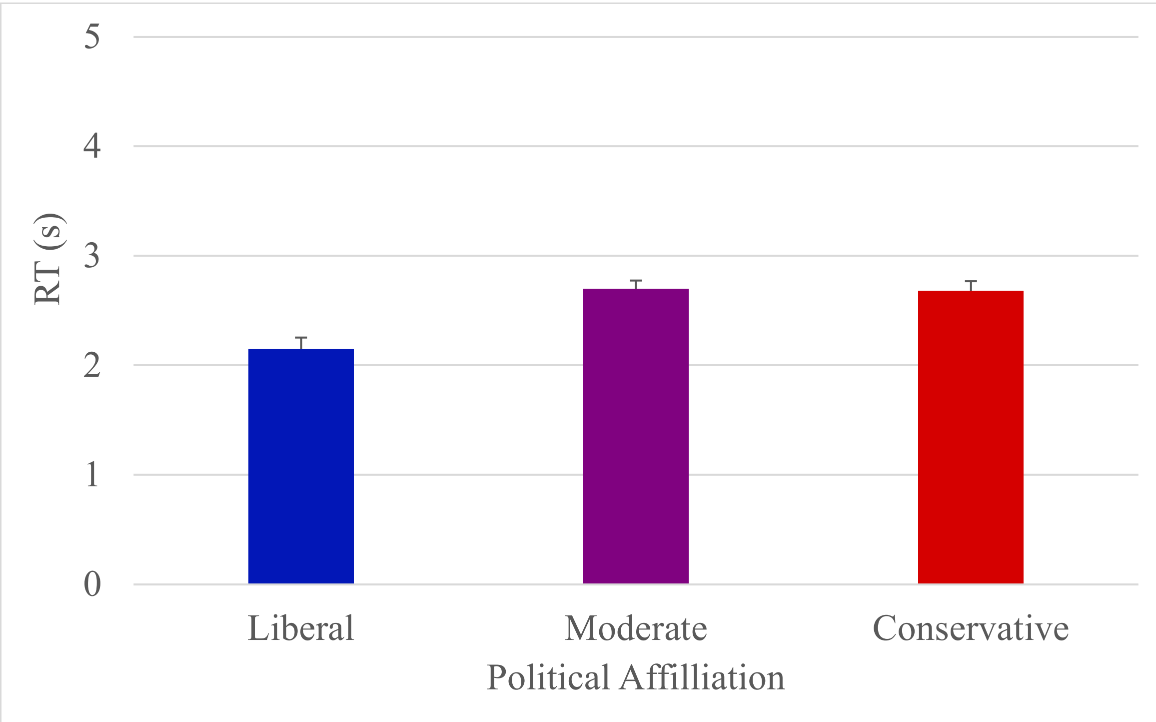
*Shape Discrimination RT by Political Affiliation*

| | | RT (s) | | | |
|---|---|---|---|---|---|
| | n | *M* | *SD* | *F*(2, 603) | $\eta_p^2$ |
| Liberal | 135 | 2.15 | 1.22 | 9.99** | .032 |
| Moderate | 263 | 2.70 | 1.23 | | |
| Conservative | 208 | 2.68 | 1.29 | | |
| Total | 606 | 2.57 | 1.27 | | |

** $p < .001$

**Figure 18**

*Effect of Political Affiliation on Shape Discrimination RT*




*Note.* The liberal group was faster than the moderate and conservative groups. Reaction times are displayed as raw mean scores.

***Relationship Between Disgust Sensitivity and Political Affiliation***

Shapiro-Wilk testing indicated that the data were not normally distributed ($p < .001$). As such, a spearman correlation coefficient was completed to assess the correlations between DS-R total score and political affiliation rating. Scores on the DS-R were considered outliers if the total score was +/- 2SD (*SD* = 15.0) from the mean (*M* = 58.99) and were removed in a pairwise fashion. Higher self-reported political conservatism was significantly associated with greater DS-R total scores (Table 42).

**Table 42**

*Descriptive Statistics and Correlations for Study Variables*

| | *n* | *M* | *SD* | 1 |
|---|---|---|---|---|
| 1. DS Total Score | 579 | 60.00 | 13.10 | - |
| 2. Political Affiliation | 606 | 4.40 | 1.88 | .247** |

** *p < .001*

***Supplementary Analysis: Exposure to COVID-19***

COVID-19 diagnoses, symptoms, and exposures were compared across political groups using a $\chi^2$ tests of independence. The conservative group had a greater proportion of participants that tested positive for COVID-19 or experienced symptoms associated with COVID-19 than the other groups. In comparison, the liberal group had a smaller portion of COVID-19 confirmed or suspected cases compared to the other groups (Tables 43 and 44).

**Table 43**

*Number of Participants in Experiment 3 that Tested Positive for COVID-19*

| | Tested positive for COVID-19 (n) | | | | |
|---|---|---|---|---|---|
| | No | Yes | $\chi^2$ | *df* | *p* |
| Liberal | 134 | 3 | 11.97 | 2 | .003 |
| Moderate | 250 | 26 | | | |
| Conservative | 187 | 28 | | | |
| Total | 571 | 57 | | | |

**Table 44**

*Number of Participants in Experiment 3 Suspected of having COVID-19*

| | Tested positive for COVID-19 (n) | | | | |
|---|---|---|---|---|---|
| | No | Yes | $\chi^2$ | *df* | *p* |
| Liberal | 119 | 18 | 18.42 | 2 | <.001 |
| Moderate | 221 | 53 | | | |
| Conservative | 146 | 67 | | | |
| Total | 486 | 138 | | | |

## Discussion

The relationship between political values and visual discrimination was investigated on the face and shape discrimination tasks. Overall, liberals were more accurate than moderates and conservatives on both discrimination tasks. Further, moderates were more accurate on both tasks than conservatives. When investigating accuracy on each face trial type, the political groups performed similarly on identical face trials but differed on ambiguous and different face trials. Liberal participants more accurately identified ambiguous faces than moderate participants, who were more accurate than conservative participants. Liberal and moderate participants were also more accurate than conservative participants on different face trials.

RTs did not significantly differ between political groups when looking across all face trials, but liberals were quicker than moderates and conservatives on the shape discrimination task. When breaking down face trials by trial type, no RT differences were observed on ambiguous face trial. However, the conservative group was significantly faster than liberals and moderates at identifying identical faces and significantly slower to respond to different face trials. Liberals performed similarly to moderates on identical faces but were faster than moderates to complete different face trials.

Overall, participants who identified as liberal demonstrated greater visual vigilance than participants who identified as conservative. These findings correspond with COVID-19 questionnaire data that indicated a greater proportion of conservative participants tested positive for (or were suspected to have) COVID-19. Participants with politically conservative values also reported higher levels of disgust sensitivity.

# Chapter 6

## General Discussion

Cognitive abilities are heightened following acute exposure to pathogen-relevant information, but little is known about how long-term exposure effects cognitive functioning (Chan et al., 2019; Chapman et al., 2013; Charash & McKay, 2002; Miller & Maner, 2012). The primary objective of the present study was to explore how cognition, specifically visual discrimination skills, are impacted by chronic BIS activation. Experiments 1 and 2 demonstrated that visual discrimination performance was less accurate at later timepoints in the pandemic, compared to earlier timepoints, and the pattern of performance varied by participants' disgust sensitivity. Disgust sensitivity minimally impacted task performance in the earlier stages of the COVID-19 pandemic (i.e., April 2020). However, as COVID-19 continued to exert its influence on daily life, differences between disgust sensitivity groups arose; individuals with LDS outperformed those with HDS three months into the pandemic and this pattern persisted across all remaining timepoints.

The analysis of face discrimination trial types indicated that the differences between disgust sensitivity groups were driven by performance on ambiguous face trials. Of the three trial types (i.e., identical, ambiguous, and different), ambiguous face trials were the most challenging as they required participants to carefully scan two faces and recognize a subtle difference between them. Participants with LDS were consistently more accurate than those with HDS on ambiguous face trials from June to October 2020. For participants in the HDS group, lower ambiguous face trial accuracy at later timepoints corresponded with quicker correct responses to identical face trials. In other words, HDS participants who quickly scanned and accurately identified faces as identical were less likely to notice subtle differences in highly similar faces.

This suggests that HDS participants were less sensitive than LDS participants to visual differences between stimuli at later timepoints. Despite a relatively small accuracy drop in ambiguous face trials, identical face trial RT of LDS participants remained consistent across timepoints. This may indicate that participants with LDS continued to carefully scan faces for differences but were slightly less successful at identifying them at later points in the pandemic. Interestingly, disgust sensitivity and timepoint did not influence different face trial accuracy but participants were quickest at correctly completing these trials in April and slowest in August. Taken together, Experiments 1 and 2 indicated that vigilance to visual differences was greatest at earlier timepoints in the pandemic (i.e., greater accuracy on ambiguous face trials, overall face trials, and shape trials; slower correct responses on identical face trials; quicker correct responses on different face trials) and declined with prolonged BIS activation. This shift was more evident in individuals with HDS than those with LDS.

Hypothesis 1 predicted that participants with HDS would outperform those with LDS on visual discrimination tasks. This hypothesis was developed at the outset of the pandemic and based upon acute BIS activation literature that indicated high pathogen avoidance motivation is associated with greater sensitivity and responsiveness to pathogen-relevant stimuli (e.g., enhanced perception, attention biases, stronger affective responses, and increased likelihood of behavioural avoidance; Kusche & Barker, 2019; Sawada et al., 2018; Schaller & Park, 2011). However, the HDS group was never more accurate than the LDS group on either visual discrimination task, indicating that the generalizability of acute BIS activation findings to chronic situations may be limited.

It was also hypothesized that participants at earlier timepoints would outperform those at later timepoints (*H2*). Support for hypothesis 2 came from previous studies that reported time-related decreases in sensitivity to fear evoking stimuli, vigilance during monotonous tasks, and prevention behaviours during health crises (i.e., H1N1; Al-Shargie et al., 2019; Atchley & Chan, 2011; Ibuka et al., 2010; Tyron, 2005). Support for this hypothesis was mixed in the present study as the variation in accuracy across timepoints was minimal for the LDS group, but the HDS group was more accurate at earlier timepoints compared to later ones. Distinctions between LDS and HDS groups emerged within the first three months of the pandemic, indicating that the differential effects of chronic BIS activation between these groups occur within a relatively short period of time.

Experiment 3 investigated whether political values impact visual discrimination performance during the COVID-19 pandemic. Demographic differences in attitudes toward COVID-19 were observed early in the pandemic and political affiliation was a particularly strong predictor of pandemic-related behaviours (de Bruin et al., 2020). Specifically, individuals with liberal values were more likely to engage in disease prevention behaviours than conservative individuals (de Bruin et al., 2020; Kerr et al., 2021; Rabin & Dutra, 2021). Hypothesis 3 anticipated that cognitive performance would mirror behavioural findings and liberal participants would outperform conservatives on visual discrimination tasks. Results from Experiment 3 support this hypothesis; liberals were more accurate than conservatives on both visual discrimination tasks and performance of participants who rated themselves as moderate fell in between these two groups. Subsequent analysis of face trial subtypes indicated that liberals were better able to spot differences between faces compared to their conservative counterparts (i.e., greater accuracy on ambiguous and different face trials). Similar to the trade-off observed in Experiment 1, conservatives were quicker to identify identical face trials while being less accurate on ambiguous face trials. Additional evidence that conservatives were less sensitive to subtle visual differences between stimuli is supported by findings that liberals were faster than conservatives at completing different face trials and shape trials. Ultimately, the results from Experiment 3 parallel behavioural studies that demonstrated conservatives were less invested in protective behaviours during the pandemic and implies that the same mechanism may underlie the cognitive and behavioural differences in political groups that follow chronic BIS activation (de Bruin et al., 2020; Kerr et al., 2021; Rabin & Dutra, 2021).

**Impact of Chronic BIS on Visual Discrimination**

Previous research has demonstrated that individuals rely on sensory cues to identify pathogen risk (Iwasa et al., 2020; Regenbogen et al., 2017). Acute BIS activation enhances the detection of perceptual stimuli and there is subjective evidence that these perceptual changes extend to pathogen-irrelevant information as well (Chan et al., 2019; Hunt et al., 2017; Nussinson et al., 2018). In order to better understand the nuances of vigilance changes during a pandemic, visual discrimination task stimuli in Experiments 1 and 2 varied by the extent that they are associated with pathogen-relevant information. Results indicated that the overall pattern of performance was consistent between face and shape discrimination tasks, suggesting vigilance changes during the pandemic generalized across visual stimuli. Based on the present findings, it appears that cognitive changes following chronic BIS activation are not limited to pathogen-relevant information but impact visual perception as a whole. This supports the idea that individuals are unconsciously scanning their environment for disease-relevant information in a way that is broad and nonspecific (Murray et al., 2019).

