SOCIAL ATTENTION IN DIVERSE SOCIAL WORLDS: BICULTURALISM, RACIAL DIVERSITY, AND REGIONAL CULTURE SHAPE GAZE CUEING BEHAVIOUR

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Abstract

Observing a directional gaze triggers an attention shift in the same direction as that gaze, also known as gaze cueing. Given that gaze cueing has been observed in human infants and monkeys, it is considered a universally evolved mechanism that provides the foundation for learning about one's social world. Recent research, however, suggests that some features of gaze cueing may be shaped by culture. One such feature is whether the gaze cueing effect is interrupted by gazes embedded in the background (i.e., social context). In this dissertation, I unpack how biculturalism, racial diversity, and regional cultures can influence the extent to which gaze cueing from a focal gaze is interrupted by gazes in the social context. This dissertation uses a multi-gaze cueing task, in which a central foreground gaze and four background gazes are presented, and gaze cueing from the foreground gaze is measured. Chapter Two presents two experiments that test whether priming interdependent vs. independent self-construals can influence gaze cueing by increasing or decreasing interference from the background gazes in two different cultural populations. We found that interdependent self-construal priming was effective for bicultural East Asian Canadians, but not monocultural European Canadians. These findings suggest that being bicultural may provide the necessary long-term experience of shifting between different modes of social attention to allow self-construal primes to be effective. Chapter Three presents two experiments that test whether the social attention system prioritizes proximal features of the social environment, such as racial makeup. Across both experiments, East Asian Canadians, East Asians from East Asia, and European-descent North Americans exhibited greater attention to the gazes of own- vs. other-race faces in an ensemble coding manner. These findings suggest that gaze cueing is driven by perceived race. Chapter Four presents a comparison of gaze cueing behaviour across two

extensively examined regions, North America and East Asia, and two less explored regions, and Middle East and South Asia. Results suggest that East Asians' gaze cueing is interrupted by the gazes in the social context to a greater extent than North Americans. Middle Easterners and South Asians display "intermediate" levels of interference from the social context between East Asians and North Americans. Altogether, this dissertation presents evidence that social attention is shaped by cultural experiences found within and across regions.

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CHAPTER ONE:

Introduction

Humans are social beings. The ability to detect, process, and respond to multiple, simultaneous cues from other humans is crucial for navigating complex social worlds, and this ability is known as social cognition (Frith, 2008). Research has demonstrated that ecological underpinnings and antecedents provide the foundation for different social worlds (Witkin & Berry, 1975; Wormley et al., 2023), and processes underlying social cognition may have evolved to adapt to various social geographies. For example, it has been argued that a culture of honour found in the U.S. South (Nisbett & Cohen, 1996) and the Arab region (San Martin et al., 2018) developed from a combination of harsh environments with little natural resources, livelihoods that depended on livestock vulnerable to theft, and a lack of regional law enforcement. On the other hand, environments in which livelihood required labourious and large-scale cooperation (e.g., rice farming areas in China; Talhelm et al., 2014) may have sculpted a social world in which people require tight-knit cooperation and dependency on one another to survive. These diverse geographical environments and their resulting social worlds may have produced social cognitive mechanisms specific to these cultures.

In this dissertation research, I focus on ways the cultural environments can shape the human mind. Specifically, I examine whether culturally variable social worlds wire the mind, such that social cognitive processes function differently to detect and process culture-specific social dynamics. Through a series of investigations, I present evidence on how a social cognitive function, social attention in the form of gaze cueing, is calibrated by long-term cultural experiences, with an emphasis on diverse cultural experiences found within and across cultural regions.

Can Culture Wire Social Attention Architecture?

An investigation of how social attention varies across cultures must first acknowledge the shared, universal role social cognition plays in the common social experiences of all humans. After all, the human species has several common goals with respect to navigating the social environment (Frith, 2008). For example, one common goal is to understand what others may be thinking, and the ability to understand that others have different mental states than one's own. This important ability, known as theory of mind, is acquired at roughly the same developmental stage across different regions of the world (e.g., Canada, Peru, India, Samoa, and Thailand; Callaghan et al., 2005). Yet exposure to diverse social worlds can still influence the development of theory of mind. Children in Western cultural contexts, such as in Australia, tend to exhibit an understanding that others have diverse beliefs earlier than children in Iran (Shahaeian et al., 2011). Because Iraninan caregivers may encourage their children to endorse harmonious and non-opposing beliefs, Iranian children may develop the ability to understand diverse beliefs later than Australian children (Shahaeian et al., 2011). These findings indicate that although regions around the world may share a similar theory of mind developmental trajectory, they may exhibit culturally specific features of theory of mind.

Another important social cognitive function is the ability to attend to the attention of others. The social attention system allows individuals to learn from other individuals about biologically relevant targets in the immediate social environment, such as the location of food or threats. One way in which people orient their attention to where others are attending to is the detection and processing of others' gazes. Observing a directional gaze triggers an automatic orientation of attention in the direction of that gaze, known as gaze cueing. A gaze cue is difficult to ignore even if the gaze is known to be uninformative (Driver et al., 1999; Friesen & Kingstone, 1998). Cueing effects driven by gazes vs. exogenous cues (e.g., highlighting a

location that a target could appear in) seem to have unique properties. Attention shifts from cues that are stimulus based (e.g., highlighting a location before a target could appear in that same location) activate incredibly quickly (e.g., 50 to 200 ms) but start to produce inhibitory effects afterwards such that participants are less likely to quickly respond to targets that appeared in the location that was cued, also known as inhibition of return (Posner & Cohen, 1984). Gazes, however, seem to strongly cue attention for a longer period of time (e.g., 200 to 700 ms) before exhibiting inhibitory effects (Friesen & Kingstone, 1998; Frischen & Tipper, 2004). The automaticity of gaze cueing, coupled with the observation that gaze cueing is observed in newborn human infants (Farroni et al., 2004) and other primates (Deaner & Platt, 2003) suggest that gaze cueing is supported by universal, evolved, social cognitive mechanisms.

Yet some aspects of gaze cueing may vary depending on the cultural environment in which gaze cueing abilities develop. Using a gaze cueing task that contained a central, foreground face flanked by multiple background faces, with the foreground and background faces gazing in the same or opposite directions, Cohen and colleagues (2017) observed culturally distinct gaze cueing patterns between North Americans and East Asians. When the foreground and background faces gazed in different directions, after 200 ms both cultural groups produced a gaze cueing effect in the direction of the foreground face, suggesting that initial social attention is focused on the focal figure (i.e., foreground face), and mismatched background gazes are not processed. After 600 ms, North Americans continued to produce a gaze cueing effect from the foreground face, consistently showing no interference from the mismatched background gazes. East Asians, however, experienced weakened gaze cueing effects after 600 ms, suggesting that when given enough time East Asians experience interference from the mismatched background gazes. These results suggest that the duration of gaze cueing effects from the foreground face, in

the context of multiple background faces, may depend on culture and that East Asians are sensitive to gaze cues in the social context to a greater extent than North Americans. Like the theory of mind example, social attention across multiple gazes can be culturally variable. Importantly, the findings from Cohen and colleagues' (2017) work suggest that social attention, long presumed to be universal, can be shaped by long-term cultural experiences.

Such results converge with a host of cultural psychological research that has demonstrated theoretically similar effects on cognition, in which East Asians attend to contextual information more than North Americans (Bodoroglu et al., 2009; Ji & Yap, 2016; Nisbett, 2003; Nisbett et al., 2001; Nisbett & Miyamoto, 2005; Witkin & Berry, 1975). Specifically, studies have also provided strong evidence that East Asians exhibit greater attention than North Americans to contextual information in visual scenes (Chua et al., 2005; Masuda & Nisbett, 2001, 2006; Yang et al., 2018) and in social environments (Ji et al., 2000; Masuda et al., 2008). Importantly, Cohen and colleagues' (2017) findings converge with neurocognitive evidence that suggest cultural variation in attention to context occurs at an early and automatic stage of attention (Goto et al., 2019; Kitayama & Murata, 2013).

The Relationship Between Social Orientation and Social Attention

Why do North Americans and East Asians exhibit different gaze cueing patterns? The answer may lie in the different social worlds, and therefore social orientations, found in each culture. Social orientation has been proposed to be one of the key explanatory psychological mechanisms that underlie observed cultural variation in cognition (Varnum et al., 2010). Cultural differences in social orientations may have emerged from a host of ecological, environmental, and linguistic factors, among others (e.g., Ji et al., 2004; Miyamoto et al., 2006; Uskul et al., 2008). A wealth of cultural psychological research suggests that North American culture may

encourage a social world in which individuals construe themselves and others to be distinct and independent, and that to learn about an individual, one must attend to the individual themselves (Markus & Kitayama, 1991; Masuda et al., 2008). This may result in the formation of a largely independent social orientation. East Asian culture, on the other hand, may encourage a social world in which individuals see themselves as embedded in an interconnected network of relationships with others, and learning about an individual may require attending to their social relationships in addition to the individual (Norenzayan & Nisbett, 2000). In turn, this may result in the formation of a largely interdependent social orientation. Due to long-term exposure to these different social worlds, the social attention system may calibrate itself to spotlight culturally relevant social cues in the environment, resulting in different 'cultural defaults' for social attention. Independent social orientations are thought to lead to context-independent cognition, in which relevant social cues are found in focal targets of interest, whereas interdependent social orientations are thought to lead to context-dependent cognition, in which relevant social cues are embedded in both focal targets and social context (Nisbett et al., 2001; Varnum et al., 2010).

The underlying theoretical explanation for Cohen and colleagues' (2017) findings suggests the following causal chain of events. Individuals who live in social worlds in which independence is the norm and people are perceived to be distinct from one another may develop an independent social orientation. These individuals then develop a mode of social attention that selectively focuses on gazes of interest and filters out gazes from the social context as irrelevant. This contrasts with those who live in social worlds in which interdependence is the norm, resulting in an interdependent social orientation. These individuals, in turn, develop a mode of social attention that processes gazes embedded in the social context in addition to gazes of

interest. In Cohen and colleagues' (2017) work, the theoretical antecedent for North Americans' gaze cueing patterns (i.e., persistent gaze cueing effects from the foreground after 200 ms and 600 ms) is a greater independent social orientation and the theoretical antecedent for East Asians' gaze cueing patterns (i.e., gaze cueing effects from foreground gaze that decrease from 200 ms to 600 ms) is a greater interdependent social orientation.

However, the relationship between social orientation and cognition may not be so straightforward. There are several issues that make studying the relationship between social orientation and cognition challenging. In this dissertation, I aimed to address two of these issues by 1) experimentally manipulating social orientation to test its effects on social attention, and 2) testing social attention beyond "Eastern" vs. "Western" cultures.

Social Orientation as an Explanatory Mechanism

The first reason why examining the relationship between social orientation and cognition is not straightforward is because empirical research is often limited to quasi-experimental work. Cultural differences in cognition between North America and East Asia are assumed to result from differing social orientations, and therefore not explicitly manipulated (Matsumoto, 1999). There are, of course, practical difficulties in confirming causal mechanisms when culture, at the outset, seems unamenable to experimental manipulation. However, cultural psychologists have provided some evidence of the link towards social orientation and social cognition by using 1) within-nation designs, and 2) cultural priming. The use of within-nation designs provides a relatively useful context to examine whether within-nation regions predicted to vary in independence and interdependence have associated context-independent or context-dependent cognition, respectively, while controlling for other cultural factors that vary between-nations, such as national culture, language, and religion (e.g., Uskul et al., 2018).

Critically, cultural priming allows for experimental manipulation by priming and activating cultural mindsets. The theory of culture-as-situated-cognition proposes that individuals can access different cultural mindsets and that individuals can dynamically access these different cultural mindsets in response to environmental cues that activate these mindsets, such as independent or interdependent mindsets (Oyserman, 2011). The temporary activation of such mindsets then produces downstream psychological processes congruent with those mindsets. Under the assumption of culture as situated cognition, this suggests that experimental manipulation of independence or interdependence can be used to confirm its role as an antecedent for context-independent or context-dependent cognition, respectively.

Social Attention Beyond the East-West Dichotomy

The second reason why examining the relationship between social orientation and cognition is not straightforward is because past research has tended to treat independent and interdependent social orientations as monolithic constructs (Vignoles et al., 2016). This may originate from past empirical research on the relationship between social orientation and cognition being limited to comparisons between "Eastern" (i.e., East Asia) and "Western" (i.e., North America or Western Europe) cultural contexts, which are presumed to be associated with interdependent and independent social orientations, respectively. However, emerging evidence suggests that social orientation is multi-dimensional and not as straightforward as Western = independent, Eastern = interdependent.

Vignoles and colleagues (2016) demonstrated, for example, that independent and interdependent social orientations can be broken into various domains, such as self-containment vs. connection to others, or self-expression vs. harmony. They also demonstrated that no "Eastern" or "Western" regional culture they measured endorsed all interdependent or

independent domains to a greater extent than the global average, respectively. In fact, many of the included regional cultures, such as Middle Eastern regions, endorsed different patterns of independent and interdependent dimensions. Despite being traditionally classified as interdependent cultures, emerging research has revealed that South Asian and Middle Eastern cultures have shown a combination of both independent and interdependent dimensions of social orientation, and context-independent and -dependent cognition (Kitayama et al., 2022; Lu et al., 2020; San Martin et al., 2018). It is therefore unclear whether an association between social orientation and cognition may be observed when studying regional cultures besides North America and East Asia.

Do Proximal Factors Override, or Depend, on Culture?

Findings from Cohen and colleagues (2017) provide novel evidence about how long-term cultural experiences can impact gaze cueing. Social factors that were examined in prior research were typically proximal to the gaze cueing experiment, such as being embedded in the stimuli itself or being primed in recent environmental history (see Dalmaso et al., 2020 for an extensive review of social modulators of gaze cueing). For example, gaze cueing effects are influenced by local features of the gaze stimuli: gaze cueing is stronger for fearful (McCrackin & Itier, 2018; Tipples, 2006) and happy faces (McCracking & Itier, 2018) vs. neutral faces, for higher vs. lower social status faces (Dalmaso et al., 2012), and for dominant vs. subordinate faces (Jones et al., 2010). Social priming has also been shown to influence gaze cueing. For example, perceivers who were primed with lower power tended to exhibit stronger gaze cueing effects than those who were primed with higher power (Cui et al., 2014; Weibuch et al., 2017). These findings illustrate a relatively straightforward effect of proximal social factors influencing gaze cueing.

Given that proximal factors are, by their nature, closer to the gaze cueing behaviour than distal factors, it might be expected that proximal manipulations of the gaze stimuli or on the perceiver will be more influential than distal factors. However, it may also be the case that the effectiveness of proximal factors *depends* on distal factors affecting the perceiver. Gender of the perceiver has been examined as a distal social factor, with women tending to exhibit greater gaze cueing effects than men because they have greater social sensitivity (Cui et al., 2014; Deaner et al., 2007), and they tend to react to social manipulations to a greater extent than men. For example, women tend to exhibit greater gaze cueing when primed with low vs. high social power and when viewing familiar vs. unfamiliar gazes, compared to men (Cui et al., 2014; Deaner et al., 2007). Whether proximal factors will override long-term cultural experiences, or whether the effectiveness of proximal factors depends on culture, is unknown. In this dissertation, I tested two proximal social factors that are relevant for understanding its influence over, or together with, culture: 1) self-construal and 2) perceived race.

Can Primed Culture Override Long-Term Cultural Experiences?

Are the cultural defaults of social attention "fixed", or can they be influenced? There are theoretical reasons why cultural defaults for social attention are not likely "fixed". The theory of culture-as-situated-cognition suggests that individuals do not have fixed cultural mindsets. Instead, individuals have access to different cultural mindsets that are activated by cultural cues in recent environmental history, such as independent and interdependent self-construal primes (Oyserman, 2011). For example, exposure to interdependent self-construal primes can prepare cognitive systems to be more sensitive to social cues in the environment (Hogeveen & Obhi, 2011; Liu et al., 2019). These findings suggests that cultural mindsets that are activated from self-construal primes may potentially override cultural defaults of the social attention system.

However, it is unclear whether self-construal primes are effective for everyone. Research comparing monocultural and bicultural individuals show differential effects of priming on automatic cognition. East Asian American biculturals who were primed with interdependent self-construals were more sensitive to incongruencies between focal and contextual information at the neural level, compared to those who were primed with independent self-construal (Fong et al., 2014). European Americans, on the other hand, did not show any differences depending on the self-construal prime. Given that automatic cognitive processes may encourage the use of culturally engrained strategies (Hong & Chiu, 2001), it could be the case that monoculturals use culturally engrained strategies to a greater extent than biculturals, who may not be as deeply attached to a cultural strategy and therefore are more receptive to the effect of self-construal priming. These findings suggest that the effectiveness of self-construal priming may depend on prior long-term cultural experiences, such as biculturalism.