Pathogen avoidance motivation has been identified as a protective factor against disease because it is associated with increased pathogen avoidance behaviours (Tybur et al., 2014). For example, individuals with greater disgust sensitivity self-report more aversive sensations in the presence of pathogen cues and, to reduce the discomfort of these sensations, they are motivated to avoid these pathogen-relevant stimuli (van Overveld et al., 2006). Therefore, it was surprising that individuals with LDS displayed greater visual vigilance than those with HDS in June, August, and October 2020. The current findings provide evidence that the BIS is a dynamic system that changes over time and certain groups may be more vulnerable to these changes than others.

Individuals with greater pathogen avoidance motivations are more avoidant of pathogen-relevant stimuli in acute BIS settings and much of the research conducted during the COVID-19 pandemic indicated that they were also more likely to engage in COVID-19 preventative behaviours (Ammann & Casagrande, 2021; Cox et al., 2020; Schaller & Park, 2011). Therefore, it at first appears that the results from Experiments 1 and 2 directly conflicted with behavioural COVID-19 literature. However, an in-depth review of studies investigating the relationship between disgust sensitivity and preventative behaviours suggested that these findings may not be contradictory to the current results. Instead, a holistic review of these studies supports the hypothesis that BIS responding changes over time. Eight studies identified a positive correlation between disgust and COVID-19 preventative behaviours including social distancing and handwashing (Ammann & Casagrande, 2021; Cox et al., 2020; Diaz & Cova, 2022; Gul et al., 2022; Olivera-La Rosa et al., 2020; Samore et al., 2021; Shook et al., 2020; Waqas et al., 2020). Of these studies, six were conducted between March and May 2020 and the two remaining studies collected data over multiple months prior to July 2020. In Experiments 1 and 2, visual discrimination performance was similar between disgust sensitivity groups in April 2020, which was the time that the majority of the aforementioned studies were conducted. However, by June 2020, the LDS group displayed consistently better visual discrimination accuracy than the HDS group in the current experiments. Interestingly, behavioural studies that were conducted in the latter months of 2020 observed that participants with LDS engaged in more preventative behaviours than those with HDS. Between September 2020 and February 2021, greater levels of disgust were associated with reduced willingness to engage in preventative behaviours (Russell et al., 2023). Additionally, individuals who reported greater disgust sensitivity in May and June 2020 were more likely to contract COVID-19 over the proceeding 4 months than those with lower disgust sensitivity (Moore et al., 2021). Supplementary analysis in the current study also indicated that HDS participants were also more likely to contract COVID-19 than LDS participants. When considering the impact of time, behavioural COVID-19 literature aligns with the current findings and suggests that disgust sensitivity may be a detriment to vigilance following chronic BIS activation.

It might be expected that visual discrimination performance would fluctuate with COVID-19 threat. When the number of cases increases in an area, so does the likelihood of contracting the virus and the BIS may be more activated during these times due to greater pathogen risk. Therefore, it is worth highlighting that visual discrimination task performance *did not* correspond with actual COVID-19 threat. Table 45 includes the number of new COVID-19 cases in the United States at each timepoint, which reflects the virus spread within the community. Based on case count, the risk of contracting COVID-19 was greatest in August and October 2020. If visual vigilance directly corresponded with pathogen risk, it would be expected that task performance would have also been greatest at the August and October timepoints. However, accuracy was lowest during these timepoints. This suggests that the magnitude of BIS activation during chronic conditions does not vary according to the risk of disease exposure.

Instead, it appears that other factors such as the subjective appraisal of risk and fatigue may have a greater influence on BIS activation than objective reality (Schaller et al., 2021).

**Table 45**

*COVID-19 Case and Death Count in United States at Each Timepoint*

| Week | # of New Cases | # of Deaths |
|---|---|---|
| April 9-15, 2020 | 206,588 | 15,650 |
| June 11-17, 2020 | 153,855 | 4,598 |
| August 20-26, 2020 | 296,311 | 6,649 |
| October 15-21, 2020 | 428,409 | 5,886 |

Data retrieved from Huang et al., 2023

The results of Experiment 1 and 2 did not map onto the objective risk of contracting COVID-19 based on case count but did correspond with other variables that may influence perceived risk. For example, accuracy was the greatest during April 2020 and this was also the timepoint with the highest death count (Table 45). During the early months of the pandemic, health care systems and the general public were unprepared and overwhelmed by the spread of COVID-19, which resulted in many fatalities despite a relatively low number of cases (Bosman & Fausset, 2020; Renda & Castro, 2020; Sheehan & Fox, 2020). The number of deaths due to COVID-19 declined over the remaining timepoints as policies, procedures, and safety recommendations were put in place to limit the spread of the virus. It is possible that fear of dying, rather than fear of becoming sick, increased BIS activation and heightened visual discrimination skills. However, this is unlikely to be the major influence in BIS activation as behavioural studies that extended later into the pandemic did not observe changes in preventative behaviours that corresponded with increased death counts that were beyond those in April 2020 (Li et al., 2021; Huang et al., 2023).

Despite the constant threat of COVID-19, concern about the virus declined as the pandemic stretched on. During the early stages of the pandemic, there were many novel events related to COVID-19 and there was much uncertainty about what was to come (Figure 1). The frequency that individuals actively searched for information related to COVID-19 was highest early in the pandemic. Between March 2020 and May 2021, the number of Google searches related to COVID-19 peaked during the first three months of the pandemic, despite the risk (i.e., case counts, deaths) being greater at latter stages of the pandemic (Ma, 2021). This suggests that the general public was most concerned about COVID-19 shortly after the pandemic was declared. These findings combined with research indicating individuals spent more time watching news and used a larger variety of news sources early in the pandemic compared to later suggests that exposure to COVID-19 related information was greatest at the beginning of the pandemic. Importantly, the number of google searches predicted human movement (e.g., stay at home vs. community engagement), vaccination rates, and other behaviours relevant to the BIS (e.g., condom use, sexual promiscuity, anti-immigration attitudes) better than the number of COVID-19 cases (Adam-Troian & Bagci, 2021; Ma, 2021; Ma & Ye, 2021; Ma & Ye, 2022; Moran et al., 2021). Therefore, it appears that exposure to information about COVID-19 influences preventative behaviours and may also contribute to changes in visual vigilance that were observed during the present study.

The BIS framework presumes that pathogen cues are necessary for BIS activation and a catalyst for related cognitive, affective, and behavioural changes. During the pandemic, individuals were exposed to information about COVID-19 (i.e., pathogen cue) through media sources such as newspaper, television, and social media (Soroya et al., 2021). This type of pathogen cue is different from acute BIS literature because it is not a direct sensory cue that is unconsciously perceived within the environment (e.g., odour, mould; Murray et al., 2019). Instead, individuals had some control over the level of pathogen-relevant information they exposed themselves to. This was particularly true when individuals were encouraged to stay home and had little interaction with the community. If an individual did not seek out or avoided COVID-19 information, they would be expected to have less BIS activation than someone who kept up to date on the status of the pandemic. Research conducted during the pandemic identified that individuals who reported greater distress when exposed to COVID-19-related information were more likely to avoid it and information avoidance was associated with reduce preventative behaviours (Siebenhaar et al., 2020; Song et al., 2021; Sultana et al., 2023). These findings may partially explain the differences between LDS and HDS groups in the current study. Participants with HDS are more likely to experience uncomfortable sensations of disgust when presented with pathogen cues (van Overveld et al., 2006). Additionally, based on the correlational analysis in Experiment 3, participants with HDS also reported greater anxiety about contracting COVID-19, which is another uncomfortable sensation. Individuals with HDS may be more likely to avoid COVID-19 information in order to minimize feelings of disgust and anxiety. With fewer pathogen cues, HDS participants would be expected to have reduced BIS activation and subsequently perform with less accuracy on visual discrimination tasks, compared to LDS participants who may be less avoidant of COVID-19 information. Although the relationship between disgust sensitivity and COVID-19 information avoidance has not been directly studied, disgust sensitivity was negatively correlated to COVID-19 knowledge in an American study (Moore et al., 2021). This suggests that individuals with greater disgust sensitivity may be less aware of the threat of COVID-19, which reduces their BIS activation. A longitudinal study found that avoidance of COVID-19 information increased over time, which may explain why HDS participants demonstrated reduced visual vigilance at later timepoints compared to earlier ones (De Bruin et al., 2021).

Alternatively, desensitization may partially explain why visual vigilance declined over the pandemic. Desensitization is the mechanism underlying exposure therapy as a treatment for anxiety; repeated exposure to an anxiety-provoking stimulus reduces an individual's physiological and affective response to that stimulus (Foa & Kozak, 1986). It is possible that individuals became desensitized to information about COVID-19 as the pandemic progressed and this muted their response to COVID-19-relevant information. Individuals with HDS may be more prone to desensitization than those with LDS because they are assumed to have experienced greater disgust and anxiety responses to the pandemic. Disgust sensitivity/proneness are associated with greater levels of pandemic-related anxiety and fear (Ammann & Casagrande, 2021; Cox et al., 2020; Wheaton et al., 2012). Furthermore, individuals with anxiety disorders such as phobias and obsessive-compulsive disorder tend to have higher levels of disgust sensitivity (Brand et al., 2013; Paluszek et al., 2020). Therefore, HDS individuals are more likely to have a greater discrepancy between their neutral and disgusted/anxious state, which provides more opportunity for affective response changes over time. They may also have been more likely to experience a shift in emotions from fear and disgust to frustration and anger as the pandemic continued (Russell et al., 2023). Desensitization and the emotional shift from fear to anger may explain why visual vigilance declined more dramatically in HDS than LDS participants as the pandemic progressed but more research is needed to support this idea.

Literature on acute BIS activation suggests that participants with HDS should be more vigilant than those with LDS, but this is inconsistent with the current findings. Beyond the explanations described above, it is possible that discrepancies between previous literature and the current findings are an artifact of two major methodology differences in the study of acute and chronic BIS activation. First, as alluded to previously, the pathogen cues used to activate the BIS differ in the pandemic and previous laboratory studies. In laboratory research, acute BIS primes provide pathogen-relevant information through the five senses (e.g., foul odours, disgust-evoking images, sick faces). In comparison, individuals infected with COVID-19 were asymptomatic when they were most likely to be contagious resulting in direct sensory cues being unreliable indicators of pathogen presence (Lee, 2020). Pathogen cues during the pandemic were often indirectly presented through media report. These reports provided information about public health measures and case counts. The complex nature of information and consequences related to the pandemic may have increased a combination of emotions such as disgust, fear, anger, and sadness, rather than disgust in isolation. Moreover, pathogen primes could also be avoided by ignoring media, while researchers have direct control over pathogen prime exposure in a laboratory setting. The possible impact of this difference on study findings was described in detail above.

The second key difference between previous laboratory settings and current pandemic research is the scope and consequences of pathogen threat and avoidance behaviours. In laboratory settings, a pathogen threat is isolated to the current context and individual. Within this context, pathogen avoidance behaviours include removing oneself from a situation or self-reporting the intention to avoid (Shakhar, 2019). These behaviours are associated with little personal cost and minimal long-term consequences. In contrast, the COVID-19 pandemic impacted humans globally and an individual's preventative behaviours extended beyond personal safety and had the potential to influence the health status of others. Preventative behaviours during the pandemic were not necessarily intuitive (e.g., mask wearing) and the safest behaviours (i.e., social distancing, stay-at-home) were associated with significant social and psychological cost including loneliness, anxiety, and perceived reductions in cognitive functioning (Haktanir et al., 2021; Kobayashi et al., 2022). It is possible that individuals with HDS may be more sensitive to the emotional and social toll of the pandemic and this may have influenced task performance beyond BIS activation.

**Relationship between Political Affiliation and Visual Discrimination**

Political affiliation was identified as one of the strongest predictors of health precautions taken during the pandemic (Ackerman et al., 2021). The clear differences in pandemic experiences across the political spectrum has resulted in an abundance of literature exploring the relationship between political affiliation and COVID-19. Different variables have been used to measure political affiliation (e.g., party identification, political spectrum placement), which can become confusing in discussing their findings. For simplicity in the current discussion, individuals who self-identified as Democrats or politically liberal will be termed *liberals* and those who self-identified Republicans or politically conservative will be termed *conservatives*. The impact of political affiliation on COVID-19 attitudes was observed as early as March 2020 and persisted throughout the pandemic (Rodriguez et al., 2022). Liberals perceived COVID-19 as a greater health risk and engaged in more protective and preventative behaviours than conservatives (Christensen et al., 2020; de Bruin et al., 2020; Kerr et al., 2021; Latkin et al., 2022; Samore et al., 2021). In comparison, conservatives were more skeptical about the seriousness of COVID-19 and perceived preventative behaviours as less beneficial to others (Cakanlar et al., 2021; Latkin et al., 2022). In Experiment 3, liberals were more accurate on visual discrimination tasks and less likely to contract COVID-19 than conservatives. Taken together, previous COVID-19 studies and Experiment 3 suggest that conservatives had reduced BIS activation during the pandemic compared to their liberal counterparts.

One of the core values of conservatism is the emphasis on sameness, including the maintenance of existing norms and traditions (Schaller et al., 2021). These ideals correspond with increased threat awareness, greater disgust sensitivity, and reduced levels of uncertainty (Kim et al., 2020; Schaller et al., 2021). These features of conservativism are typically associated with increased pathogen avoidance and disease prevention behaviours (Schaller et al., 2021). However, as illustrated in the previous paragraph, conservatives responded in the opposite manner during the COVID-19 pandemic. Experiments 1 and 2 indicated that the subjective appraisal of threat may have a greater influence on BIS activation than the objective threat. It appears that factors beyond the objective risk and consequences of contracting COVID-19 influenced how the threat of COVID-19 was appraised. For conservatives, this appraisal was counterintuitive to their values and increased their risk of disease.

An American federal election was scheduled for November 2020 and the COVID-19 pandemic was declared eight months prior. As a result, the pandemic became a partisan issue and was highly politicized (Ruisch et al., 2022; Samore et al., 2021). Stances taken by the two major political parties in the United States were polarizing; the Democratic Party highlighted health risks associated with COVID-19 and community responsibility to engage in preventative behaviours, while the Republican Party emphasized the economic and personal liberty costs of COVID-19 closures and restrictions. These opposing perspectives were reflected in media, which was the primary way information about COVID-19 was obtained (Oh et al., 2020; Soroya et al., 2021).

Media sources offered vastly different messages around COVID-19 that impacted perceived threat of the virus and activation of the BIS (Allcott et al., 2020). Even within a single news source, COVID-19 messaging was sometimes inconsistent. Fox News is a conservative-leaning news network that shifted its perspective on COVID-19 in parallel with messaging from the White House (Simonov et al., 2020). Initially, Fox News identified COVID-19 as a hoax but described it as a crisis once it was declared a national emergency (March 2020). Unfortunately, the network's emphasis on health and science was short-lived and quickly shifted toward focusing on the negative impact of pandemic-related shutdowns on the well-being of Americans. These shifting messages corresponded with the attitudes of conservatives toward COVID-19. When Donald Trump created a COVID Task Force and declared COVID-19 to be a national emergency, the number of COVID-19 related google searches immediately grew in Republican leaning states (Xu & Margolin, 2023). However, support for vaccinations and trust in the CDC declined when Donald Trump returned to minimizing the threat of COVID-19 (Romer & Hall Jamieson, 2021).

Conservative media use was also associated with reduced perceived efficacy of preventative behaviours and intention to engage in them (Moon et al., 2022). Moreover, although preventative behaviours declined over time regardless of political affiliation, individuals who preferred conservative news outlets declined faster (Zhao et al., 2020). These findings highlight the influence that politicians and media can have on pathogen-relevant behaviour. When considering Experiment 3, conservatives were less vigilant on visual discrimination tasks than liberals. It is likely that differing levels of BIS activation between conservatives and liberals are a consequence of political and media messages related to COVID-19.

Although some media sources provided information consistent with the scientific and medical community's stance on COVID-19, others spread misinformation. WHO declared the rapid spread of misinformation during COVID-19 as an "infodemic" and warned that this misinformation could hinder pandemic efforts (Zarcostas, 2020). Behaviour discrepancies between conservatives and liberals were connected to varying levels of trust in Donald Trump vs. science (Ruisch et al., 2021). Conservative media sources were more likely to spread misinformation than liberal media sources. For example, conservative-leaning newspapers and news networks were more likely to contain misinformation about the virus and preventative measures than liberal-leaning sources (Mach et al., 2021; Muddiman et al., 2020). Additionally, misinformation about COVID-19 was spread by prominent members of the Republican conservative party. Donald Trump, who was president of the United States when the pandemic was first declared, perpetuated the infodemic and amplified conspiracy theories by claiming COVID-19 was a hoax and that the virus was man-made in China (Jurkowitz & Mitchell, 2020; Motta et al., 2020; Simonov et al., 2020). The White House created further distrust in science and medical professionals by stating that any views that opposed theirs were an attempt to undermine the president prior to the election. Therefore, it is not surprising that liberals reported being more trusting of medical experts, less trusting of politicians, and more critical of government responses than conservatives (Kerr et al., 2021). Individuals exposed to misinformation about COVID-19 were more likely to engage in superficial processing of the information and less likely to seek out additional information about COVID-19 (Kim et al., 2020). Conservative media viewers also endorsed greater beliefs in conspiracy theories and this relationship remained significant when demographic variables such as education, ethnicity, and income were controlled (Romer & Hall Jamieson, 2021). Overall, conservatives were more likely to be exposed to misinformation about COVID-19 that minimized the seriousness of the virus. This misinformation would further reduce BIS activation by decreasing the perceived threat of COVID-19, utility of preventative measures, and exposure to alternative information.

**Limitations**

Studying BIS activation during a pandemic was associated with significant benefits (e.g., high ecological validity) and important limitations. COVID-19 impacted the entire United States, which prevented the inclusion of a control group and experimental manipulation of pathogen exposure. The lack of a control group and experimental manipulation precludes any cause-and-effect relationships and, although it is assumed, it cannot be said with certainty that the findings are a consequence of BIS activation. In order to ensure an adequate sample was collected at all timepoints, data were collected cross-sectionally. A longitudinal study would have provided insights into how an individual's visual discrimination performance changes over time rather than how group differences vary at different timepoints. Previous literature has demonstrated that cognitive abilities are enhanced following acute BIS activation (Chan et al., 2016, 2019; Hunt et al., 2017; Nussinson et al., 2018; Tskhay et al., 2016) but no pre-pandemic baseline data were collected prior to the spread of COVID-19. Therefore, it is assumed visual discrimination performance was enhanced in April 2020 compared to pre-pandemic levels. However, it is not possible to determine whether cognitive changes from baseline occurred at the beginning of the pandemic. It is possible that visual vigilance remained consistent between pre-pandemic and early pandemic timepoints but became impaired as the pandemic continued but there is limited evidence to support this.

The current study was conceptualized and created in response to the COVID-19 pandemic. Unfortunately, data collection could not be conducted until stimuli development was complete. The first round of data collection took place in April 2020 and LDS and HDS groups performed similarly on both visual discrimination tasks at that time. Based on these findings, it is assumed that the pandemic initially impacted the visual discrimination skills of both groups similarly. Alternatively, it is possible that HDS participants displayed enhanced vigilance compared to LDS participants in the days that followed the declaration of the pandemic (March 2020), but these skills had already declined by April 2020. This question cannot be answered with current dataset.

Images in the face discrimination task were matched based on skin colour and tone. The majority of individuals whose faces were used in this task self-identified as white, but two trials included faces of individuals who self-identified as Asian. In order to determine whether these faces influenced performance, t-tests were run to compare task accuracy when Asian faces were and were not included. Results indicated that performance on ambiguous and overall face trials was more accurate when the Asian faces were included. The inclusion of Asian faces is expected have minimally impacted the current results because all participants were exposed to the same faces regardless of disgust sensitivity, timepoint, or political affiliation. Despite this, these findings are interesting and important to note. The Asian population in the United States experienced increased prejudice during the COVID-19 pandemic and COVID-19 was informally called 'Chinese Virus', 'Wuhan Virus', and 'Kung Flu' by prominent American politicians (Asian Pacific Policy and Planning Council, 2020; Reny & Barreto, 2020; Tahmasbi et al., 2021; Ziems et al., 2020). The discriminatory connection that was artificially created between people of Asian descent and COVID-19 may have biased the BIS to be particularly attuned to Asian faces. Future research should explore whether visual discrimination performance differs across races following BIS activation.

When the questionnaire was first developed, there was little information about the BIS in the context of COVID-19. In retrospect, it would have been beneficial to gather information about participants COVID-19 preventative behaviours, compliance to recommendations, and information exposure (e.g., frequency, sources). This would have allowed for the relationship between visual vigilance, pandemic behaviours, and COVID-19 information exposure to be directly studied rather than inferred using other literature. Additional demographic information related to education and experience with science (e.g., career, academics) may also have provided insights into the mechanisms underlying differences in visual discrimination performance between groups.

The current questionnaire relied on self-report measures, which are vulnerable to biased reporting (Ruisch et al., 2022). Self-report measures have been demonstrated to inflate the relationship between disgust sensitivity and pandemic-related preventative behaviours (Fazio et al., 2021; Ruisch et al., 2022). This inflation is expected to be due to biases in self-report and the overlap between items related to disgust sensitivity and preventative behaviours. In the current study, objective indicators of performance (i.e., accuracy, RT) were used to measure BIS outcomes that do not have an obvious connection with items on the DS-R. Despite the risk of inflation being relatively low, it is possible that the DS-R may have exaggerated the relationship between disgust sensitivity and vigilance.

Participants were recruited through MTurk, which allowed data to be collected while abiding to social distancing recommendations. Although MTurk's participant pool is more representative than college samples, it is does not capture the diversity of the American population (Paolacci & Chandler, 2014). Studies completed before the COVID-19 pandemic indicated that MTurk samples are younger, more educated, more liberal, less religious, less extraverted, less likely to report being in good health or be vaccinated for the flu, and less likely to have health insurance than national samples (Levay et al., 2016; Paolacci & Chandler, 2014; Walters et al., 2018). However, new workers that joined the platform after the pandemic was declared shifted the demographic make-up of the participant pool. Compared to February 2020, the MTurk participant pool was more representative of the general population in July 2020; participants were less likely to be white and more likely to be republican during the pandemic. However, the participant pool during the pandemic was more likely to fail validity checks and less likely to be consistent across responses than the pool prior to COVID-19 (Arechar & Rand, 2021). This is consistent with the high proportion of participants (i.e., 28-39%) that were removed from data analysis during the current study due to incomplete or invalid data.

The questionnaire also used single-item self-report measures to assess political affiliation, which increases the likelihood of measurement errors and reduces predictive validity compared to multiple-item measures (Diamantopoulos et al., 2012). Information about participants political affiliations were collected in the Summer and Fall of 2020. At this time, the federal election was months away and social justice movements like Black Lives Matter were spreading across the United States. These events contributed to highly polarized political views in the mass public, which was associated with greater self-censorship about political beliefs than had been observed in the past (Ekins, 2020; Gibson & Sutherland, 2023). The majority of central liberals (52%) and conservatives (77%) reported self-censoring their political opinions, while the majority of strong liberals (58%) felt comfortable sharing their beliefs (Ekins, 2020). This is consistent with previous research that has found individuals underreport their support for Donald Trump in research and national surveys (Clinton et al., 2021; Romer & Hall Jamieson, 2021). This may have biased participant responses on the political affiliation question toward the middle of the scale and inflated the number of participants that identified as moderate. It may also have biased the liberal and conservative groups to include only participants with strong political identities. Future research would benefit from including multiple questions related to political beliefs, such as those included in the 12-item social and economic conservatism scale, as this may reduce biases and self-censorship in participant responses (Everett, 2013).

**Conclusion**

The current dissertation provides valuable contributions to the BIS literature despite its limitations. To the best of my knowledge, these experiments are the first to explore cognition in the context of chronic BIS activation. Notable strengths of the experiments include the use of the COVID-19 pandemic as an ecologically valid and prolonged pathogen prime. Additionally, vigilance was measured using an objective task in order to reduce biases. The use of an objective task also extended previous BIS research by demonstrating that perceptual contrast changes are not only subjectively reported but can be quantified as well (Nussinson et al., 2018). Moreover, visual discrimination skills were explored using pathogen-relevant (i.e., faces) and pathogen-irrelevant (i.e., shapes) stimuli to provide insight into the specificity of vigilance changes. The current findings indicate that visual vigilance changes are broad and not restricted to pathogen-relevant information in the context of chronic BIS activation. Lastly, the current cognitive findings parallel published behavioural data that was collected during the COVID-19 pandemic. This supports BIS theory that cognitive and affective changes following BIS activation drive behavioural responses aimed to reduce pathogen threat (Schaller & Park, 2011).