Can Perceived Race Override Long-Term Cultural Experiences?

In an increasingly globalized world, individuals from different cultures are afforded greater opportunities to interact with people from different cultural backgrounds and perceived races. Racial diversity is a highly visible feature of the social environment that may potentially override cultural defaults of the social attention system. Face perception research has demonstrated a relatively robust ingroup advantage for processing faces from the same racial group than faces from other racial groups. This ingroup advantage, also known as the Own-Race Bias, results in better own-race facial recognition and identification (Hugenberg et al., 2007; Hugenberg et al., 2010; Meissner & Brigham, 2001) and emotion and mental state inference (Adams et al., 2010; Elfenbein & Ambady, 2002; Friesen et al., 2019). Is there also an own-race gaze cueing effect in which gaze cueing is stronger for own- vs. other-race faces?

There is evidence to suggest that White individuals exhibit stronger gaze cueing effects from White vs. Black gazes (Pavan et al., 2011; Weisbuch et al., 2017), suggesting an own-race gaze cueing bias. However, evidence in the gaze cueing literature is mixed as to whether there are own-race gaze cueing biases for White and East Asian faces. For example, White Italians do not show different gaze cueing effects between White and East Asian faces, and Chinese from Mainland China seem to show even greater gaze cueing effects from White vs. East Asian faces (Zhang et al., 2020). Why does there not always seem to be an own-race gaze cueing bias for White and East Asian perceivers attending to White and East Asian target faces?

One possibility is that own-race gaze cueing biases depend on the perceiver's long-term experiences in the broader interracial context, a critical distal factor. Previous null findings of own-race gaze cueing bias have been observed in racially homogenous contexts, such as in Italy and China, with individuals from the racial majority. The influence of race as a proximal cue for ingroup membership may be more relevant for those who have grown up in a historically racially diverse context. For example, North America has a long history of anti-Asian racism, in which White individuals had greater status and power over East Asians (Kawai, 2005). Both perceiving the self as having higher power than the observed gaze, or perceiving the gaze as having lower status, decreases the strength of gaze cueing (Cui et al., 2014; Weisbuch et al., 2017). If White individuals from North America perceive East Asians as having lower status or power than White individuals, then in the context of the multi-gaze cueing task with White and East Asian gazes they may exhibit decreased gaze cueing effects from East Asian vs. White gazes, demonstrating an own-race gaze cueing bias.

East Asians from North America may also exhibit an own-race gaze cueing bias, but for different reasons. Since East Asians tend to have less power and status when interacting with

racial majority members, forming intra-ethnic coalitions may be an important strategy for effectively navigating through interracial social contexts (Lu et al., 2022). Attention to other East Asians may serve as an important mechanism to bolster intra-ethnic coalitions. In the context of the multi-gaze cueing task with White and East Asian gazes, then, they may exhibit increased gaze cueing effects for East Asian vs. White gazes, demonstrating an own-race gaze cueing bias.

Another possibility is that long-term cultural experiences influence whether race is perceived as a cue for ingroup membership. People from more interdependent cultures, such as East Asian culture, may have different definitions for ingroup members beyond using race. For example, East Asians may be more concerned with whether they have personal direct or indirect relationships with others than if they share racial membership (Yuki et al., 2003, 2005). This suggests that the effectiveness of own- vs. other-race faces in influencing gaze cueing may depend on long-term cultural experiences.

Overview of Dissertation Research

This dissertation aims to extend in significant ways on the initial findings by Cohen and colleagues (2017) by testing how different types of long-term cultural experiences influence gaze cueing across three manuscripts.

The three manuscripts presented in Chapters Two, Three, and Four represent two broad goals. My first goal was to explore the role of social orientation in social attention. Specifically, in Chapter Two, I experimentally tested whether social orientation affected social attention, and whether this depended on monocultural vs. bicultural experiences. In Chapter Four, I explored whether culturally variable gaze cueing patterns was linked to independent vs. interdependent social orientation across multiple regional cultures, including two understudied regions: Middle

East and South Asia, and two well-studied regions: North America and East Asia. A subgoal of Chapter Four was to provide the first empirical investigation of social attention behaviour within individuals from Middle Eastern and South Asian regions to contribute to "globalizing" cultural psychological research beyond dichotomous "Eastern" and "Western" cultural comparisons.

The second goal was to examine if proximal social factors can override culture to shape social attention, or if the effectiveness of proximal social factors depend on culture. In Chapter Two, I tested whether proximal forms of culture, such as primed independent or interdependent mindsets in European and East Asian Canadians would override long-term distal cultural experiences. In Chapter Three, I tested whether racial diversity, a highly proximal feature of the social environment impacted social attention, I further examined whether this depended on long-term cultural experiences by testing how North Americans and East Asians deploy social attention across White and Asian foreground and background gazes.

Note for Manuscripts

The order of the manuscripts presented in Chapters Two, Three, and Four is presented chronologically. The manuscript in Chapter Two was published in 2021 in *PLoS One*, and data collection took place in-laboratory before the onset of the COVID-19 pandemic. Data for the manuscripts in Chapters Three and Four were collected concurrently from 2021 to 2023 using an online version of the gaze cueing that I programmed to adapt to online data collection during the pandemic. Manuscripts in Chapters Three and Four have yet to be submitted to a journal. References are self-contained in each manuscript, and references from Chapters One and Five are contained in the final reference section.

CHAPTER TWO:

Does Self-Construal Shape Automatic Social Attention?

This chapter is adapted from a published manuscript, and minor changes have been made by request from the committee.

Lo, R. F., Ng, A. H., Cohen, A. S., & Sasaki, J. Y. (2021). Does self-construal shape automatic social attention? *PLoS One, 6*(2), e024657. https://doi.org/10.1371/journal.pone.0246577

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Abstract

We examined whether activating independent or interdependent self-construal influences attention shifting across multiple gaze cues. European Canadians (Study 1) and East Asian Canadians (Study 2) primed with independence vs. interdependence completed a multi-gaze cueing task with a central face gazing left or right, flanked by multiple background faces that either matched or mismatched the direction of the foreground gaze. Results showed that European Canadians (Study 1) mostly ignored background gaze cues and were uninfluenced by the self-construal primes. However, East Asian Canadians (Study 2), who have cultural backgrounds relevant to both independence and interdependence, showed different attention patterns by prime: those primed with interdependence were more distracted by mismatched (vs. matched) background gaze cues, whereas there was no change for those primed with independence. These findings suggest activating an interdependent self-construal prepares social attention mechanisms to be sensitive to gaze cues in the social context, but only for those who may find these representations meaningful.

Chapter Two: Does Self-Construal Shape Automatic Social Attention?

Humans easily infer what others want or feel by following their gaze (Friesen & Kingstone, 1998). This ability—called social attention—is automatic, early developing (Farroni et al., 2004), and often assumed to be resistant to external influence. Yet attention shifting to multiple gaze cues, even at the automatic level, varies in different cultures (Cohen et al., 2017). Although long-term exposure to different cultural contexts may impact the social attention system, it is unknown whether more proximal cultural information in the environment, such as cultural primes, can influence automatic processes in social attention. In the present research, we examine how activating different self-construals can influence automatic attention to gaze cues.

Central to literature on social attention is the gaze cueing paradigm: a directional gaze can facilitate reaction times to perceiving targets that eventually appear in the same vs. opposite direction (Friesen & Kingstone, 1998; Posner, 1980). This "cueing effect" occurs despite cues being uninformative about where the target appears (i.e., when only 50% of cues are valid) and even when participants are explicitly informed that cues are nonpredictive, suggesting that gaze cues trigger attention shifting automatically (Driver et al., 1999). The automaticity of the gaze cueing effect depends on stimulus onset asynchrony (SOA: interval of time between when cue and target appear). Automatic attention shifting in response to gaze cues is triggered as early as 200 ms SOA and typically persists until 600–700 ms SOA (Driver et al., 1999; Friesen & Kingstone, 1998). When the target appears 700 ms after the gaze cue, individuals have enough time to re-position their gaze, so gaze cueing effects after 700 ms tend to be weaker in magnitude or reversed because they reflect volitional, not automatic, attention.

The automatic cueing interval, however, can be penetrated by top-down knowledge (see Dalmaso et al., 2020 for a review), including the cultural context. Cohen and colleagues (2017)

found that the cueing effect varied across cultures and SOA in a multi-gaze cueing task with background gazes looking in a different direction than the foreground gaze. While there were no cultural differences at the earliest SOA (200 ms), at the later SOA (600 ms), cultural differences emerged: East Asian participants, but not European Americans, experienced interference from mismatched background gazes, interrupting automatic attention shifting from the foreground gaze. This is consistent with other cultural psychological research that has demonstrated cognitive differences between North Americans and East Asians (Nisbett et al., 2001), and specifically, attention to social contextual information, like background faces' emotional states (Masuda et al., 2008; Masuda et al., 2012) when processing visual scenes with foreground and background faces. Cohen and colleagues' (2017) findings further suggest that cultural contexts may calibrate social attention mechanisms to attend narrowly (focused on a singular face) versus broadly (across multiple background faces).

Yet what remains unknown is the level of cultural information integrated in the social attention system. Findings from Cohen and colleagues (2017) suggest that distal cultural factors can result in different settings for the social attention system due to repeated cultural inputs over time. However, can proximal factors that operate over much shorter timescales, such as cultural primes, influence the social attention system? Research suggests that proximal factors such as independent versus interdependent self-construals (i.e., representations of the self as separate from or connected to others; Markus & Kitayama, 1991) can elicit associated cognitive processes (Choi et al., 2016; Liu et al., 2019) that are relevant to social attention. If thinking of the self as connected to others can broaden the mode of social attention to integrate multiple social cues, this implicates that the social attention system, and gaze cues in particular, may be less rigid to external influences than typically regarded. The social attention system, then, may be more

susceptible to proximal information to navigate social environments that might necessitate attending to others' mental states.

However, will priming self-construal affect social attention for any cultural group? There is evidence that both self-construals co-exist to varying degrees in all individuals and are activated by specific social domains (Oyserman & Lee, 2008), suggesting, on one hand, that priming different self-construals may activate mechanisms in the social attention system for any cultural group. On the other hand, these mechanisms may be well-practiced and difficult to change (i.e., uninfluenced by priming) if the social attention system has already been set from long-term exposure. It is currently unknown whether the social attention system will prioritize proximal cultural information that differs from cultural default settings or whether the social attention system will be rigid to proximal cultural information, maintaining cultural default settings.

In Study 1, we examine whether activating independent versus interdependent self-construal can penetrate automatic mechanisms of social attention to attend more narrowly or broadly for European Canadians. In previous research, European Americans tended to exhibit a narrow mode of attention (Cohen et al., 2017), consistent with independent self-construals, so whether European Americans will prioritize the integration of the interdependent self-construal prime over their cultural defaults for a narrow mode of social attention is unknown.

Our predictions focus on conditions of mismatched cues, when foreground and background gaze directions do not match, in the automatic cueing interval (200 and 600 ms SOA). Given that prior research has successfully demonstrated that self-construal priming can shift visual attention (Choi et al., 2016; Liu et al., 2019), we hypothesized that the social attention system would, too, be malleable to proximal cultural information in the environment.

Specifically, we hypothesized that under mismatched conditions (i.e., background faces gaze in the opposite direction of the foreground face's gaze), European Canadians primed with independence should increase attention to the foreground gaze cue, which should result in significant cueing effects in the automatic cueing interval; interdependent primes should increase attention to both foreground and background, such that incongruent gazes in the background should interfere with processing foreground gazes that are congruent with the target, dampening cueing effects in the automatic cueing interval. We also include another SOA, at 1,000 ms, to increase trial diversity in the experiment and improve participant vigilance.

Given evidence that priming effects in gaze cueing are relatively proximal and may occur as early as 200 ms SOA (Cui et al., 2014; Dalmaso et al., 2012), but cultural influences are relatively distal and only observed at 600 ms SOA (Cohen et al., 2017), we did not have clear predictions about whether the predicted priming effects should occur earlier (200 ms) or later (600 ms SOA) in the automatic cueing interval.

All data, analyses, and supplementary materials are available on Open Science Framework (https://osf.io/5pqdy/).

Study 1

Method

Participants and Design

We intended to collect a minimum of 50 participants per prime group and initially recruited a sample of 138 European Canadian undergraduates to account for exclusions. Of the 138 participants, 37 were excluded and removed prior to analyses: 31 did not meet cultural background criteria (e.g., self-reporting as Middle Eastern) and 6 were unusable due to

unforeseen circumstances (e.g., not following instructions). The final sample included 101 participants (M_{age} = 20.32 years, SD_{age} = 4.76; 71.29% female) who were of Western European descent and born in Canada, with at least one parent born in Canada. These criteria ensured a relatively uniform, monocultural background, as the data collection location (Toronto) has a large proportion of recent European immigrants from countries in Southern, Central, and Eastern Europe known to be more interdependent cultures (Lalonde et al., 2013; Varnum et al., 2008). We conducted a power analysis based on findings from Cohen and colleagues (2017), with a 3-way interaction effect size of $\eta_p^2 = 0.051$. We made the conservative estimate that priming effects could be smaller than cultural group differences, so we used an $\eta_p^2 = 0.031$, or $f = 0.17$ as our estimation of a meaningful effect size to calculate power. Power analyses indicated that Study 1 has 99.2% power to detect $f = 0.17$ between Matching Condition, SOA, and Prime, with an $N = 101$, number of groups = 2 (Prime: Independent vs. Interdependent), number of measurements = 6 (Matching Condition: Matched, Mismatched × SOA: 200, 600, 1,000), correlation amongst repeated measures = 0.5 (conservative estimate), nonsphericity correction $\varepsilon = 0.75$ (conservative estimate).

This study utilized a 2 (Matching Condition: Matched background and foreground gazes vs. Mismatched background and foreground gazes) × 3 (SOA: 200 ms vs. 600 ms vs. 1,000 ms) × 2 (Prime: Independent vs. Interdependent) mixed design, with repeated measures on the first two factors.

Apparatus and Stimuli

The experiment completed in the laboratory. The multi-gaze cueing task was presented on a monitor 47.5cm (L) × 29.5 cm (W) with 1680 × 1050 pixel-resolution, positioned 60 cm away from participants. A 7-inch ICU Personal Convex Mirror was attached to the top center of

the monitor and angled downwards, so that participants' eye movements would be noticeable to the experimenter sitting behind the participant. This setup, used in previous social attention research requiring eye-movement monitoring (Kingstone & Pratt, 1999), allowed the experimenter to check that participants did not make eye movements before target onsets.

The multi-gaze cueing task, run with E-Prime Software (2.0.8.90), presented a foreground face in the center of the screen flanked by two background faces on each side (four background faces total). Each of the five faces was randomly selected from a set of 12 faces varying in gender and ethnicity, and the target was a white square (stimuli measurements are listed in Table 1).

Table 1

Stimuli Measurements used in Study 1 and 2

Stimuli	Centimeters	Degrees of Visual Angle
Background faces		
Distance from center of screen to center of image		
Left- and rightmost face	10.05	9.57°
Second left- and rightmost face	5.65	5.39°
Image size		
Whole face (left to right edge of face)	4.90	4.68°
Eye region (leftmost part of left eye to rightmost part of right eye)	3.30	3.15°
Left eye (leftmost to rightmost part of left eye)	0.95	0.91°
Foreground face		
Distance from center of screen to center of image	0	0°
Image size		
Whole face (left to right edge of face)	6.50	6.20°
Eye region (leftmost part of left eye to rightmost part of right eye)	3.85	3.68°
Left eye (leftmost to rightmost part of left eye)	1.65	1.58°
Target		
Distance from center of screen to center of image	15.30	14.53° (left or right side)
Image size	1.90	1.81°

Note. Centimeters refer to size measured on the physical monitor. Degrees of visual angle (units to measure size of stimulus on the retina) were calculated with a distance of 60 cm between participant and monitor.

Materials

Pronoun Circling Task. Participants were randomly assigned to either the independent or interdependent prime from the Pronoun Circling Task (Gardner et al., 1999). The Pronoun Circling Task was designed to make salient an independent or interdependent self-construal by reading a paragaph about an event, and circling the pronouns in the paragraph. Oyserman and Lee (2008) conducted a meta-analysis on priming tasks and found that The Pronoun Circling Task was one of the most effective priming tasks for cognitive outcomes. The paragraph in the independent prime describes an event about oneself, so all pronouns that are to be circled are personal pronouns (e.g., "I," "myself"). The paragraph in the interdependent prime version of the task describes an event about oneself along with others, so the pronouns are personal plural pronouns (e.g., "we," "us"). To safeguard against priming effects weakening across trial blocks, four different versions of the task (the original plus 3 created versions) were used per prime. The participant completed a different version of the task before each trial block, with all versions priming the same self-construal across the four experimental blocks for each. Four set orders for the versions were created via Latin square design, and each participant was assigned an order randomly without replacement.

Procedure

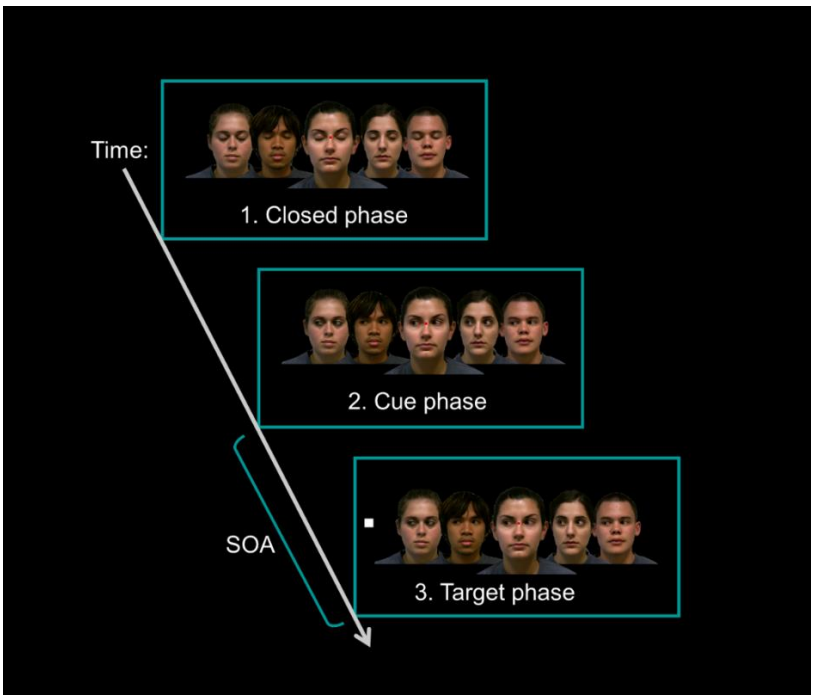
There were 520 trials in total, with 240 test trials (40 trials in each match × SOA condition), 240 filler trials, and 40 catch trials. Trials were evenly distributed across 4 blocks (130 trials per block). On test trials, foreground and background faces gazed equally and randomly to the left and right, and the target appeared equally and randomly to the left and right of faces. SOA condition was selected randomly without replacement. The foreground gaze cue was congruent with the target on half the trials and incongruent on the other half. Filler trials were like test trials except foreground and background faces gazed forward, rather than left or

right. These were included to create stimulus diversity, so that participants could not easily predict gaze direction on each trial. On catch trials, no target appeared to ensure participants were paying attention to the onset of the target and not making anticipatory responses

As seen in Figure 1, each trial had three phases. In the closed phase, all faces appeared with eyes closed for 500 ms, and the fixation dot was positioned on the foreground face between the eyes, alongside background faces. In the cue phase, foreground and background faces gazed either left or right. All background faces gazed in the same direction and were just as likely to be congruent as incongruent with the foreground face's gaze direction. In the target phase, cues remained on-screen while the target appeared to the left or right of the faces after 200, 600, or 1,000 ms from cue onset. Trials ended if participants responded with a spacebar press or if there was no response after 2,000 ms from target onset.

Figure 1

Timeline for Test Trials



Participants' reaction times (RTs) were recorded from target onset to the spacebar response. We processed the RT data by removing anticipation trials, expiration trials, and outliers (see Table 2 for a breakdown of all trials removed). In Figure 2, we illustrate how we computed the dependent variable, cueing effect index. We subtracted RTs on congruent trials (i.e., when foreground gaze predicted target location) from RTs on incongruent trials (i.e., when foreground gaze did not predict target location) for each SOA and Matching Condition (i.e., whether foreground and background gaze direction matched or not). This resulted in 6 cueing effect indices per participant (Matching Condition × SOA). A positive index indicates a stronger cueing effect from the foreground gaze, an index not different from zero indicates no cueing effect, and a negative index indicates a stronger reverse cueing effect.

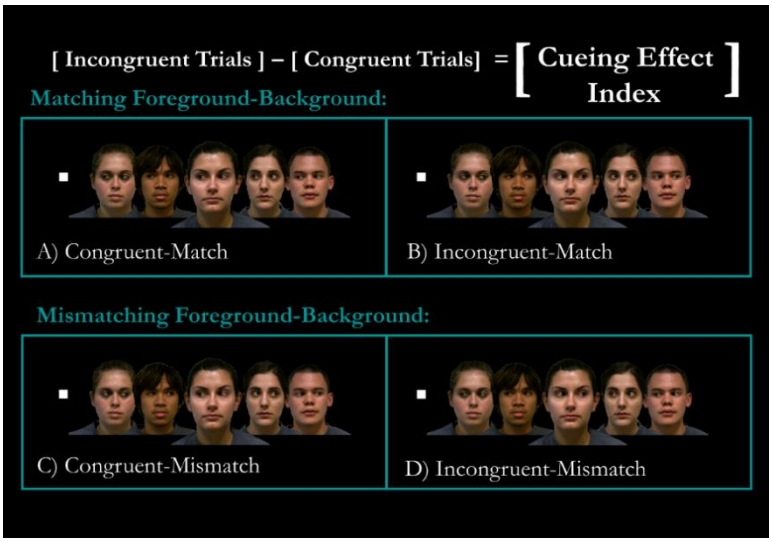
Table 2

Data Cleaning Analysis for European Canadians

	Criteria	Percentage of All Trials (%)
Outlier Trials	Reaction time to detect target was 2 SD above or below the grand mean across all trials per participant at each SOA	4.34%
Anticipation Trials	Reaction time to detect target was less than 100 ms	0.26%
Expiration Trials	Reaction time was greater 2,000 ms, indicating no response was made to locate target	0.36%

Figure 2

Trials Types and Cueing Effect Index



Note. The foreground gaze was either directed away from (incongruent, left column) or towards (congruent, right column) the target (white square), and either matched (top row) or mismatched (bottom row) background gaze cues. The cueing effect index was calculated by subtracting congruent from incongruent trial reaction times.

The experimenter instructed the participant to look at the central fixation point, and to respond with a spacebar press with their dominant hand's index finger when they see the target appear. They did not need to respond if no target appeared. Participants were also told the purpose of the mirror and to ignore it. The experimenter sat approximately 90 cm behind participants to track their gazing.

Results and Discussion

See Table 3 and Figure 3 for cueing effects by Matching Condition, SOA, and Prime. A mixed 2 × 3 × 2 ANOVA revealed a marginal main effect of Matching Condition: the cueing effect index was stronger under matched than mismatched conditions, $F(1, 99) = 3.73$, $p = .056$, $\eta_p^2 = .04$. There was a marginal interaction between Matching Condition and SOA, $F(2, 198) = 2.83$, $p = .061$, $\eta_p^2 = .03$. There was no main effect of Prime, $F(1, 99) = 0.52$, $p = .472$, $\eta_p^2 = .005$, and there were no two- or three-way interactions of Prime with Matching Condition and SOA, $ps > .55$, η_p^2s $< .004$, suggesting the primes did not shift the social attention system into narrower or wider modes of attention.

Table 3

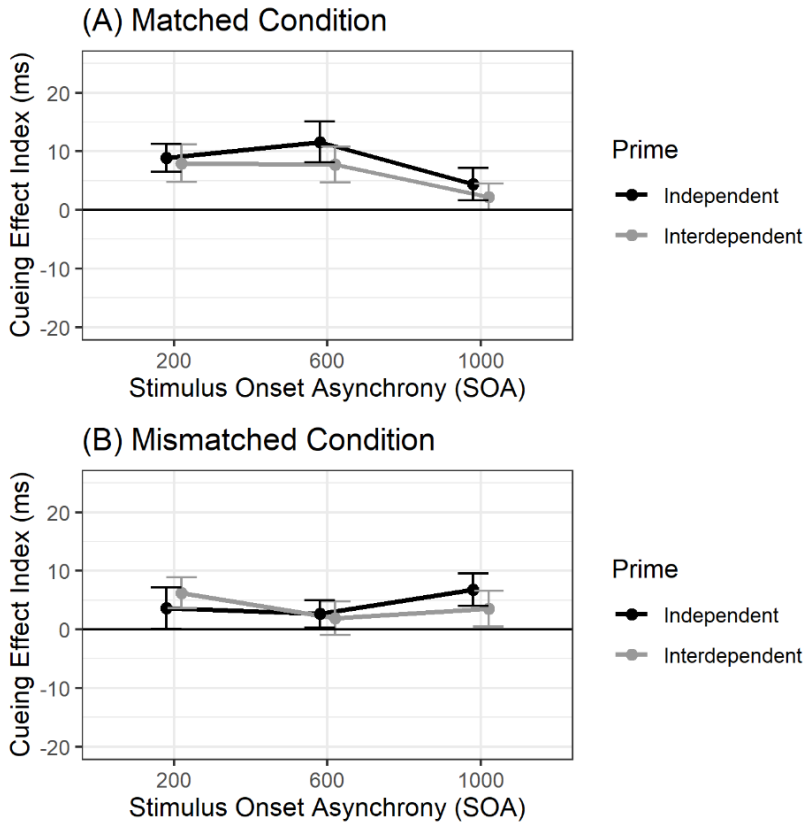
Cueing Effect Indices for European Canadians

	Matched Condition			Mismatched Condition		
	M	*SE*	95% CI	*M*	*SE*	95% CI
Independent						
200ms	8.85	2.38	[4.08, 13.62]	3.62	3.51	[-3.42, 10.66]
600 ms	11.60	3.52	[4.54, 18.66]	2.65	2.36	[-2.10, 7.39]
1,000 ms	4.40	2.77	[-1.16, 9.96]	6.78	2.77	[1.22, 12.35]
Interdependent						
200 ms	7.95	3.20	[1.52, 14.39]	6.24	2.62	[0.96, 11.51]
600 ms	7.76	3.06	[1.61, 13.91]	1.90	2.88	[-3.90, 7.69]
1,000 ms	2.23	2.24	[-2.28, 6.74]	3.58	3.05	[-2.55, 9.72]

Note. Means (*M*), standard errors (*SE*), and 95% mean confidence intervals of cueing effects by subtracting congruent foreground trials from incongruent foreground trials by Condition (Matched vs. Mismatched), Prime (Independent vs. Interdependent), and Stimulus Onset Asynchrony (SOA; 200 vs. 600 vs. 1,000 ms).

Figure 3

Cueing Effect Indices for European Canadian



Note. Cueing Effect Index as a function of SOA and prime for (A) matched and (B) mismatched conditions. Error bars represent standard error of the mean. Participants are European Canadians.

To investigate the nature of the Matching Condition × SOA interaction, we conducted one-way ANOVAs of Matching Condition on cueing effects by each SOA separately. Under 200 ms SOA, there was no effect of Matching Condition, $F(1, 100) = 1.70$, $p = .195$, $\eta_p^2 = .02$, suggesting cueing effects did not differ whether foreground and background gazes matched or mismatched. One sample *t*-tests against zero present that cueing effects are significantly above zero under both matched, $t(100) = 4.28$, $p < .001$, $d = 0.43$, and mismatched conditions, $t(100) = 2.22$, $p = .029$, $d = 0.22$.

Under 600 ms SOA, there was a significant effect of Matching Condition, $F(1, 100) = 6.24$, $p = .014$, $\eta_p^2 = .06$, where cueing effects under matched conditions were significantly greater than mismatched conditions. One sample *t*-tests against zero showed significant cueing effects under matched conditions, $t(100) = 4.16$, $p < .001$, $d = 0.41$, and no cueing effects under mismatched conditions, $t(100) = 1.24$, $p = .219$, $d = 0.12$. The lack of cueing effect under mismatched conditions at 600 ms SOA was unexpected and similar to East Asians in prior research (Cohen et al., 2017), suggesting European Canadians, under mismatched conditions, may have broadened their scope of attention to incorporate both foreground and background gaze cues. This may be a result of our European Canadians being more broadly interdependent—and similar to East Asians (Cohen et al., 2017)—than initially hypothesized. Research with other Europeans from the local context (i.e., Toronto) has suggested that non-Western European culture is highly salient, and that these European-descent individuals retain languages, cultural attitudes, and beliefs, from their heritage (Lalonde et al., 2013) which may be more interdependent in nature.

There was no significant effect of Matching Condition under 1,000 ms SOA, $F(1, 100) = 0.58$, $p = .450$, $\eta_p^2 = .006$, suggesting cueing effects did not differ whether foreground and background gazes matched or mismatched. One sample *t*-tests against zero was marginally significant for cueing effects above zero for matched conditions, $t(100) = 1.87$, $p = .064$, $d = 0.19$, and significant for cueing effects above zero for mismatched conditions, $t(100) = 2.55$, $p = .012$, $d = 0.25$. The cueing effect re-occuring at 1,000 ms SOA was unexpected, but as it occurs falls outside of the automatic cueing interval, it does not provide a meaningful understanding of whether the primes penetrated automatic mechanisms for social attention, and furthermore, there was no difference in cueing effects between primes.

In addition to our Frequentist (referred to as NHST: Null Hypothesis Significance Testing) analyses, we also conducted Bayesian analyses. A Bayesian ANOVA with a default prior, $r = 0.5$ (fixed effects), showed the data support a null model (including all lower order effects) over the alternative 3-way model (15.6:1 odds in favor of the null relative to the alternative, or $BF_{01} = 15.6$), which is consistent with our NHST analyses that the primes did not interact with matching condition or SOA.

Overall, European Canadians did not shift their patterns of social attention in response to the independent and interdependent manipulation, suggesting their social attention system was not malleable to self-construal primes. This may suggest at first glance that the social attention system, broadly, is relatively inflexible to proximal factors. However, this seems somewhat unlikely given previous research demonstrating priming effects on the social attention system (Cui et al., 2014; Dalmaso et al., 2012). Instead, it may be the case that the extent to which priming can influence the social attention system should depend on familiarity of the prime. In the context of the current study, for the social attention system to shift narrowly and broadly in response to independent and interdependent primes, respectively, the social attention system may already need experience with switching between narrow and broad modes of attention in response to environmental cues of independence and interdependence. A crucial sample to test this with would be biculturals, who engage with both a mainstream and heritage culture (Hong et al., 2000). Given that biculturals often experience switching between cultures, they may also be well-practiced in switching between different modes of social attention, so they may be more responsive to the primes. Thus, in Study 2, we test the impact of priming self-construal on the social attention system for biculturals.

Study 2

We pre-registered Study 2 to test our hypotheses with East Asian Canadian biculturals using identical analyses from Study 1 (https://osf.io/yzvmt/). Given that East Asian Canadians may be more well-practiced than European Canadians at shifting between self-construals as demanded by their different cultural contexts, we hypothesized that East Asian Canadians should respond to the prime such that those primed with independence would exhibit a narrow mode of attention with cueing effects appearing across both matched and mismatched conditions. East Asian Canadians primed with interdependence, however, should exhibit a broader mode of attention with dampened cueing effects under mismatched conditions.

Method

Participants and Design

The initial sample size was 164 participants, as we aimed to match the number of Study 1 participants (N = 101), while oversampling to account for East Asian Canadians who would not meet our inclusion criteria. Sixty-two participants were excluded from the data: 47 participants were removed for not meeting the cultural background inclusion criteria (e.g., living in East Asia for more than 16 years, one parent born in Canada, etc.), and 15 whose data were unusable due to external circumstance (e.g., participant not following instructions). The final sample included 102 East Asian Canadian undergraduates (M_{age} = 19.70 years, SD_{age} = 2.62; 55.88% female) who had not lived in East Asia for more than 16 years, with both parents born in East Asia. These criteria ensured participants were sufficiently exposed to both East Asian and Canadian culture. These also mirror the requirements Cohen and colleagues (2017) had for their East Asian monocultural sample who lived in East Asia for at least 16 years. Out of the final sample, 37 were not born in Canada (age of arrival: M = 7.54 years, SD = 4.50). Power analysis indicated that Study 2 has 99.3% power to detect a small interaction (f = 0.17, or η_p^2 = 0.03) between

Condition, SOA, and Prime conditions using the same parameters and justifications as Study 1, except for the sample size (N = 102).