This dissertation provides three important insights into the impact of chronic BIS activation on cognition. First, Experiments 1 and 2 demonstrate that vigilance declines within months of chronic pathogen threat. This finding is particularly important to BIS literature because it suggests that BIS responses are dynamic and change over time. Therefore, caution is warranted when generalizing findings from one study to different phases of the pandemic and readers are encouraged to carefully consider dates of data collection when interpreting results.

Importantly, trait-like predispositions toward pathogen avoidance (i.e., disgust sensitivity) differentially impact BIS responding following chronic activation. This finding is inconsistent with previous literature; individuals with greater responsiveness to pathogen cues within an acute context are more vulnerable to vigilance decline following chronic BIS activation. This provides evidence that the protective factors that minimize pathogen exposure in acute settings may become risk factors for pathogen exposure in chronic contexts.

A second major contribution of this dissertation is the observation that the objective risk of pathogen contact does not correspond with BIS responsivity. Vigilance declined over time despite an increase in COVID-19 cases in later months. This suggests that factors beyond infection risk, such as perceived threat, have a greater influence on chronic BIS activation than the likelihood of pathogen contact. This finding implies that interventions designed to encourage preventative behaviours should not rely on case count and risk to motivate compliance. Instead, targeted interventions that reduce information avoidance, improve the accessibility of scientific information, and minimize desensitization/fatigue may prove to be more fruitful strategies to reduce the spread of infectious disease.

Third, results from Experiment 3 indicate that the BIS is sensitive to societal forces. The political beliefs of conservatives contradicted their high threat awareness and self-interest in pathogen avoidance, which corresponded with reduced vigilance compared to liberals. This provides evidence that factors unrelated to the BIS (e.g., political affiliations) may be capable of negatively impacting cognitive skills that are outside of conscious awareness and increasing the risk of pathogen contact.

In summary, the current dissertation studied the impact of chronic BIS activation on visual vigilance. This dissertation provides evidence that cognitive changes occur with prolonged pathogen threat and that these changes are not a consequence of changing infection rates. This dissertation also identifies that cognitive changes following chronic BIS activation are not uniform across groups and certain populations are at greater risk of having reduced vigilance than others. Ultimately, this dissertation provides a framework for understanding how chronic BIS activation impacts the unconscious processing of pathogen cues within the environment.

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# APPENDICES

## Appendix A

### Face Discrimination Task Stimuli

This appendix contains a detailed description of the face discrimination task including all possible stimuli combinations. During this task, participants were presented with two faces and asked to determine whether the faces were identical or different. Faces were taken from the Face Research Lab – London Set database (DeBruine & Jones, 2017). This was the first task completed by participants after consenting to participate in the study.

**Instructions**

Participants were presented with an instructions screen that read:

" Instructions:

You will be presented two faces and we want you to decide whether the faces are IDENTICAL or different. Some of the images will be very similar to each other but if there is anything different between the two of them, they are different.

If the faces are the same press the "z" key. If the faces are different press the "m" key.

Please work as quickly as you can without making mistakes.

On the next slide there is an example.

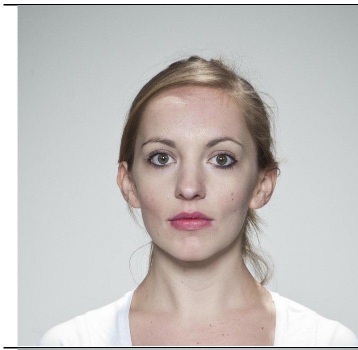
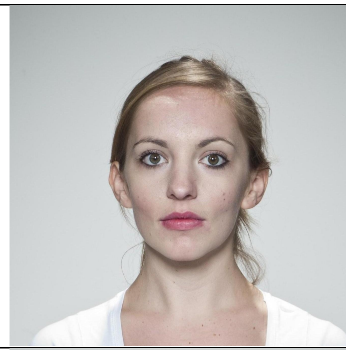
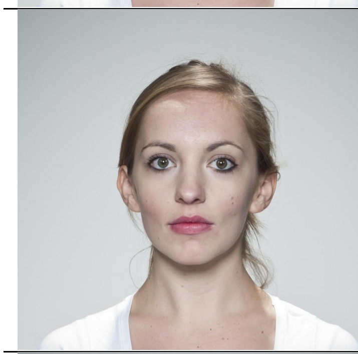
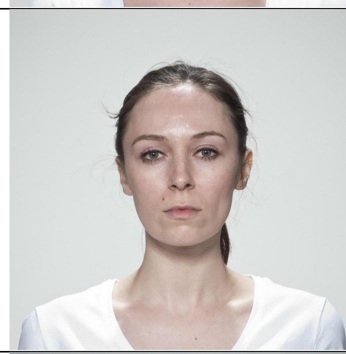
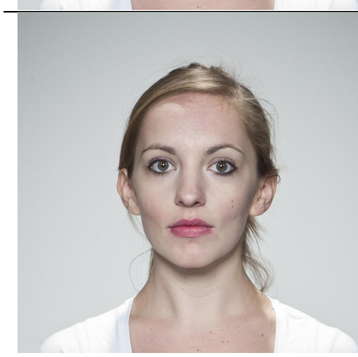
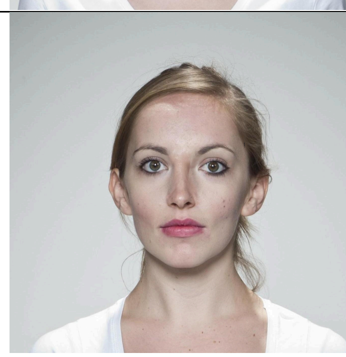
Press Spacebar when you are finished reading these instructions."

**Demonstration Items**

Three demonstration items were shown, one for each trial type (i.e., identical, ambiguous, and different). The images and provided prompt for demonstration items are included in Table 45.

**Figure 19**

*Face Discrimination Task Demonstration Items*

| Stimuli | | Prompt |
|---|---|---|
|  |  | Here the faces are the same. So you would push the “z” key.<br><br>Press the “z” key to continue. |
|  |  | Here the faces are different. So you would push the “m” key.<br><br>Press the “m” key to continue. |
|  |  | Here the faces are different. Although the two faces look very similar, the nose is different between the two images. Because the pictures are NOT identical, you would push “m”.<br><br>Press the “m” key to continue. |

**Practice Trials**

After viewing the demonstration items, participants completed 6 practice trials (2 of each trial type). The order practice trials was counterbalanced across participants. Participants were provided feedback after each trial and were required to make the correct response to progress to the next trial. The instructions for the practice items were as follows.

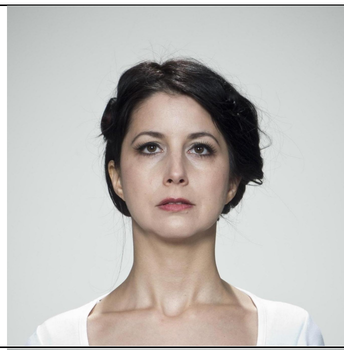
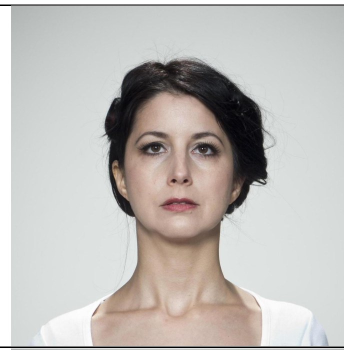
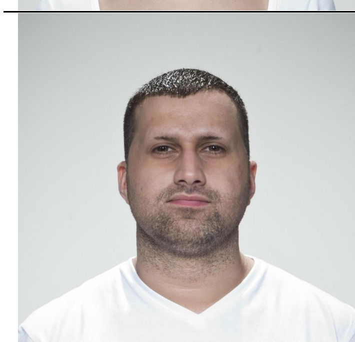
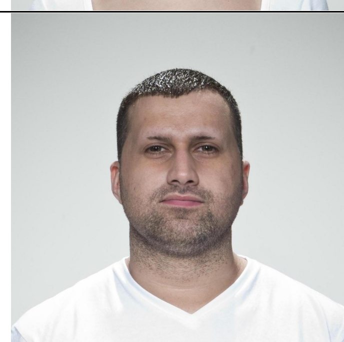
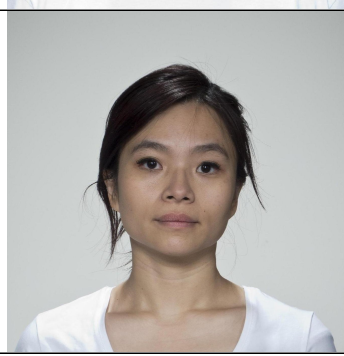
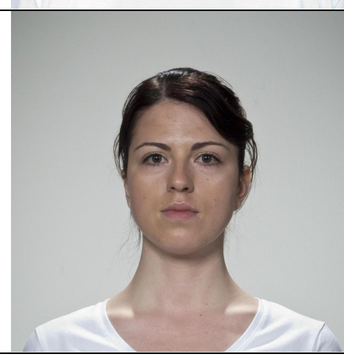
“Now you will try a few for practice.

Remember, press “z” if the images are identical and “m” if they are different. Some images might be similar but if they are not identical make sure you click “m”.”

The stimuli and feedback provided for the identical and different practice trials can be found in 46.

**Figure 20**

*Identical and Different Face Trial Practice Items*

| Trial Type | Stimuli | | Feedback |
|---|---|---|---|
| Identical Faces |  |  | If pressed “z”: “That’s right! The images are identical. Press “z” to continue.” |
| |  |  | If pressed “m”: “That’s not quite right. The images are identical. Therefore you should press “z”. Press “z” to continue.” |
| |  |  | If pressed “z”: “That’s not quite right. The images show two different people and are not identical. Therefore you should press “z”. |

| | | |
|---|---|---|
| Different Faces |  | Press “z” to continue.”<br><br>If pressed “m”: “That’s right! The images are different. Press “m” to continue.” |

The stimuli and feedback for ambiguous trials can be found in Figure 47. Notably, visual feedback (i.e., faces with circles indicating changes) was provided to all participants regardless of whether they responded correctly on the practice trial.

**Figure 21**

*Ambigious Face Trial Practice Items*

Practice Trial – Ambiguous Stimuli 1

If pressed “z”:
“That’s not quite right, something is different between those two images. The images have different lips. Therefore you should press “m”. Press “m” to continue.”

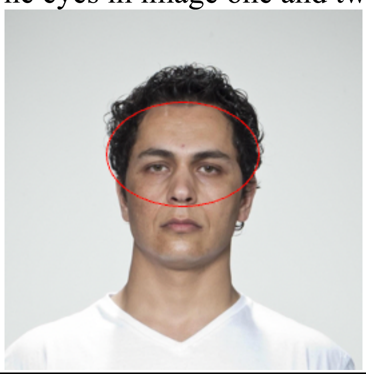
If pressed “m”:
“That’s right! The lips in image one and two are different. Press ”m” to continue”

Practice Trial – Ambiguous Stimuli 2

If "z" pressed:
"That's not quite right, something is different between those two images. The images have different eyes. Therefore you should press "m". Press "m" to continue."

If "m" pressed:
"That's right! The eyes in image one and two are different. Press "m" to continue."

**Face Discrimination Trials**

After participants had completed all 6 practice trials, they were provided a reminder of the task rules.

"Now that you have had a couple of practice rounds, we will begin the trials.

There will be 30 trials in total.

Remember:

You will be presented two faces and we want you to decide whether the faces are IDENTICAL or different. Some of the images will be very similar to each other but if there is ANYTHING different between the two of them, they are different.

If the faces are the same press the "z" key. If the faces are different press the "m" key.

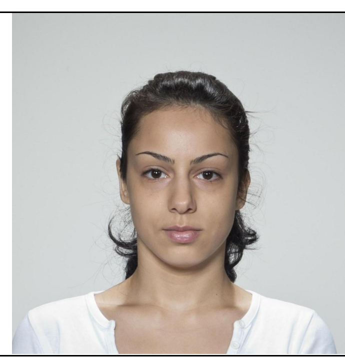
Please work as quickly and accurately as you can.