Apparatus, Stimuli, Materials, and Procedure

These were identical to Study 1. See Table 4 for a breakdown of trials removed for RT processing.

Table 4

Data Cleaning Analysis for East Asian Canadians

	Criteria	Percentage of All Trials (%)
Outlier Trials	Reaction time to detect target was 2 SD above or below the grand mean across all trials per participant at each SOA	1.66%
Anticipation Trials	Reaction time to detect target was less than 100 ms	0.12%
Expiration Trials	Reaction time was greater 2,000 ms, indicating no response was made to locate target	0.20%

Results and Discussion

See Table 5 and Figure 4 for cueing effects by Matching Condition, SOA, and Prime. A mixed 2 × 3 × 2 ANOVA revealed a main effect of Matching Condition: the cueing effect was stronger under matched than mismatched conditions, $F(1, 100) = 20.02$, $p < .001$, $\eta_p^2 = .17$. There was a marginal interaction between Prime and Matching Condition, $F(1, 100) = 3.84$, $p = .053$, $\eta_p^2 = .04$. This was qualified by a marginal 3-way interaction between Prime, Matching Condition, and SOA, $F(2, 200) = 2.94$, $p = .055$, $\eta_p^2 = .03$. The effect size of this 3-way

interaction was accurately estimated from our power analyses where we conservatively estimated a potential effect size of $\eta_p^2 = .031$. Cohen and colleagues (2017) estimated $\eta_p^2 = .051$ from their 3-way Culture × Matching Condition × SOA interaction, which can be found in our 3-way Prime × Matching Condition × SOA interaction effect size confidence interval, 95% CI [0.00, 0.08], suggesting comparable effect size estimations between the two studies. Nevertheless, we acknowledge that our findings are not statistically significant by NHST standards.

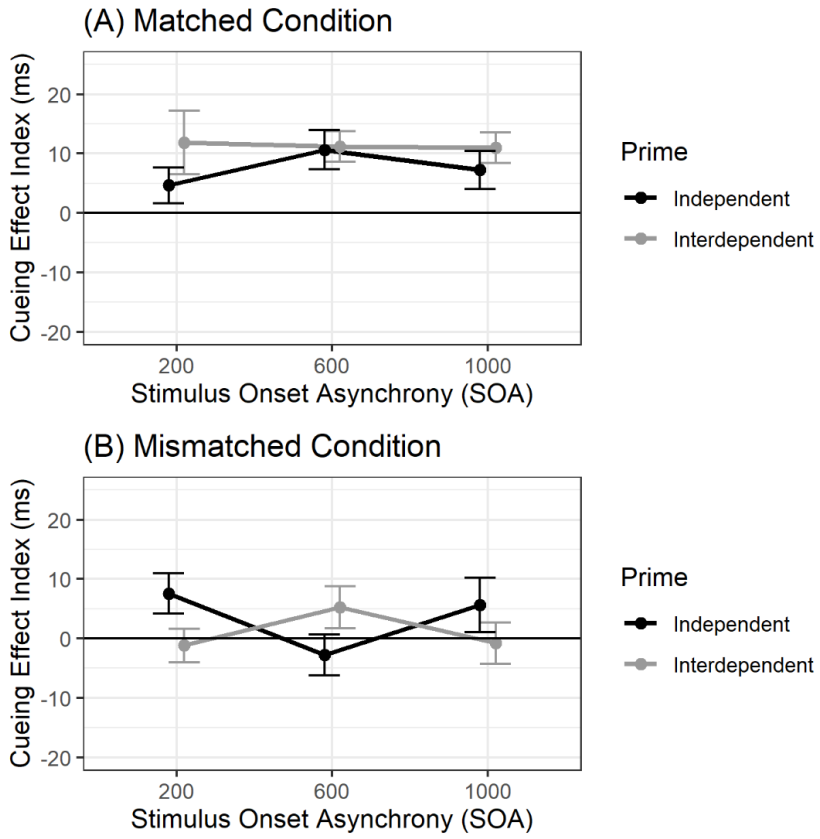
Table 5

Cueing Effect Indices for East Asian Canadians

	Matched Condition			Mismatched Condition		
	M	SE	95% CI	M	SE	95% CI
Independent						
200 ms	4.64	2.97	[-1.32, 10.60]	7.59	3.35	[0.89, 14.30]
600 ms	10.64	3.30	[4.03, 17.25]	-2.73	3.44	[-9.61, 4.15]
1,000 ms	7.24	3.18	[0.87, 13.60]	5.65	4.55	[-3.46, 14.75]
Interdependent						
200 ms	11.85	5.30	[1.16, 22.54]	-1.17	2.82	[-6.87, 4.52]
600 ms	11.19	2.60	[5.94, 16.43]	5.27	3.52	[-1.82, 12.37]
1,000 ms	11.02	2.57	[5.83, 16.20]	-0.78	3.50	[-7.84, 6.28]

Figure 4

Visualization of Cueing Effect Indices for East Asian Canadians



Note. Cueing Effect Index as a function of SOA and prime for (A) matched and (B) mismatched conditions. Error bars represent standard error of the mean. Participants are East Asian Canadians.

To examine the nature of the 3-way interaction, data were analyzed separately by SOA. Under 200 ms SOA, a 2 × 2 (Prime × Matching Condition) mixed ANOVA revealed an interaction between Prime and Matching Condition, $F(1, 100) = 5.91$, $p = .017$, $\eta_p^2 = .06$. The 95% confidence interval of the Prime × Matching Condition interaction, 95% CI [0.001, 0.16], also includes the parallel 2-way interaction effect size found in Cohen and colleagues (2017) ($\eta_p^2 = .058$). The interaction emerged because of a difference between match and mismatch

conditions for interdependent primes but not for independent primes. Specifically, for interdependent primes, the cueing effect was larger when the gaze cues matched (M = 11.84 ms, SD = 35.58 ms) than when they mismatched (M = -1.17 ms, SD = 18.95 ms), $t(100) = 2.65$, $p_{tukey} = .046$, $d = 0.26$. One sample t-tests against zero demonstrated significant cueing effects under matched conditions, $t(44) = 2.23$, $p = .031$, $d = 0.33$, but not under mismatched conditions, $t(44) = -0.42$, $p = .680$, $d = 0.06$. For independent primes, the cueing effect did not differ between matched (M = 4.64 ms, SD = 22.45 ms) and mismatched conditions (M = 7.59 ms, SD = 25.26 ms), $t(100) = -0.68$, $p_{tukey} = .91$, $d = 0.06$. One sample t-tests against zero were significant for the mismatched condition, $t(56) = 2.27$, $p = .03$, $d = 0.30$, but not for the matched condition, $t(56) = 1.56$, $p = .12$, $d = 0.21$. This suggests that at 200 ms SOA, those primed with interdependence integrated the background gaze cues, particularly the mismatched ones, which interfered with processing foreground gaze cues at an early stage of the automatic cueing interval. Those primed with independence, however, still exhibited cueing effects from the foreground gaze under mismatched conditions, suggesting more attention to the foreground gaze.

Under 600 ms SOA, a 2 × 2 (Prime × Matching Condition) mixed ANOVA revealed that the predicted Prime × Matching Condition interaction was not significant, $F(1, 100) = 1.11$, $p = .295$, $\eta_p^2 = .01$. There was a main effect of Matching Condition, $F(1, 100) = 7.42$, $p = .008$, $\eta_p^2 = .07$, where matched conditions produced greater cueing effects than mismatched conditions Collapsing across prime groups, those in the matched condition produced cueing effects above zero, $t(101) = 5.03$, $p < .001$, $d = 0.50$, but those in the mismatched condition did not, $t(101) = 0.32$, $p = .748$, $d = 0.03$.

For those primed with independence under mismatched conditions, experiencing a cueing effect at 200 ms SOA, but not at 600 ms SOA suggests the background gazes interfered with

foreground gaze cueing at a later (i.e., 600 ms) SOA, replicating previous effects found for unprimed East Asians (Cohen et al., 2017), suggesting a null effect of the independent prime. Those primed with interdependence under mismatched conditions, however, experienced no cueing effect across both 200 and 600 ms SOA, suggesting that manipulating self-construal can impact social attention mechanisms even earlier than distal cultural factors previously shown to affect gaze cueing at 600 ms SOA (Cohen et al., 2017). Importantly, the current study's effect sizes are comparable to Cohen and colleagues' (2017) previous findings, suggesting that self-construal may be one aspect of the cultural environment that can program the social attention system.

Under 1,000 ms SOA, a 2 × 2 (Prime × Condition) mixed ANOVA revealed a main effect of Condition, $F(1, 100) = 4.64$, $p = .034$, $\eta_p^2 = .04$, where matched conditions produced greater cueing effects than mismatched conditions. The Prime × Condition interaction was not significant, $F(1, 100) = 2.70$, $p = .104$, $\eta_p^2 = .03$. Again, collapsing across prime groups, those in the matched condition produced cueing effects above zero, $t(101) = 4.23$, $p < .001$, $d = 0.42$, but those in the mismatched condition did not, $t(101) = 0.94$, $p = .35$, $d = 0.09$. The persistent cueing effect at 1,000 ms SOA under mismatched conditions was unexpected, but again, cueing effects outside the automatic cueing interval are uninterpretable in the context of the current research question. A 1,000 ms condition was included in part to conform to prior studies which typically include a long SOA and in part to prevent participants from predicting when the target would appear, forcing them to attend to where it appeared. If participants know when a target will appear, they can press the response key after the known delay without needing to attend to where it appears, undermining the logic of the spatial gaze cueing paradigm.

The Bayesian analysis allows clearer interpretation of the direction of evidence towards the null or alternative: A Bayesian ANOVA (all analyses described used a default prior, $r = 0.5$, fixed effects) showed the data barely support the alternative 3-way model over the null model (including all lower order effects), with 1.5:1 odds in favor of the alternative 3-way model ($BF_{10} = 1.5$). The support is not strong (Bayes factors are considered "substantial" when they are at least greater than 3; Jeffreys, 1961). At the 200 ms SOA, the data support models containing the Condition × Prime interaction over equivalent models without the effect, $BF_{incl} = 3.25$, but at the 600 ms SOA, the data most strongly favor models with only the Condition main effect, $BF_{incl} = 19.3$, consistent with NHST analyses.

For the interdependent prime group, Bayesian *t*-tests (all tests described used a default Cauchy prior, width = $1/\sqrt{2}$) found evidence for the null (cueing effect not different from zero) over the alternative hypothesis (cueing effect greater than zero) at the 200 ms SOA, $BF_{01} = 5.70$, and weak evidence for the null at the 600 ms SOA, $BF_{01} = 2.19$. For the independent prime group, the evidence favored the null over the alternative at the 600 ms SOA, $BF_{01} = 5.12$ but not at the 200 ms SOA, $BF_{01} = 0.65$. These Bayesian results converge with the NHST results to suggest that the interdependent prime resulted in interference from the background gaze cues at 200 ms SOA, with less strong evidence at 600 ms SOA. Converging across NHST and Bayesian results for the independent prime, there was inconclusive evidence at 200 ms SOA, and weakened cueing effects at 600 ms SOA. These results suggest that the independent prime was not effective at shifting the mode of social attention to be narrowed on the foreground gaze.

In additional analyses, we examined whether including birth status (i.e., being born in Canada or not) as a covariate resulted in differences in this 3-way interaction, given that some participants were born in Canada ($n = 65$), and some were born elsewhere but arrived in Canada

at a very early age (n = 37). Birth status had a significant effect, $F(1, 99) = 5.31$, $p = .023$, $\eta_p^2 = .05$. Those who were born in Canada had smaller cueing effects, $M = 3.65$, $SE = 1.16$, 95% CI [1.37, 5.39], than those who were not born in Canada, $M = 9.64$, $SE = 1.95$, 95% CI [5.80, 13.50]. This can be interpereted as those born in Canada may experience interference from the background gaze cues compared to those who were not born in Canada. After accounting for birth status, the 3-way interaction between Prime, SOA, and Condition becomes conventionally significant, and the effect size is identical to the original 3-way interaction, $F(2, 198) = 3.14$, $p = .045$, $\eta_p^2 = .03$. These covariate results suggest that birth status did not substantially influence the presented results.

General Discussion

This research demonstrates that proximally activated self-construals can influence mechanisms of social attention, but crucially, this effect existed only among biculturals (Study 2), who should be sensitive to and experienced with both independent and interdependent self-construals, and not monoculturals (Study 1). Indeed, we provided some initial evidence that self-construal primes may only influence the social attention system for cultural groups such as East Asian biculturals that likely have experience shifting their attention to attend more narrowly or more broadly in response to culturally relevant cues in their environment.

When primed with interdependence, East Asian Canadians were influenced by mismatched gaze cues. Interdependence broadened their scope of attention, leading them to attend more to background gaze cues and interfering with attention shifting in response to the foreground gaze cue. We initially considered that priming effects could happen either at 200 ms SOA, because priming can immediately activate related concepts (Cui et al., 2014; Dalmaso et

al., 2012), or at 600 ms SOA, because research shows distal cultural influences penetrate the social attention system after a minimum amount of time has passed (Cohen et al., 2017). In the present research, interdependent priming reduced the cueing effect across both 200 *and* 600 ms SOA, suggesting proximal cultural factors, such as primed self-construal, can have a quicker and longer lasting influence on the social attention system than even distal cultural factors.

When primed with independence, East Asian Canadians unexpectedly were still influenced by mismatched gaze cues and showed no cueing effect at the later automatic cueing interval, 600 ms SOA, while the cueing effect did appear at the earlier, 200 ms SOA. This is similar to monocultural East Asians that were not primed with self-construal found in previous research (Cohen et al., 2017). Although in the current study we expected that East Asian Canadians primed with independence would show the cueing effect at both 200 ms and 600 ms SOA, it is possible that East Asian Canadians have a primarily interdependent self-construal, and the proximal independence prime was not enough to switch the social attention system into a narrow scope of attention in the later automatic cueing interval.

Yet, importantly, automatic cueing patterns differed for East Asian Canadians depending on whether they were primed with interdependence or independence. These results suggest that highlighting the self as separate or connected to others can change attentional strategies at the automatic level. Even for the same group of biculturals—in this case, East Asian Canadians—it seems that their social attention system may operate differently at an automatic level depending on whether they think of themselves as independent or interdependent in the moment. Previous research has also demonstrated that priming proximal information can result in different attention strategies (Choi et al., 2016; Liu et al., 2019; Ueda et al., 2012). Yet the current research demonstrates that even at the automatic level, self-construal is an important aspect of the cultural

environment that can program the social attention system. More broadly, the visual attention system may allow itself to be continuously shaped throughout adulthood by proximal environmental influences to adjust across varying social environments. Biculturals may develop the capacity for different attention strategies and readily integrate social orientation information to shift attentional settings to suit their current social environments.

The current research demonstrates the necessity of examining multiple cultural groups to test how predictions generalize to other populations. If we had only conducted this study with European Canadians (Study 1), we would have incorrectly concluded that the social attention system could not be modulated by proximal cultural information in the environment and that the calibration of the social attention system remains relatively rigid from early development. Yet although European Canadians were indeed uninfluenced by self-construal primes in Study 1, Study 2 demonstrated that East Asian Canadians were influenced by priming and diverged from the typical automatic cueing effect: when foreground and background gazes mismatched, East Asian Canadians seemed to find these mixed signals distracting, particularly after the interdependent prime.

This divergent effect of self-construal primes on social attention shifting for monoculturals vs. biculturals has implications for understanding how proximal cultural information is integrated into not only the social attention system, but also the visual attention system more broadly. Our findings suggest that proximally activated information must be easily accessible and well-practiced in order to impact bottom-up, attentional processes. Similar findings have also been demonstrated in previous research with self-construal priming and biculturals, where European Americans fail to show differential cognitive responses to

independent and interdependent self-construal primes compared to East Asian American biculturals (Fong et al., 2014; Gardner et al., 2004; Xi et al., 2018).

At first glance, these findings of self-construal priming on biculturals collectively seem to contradict research suggesting the co-existence of different self-construals in any cultural group (Oyserman, 2011; Oyserman & Lee, 2008) and self-construal priming effects on visual attention in multiple cultural groups (Choi et al., 2016; Liu et al., 2019). Whether self-construal priming effects can shape visual attention, however, may depend on task conditions. Hong and Chiu (2001) suggested that the use of culture-specific strategies may be more likely to occur under conditions of high cognitive load or when rapid decision making is required, which may encourage the use of culturally engrained strategies. This might suggest that with the multi-gaze cueing task, where rapid decision making is required, European Canadian monoculturals defaulted to culturally engrained strategies, which was to maintain a narrow mode of attention. In contrast, East Asian Canadian biculturals may not be deeply attached to a culturally engrained strategy as strongly as monoculturals; their experience deploying both narrow and broader modes of attention might result in an attention system that is more malleable to proximal influences and can flexibly shift between different modes of attention.

Another potential reason why priming failed to shift European Canadians' modes of attention in the current study may be that the multi-gaze cueing task demands rapid responses to complex social stimuli, as opposed to non-social stimuli (e.g., natural scenes, dots) used by past studies to test the effects of self-construal priming on attention (Choi et al., 2016; Liu et al., 2019). Prior experience shifting between modes of attention may not be as important for non-social stimuli as it is for social stimuli because the latter is associated with social norms of appropriate behavior and potential social consequences. In the current study's context, European

Canadians may not have as much experience reflexively attending to the social cues of the group, resulting in rigid orienting to the individual.

The current findings also have implications for elucidating psychological mechanisms that underlie known cultural differences in visual attention. Social orientation (towards independent or interdependent thinking) is largely considered the explanatory mechanism that underlies cultural variation in analytical or holistic thinking (Varnum et al., 2010). Results from Study 2 suggest that when East Asian Canadians are primed with an interdependent self-construal, they tend to deploy a broader mode of attention to integrate background gaze cues, which supports the proposed link between interdependence and holistic thinking. Our findings provide initial evidence that shifts in social orientation can cause variation in automatic social attention strategies. Furthermore, our findings extend cultural psychological research beyond group comparison research by explicitly manipulating proposed proximal mechanisms that underlie cultural variation in cognition (see Miyamoto, 2013 for more on proximal vs. distal influences that underlie cultural variation in cognition).

We found significant cueing effects at 1,000 ms SOA under some matched and mismatched conditions. In a “single face” gaze-cueing task, the cueing effect typically disappears or reverses (gaze cues facilitate detecting targets that appear in the opposite direction) by 1,000 ms SOA (Frischen & Tipper, 2004; Posner & Cohen, 1984; however, this is not always the case; see Frischen & Tipper, 2006). In a task with complex social stimuli in the background, disappearing or reversed cueing effects may not be as typical at 1,000 ms SOA, so using prior research from other tasks to understand what happens at long SOAs in the multi-gaze cueing task may be misleading. Considering that 1,000 ms SOA is when voluntary attention shifting can

occur, the mixed results at 1,000 ms SOA should not impact the findings found within the automatic cueing interval.

We did not include a control condition in which participants received no self-construal prime. A control condition would be useful for interpreting certain priming effects across the two studies, illuminating whether the independent prime is influencing attention shifting from baseline, the interdependent prime is influencing attention shifting from baseline, or both. A further question, however, is what exactly a "baseline" should be for biculturals. How unprimed biculturals would react to this task is unclear because biculturals have multiple ways of negotiating their cultural backgrounds and associated values (West et al., 2017). These different bicultural negotiation strategies may then result in different "baseline" patterns of attention shifting. Future research using this task on unprimed biculturals, perhaps together with specific biculturalism measures, would help document how acculturation shapes automatic social attention processes.

Overall, these findings suggest that proximal cultural factors can shape social attention mechanisms to attune to culturally important information in a complex social environment and that priming interdependent self-construal can further activate a broader scope of attention in the social attention system. These self-construals may also have different downstream consequences for those who attach significance to them. It is imperative, then that social attention research includes people from different societies since distal sociocultural experiences not only calibrate the social attention system itself, but also interface with proximal cultural factors to shape social attention.

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CHAPTER THREE:

Racial Context Influences

Reflexive Gaze Cueing Behaviour

Abstract

Observation of another person's directional gaze produces a shift in attention in the same direction; this is called gaze cueing. Past research has shown that whether the gaze is the same or different race as the perceiver's influences degree of gaze cueing. In the present research, two studies were conducted to test whether perceived race of the gaze influences gaze cueing in a context with multiple gazes, and whether this depends on culture. Study 1 recruited European and East Asian Canadians, and Study 2 recruited White North Americans and East Asians from East Asia. Participants completed a multi-gaze cueing task where the direction of the foreground and multiple background gazes matched or mismatched. Race of the foreground face (Asian vs. White) was manipulated in both studies. The race of the background faces was White in Study 1 or Asian vs. White in Study 2. Gaze cueing was measured at both an early and later stage of automatic attention (200 or 600 ms SOA). Study 1 results revealed gaze cueing behaviour that reflected a preference for own-race faces, but this pattern of gaze cueing behaviour was found across trials instead of trial-by-trial. For European Canadians, their gaze cueing effect at 200 ms SOA was strong, but at 600 ms SOA their gaze cueing effect was interrupted by White background gazes. For East Asian Canadians, however, a consistent gaze cueing pattern of the foreground gaze was found from 200 to 600 ms SOA, with no apparent interference experienced from White background gazes. Study 2 results revealed that when foreground and background faces could contain own- and other-race faces, both cultural groups exhibited persistent cueing effects from the foreground gaze across SOAs. Altogether, findings reveal that complex social scenes recruit broad social attention strategies that are sensitive to racial cues.

Chapter Three: Racial Context Influences Reflexive Gaze Cueing Behaviour

Observing another person's gaze triggers an automatic orientation of attention in the direction of that gaze, also known as gaze cueing (Friesen & Kingstone, 1998). Research has suggested that both distal and proximal sociocultural factors can modulate the strength of gaze cueing (Cohen et al., 2017; Dalmaso et al., 2020; Lo et al., 2021). Culture, a relatively distal factor, can influence the persistence of gaze cueing across multiple faces over time (Cohen et al., 2017). Whether the gaze comes from the same perceived race, a relatively proximal[1] factor, has also been shown to influence gaze cueing (Pavan et al., 2011; Weisbuch et al., 2017; Zhang et al., 2020). As globalization around the world continues, the frequency with which people from different cultures interact with people from different races is steadily increasing, so understanding how the culture of the perceiver, and race of the perceived face, jointly influence social cognition is vital. In two studies, we test how culture and race influence gaze cueing across multiple gazes.

Culture Influences Social Attention

In the gaze cueing paradigm, a central face gazes to the left or right (Friesen & Kingstone, 1998). Shortly after, a target appears to the left or right of the central face, and participants are instructed to respond by pressing a key once they detected the target. A gaze cue (i.e., the direction of the central face's gaze) in the same direction as the target's location has been shown to elicit faster responses than when the gaze cue is not in the same direction. This occurs because attention is shifted in the direction of the gaze cue and therefore more time is needed to correct the orientation of the attention if the attention has been shifted in a direction

[1] The assumption that culture is distal comes from the logic that its influence is from past historical exposure and is not explicitly highlighted or embedded in the moment of behaviour. We acknowledge that the influence of perceiving an own- or other-race face is also distal because it comes from past historical experiences as a racial majority or minority member in a racially diverse context. Relative to culture, however, race is proximal because it is visually embedded in the target of attention.

opposite to the target's location. Gaze cueing occurs even when gaze cues are known to be nonpredictive of target locations (Driver et al., 1999; Friesen & Kingstone, 1998), suggesting that mechanisms supporting gaze cueing are triggered in an automatic fashion and hard to inhibit.

The size of gaze cueing effects typically depend on how quickly the target appears after the gaze cue, otherwise known as stimulus onset asynchrony (SOA). When the target appears 200–700 ms after the gaze cue appears, the gaze cueing effect is considered automatically triggered because individuals consistently orient their attention toward the direction of the gaze cue, influencing how quickly they can respond to the target after (Driver et al., 1999; Friesen & Kingstone, 1998; Friesen et al., 2005). However, when the target appears 700 ms after the gaze cue, individuals have enough time to deliberately re-orient their attention to their original position. Gaze cueing effects after 700 ms, therefore, tend to reflect volitional, not automatic attention, and are typically smaller than when SOAs are less than 700 ms (Frischen & Tipper, 2004).

Cohen and colleagues (2017) examined cultural variation in gaze cueing in the context of multiple gazes. They compared North Americans' and East Asians' gaze cueing effects with a multi-gaze cueing task that presented a central, focal face flanked by multiple background faces. The foreground face and all background faces gazed in different directions, and a peripheral target appeared either 200, 600, or 1,000 ms after the gaze cues. They observed cultural differences in the pattern of gaze cueing effects from 200 ms to 600 ms SOA when the foreground and background faces gazed in mismatched directions. For North Americans, their gaze cueing effects persisted across 200 ms to 600 ms (i.e., early and late stages of automatic cueing) suggesting that their attention was consistently oriented in the same direction as the

foreground gaze. East Asians, however, exhibited a gaze cueing effect at 200 ms that weakened at 600 ms SOA. This cultural difference in gaze cueing patterns across SOAs is explained by 600 ms, but not 200 ms, providing sufficient time for mismatched background gazes to be processed. At 600 ms SOA, North Americans seemed able to ignore the mismatched background gazes, but East Asians could not, resulting in mismatched background gazes interrupting East Asians' gaze cueing effects from the foreground gaze.

Together, these results suggest that cultural experiences that emphasize greater attention to social relationships, such as East Asian culture, may encourage a mode of social attention that includes background gaze cues in the social context. Importantly, the influence of culture was also observed during the automatic cueing interval, suggesting that culture can shape automatic processes underlying social attention.

Own-Race Bias and Social Attention

Besides culture, other sociocultural factors may shape how social attention is deployed. One important predictor of attention towards others may be whether they are racial ingroup members. Thus, what race face the gaze cue is coming from may influence how people deploy attention.

Research has shown an ingroup advantage for processing own- vs. other-race faces. For example, research on the Own-Race Bias indicates that people are better at recognizing faces from their own vs. other races (Hugenberg et al., 2007; Hugenberg et al., 2010; Meissner & Brigham, 2001; Vingilis-Jaremko et al., 2020). People are also more accurate at identifying emotional and mental states on own-race faces (Adams et al., 2010; Elfenbein & Ambady, 2002; Friesen et al., 2019; Lo et al., 2022). One potential mechanism of these ingroup advantages may

be attention to the eyes, with perceivers attending more to the eyes of own- vs. other-race faces, leading to better identification and more accurate emotion and mental state inferences (Friesen et al., 2019; Kawakami et al., 2014).

Given that gaze cueing effects are related to attention to the eyes and that own-race faces elicit stronger attention to the eyes, gaze cueing effects may be larger for own- vs. other-race faces. There is evidence to suggest this is the case in the context of White and Black faces. When presented with a singular face with the race of the face varying between White and Black, White individuals from the U.S. and Italy exhibit reflexive own-race gaze cueing biases: specifically, they exhibit stronger gaze cueing effects from White vs. Black faces (Pavan et al., 2011; Zhang et al., 2020; Weisbuch et al., 2017). They also experience greater attentional interference when White vs. Black faces are embedded in the social context as background faces (Dalmaso et al., 2015). These findings suggest that White individuals exhibit attentional preference for the gazes of White vs. Black faces.

In the context of White and East Asian faces, however, evidence is mixed. Zhang and colleagues (2020) tested gaze cueing effects from White and East Asian faces with White Italians and Mainland Chinese in their respective countries. They found that Italians exhibited similar gaze cueing effects from both White and East Asian faces, and Mainland Chinese perceivers consistently exhibited gaze cueing effects for White faces over East Asian faces (Zhang et al., 2020). This pattern of findings may be explained by the perceived power or status associated with certain racial groups in a given social context, with individuals exhibiting smaller gaze cueing effects when attending to faces from racial groups with lower perceived power (Weibuch et al., 2017). Zhang and colleagues' (2020) results suggest that Italians may not perceive East Asians as particularly low status or power, and that Mainland Chinese may perceive White

individuals as having relatively high status or power compared to members of their own race (Qian et al., 2016).

Own-Race Gaze Cueing Bias with White and East Asian Faces in North American Context

However, Zhang and colleagues' findings may be limited to the cultural and interracial context in which these findings were observed. Their participants were White Italians from Italy and Chinese from Mainland China, both of whom grew up as the racial majority in racially homogenous countries. Their findings may not replicate with White and East Asian individuals from a North American cultural context. Compared to Italy or China, North America is racially diverse, with White individuals being the racial majority group. There is a long history of discrimination and racism from White individuals towards East Asian individuals (see Lo et al., 2022 and Padgett et al., 2020 for explorations of East Asian Americans and Canadians' racially minoritized experiences), and East Asians are perceived to have less power or status. Given the robust own-race advantages in identification and emotion recognition for White North Americans (Elfenbein & Ambady, 2002; Meissner & Brigham, 2001), and that perceiving lower power or status gazes (e.g., White individuals perceiving East Asian gazes) is associated with weaker gaze cueing effects (Weisbuch et al., 2017), White North Americans are predicted to exhibit own-race gaze cueing biases for White vs. East Asian faces.

Unlike the Chinese from Mainland China in Zhang and colleagues' (2020) findings, East Asians in North Americans are a racially minoritized social group with less power and status compared to White individuals. It may therefore be important for East Asians in North America to prioritize attention towards own-race individuals and engage in greater intra-ethnic coalition to navigate interracial social contexts (e.g., Lu et al., 2022). Initial evidence for East Asians in North America engaging in preferential attention towards own-race individuals faces comes from

East Asian Canadians demonstrating better recognition of East Asian faces over White faces (Vingilis-Jaremko et al., 2020). Therefore, East Asian individuals in North America are predicted to exhibit own-race gaze cueing biases for East Asian vs. White faces.

Cultural Variation in the Own-Race Gaze Cueing Bias

An alternative outcome to the own-race gaze cueing bias hypothesis may be that the own-race gaze cueing bias may depend on culture. The ingroup–outgroup distinction that race is thought to cue may depend on cultural upbringing. Whereas people from independent cultures may use racial group membership as an important cue for identifying ingroup members, people from interdependent cultures may be more concerned with their personal, direct or indirect, relationships with an ingroup member, suggesting their attention is not necessarily biased towards strangers in a racial ingroup over a racial outgroup (Yuki et al., 2003, 2005). Ng and colleagues (2016) demonstrated that although European Canadians exhibited an ingroup advantage for recognizing the faces of experimentally manipulated minimal groups (e.g., university affiliation), 1st generation East Asian Canadians did not exhibit an ingroup advantage. Research on Chinese individuals' attention towards gazes from outgroup members (i.e., Koreans) demonstrated no such ingroup bias for Chinese vs. Korean gazes (although different effects emerge when gazes belong to outgroup members manipulated to be threatening; Chen & Zhao, 2015). For East Asians, a social category such as racial membership may not be sufficient to cue ingroup advantages in social cognition, like the own-race gaze cueing bias. Another possibility, then, is that White individuals in North America may exhibit an own-race bias, but East Asian individuals may not.

Overview of the Current Studies

In two studies, we sought to test own-race gaze cueing biases in a multiple gaze context, and whether this depended on culture. We used a multi-gaze cueing task, which measures whether attention oriented by the focal gaze of interest (i.e., from the central, foreground face), is interrupted by gazes embedded in the social context (i.e., background faces) across early and late stages of automatic cueing (i.e., 200 ms and 600 ms SOA). In Study 1, we tested European and East Asian Canadians, and the multi-gaze cueing task comprised of only White faces in the background, but the race of the foreground varied between White or Asian. In Study 2, we tested European Americans and East Asians, and both the foreground and background faces in the multi-gaze cueing task varied by race (White or Asian).

Study 1

In Study 1, we proposed different sets of hypotheses depending on whether the foreground and background faces were the same vs. different race. When foreground and background race are both White, there is no competing race information between the foreground and background faces. Therefore, when the race of the foreground and background faces are White, we expected that each cultural group would exhibit a pattern of gaze cueing that was typical for their cultural group (Cohen et al., 2017): European Canadians should experience persistent gaze cueing effects across both SOAs, whereas East Asian Canadians should experience stronger gaze cueing effects at 200 ms vs. 600 ms SOA.