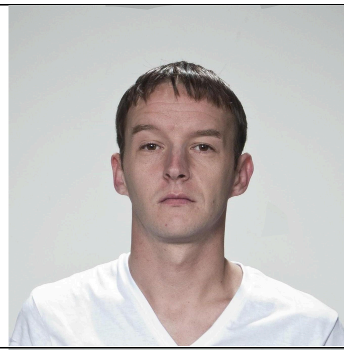
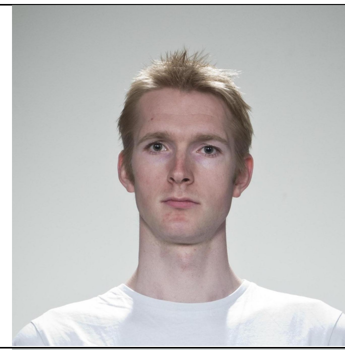
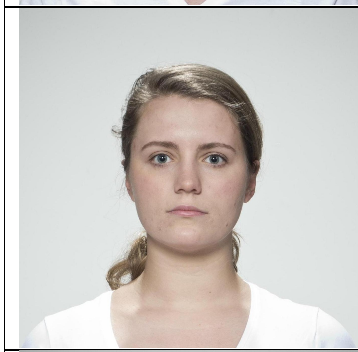
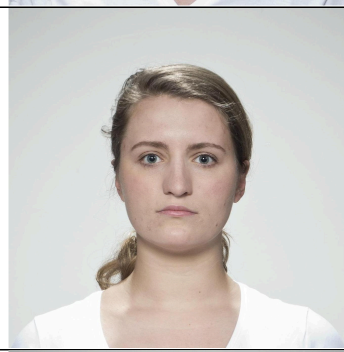
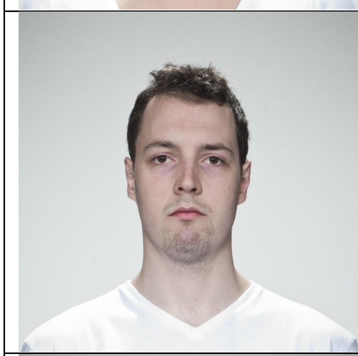
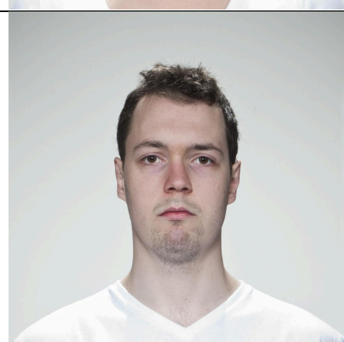
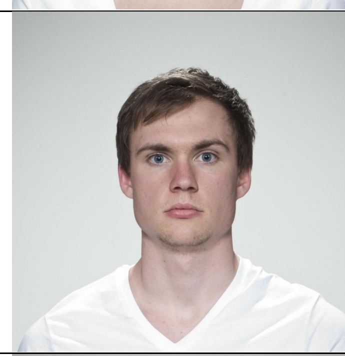
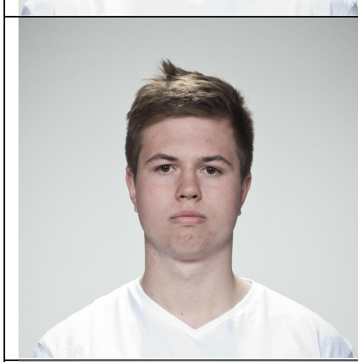
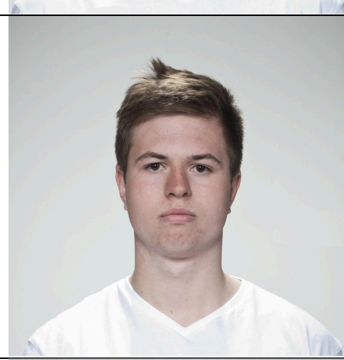
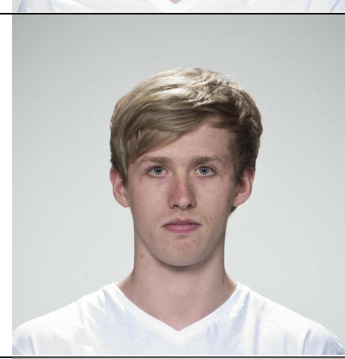
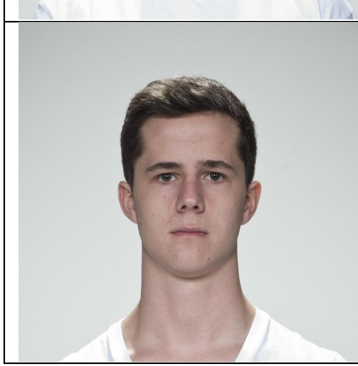
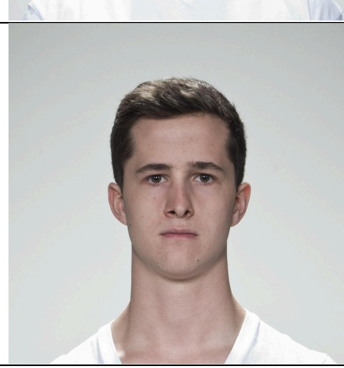
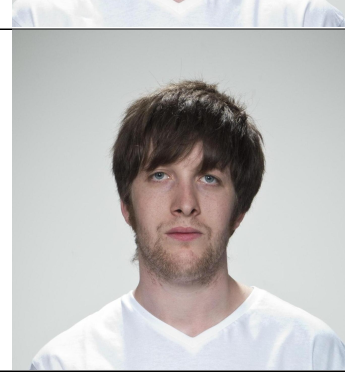
Press Spacebar when you are finished reading these instructions."

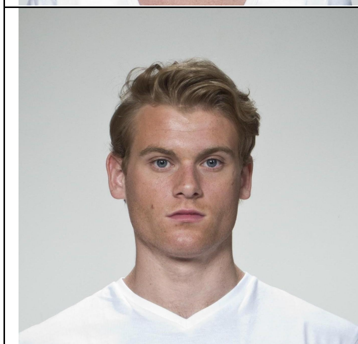
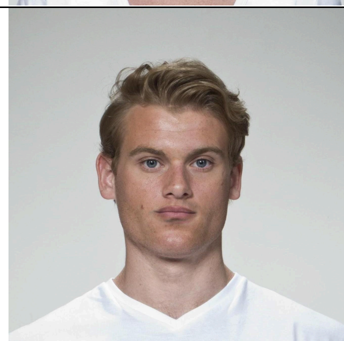
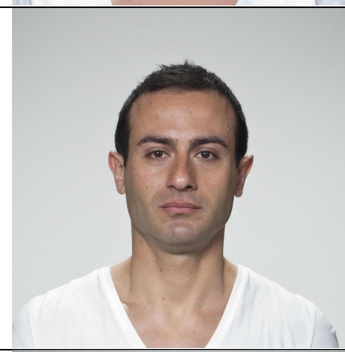
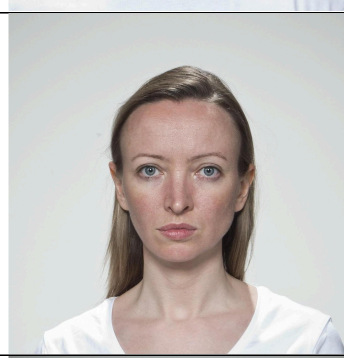
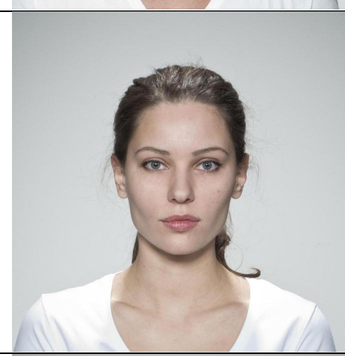
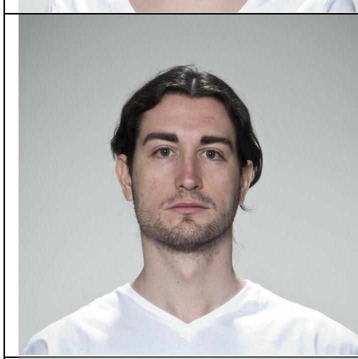
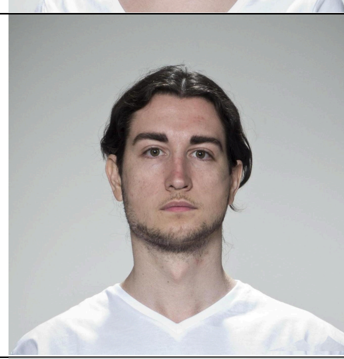
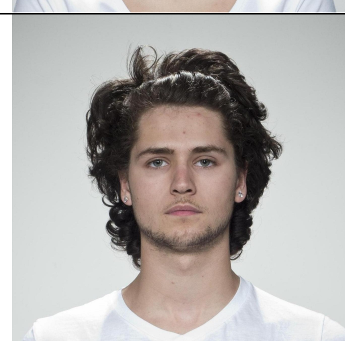
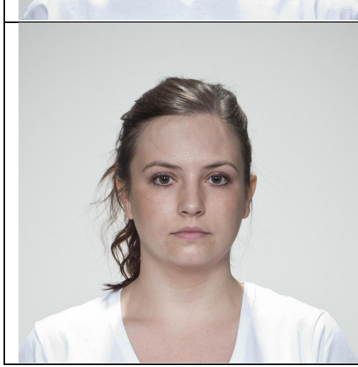
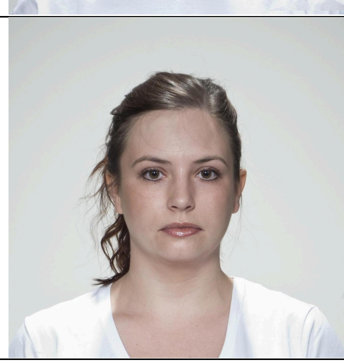
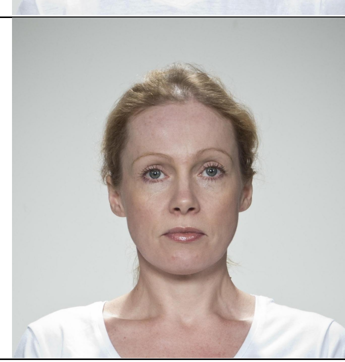
After viewing the reminder of task rules, participants then completed 30 face discrimination task trials. All possible face combinations for the face discrimination trials can be found in Figure 22. For each trial, participants were shown two images. The original image was always presented on the left and the second image was presented on the right. For "identical" trials, the second image was a duplication of the original image. For "ambiguous" trials, the second image was similar to the original image but had one facial feature from the paired different face was transposed onto it (see "merged feature" in Table X[facediscrimstim]). For "different" trials, the second image was a different face. Each original image was included in a single trial so saw all 30 original images. The trial type for each original image and order that images were presented was counterbalanced across participants. Between each trial was a fixation cross (150ms). The trial did not end until participants responded. Participants did not receive feedback for their performance during the task. Reaction time and response ("m" or "z" key) were recorded.