When foreground and background race are not the same, however, there is an opportunity to test for an own-race gaze cueing bias, and whether culture moderates the own-race gaze cueing bias. For trials with an Asian foreground face and White background faces, the following competing hypotheses are proposed:

1. In the *own-race bias hypothesis*, both cultural groups will exhibit greater attention to own- vs. other-race faces. European Canadians should exhibit a stronger gaze cueing effect at 200 ms vs. 600 ms SOA. This would suggest that when they are given enough time, European Canadians experience a weaker gaze cueing effect from Asian foreground faces and interference from White background gazes. East Asian Canadians should exhibit a strong gaze cueing effect at both 200 ms and 600 ms SOA, reflecting that East Asian Canadians prioritize attention to Asian foreground face and are able to ignore White background faces.
2. In the *cultural moderation hypothesis*, culture should moderate the own-race gaze cueing bias effect. Specifically, European Canadians are hypothesized to exhibit an own-race gaze cueing bias, by demonstrating a stronger gaze cueing effect at 200 ms vs. 600 ms SOA. East Asian Canadians, on the other hand, are hypothesized to exhibit a typical gaze cueing bias influenced by culture and not an own-race gaze cueing bias. This means they will also exhibit a stronger gaze cueing effect at 200 ms vs. 600 ms SOA (as observed in Cohen et al., 2017). Effectively, both cultural groups should show stronger gaze cueing effects at 200 ms vs. 600 ms SOA, but this pattern should be driven by different underlying mechanisms.

Previous research using the multi-gaze cueing task typically manipulate whether foreground and background faces gaze in matched or mismatched directions, and cultural variation in gaze cueing patterns typically occurred under mismatched conditions (Cohen et al., 2017; Lo et al., 2021). Given that the current set of studies are the first to manipulate race with the multi-gaze cueing task, it was unclear whether the effect of different race faces between the foreground and background would only influence gaze cueing if the background faces were

also gazing in mismatched vs. matched directions with the foreground face. In the current studies, we include matching condition as an experimental factor to ensure trial diversity, but we did not have any explicit predictions about whether the hypothesized effects would be observed under mismatched vs. matched conditions.

Method

Participants and Design

The sample size goal was to recruit a minimum of 50 European Canadians and 50 East Asian Canadians. This goal was set to meet an oversampling estimate for minimum overall sample size of 76 calculated from an a priori power analysis, to detect an effect size of $f = 0.17$ (approximately $\eta_p^2 = 0.031$, Lo et al., 2021) with 95% power, 0.05 error rate, for a repeated-measures design (2 groups, 4 measures). We recruited 104 participants, but we removed four participants because there were technical issues reported while completing the study (e.g., participant's computer shutting down). The final sample size was 100 participants: 52 East Asian Canadians (M_{age} = 19.60 years, SD_{age} = 2.56, 65% female, 31% male, 4% other) and 48 European Canadians (M_{age} = 21.40 years, SD_{age} = 5.87, 75% female, 23% male, 2% other). European Canadians were of Western European descent, born in Canada, with both parents born in Canada. East Asian Canadians were of East Asian descent, with both parents born in East Asia (e.g., China, Hong Kong, South Korea). Most were Chinese ethnicity (85%), with the minority being Korean (12%), and one being mixed East Asian ethnicities. Over three quarters of the East Asian Canadians were born in Canada (77%), with the rest arriving in Canada between the ages of 0 and 11 years, and 6.70 years was the average age of arrival to Canada (SD = 4.14). Participants were recruited from York University's undergraduate research pool, who were compensated with course credit.

This study used a 2 (Culture: European Canadian vs. East Asian Canadan) × 2 (Matching Condition: Matched background and foreground gazes vs. Mismatched background and foreground gazes) × 2 (SOA: 200 ms vs. 600 ms) × 2 (Foreground Race: White vs. Asian) mixed design, with the last three factors as within-subjects.

Multi-Gaze Cueing Task

Sixteen unique face stimuli from the Chicago Face Database (Ma et al., 2015) were used, with eight East Asian and eight White faces (four male and four female for each race). Using the norming data provided by Chicago Face Database, we selected faces that were perceived to be university-level aged (20-25 years old) and as East Asian (referred to as Asian throughout the chapter) or White (i.e., percentage of ratings categorizing faces as Asian or White had to be at least 90%). All faces from the Chicago Face Database had forward gazes, with additional left-gazing and right-gazing (and new forward-gazing[2]) faces created using Adobe Photoshop. Stimuli sizes in cm and visual angles are reported in Table 1.

[2] We created new forward-gazing faces from the Chicago Face Database to match the eyes of the artificial left- and right-gazing faces.

Table 1

Stimuli Measurements used in Study 1 and 2

Stimuli	Centimeter	Visual Angle
Background faces		
Distance from fixation cross to center of image		
Left- and rightmost face	8.0	7.63°
Second left- and rightmost face	4.5	4.29°
Image size		
Whole face (left to right edge of face)	3.80	3.62°
Eye region (leftmost part of left eye to rightmost part of right eye)	2.0	1.91°
Eye length (leftmost to rightmost part of left eye)	0.7	0.67°
Foreground face		
Distance from fixation cross to center of image	0	0°
Image size		
Whole face (left to right edge of face)	5.25	5.01°
Eye region (leftmost part of left eye to rightmost part of right eye)	3.0	2.86°
Eye length (leftmost to rightmost part of one eye)	0.9	0.86°
Target		
Distance from fixation cross to target (left or right side)	13.0	12.37°
Image size	0.5	0.48°
Fixation cross		
Image size	0.5	0.48°

Note. Measurements are average estimates because all stimuli have slightly different sizes. Visual angles were computed with a viewing distance of 60 cm.

The task was programmed on PsychoPy (version 2021.2.3) using the Builder interface, with Python and JavaScript code snippets. The task was then compiled entirely into JavaScript and hosted on Pavlovia. There were 440 trials in total, with 320 test trials (40 trials per combination of Matching Condition × SOA × Foreground Race), 80 filler trials, and 40 catch trials. Trials were evenly distributed across 2 blocks (220 trials per block). On test trials, foreground and background faces gazed equally and randomly to the left and right, and the target appeared equally and randomly to the left and right of faces. Stimulus onset asynchrony (SOA), the amount of time between cue onset and target onset condition, was selected randomly between 200 ms or 600 ms without replacement. The central cue was congruent with the target on half the trials and incongruent on the other half. In filler trials, foreground and background faces gazed forward, rather than left or right; they were included to create stimulus diversity, so that participants could not easily predict gaze direction on each trial. On catch trials, no target appeared to ensure participants were paying attention to the onset of the target and not making anticipatory responses. For all trials, background faces were always pulled from the entire pool of eight White faces. Foreground faces were pulled from the entire pool of eight Asian faces and eight White faces, so each trial had an equal probability of presenting an Asian or White foreground face. See Figure 1 as an example of trials by foreground race.

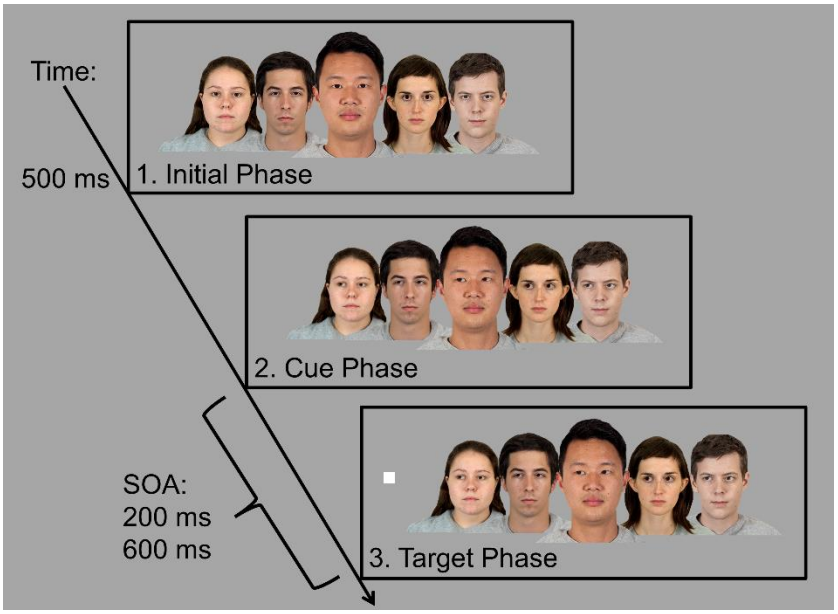
Figure 1

Trials by Foreground Race in Multi-Gaze Cueing Task in Study 1

Each trial had three phases; Figure 2 provides an outline of a trial that includes all three phases. In the initial phase, all faces appeared with forward gazes for 500 ms, and the fixation cross was positioned at the center of the screen, on the foreground face between the eyes. In the cue phase, foreground and background faces gazed either to the left or right. All background faces gazed in the same direction and were just as likely to be matched or mismatched with the foreground face's gaze direction. In the target phase, cues remained on-screen while the target appeared to the left or right of the faces after 200 or 600 ms from cue onset. Trials ended if participants responded with a spacebar press or at 2,000 ms after target onset if there was no response. Participants' reaction times (RTs) were recorded from target onset to the spacebar response. RT data were processed by removing all filler and catch trials, followed by anticipation, expiration, and outlier trials (see Table 2 for a complete description of each trial type and percentage of trials removed by cultural group).

Figure 2

Timeline for Test Trials



Note. Stimuli in this figure are not depicted to scale.

Table 2

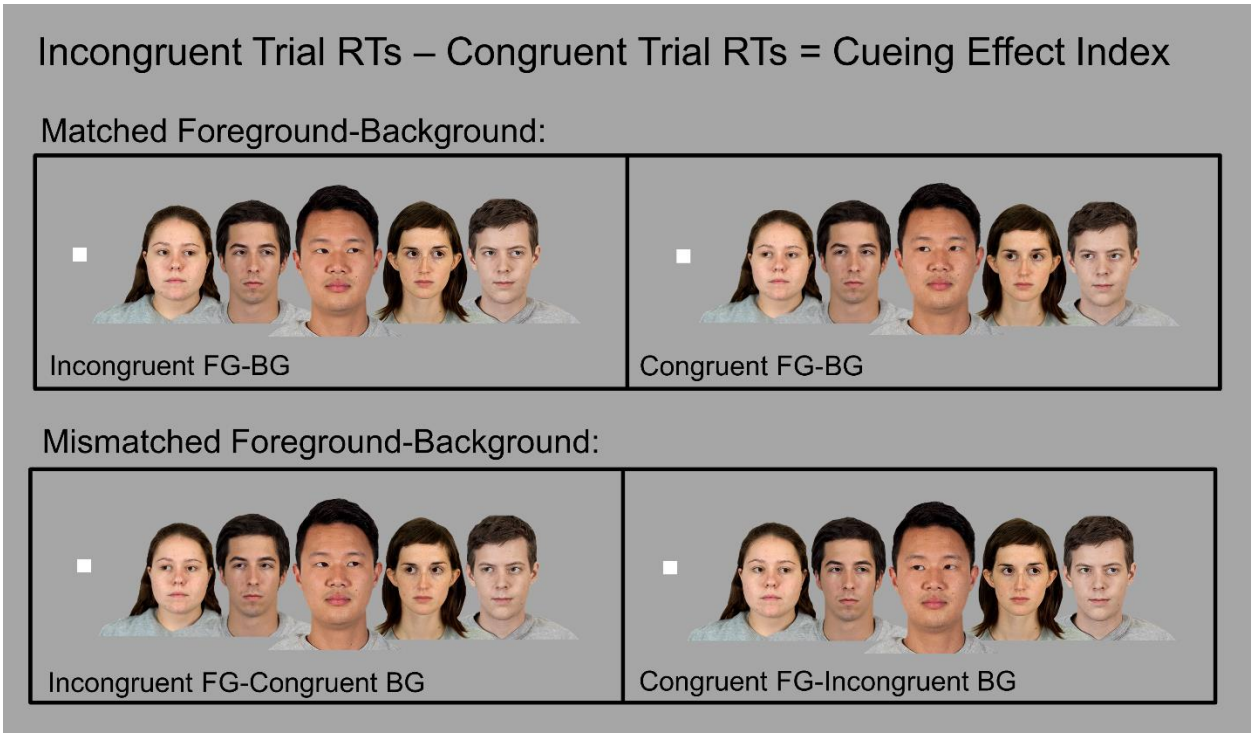
Percentage of Anticipation, Expiration, and Outlier Trials Removed in Study 1

Type of Trial	Description of Trial	European Canadian	Asian Canadian
Anticipation	Reaction time to detect target was less than 100 ms, suggesting an anticipatory response not reflective of attention to target onset.	0.18%	0.21%
Expiration	No response, indicating failure to detect target within 2,000 ms.	0.04%	0.16%
Outlier	Reaction time to detect target was 2 SD above or below the grand mean across all trials per participant at each SOA. Note that the grand means by participant were computed after anticipation and expiration trials were removed.	4.20%	4.34%

In Figure 3, we illustrate how the dependent variable, cueing effect index, was computed. RTs on congruent trials (i.e., when foreground gaze predicts target location) are subtracted from RTs on incongruent trials (i.e., when foreground gaze did not predict target location). Cueing effect indices under matched conditions are computed for trials where foreground and background gazes are looking in the same direction, whereas cueing effect indices under mismatched conditions are computed for trials where foreground and background gazes are looking in different directions. Eight cueing effect indices are computed per participant, one for each combination of Matching Condition × SOA × Foreground Race. A positive cueing effect index results from incongruent foreground trials having a larger RT (i.e., slower RT) compared to congruent foreground trials, which represents that attention was oriented in the direction of the foreground gaze. A cueing effect index not different from zero indicates no particular shifting of attention in the direction of the foreground gaze. A negative cueing effect index indicates a stronger shifting of attention in the opposite direction of foreground gaze.

Figure 3

Trials Types and Cueing Effect Index



Note. Stimuli in this figure are not depicted to scale.

Procedure

To sign up for the study online, participants needed to meet the following technological and equipment requirements: (1) use a laptop or desktop computer with a minimum monitor size of 13 inches; (2) use a full-sized keyboard with access to the spacebar and arrow keys; (3) access to a ruler or tape measure; (4) access to a standard sized card, such as a credit card (i.e., 3.38 × 2.13 inches). We developed a procedural pipeline to approximate similar viewing conditions across participants. First, participants were prompted to complete a card re-sizing task, which requires access to a standard sized card and arrow keys on a keyboard. This task has been used before to estimate current monitor resolution and re-size all subsequent presented images so that

images are displayed at a consistent size across various monitor resolutions (Morys-Carter, 2021). Second, participants were prompted to measure 60 cm between their face and their computer monitor using the ruler or tape measure they brought to the study. Third, participants were also asked to center their desktop monitor or laptop in front of themselves. These requirements were to ensure that the multi-gaze cueing task appear in a standardized format across a variety of computer monitor sizes.

We designed a novel remote experimenter procedure in which participants met the experimenter in a Zoom room, turn on their webcam, remain unmuted, and share their computer screen. The experimenter provided the link to a Qualtrics survey in the Zoom chat, and participants were told to open the webpage and share their screen through Zoom. Participants were told to use a Google Chrome internet browser if it was already installed, with Firefox and Safari as a second choice if they had a Windows or Mac operating system, respectively. The experimenter guided participants to open a new window to the multi-gaze cueing task hosted on Pavlovia. At this point, the experimenter made sure the participant hid their Zoom webcam self-view and experimenter view so that they could not distract them during the study. The experimenter then pretended to set up a webcam-based eye-tracker calibration to encourage participant adherence.

At the start of each trial, participants were instructed to attend to the fixation cross between the foreground face's eyes, and to respond with a spacebar press if a white square target appeared to the left or right of the faces. They were given a practice block of 20 trials, after which they completed two blocks of real trials. There was a 40 second break after the first block. After completing the multi-gaze cueing task, participants removed their screen share, but remained unmuted and completed the self-report measures on Qualtrics.

Results

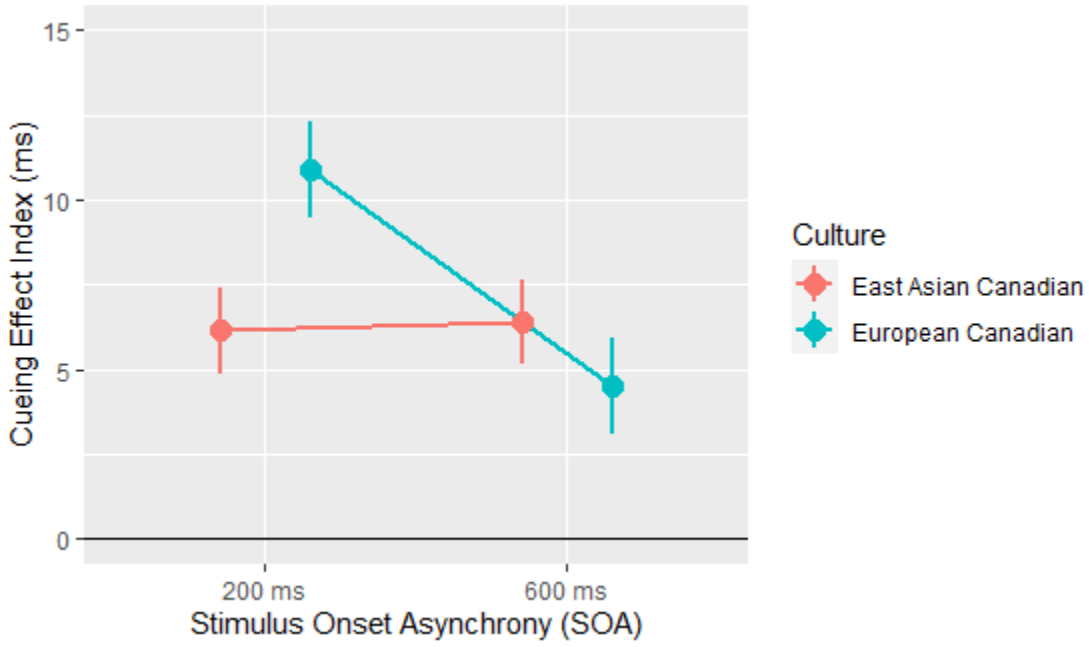
An initial omnibus 2 (Culture: European Canadian vs. East Asian Canadian) × 2 (Matching Condition: Matched background and foreground gazes vs. Mismatched background and foreground gazes) × 2 (Foreground Race: White vs. Asian) × 2 (SOA: 200 ms vs. 600 ms) mixed ANOVA revealed a main effect of Matching Condition, $F(1, 97) = 18.05$, $p < .001$, $\eta_p^2 = 0.16$. Cueing effect indices were larger for matched ($M = 10.10$, $SD = 18.80$) compared to mismatched ($M = 3.78$, $SD = 18.60$) trials, suggesting that attention was strongly oriented in the direction of the foreground gaze when the background faces were gazing in the same vs. opposite direction. All cueing effect indices by Matching Condition were greater than 0, suggesting there was an attentional orientation in the direction of the foreground gaze under mismatched conditions despite a decrease in the size of the cueing effect index under mismatched trials; Matched: $t(399) = 10.80$, $p < .001$, $d = 0.54$, Mismatched: $t(399) = 4.06$, $p < .001$, $d = 0.20$. There was also a main effect of SOA, $F(1, 97) = 4.47$, $p = .037$, $\eta_p^2 = 0.04$. Cueing effect indices were larger under 200 ms SOA ($M = 8.42$, $SD = 19.20$) than under 600 ms SOA ($M = 5.50$, $SD = 18.70$), in line with previous research suggesting that attention oriented in the direction of the foreground gaze is stronger under short durations between gaze cue onset and target onset. Both cueing effect indices, however, were greater than 0, suggesting attention was oriented in the direction of the foreground gaze regardless of SOA; 200 ms: $t(399) = 8.79$, $p < .001$, $d = 0.44$, 600 ms: $t(399) = 5.87$, $p < .001$, $d = 0.29$.

The two-way interaction between Culture and SOA was also statistically significant, $F(1, 97) = 5.48$, $p = .021$, $\eta_p^2 = 0.05$. The interpretation of a cueing effect index at 600 ms SOA is unclear without a reference cueing effect index at 200 ms SOA, so a comparison between cueing effect indices by SOA within culture was made. As depicted in Figure 4, European Canadians'

cueing effect indices were greater under 200 ms (M = 10.90, SD = 19.50) vs. 600 ms SOA (M = 4.50, SD = 19.70), $t(97) = 3.10$, $p = .013$, $d = 0.32$. For Asian Canadians, cueing effect indices did not differ by SOA (200 ms: M = 6.14, SD = 18.60; 600 ms: M = 6.42, SD = 17.80), $t(97) = 0.16$, $p = .999$, $d = 0.02$. All cueing effects indices were greater than 0; European Canadian at 200 ms SOA: $t(191) = 7.74$, $p < .001$, $d = 0.56$, European Canadian at 600 ms SOA: $t(191) = 3.16$, $p = .002$, $d = 0.23$, East Asian Canadian at 200 ms: $t(207) = 4.76$, $p < .001$, $d = 0.33$, East Asian Canadian at 600 ms: $t(207) = 5.21$, $p < .001$, $d = 0.36$. These results suggest that East Asian Canadians demonstrated attention oriented in the direction of the foreground gaze at both 200ms and 600ms SOAs and did not experience interference from the background gazes. European Canadians displayed a stronger cueing effect index under 200 ms vs. 600 ms SOA, suggesting they experienced interference from the background gazes under 600 ms SOA. There were no main effects of or interactions with Foreground Race or Matching Condition, suggesting that race of the foreground gaze or whether foreground and background gazes matched vs. mismatched did not seem to influence gaze cueing behaviour.

Figure 4

Cueing Effect Indices by Culture and SOA



Note. Points represent mean estimates, and error bars represent standard error of the mean.

Discussion

Study 1 results indicate a culture by SOA interaction, where European Canadians exhibited stronger cueing effect indices under 200 ms vs. 600 ms SOA, suggesting that at longer durations they experienced interference from the background gazes that interrupted their gaze cueing from the foreground gaze. East Asian Canadians, on the other hand, did not exhibit differences in cueing effect indices across both SOAs, suggesting their attention was consistently oriented in the direction of the foreground gaze. At first glance, the observed cultural differences in gaze cueing behaviour in the current study—European Canadians demonstrating stronger cueing effect indices at 200 ms vs. 600 ms SOA and East Asian Canadians demonstrating consistent cueing effect indices at 200 ms and 600 ms SOA—seem to run counter to the results

of previous research. Previous work suggesting cultural differences in the cueing effect indices typically show that East Asians demonstrate stronger cueing effect indices at 200 ms vs. 600 ms SOA, whereas North Americans demonstrate consistent cueing effect indices at 200 ms and 600 ms SOA (Cohen et al., 2017; Lo et al., 2021).

The current study's seemingly opposite effects may indirectly reflect differential processing of the foreground race, albeit in a manner that takes into account racial diversity *across* trials rather than within trials. Across the entire experiment, participants viewed the foreground face to be racially heterogenous (i.e., either Asian or White), whereas the background faces were always racially homogenous (i.e., always White). European Canadians may have exhibited a pattern of gaze cueing that was stronger at 200 ms SOA and weaker at 600 ms SOA because at 200 ms, there is insufficient time for background gazes to interrupt gaze cueing. However, by 600 ms, they experienced both 1) weakened foreground gaze cueing effects from the occasional Asian foreground face, and 2) interference from homogenous White background gazes. For East Asian Canadians, the occasional Asian foreground face (i.e., ingroup member) may facilitate greater vigilance towards the foreground face in general, reducing any potential interference from the White background faces even at 600 ms SOA. Thus, it is possible that the occasional presence of a different race face in the foreground can change the overall racial context of the gaze cueing task, which broadly influences gaze cueing behaviour.

None of our competing hypotheses explicitly accounted for this processing of race across trials, but results seem to resemble our predictions for the own-race bias hypothesis: both cultural groups prioritized gaze cues from own- vs. other-race faces. However, these predictions were observed across all trials, as opposed to only within the trials in which foreground and background faces had different races. The integration of race information across trials resembles

a cognitive process known as ensemble coding, in which the observation of multiple social cues can trigger cognitive mechanisms that support the perceptual summarization of information across social crowds, such as the average emotion of a crowd (Phillips et al., 2014; Alt & Phillips, 2022). Results from Study 1 are best understood from an ensemble coding point of view: across all trials, European Canadians saw the background gazes to reliably contain ingroup members, so they experienced interference from the background gazes, but East Asian Canadians saw the foreground gaze to reliably contain ingroup members, so they exhibited consistent gaze cueing effects.

An alternative explanation to the findings reported in Study 1 is that East Asian Canadians simply exhibited a more "North American" cultural mode of social attention which is why they consistently attended to the foreground gaze. Previous research suggests that East Asian Canadians may easily shift into modes of social attention that decreases or increases the interference from background faces depending on cultural cues in the environment (e.g., reminders of the self as independent or interdependent; Lo et al., 2021). East Asian Canadians in the current study may have exhibited a 'default' mode of social attention that focuses on the foreground face, resembling European Canadians, and not an "East Asian" cultural mode of social attention unless exposed to the appropriate cultural cues in the environment (e.g., interdependent cultural prime). Over three quarters of the East Asian Canadian sample was born in Canada, and the average age of arrival for those not born in Canada was six, which is the typical starting age for Canadian primary schools. This means that most of the East Asian Canadian sample completed their education in Canada for as long as the European Canadians sample, suggesting our East Asian Canadian sample is highly acculturated to Canadian culture.

In Study 2, we attempted to rule out the possibility that the observed effects were due to East Asian Canadians being Canadian acculturated by recruiting East Asians from East Asia, in addition to White North Americans. In Study 2, we also changed the multi-gaze cueing task to test a new own-race bias hypothesis based on Study 1 findings. If participants are processing race information across trials, rather than trial-by-trial, then varying the foreground and background faces by race should result in no gaze cueing differences between the cultural groups. This is because both cultural groups should see that the foreground and background faces could always contain faces from racial ingroup members, resulting in consistent gaze cueing from the foreground face. In Study 2, we predict that both cultural groups should exhibit gaze cueing effects across all conditions.

Study 2

Method

Participants and Design

The sample size goal was to exceed the estimated minimum sample size of 76 reported in Study 1, with an end goal of 50 North Americans and 50 East Asians. We initially recruited 87 participants with complete reaction time and survey data and removed two participants because of noted issues while completing the study. The final sample size was 85 participants: 41 East Asians (M_{age} = 22.22 years, SD_{age} = 3.50) and 44 North Americans (M_{age} = 28.57 years, SD_{age} = 6.69). North Americans were comprised of 27 European Americans, and 17 European Canadians. All North Americans were born in either Canada or the U.S., with parents born in either country. European Americans were recruited from Prolific, an online-crowd sourcing platform, for £6 GBP (n = 27), and European Canadians were recruited from York University's

research pool (n = 4) and Kijiji, an online advertisement board for $10 CAD ($n$ = 13). East Asians mostly came from China (66%), with the rest from Hong Kong (12%), Vietnam (7%), South Korea (7%), and other (7%), with an average age of arrival to Canada of 16.67 (SD = 4.73). This was to ensure that the East Asian sample was less acculturated to Canadian culture. East Asians were mostly recruited from York University's research pool (n = 21) and Kijiji (n = 20).

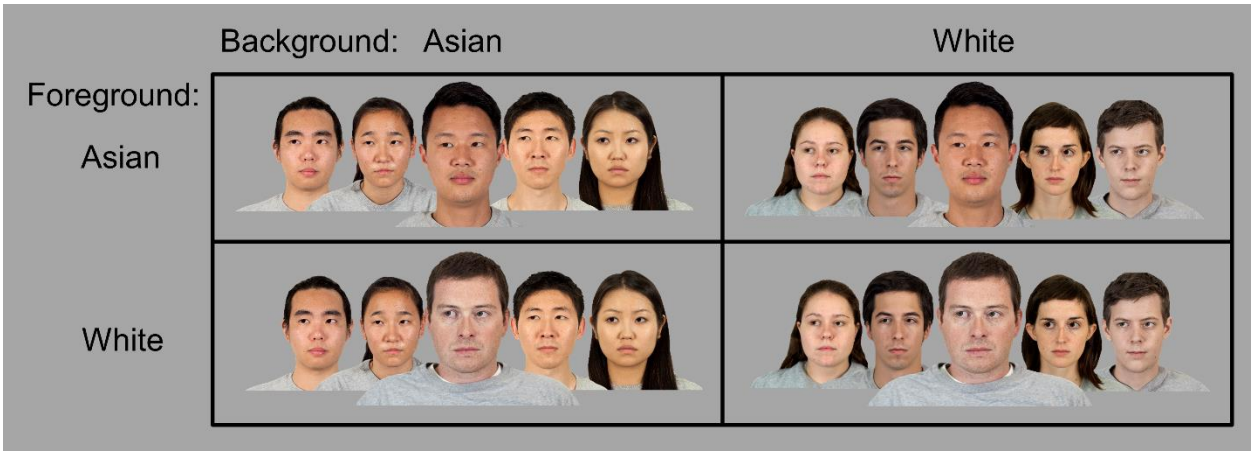
This study used a 2 (Culture: North American vs. East Asian) × 2 (Matching Condition: Matched background and foreground gazes vs. Mismatched background and foreground gazes) × 2 (SOA: 200 ms vs. 600 ms) × 2 (Foreground Race: White vs. Asian) × 2 (Background Race: White vs. Asian) mixed design, with all factors as within-subjects except culture.

Stimuli

The same face stimuli from Study 1 were used in Study 2. The basic design of the multi-gaze cueing task used in Study 2 was the same as Study 1, except the race of both the foreground and background faces could vary equally (see Figure 5 for example trials), and there were more trials. There were 704 trials in total, with 512 test trials (32 trials per combination of Matching Condition × SOA × Foreground Race × Background Race), 128 filler trials, and 64 catch trials. We chose this number of trials to ensure a similar number of trials per combination of all conditions like in Study 1, and to also ensure that we did not exacerbate participant fatigue. Trials were evenly distributed across 4 blocks (176 trials per block).

Figure 5

Trials by Foreground Race in Multi-Gaze Cueing Task



Procedure

The procedure of Study 2 was largely the same as Study 1. See Table 3 for the percentage of anticipation, expiration, and outlier trials removed. Because the number of trials was larger in Study 2, participants were presented with four blocks of trials after completing an initial practice block of 20 trials.

Table 3

Percentage of Anticipation, Expiration, and Outlier Trials Removed in Study 2

Type of Trial	Description of Trial	European Canadian	Asian Canadian
Anticipation	Reaction time to detect target was less than 100 ms, suggesting an anticipatory response not reflective of attention to target onset.	0.27%	0.41%
Expiration	No response, indicating failure to detect target within 2,000 ms.	0.10%	0.12%
Outlier	Reaction time to detect target was 2 SD above or below the grand mean across all trials per participant at each SOA. Note that the grand means by participant were computed after anticipation and expiration trials were removed.	4.24%	4.27%

Results

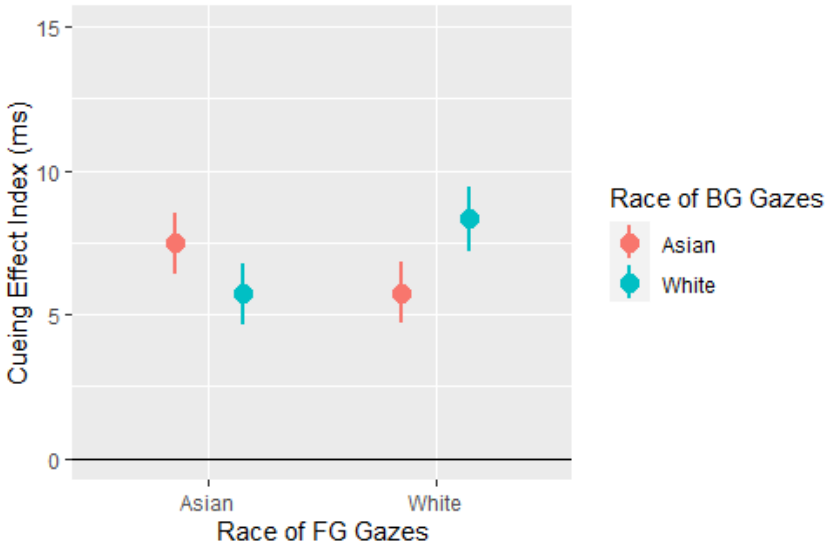
An initial omnibus 2 (Culture: North Americna vs. East Asian) × 2 (Matching Condition: Matched background and foreground gazes vs. Mismatched background and foreground gazes) × 2 (SOA: 200 ms vs. 600 ms) × 2 (Foreground Race: White vs. Asian) × 2 (Background Race: White vs. Asian) mixed ANOVA revealed a main effect of Matching Condition, $F(1, 82) = 57.76$, $p < .001$, $\eta_p^2 = 0.41$. Similar to Study 1 results, cueing effect indices were larger for matched ($M = 10.69$, $SD = 20.07$) compared to mismatched trials ($M = 2.96$, $SD = 18.57$), suggesting that cueing effect indices were greater when all faces were gazing in the same direction, than in opposite directions. All cueing effect indices were greater than 0, but notably stronger with matched vs. mismatched trials; Matched: $t(679) = 13.88$, $p < .001$, $d = 0.53$, Mismatched: $t(679) = 4.15$, $p < .001$, $d = 0.16$.