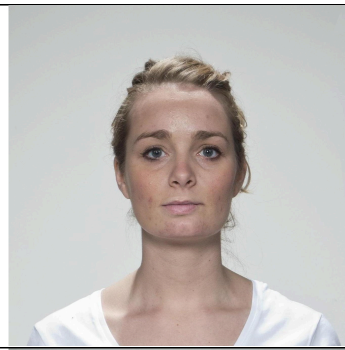
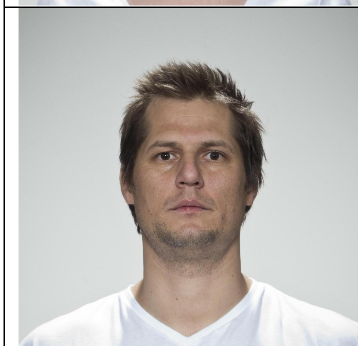
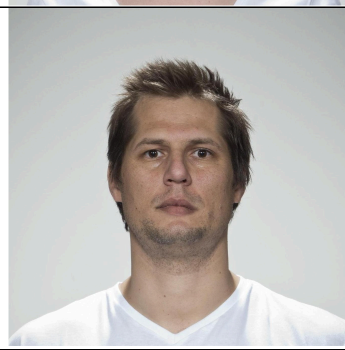
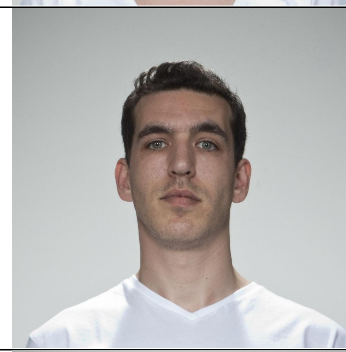
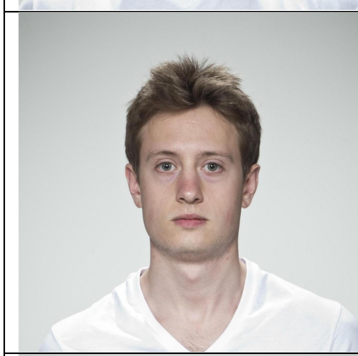
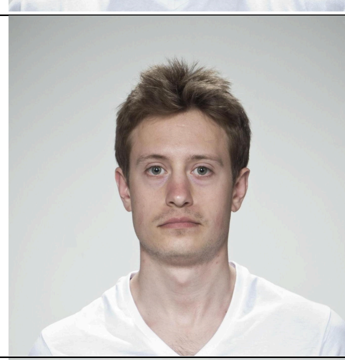
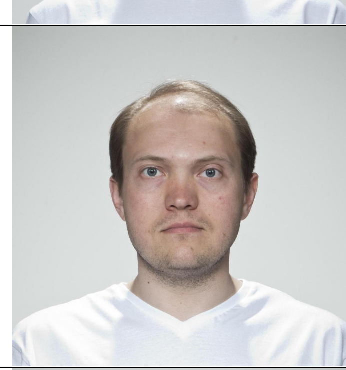
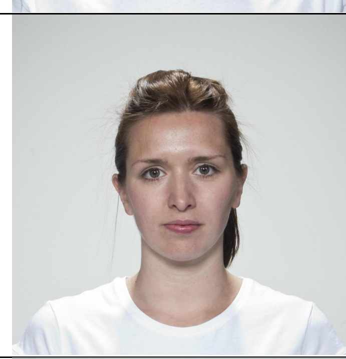
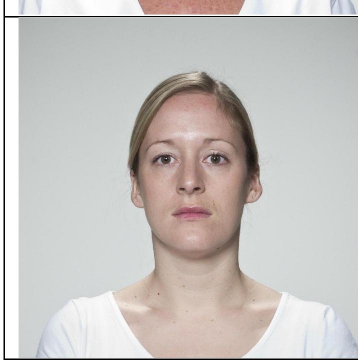
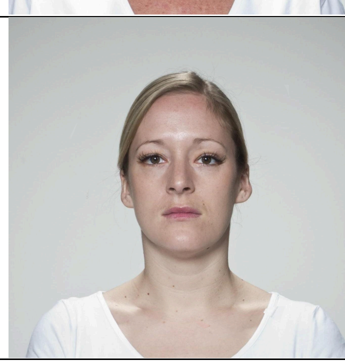
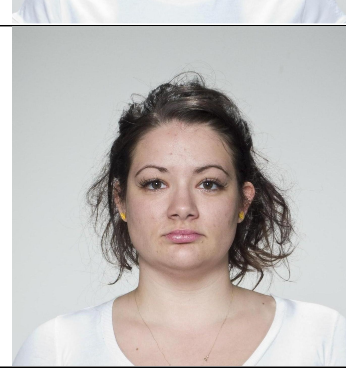
**Figure 22**

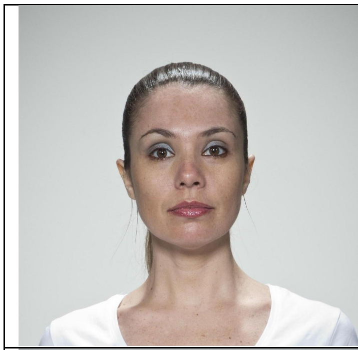
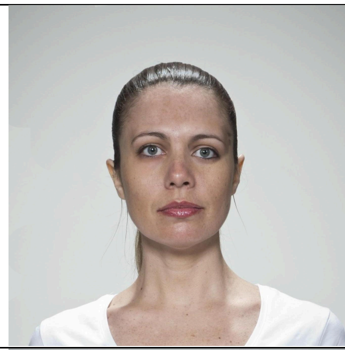
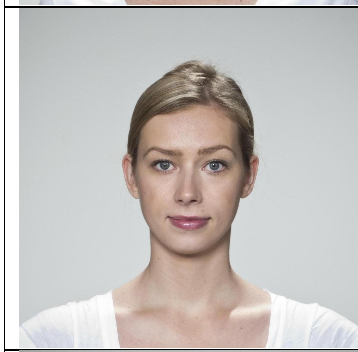
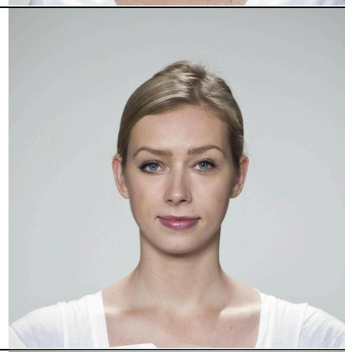
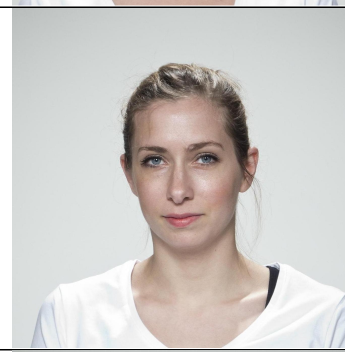
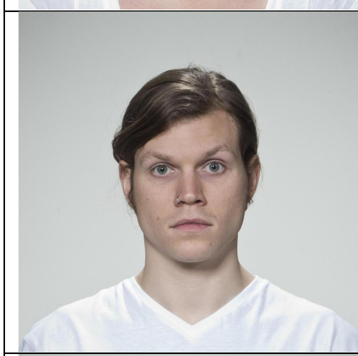
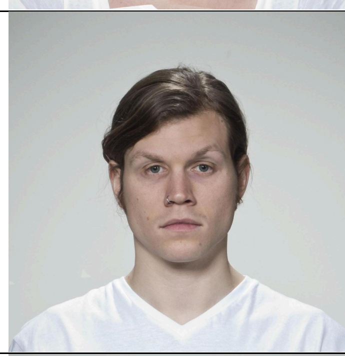
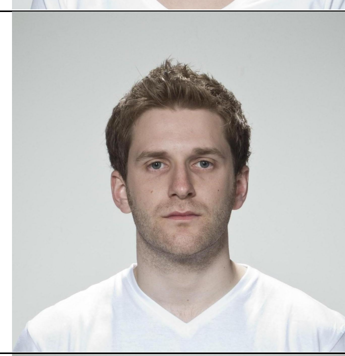
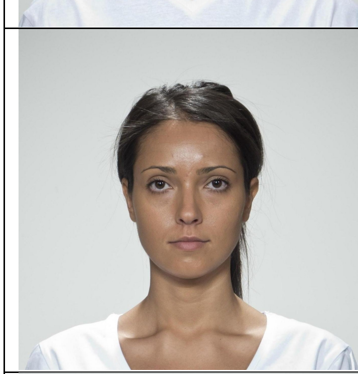
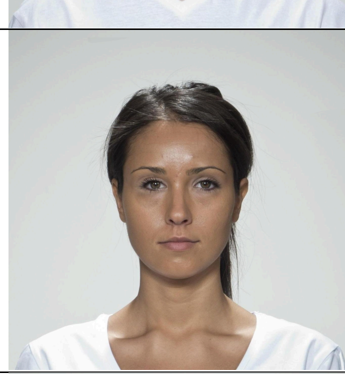
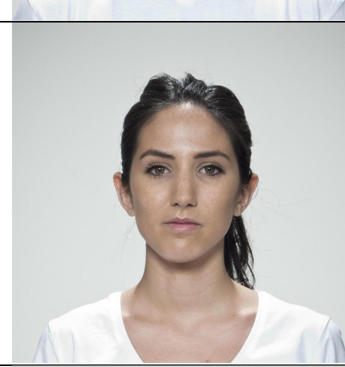
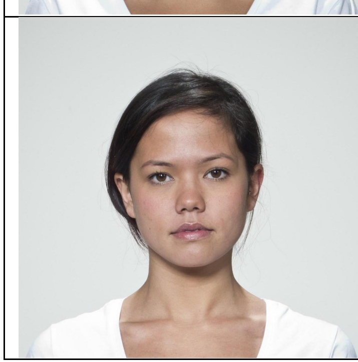
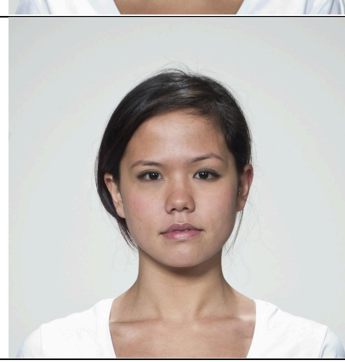
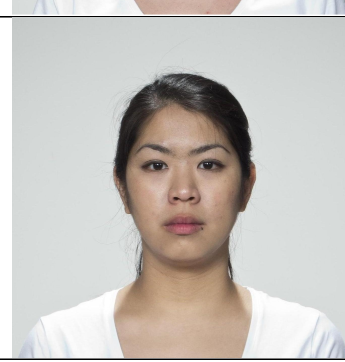
*Face Discrimination Task Stimuli*

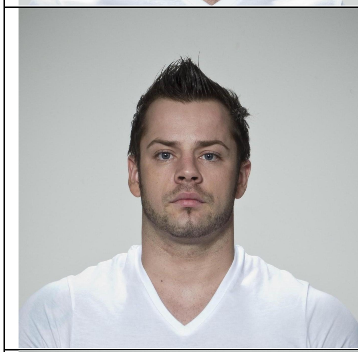
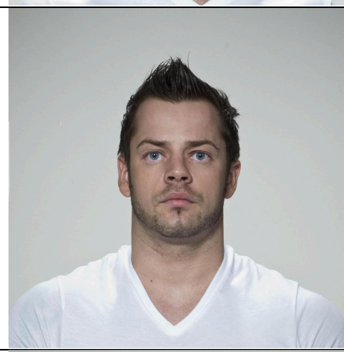
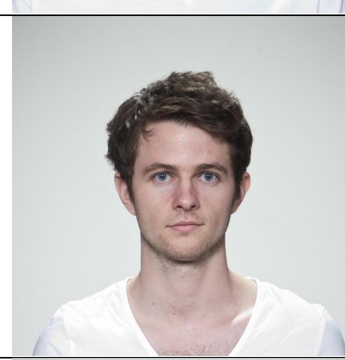
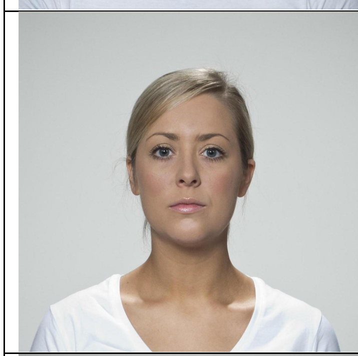
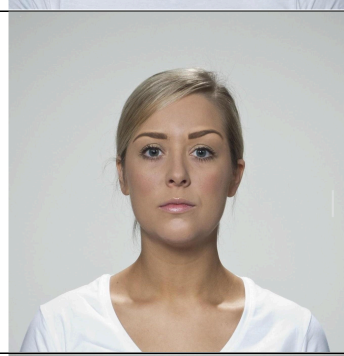
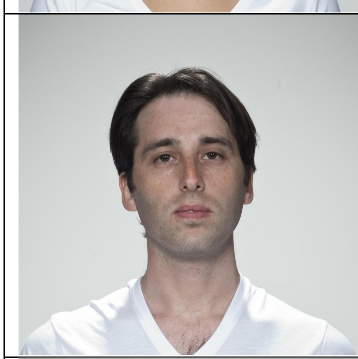
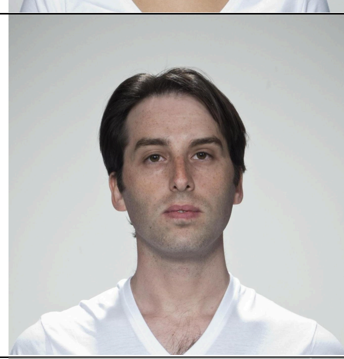
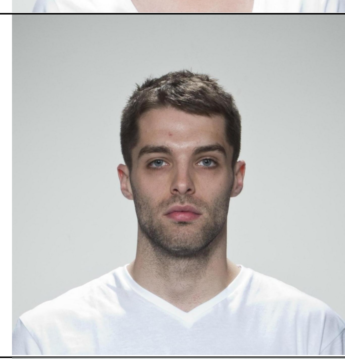
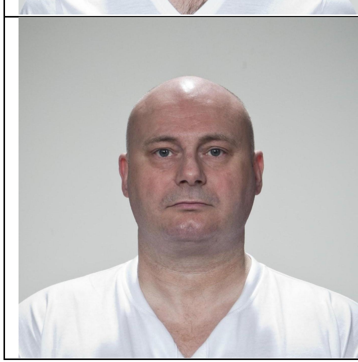
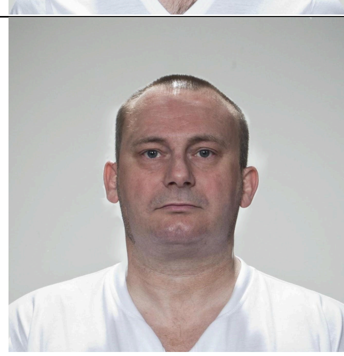
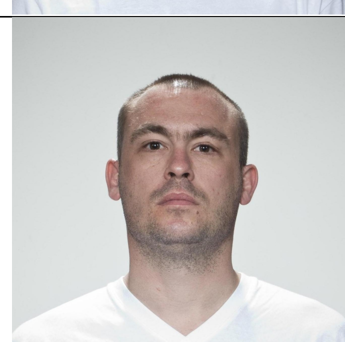
| Original | Merged Feature | Different Face | Transposed Feature |
|---|---|---|---|
|  |  |  | Nose |

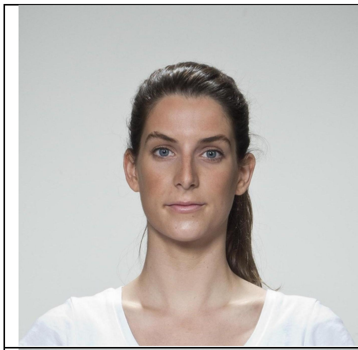
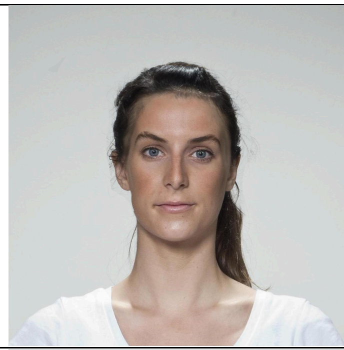
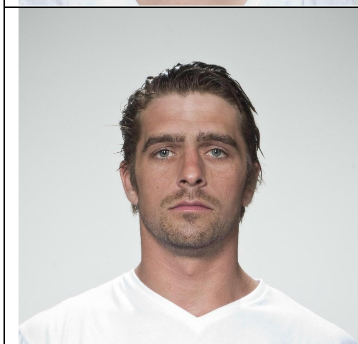
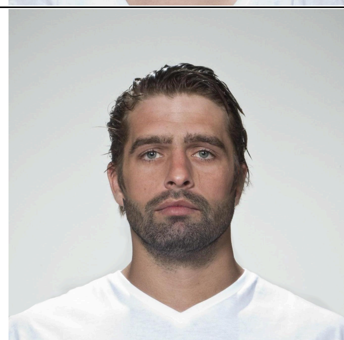
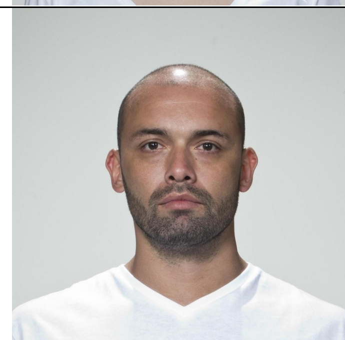
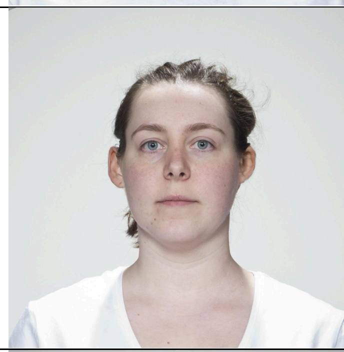
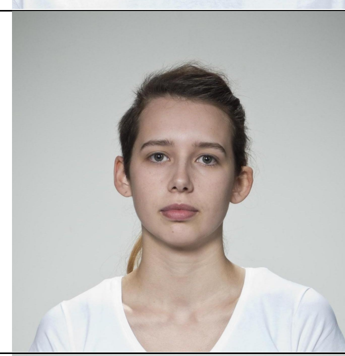
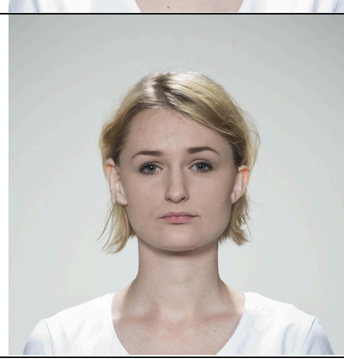
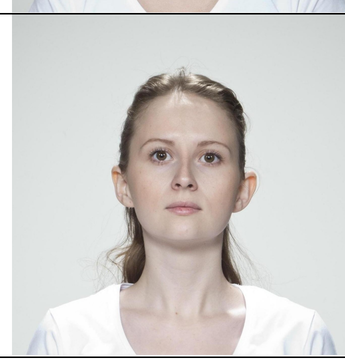
| | | | |
|---|---|---|---|
|  |  |  | Nose |
|  |  |  | Nose |
|  |  |  | Nose |
|  |  |  | Nose |
|  |  |  | Nose |

| | | | |
|---|---|---|---|
|  |  |  | Mouth |
|  |  |  | Mouth |
|  |  |  | Mouth |
|  |  |  | Mouth |
|  |  |  | Mouth |

| | | | |
|---|---|---|---|
|  |  |  | Mouth |
|  |  |  | Mouth |
|  |  |  | Mouth |
|  |  |  | Mouth |
|  |  |  | Eyes |

| | | | |
|---|---|---|---|
|  |  |  | Eyes |
|  |  |  | Eyes |
|  |  |  | Eyes |
|  |  |  | Eyes |
|  |  |  | Eyes |

| | | | |
|---|---|---|---|
|  |  |  | Eyes |
|  |  |  | Eyes |
|  |  |  | Eyebrows |
|  |  |  | Eyebrows |
|  |  |  | Hair |

| | | | |
|---|---|---|---|
|  |  |  | Hair |
|  |  |  | Facial hair |
|  |  |  | Ears |
|  |  |  | Ears |

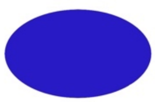
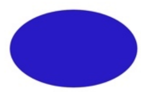
## Appendix B

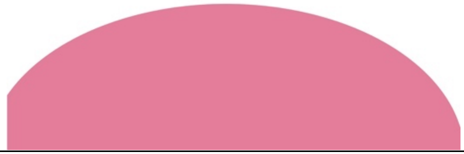
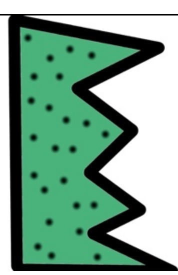
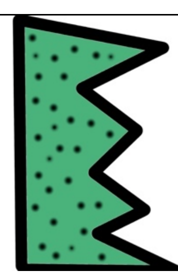
## Shape Discrimination Task Stimuli

This appendix contains all stimuli used within the shape discrimination task. All shapes are presented as two versions (A and B; Figure 23). During the task, Version A was duplicated so participants saw two identical Version A shapes and one corresponding Version B shape. Shape presentation and the location of the Version B shape were counterbalanced across trials. Stimuli are grouped according to the principal feature that was altered (i.e., size, colour, and placement). Participants were asked to identify which shape was different than the other two as quickly as they can. They completed 3 practice trials prior to beginning the task and stimuli for the practice trials is included in Figure 23. Participants were provided feedback on their practice trial responses.

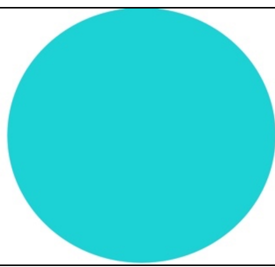
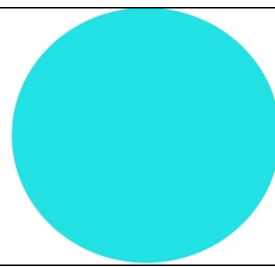
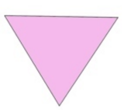
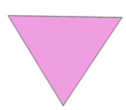
**Figure 23**

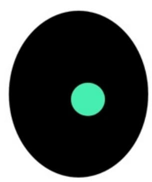
*Shape Discrimination Task Stimuli*

| Altered Feature: Size | | |
|---|---|---|
| Version A | Version B | Special Notes |
|  |  | Practice trial |
|  |  | Shape size |
|  |  | Shape size |
|  |  | Shape size |
|  |  | Shape size |

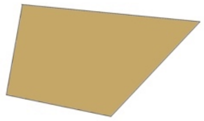
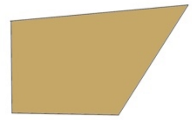
| | | |
|---|---|---|
|  |  | Shape height |
|  |  | Left side length |
|  |  | Base length |
|  |  | Top angle |
|  |  | Bottom right angle |
|  |  | Dot count |

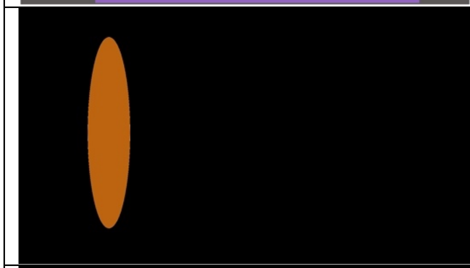
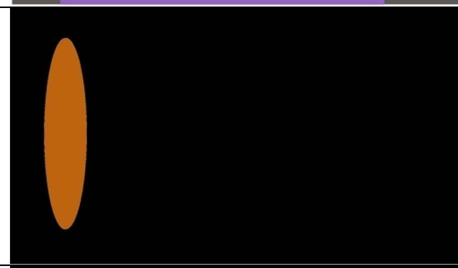
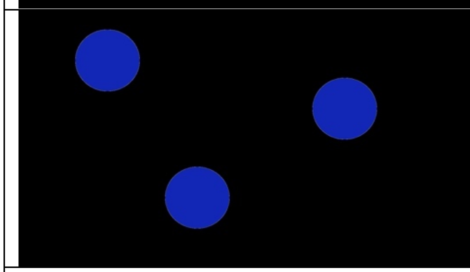
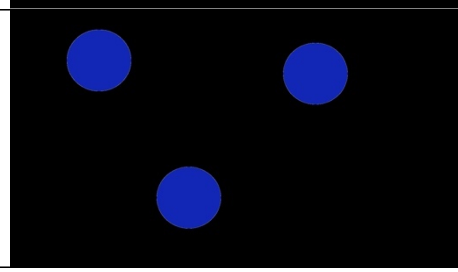
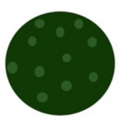
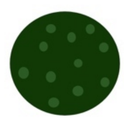
| **Altered Feature: Colour** | | |
|---|---|---|
| Version A | Version B | Special Notes |

| | | |
|---|---|---|
|  |  | Practice trial |
|  |  | Shape colour |
|  |  | Shape colour |
|  |  | Shape colour |
|  |  | Shape colour |
|  |  | Shape colour |

| | | |
|---|---|---|
|  |  | Shape colour |
|  |  | Fill colour |
|  |  | Outline colour |
|  |  | Dot colour |
|  |  | Colour proportions |

| **Altered Feature: Placement** | | |
|---|---|---|
| Version A | Version B | Special Notes |
|  |  | Practice trial |

| | | |
|---|---|---|
|  |  | Shape rotation |
|  |  | Shape rotation |
|  |  | Shape rotation |
|  |  | Shape rotation |
|  |  | Shape rotation |
|  |  | Shape reflection |

| | | |
|---|---|---|
|  |  | Shape location |
|  |  | Shape location |
|  |  | Right dot placement |
|  |  | Top left dot placement |

## Appendix C

## Demographic and COVID-19 Anxiety Questionnaires

Below is the questionnaire used for data collection during May and June 2020 timepoints.

How old are you?

________

If you had to select one response that best describes your current gender identity, what would it be?

- Man/boy
- Woman/girl
- Indigenous or other cultural gender identity (e.g., two-spirit)
- Non-binary, genderqueer, agender, or a similar identity

What ethnicity do you identify with?

- African American/Black/African Origin
- Asian-American/Asian Origin/Pacific Islander
- Latino-a/Hispanic
- American Indian/Alaska Native/Aboriginal Canadian
- European Origin/White
- Middle Eastern/Arab
- Bi-racial/Multiracial
- An ethnicity not listed above

In what city, state/province, and country do you currently reside?

____________, __________________, ____________

Have you ever tested positive for covid-19?

Yes No

If yes, what was the approximate date of the diagnosis?

______

If no, have you experienced symptoms and were concerned you had covid-19 but were not tested

Yes No

Do you know someone who has tested positive for covid-19?

Yes No

If yes, what was their relationship to you and when did they receive this diagnosis (e.g., coworker, March 2020)? (if more than 3 individuals, list those who you spend the most time with)?

_______

_______

_______

Have any of your family members or friends presented with symptoms of covid-19 but were never tested?

Yes No

Rate your <u>current</u> anxiety regarding your fear of contracting covid-19

1 2 3 4 5 6 7 8 9 10

Rate your <u>current</u> anxiety regarding your fear of family members or friends contracting covid-19

1 2 3 4 5 6 7 8 9 10

Below is the questionnaire used for data collection during August and October 2020 timepoints. Questions with an asterisk (*) indicate the question was added or altered from the questionnaire used in April and June 2020.

How old are you?

________

If you had to select one response that best describes your current gender identity, what would it be?

- Man/boy
- Woman/girl
- Indigenous or other cultural gender identity (e.g., two-spirit)
- Non-binary, genderqueer, agender, or a similar identity

What ethnicity do you identify with?

- African American/Black/African Origin
- Asian-American/Asian Origin/Pacific Islander
- Latino-a/Hispanic
- American Indian/Alaska Native/Aboriginal Canadian
- European Origin/White
- Middle Eastern/Arab
- Bi-racial/Multiracial
- An ethnicity not listed above

In what city, state/province, and country do you currently reside?

___________, _________________, ___________

*What of these describes your income last year?

- $0
- $1 to $9,999
- $10,000 to $24,999
- $25,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 and greater
- Prefer not to answer

*Which of these describe you *currently*?

- Full-time employed
- Part-time employed
- Not employed for pay

- Caregiver (e.g., children, elderly)
- Homemaker
- Full-time student
- Part-time student
- Other

*Which of these described you *in January 2020*?
- Full-time employed
- Part-time employed
- Not employed for pay
- Caregiver (e.g., children, elderly)
- Homemaker
- Full-time student
- Part-time student
- Other

*How do you identify politically?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Strongly liberal | | | Moderate | | | Strongly conservative |

*Which of your countries political parties best reflects your values?

____________________

*How many people live in your home with you?

______

*What is your relationships to the people you live with?

______

Have you ever tested positive for covid-19?
Yes No

If yes, what was the approximate date of the diagnosis?

______

If no, have you experienced symptoms and were concerned you had covid-19 but were not tested
Yes No

Do you know someone who has tested positive for covid-19?
Yes No

If yes, what was their relationship to you and when did they receive this diagnosis (e.g., coworker, March 2020)? (if more than 3 individuals, list those who you spend the most time with)?

_______
_______
_______

*Have any of your family members presented with symptoms of covid-19 but were never tested?
Yes No

*Have any of your close friends presented with symptoms of covid-19 but were never tested?
Yes No

Rate your <u>current</u> anxiety regarding your fear of contracting covid-19
1 2 3 4 5 6 7 8 9 10

*Rate your <u>current</u> anxiety regarding your fear of family members contracting covid-19
1 2 3 4 5 6 7 8 9 10

*Rate your <u>current</u> anxiety regarding your fear of friends contracting covid-19
1 2 3 4 5 6 7 8 9 10

## Appendix D

### Disgust Scale – Revised

Below are the items included in the DS-R (Haidt, McCauley, & Rozin, 1994; Modified by Olatunji et al., 2007). When scoring the DS-R, items 1, 6, and 10 are reverse coded and items 12 and 16 are removed. The total score can range from 0 to 100.

**Please indicate how much you agree with each of the following statements, or how true it is about you. Please write a number (0-4) to indicate your answer:**

**0** = Strongly disagree (very untrue about me)
**1** = Mildly disagree (somewhat untrue about me)
**2** = Neither agree nor disagree
**3** = Mildly agree (somewhat true about me)
**4** = Strongly agree (very true about me)

_____1. I might be willing to try eating monkey meat, under some circumstances.
_____2. It would bother me to be in a science class, and to see a human hand preserved in a jar.
_____3. It bothers me to hear someone clear a throat full of mucous.
_____4. I never let any part of my body touch the toilet seat in public restrooms.
_____5. I would go out of my way to avoid walking through a graveyard.
_____6. Seeing a cockroach in someone else's house doesn't bother me.
_____7. It would bother me tremendously to touch a dead body.
_____8. If I see someone vomit, it makes me sick to my stomach.
_____9. I probably would not go to my favorite restaurant if I found out that the cook had a cold.
_____10. It would not upset me at all to watch a person with a glass eye take the eye out of the socket.
_____11. It would bother me to see a rat run across my path in a park.
_____12. I would rather eat a piece of fruit than a piece of paper
_____13. Even if I was hungry, I would not drink a bowl of my favorite soup if it had been stirred by a used but thoroughly washed flyswatter.
_____14. It would bother me to sleep in a nice hotel room if I knew that a man had died of a

heart attack in that room the night before.

**How disgusting would you find each of the following experiences? Please write a number (0-4) to indicate your answer:**

**0** = Not disgusting at all

**1** = Slightly disgusting

**2** = Moderately disgusting

**3** = Very disgusting

**4** = Extremely disgusting

____15. You see maggots on a piece of meat in an outdoor garbage pail.

____16. You see a person eating an apple with a knife and fork

____17. While you are walking through a tunnel under a railroad track, you smell urine.

____18. You take a sip of soda, and then realize that you drank from the glass that an acquaintance of yours had been drinking from.

____19. Your friend's pet cat dies, and you have to pick up the dead body with your bare hands.

____20. You see someone put ketchup on vanilla ice cream, and eat it.

____21. You see a man with his intestines exposed after an accident.

____22. You discover that a friend of yours changes underwear only once a week.

____23. A friend offers you a piece of chocolate shaped like dog-doo.

____24. You accidentally touch the ashes of a person who has been cremated.

____25. You are about to drink a glass of milk when you smell that it is spoiled.

____26. As part of a sex education class, you are required to inflate a new unlubricated condom, using your mouth.

____27. You are walking barefoot on concrete, and you step on an earthworm.

## Appendix E

## Covariate Analysis

It was possible that political affiliation could covary with disgust sensitivity and/or age. In order to investigate the influence of these two variables on the findings in Experiment 3, separate one-way analysis for covariances (ANCOVAs) were conducted. The independent variable was political affiliation (3 levels: liberal, moderate, conservative) and covariates were age and disgust sensitivity (i.e., total score on the DS-R). The dependent variables were accuracy and RT on correct trials. Data were separately analyzed for overall face trials, identical face trials, ambiguous face trials, different face trials, and shape trials.

### Face Discrimination Task Performance

#### *All Trials*

**Accuracy.** There was a significant effect of political affiliation on face discrimination task accuracy after controlling for age and disgust sensitivity ($F(2, 598) = 14.14$, $p < .001$, $\eta_p^2 = .045$). Planned contrasts revealed that liberals ($p < .001$, 95% CI [1.29, 2.64]) and moderates ($p = .001$, 95% CI [.40, 1.60]) were significantly more accurate than conservatives when all face trial types were combined. The covariate of age was not significantly related to political affiliation ($p = .83$). In comparison, the covariate of disgust sensitivity was significantly related to political affiliation ($F(1, 598) = 20.81$, $p < .001$, $\eta_p^2 = .034$).

**Reaction Time.** There was no significant effect of political affiliation on face discrimination task RT ($p = .096$) nor was there a relationship between political affiliation and age ($p = .48$). However, there was a significant relationship between political affiliation and disgust sensitivity ($F(1,593)=5.48$, $p = .020$, $\eta_p^2 = .009$).

### *Identical Face Trials*

**Accuracy.** There was no significant effect of political affiliation on identical face trial accuracy ($p$ = .30) nor was political affiliation significantly related to age ($p$ = .79) or disgust sensitivity ($p$ = .72).

**Reaction Time.** There was a significant effect of political affiliation on identical face trial RT after controlling for age and disgust sensitivity ($F(2, 597) = 5.25$, $p = .006$, $\eta_p^2 = .017$). Planned contrasts indicated that liberals ($p$ = .019, 95% CI [.08, .87]) and moderates ($p$ = .002, 95% CI [.194, .854]) were significantly slower to complete identical face trials than conservatives. The covariate of age was not significantly related to political affiliation ($p$ = .214) but there was a significant relationship between disgust sensitivity and political affiliation ($F(1, 597) = 14.69$, $p < .001$, $\eta_p^2 = .024$).

### *Ambiguous Face Trials*

**Accuracy.** There was a significant effect of political affiliation on ambiguous face trial accuracy after controlling for age and disgust sensitivity ($F(2, 598) = 18.65$, $p < .001$, $\eta_p^2 = .059$). Planned contrasts revealed that liberals ($p$ = <.001, 95% CI [1.26, 2.45]) and moderates ($p$ <.001, 95% CI [.37, 1.37]) were significantly more accurate on ambiguous face trials than conservatives. There was no significant relationship between age and political affiliation ($p$ = .85). In comparison, disgust sensitivity was significantly related to political affiliation ($F(1, 598) = 22.15$, $p < .001$, $\eta_p^2 = .036$).

**Reaction Time.** There was no significant effect of political affiliation on ambiguous face trial RT ($p$ = .20) nor was political affiliation significantly related to age ($p$ = .25) or disgust sensitivity ($p$ = .20).

### *Different Face Trials*

**Accuracy.** There was a significant effect of political affiliation on different face trial accuracy after controlling for age and disgust sensitivity ($F(2, 598) = 5.13$, $p = .006$, $\eta_p^2 = .017$). Planned contrasts revealed that liberals ($p$ = .002, 95% CI [.12, .52]) and moderates ($p$ = .04, 95% CI [.01, .34]) completed different face trials with greater accuracy than conservatives. The age was not significantly related to political affiliation ($p$ = .80). In comparison, disgust sensitivity was significantly related to political affiliation ($F$(1, 598) = 8.34, $p$ = .004, $\eta_p^2$ = .014).

**Reaction Time.** There was a significant effect of political affiliation on different face trial RT after controlling for age and disgust sensitivity ($F$(2, 593) = 13.24, $p$ < .001, $\eta_p^2$ = .043). Planned contrasts revealed that liberals ($p$ < .001, 95% CI [-.56, -.25]) and moderates ($p$ = .023, 95% CI [-.28, -.02]) were significantly faster on different face trials than conservatives. Age was significantly related to political affiliation ($F$(1, 593) = 17.54, $p$ <.001, $\eta_p^2$ = .029), but disgust sensitivity was not ($p$ = .20).

**Shape Discrimination Task Performance**

***Accuracy***

Political affiliation had a significant effect on shape discrimination accuracy after controlling for age and disgust sensitivity ($F$(2, 602) = 15.87, $p$ < .001, $\eta_p^2$ = .050). Planned contrasts revealed that liberals ($p$ < .001, 95% CI [1.88, 3.95]) and moderates ($p$ = .001, 95% CI [.76, 2,49]) were significantly more accurate on the shape discrimination task than conservatives. The relationship between age and political affiliation was not significant ($p$ = .25). In comparison, disgust sensitivity was significantly related to political affiliation ($F$(1, 602) = 17.87, $p$ < .001, $\eta_p^2$ = .029).

***Reaction Time***

There was a significant effect of political affiliation on shape discrimination RT after controlling for age and disgust sensitivity ($F$(2, 598) = 8.79, $p$ < .001, $\eta_p^2$ = .029). Planned contrasts revealed that liberals ($p$ = .001, 95% CI [-.75, -.18]) were significantly faster to complete different face trials than conservatives. Moderates and conservatives did not significantly differ ($p$ = .53). Political affiliation was not significantly related to the covariates of age ($p$ = .50) or disgust sensitivity ($p$ = .063).

## VITA AUCTORIS

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