We also observed a two-way interaction between Foreground Race and Background Race interaction, $F(1, 82) = 6.20$, $p = .015$, $\eta_p^2 = 0.07$. As seen in Figure 6, the statistically significant

interaction comes from how cueing effect indices were somewhat higher when foreground and background faces were the same vs. different race, suggesting that race congruency between the foreground and background faces improved the cueing effect from the foreground gaze. However, none of the post-hoc *t*-tests were statistically significant. The effect of White foreground face on cueing effect indices was somewhat greater when the background faces were also all White (M = 8.34, SD = 20.61) vs. when they were all Asian (M = 5.75, SD = 19.30), $t(82) = 1.98$, $p = .205$, $d = 0.15$, although not statistically significant. The same, not statistically significant effect occurred for Asian foreground race, albeit the difference was smaller: the effect of Asian foreground face on cueing effect indices was somewhat greater when the background faces were all Asian (M = 7.48, SD = 19.63) vs. when they were all White (M = 5.71, SD = 19.25), $t(82) = 1.31$, $p = .558$, $d = 0.10$. All cueing effects were above 0, suggesting that participants' attention was oriented in the direction of the foreground gaze; White Foreground–White Background: $t(339) = 7.46$, $p < .001$, $d = 0.40$, Asian Foreground–Asian Background: $t(339) = 7.03$, $p < .001$, $d = 0.38$, White Foreground–Asian Background: $t(339) = 5.50$, $p < .001$, $d = 0.30$, Asian Foreground–White Background: $t(339) = 5.47$, $p < .001$, $d = 0.30$.

Figure 6

Plot of Cross-Over Interaction Pattern Between Foreground and Background Race



Note. Points represent mean estimates, and error bars represent standard error of the mean.

Crucially, there was no evidence of an effect of culture or SOA, as observed in Study 1, indicating that varying races in the foreground and background resulted in both cultural groups exhibiting similar gaze cueing patterns across SOAs. These findings corroborate the modified Study 1 hypothesis that the own-race gaze cueing bias is observed across trials rather than within trials. For North Americans, varying the race of both the foreground and background faces resulted in consistent cueing effect indices across both SOAs, differing from European Canadians in Study 1 where they experienced interference from the background faces at 600 ms vs. 200 ms SOA. The difference between Study 1 European Canadians and Study 2 North Americans is presumably due to Study 2 background faces no longer containing only own-race (i.e., White) faces.

Conversely, varying the race of both the foreground and background resulted in East Asians producing consistent cueing effect indices, which was also observed for Study 1 East Asian Canadians. The similarity in cueing effect indices across SOAs between Study 1 East Asian Canadians and Study 2 East Asians rules out the possibility that the Study 1 East Asian Canadians only produced consistent cueing effect indices across SOAs because they are Canadian acculturated and acted in a "Westernized" mode of social attention. It is therefore more likely that East Asians in Study 2 produced consistent cueing effect indices because of the presence of Asian faces in the foreground face, similar to East Asian Canadians in Study 1.

General Discussion

The purpose of the current research was to test whether race and culture influenced gaze cueing behaviour in a multiple gaze context. In Study 1, Asian or White faces were used to manipulate foreground gaze, with background gazes always comprised of White faces. Results revealed that East Asian Canadians' cueing effect indices did not differ across 200 and 600 ms SOAs, suggesting persistent attention towards the foreground gaze. Importantly, the race of the foreground face did not qualify this pattern, suggesting that the randomly intermixed Asian foreground face triggered greater attention towards the foreground gaze across the entire multi-gaze cueing task. European Canadians, on the other hand, exhibited cueing effect indices toward the foreground gaze at 200 ms SOA, with weaker effects at 600 ms SOA. Again, this did not vary by the race of the foreground face, suggesting that given enough time (600 ms), European Canadians experienced interference from own-race (i.e., White) faces in the background and exhibited weaker cueing effects from the foreground face across all trials. These findings suggest that participants pooled information about race across trials.

In Study 1, presenting different race faces in the foreground (i.e., Asian and White), and keeping the background faces the same race (i.e., White) may have created two different racial contexts: the foreground was racially heterogenous, and the background was racially homogenous. This resulted in both cultural groups exhibiting different behaviours: East Asian Canadians attended to the racially heterogenous foreground with their own race occasionally represented and did not experience interference from the White background faces across both SOAs. European Canadians experienced interference at 600 ms vs. 200 ms SOA from the White background faces. Together these results suggest that both cultural groups may have exhibited a form of own-race gaze cueing bias, albeit in a manner that considered racial diversity across all trials.

In Study 2, participants were presented with both Asian or White faces in the foreground and background. Including Asian or White faces in the foreground and background should make participants perceive both the foreground and background as equivalently racially heterogenous and importantly, inclusive of racial ingroup members for North Americans and East Asians. This means there should be less interference from the background faces when producing a cueing effect from the foreground face. In accordance with this possibility, both North Americans and East Asians exhibited similar cueing effect indices across both SOAs, demonstrating minimal interference experienced from the background gazes. Altogether, findings from Study 1 and Study 2 suggest that people were sensitive to the racial diversity across gazes, though the own-race gaze cueing bias appears to emerge in a holistic manner across trials.

Rather than gaze cueing behaviour changing when foreground race varied trial-by-trial, participants may have summarized the racial diversity of the entire social context across multiple trials and adjusted their attention accordingly. The current experiments' multi-gaze cueing task

contained five faces, which is enough to potentially trigger different cognitive mechanisms that support the processing of social groups, also known as ensemble coding, or the perceptual summarization of information across social crowds (Alt & Phillips, 2022; Phillips et al., 2014). Although this is not the first time ensemble coding processes have been observed for multiple gaze cues (e.g., Capozzi et al., 2018; Capozzi et al., 2021; Sweeney & Whitney, 2014) or for the racial diversity of social crowds (e.g., Phillips et al., 2018), the current studies demonstrate a unique ensemble coding process of racially diverse gaze cues that occurs in a temporal fashion across experimental time. This is unique because ensemble coding of gaze cues or racial diversity of social crowds tends to be observed at the trial-level, not across trials. It could be the case that the cognitive complexity of integrating multiple gaze cues in combination with race information requires more time than the duration of a singular trial, and that information about race in addition to gaze cues is updated over the duration of the experiment.

Limitations and Future Directions

Study 1 compared East Asian Canadians and European Canadians to test for the own-race gaze cueing bias, and whether culture moderates this effect. We specifically tested East Asian Canadians because we anticipated that East Asian Canadians being racially minoritized in Canada may increase motivation to engage in intra-ethnic coalition through preferential attention to own-race gazes. This contrasts with East Asians from East Asia, in which prior research has shown that they do not preferentially attend to own-race gazes (Zhang et al., 2020). However, a more effective way to demonstrate this point in Study 1 would have been to also include East Asians from East Asia, who have less racially minoritized experiences. If East Asians from East Asia exhibited a mode of social attention typical for that cultural group instead of an own-race gaze cueing bias, then that would suggest East Asian Canadians' own-race gaze cueing bias

results reflect their racially minoritized experiences. If East Asians from East Asia exhibited an own-race gaze cueing bias, however, then that would suggest more strongly that own-race gaze cueing bias overrides any potential influence from cultural or racialized experiences.

An important follow-up study to confirm the ensemble coding interpretation of the results from Study 1 would be to manipulate only the race of the background. If the background is manipulated to be racially heterogenous (i.e., all background faces are either White or Asian), and the foreground gaze is always White, this would allow us to confirm the own-race gaze cueing bias deployed in an ensemble coding manner: European Canadians should exhibit similar cueing effects from the consistent White foreground gaze across both SOAs. Asian Canadians should exhibit weakened cueing effects at 600 ms vs. 200 ms SOA because they should experience interference from the background faces that occasionally display all-Asian faces.

Lastly, it is important to note that only one comparison of cultural groups and target races was used in the study, and theorizing of effects by race depended on a specific interracial context: North America. Follow-up studies that include other untested cultural groups, target races, and different interracial contexts, should be conducted before concluding that race is more influential for social attention than culture. This includes testing other combinations of 1) cultural groups, 2) majority-minority (e.g., White and South Asian) and intra-minority (e.g., South Asian and East Asian) target race comparisons, and 3) different interracial contexts beyond North America (e.g., U.K., Singapore).

Conclusion

Overall, the results of this study have important implications for intercultural and interracial interactions in North America. Although culture is an important, consistent influence

in people's lives, the impact it may have on reflexive, social cognitive processes in people's day-to-day interactions may be limited when more proximal, readily accessible environmental cues are available, such as race and racial diversity of groups. It is important that in a social world with ever-increasing contact and interaction between different social groups that future research interrogates how social cognitive processes adapt and change to navigate racially diverse social environments.

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CHAPTER FOUR:

Regional Culture Shapes Automatic Gaze Cueing

Abstract

People tend to shift their attention when they see another person's averted gaze in the direction of that gaze. This effect is called gaze cueing. Past research has shown that East Asians' gaze cueing from a central gaze is interrupted by gazes embedded in the social context to a greater extent than North Americans. We extend these findings by testing whether cultural groups from other regions tend to exhibit gaze cueing patterns like North Americans or East Asians. In a quasi-experiment, we tested individuals from four regions: North America, Middle East, South Asia, and East Asia. We used a multi-gaze cueing task that contained trials with a central, foreground face gazing left or right, flanked by multiple background faces that either matched or mismatched the direction of the foreground gaze. Participants responded to the appearance of a target square that would appear in the periphery of the gazes. Results replicated previous results such that East Asians experienced interference from the background gazes when responding to the target, reflecting greater sensitivity to background gazes compared to North Americans. Middle Easterners' and South Asians' gaze cueing were not significantly different than North Americans or East Asians. A subsequent linear pattern analysis suggested that Middle Easterners and South Asians occupied an "intermediate" mode of social attention between North Americans' and East Asians' gaze cueing patterns, with evidence pointing to the order of effects, from least to most sensitive to background gazes, as North Americans, South Asians, Middle Easterners, and East Asians.

Chapter Four: Regional Culture Shapes Automatic Gaze Cueing

Humans are intrinsically social. To survive and thrive in their social environments, humans have developed specialized cognitive mechanisms to accurately detect, process, and infer social information from a variety of social cues (Frith, 2008). Gazes, in particular, convey valuable information about the surrounding environment, and perceiving another's gaze can elicit early, automatic shifting of attention in the direction of that gaze. This is referred to as gaze cueing (Friesen & Kingstone, 1998). How gaze cueing is deployed in more complex social environments involving multiple gazes may depend on culture, with previous research providing evidence that North Americans and East Asians differ in their gaze cueing behaviour (Cohen et al., 2017; Lo et al., 2021).

Research on cultural variation in cognition in general has tended to focus on comparing individuals from North America and East Asia, with East Asians exhibiting greater attention and memory for contextual information compared to North Americans (e.g., Masuda & Nisbett, 2001; Masuda et al., 2008; Yang et al., 2018). Emerging evidence has extended beyond East Asia and North America to document regional variation in cognition (e.g., San Martin et al., 2018; Savani, 2020; Uskul et al., 2023), and conflicting evidence makes it unclear whether individuals from the Middle East and South Asia would exhibit context-dependent cognition in gaze cueing. In the present research, we explored whether individuals from two understudied regions, Middle East and South Asia, vary in their attention to multiple gazes compared to individuals from two well-studied regions, North America and East Asia.

Culture and Social Attention

A landmark study by Friesen and Kingstone (1998) introduced a paradigm to test the automaticity of gaze cueing. In this paradigm, a cartoon face gazes to the left or right, and a target shortly after appears to the left or right of the cartoon face. When the target appears in the same direction as the gaze, participants respond quickly, compared to when the target appears in the opposite direction of the gaze. This difference in reaction times between trials with incongruent and congruent gazes is called the "gaze cueing effect" and occurs because perceiving an incongruent gaze shifts visual attention in the opposite direction of the target and participants require more time to change their visual orientation to the correct location of the target, compared to perceiving a congruent gaze.

The gaze cueing effect depends on stimulus onset asynchrony (SOA), which is the amount of time between when the gaze cue appears and when the target appears. A gaze cueing effect is triggered when targets appear 200–700 ms after the gaze cue appears, which is referred to as the automatic cueing interval. When the targets appear more than 700 ms after the gaze cue, there is enough time for an individual to return their orientation to their original position (often a central fixation point), so gaze cueing effects after 700 ms SOA are typically weakened or reversed (Driver et al., 1999). These results suggest that gaze cueing is automatic when SOA is within 200–700 ms and may be subject to volitional control after that interval.

Cohen and colleagues (2017) theorized that long-term cultural experiences can calibrate the social attention system to impact gaze cueing behaviour. They tested gaze cueing behaviours of North Americans and East Asians in a multiple gaze context, with a central, focal gaze flanked by multiple background gazes. Participants were asked to keep their gaze in the center, and to respond when they detected a peripheral square target that appeared either 200, 600, or 1,000 ms after the gaze cues appeared. Before the target appeared, all the background faces looked in

either the same or opposite direction as the foreground gaze (i.e., matched vs. mismatched gazes). They observed cultural differences in gaze cueing patterns between 200 ms and 600 ms SOA. Americans exhibited a strong cueing effect from the foreground gaze (i.e., a narrow mode of attention), even when the background gazes were looking in the opposite direction, across 200 ms and 600 ms SOA. This finding suggested that mismatched background gaze cues did not interrupt Americans' gaze cueing from the foreground gaze. East Asians, on the other hand, exhibited a stronger gaze cueing effect at 200 ms that weakened at 600 ms SOA, only when the background gazes were mismatched with the foreground gaze. These findings demonstrate that cultural differences in gaze cueing patterns with multiple gazes may emerge at a relatively late stage of automatic cueing (i.e., 600 ms) because background gazes may require a minimum amount of time to process. Gaze cueing patterns at an early SOA (i.e., 200 ms), however, provide a physical limitation such that no cultural group has enough time to 96rocesss background gaze cues, and their gaze cueing effects at an early SOA serve as their default gaze cueing effect.

Cohen and colleagues (2017) concluded that differences in gaze cueing patterns may depend on culture such that cultural experiences involving greater attention to social relationships (i.e., East Asian culture) may encourage a broader mode of social attention towards gaze cues in the social context. Although not explicitly hypothesized, they also observed that the role of cultural experiences may be more influential when the social context provides conflicting social cues (i.e., mismatched foreground and background gazes).

Regional Variation in Cognition and Underlying Mechanisms

In addition to social attention, research has documented cultural variation in visual cognition more broadly, with an emphasis on comparing individuals from North America and East Asia. Specifically, East Asians have been shown to display more eye fixations to a visual

context (Chua et al., 2008), encode and recall more contextual information (Yang et al., 2018), attend to changes within the context (Masuda & Nisbett, 2006), and use the context to evaluate the focal parts of the scene (Masuda et al., 2008) to a greater extent than North Americans. Cultural variation in context-dependent visual cognition is also implicated at the neural level. Compared to European Americans, East Asian Americans exhibit greater event-related potential activity associated with attention towards contextual information when observing visual scenes with incongruent focal and contextual information, suggesting that East Asians are sensitive to the relationship between focal and contextual information (Goto et al., 2010; Lewis et al., 2008). Altogether, there is evidence that culture can shape volitional and automatic processes underlying visual cognition.

Mechanisms proposed to underlie and explain this cultural variation in visual cognition include social orientation. North Americans are thought to possess an independent self-construal, which is the construal of the self as unique, autonomous, and independent of others (Markus & Kitayama, 1991). East Asians, on the other hand, are thought to possess a construal of the self that is more embedded within certain social relationships. This is associated with an obligation to attend to social relationships, a motivation to avoid conflict or rejection from important others, and a minimized desire to stand out or be different from others (Hashimoto & Yamagishi, 2013; Kim & Markus, 1999; Kitayama et al., 2022; Vignoles et al., 2016). Independent self-construals, as observed for North Americans, are thought to produce context-independent cognition, such that attention is placed on focal entities, and the context that the entity appears in is seen as less important (Varnum et al., 2010). Interdependent self-construals, as observed for East Asians, are thought to result in context-dependent cognition, such that attention is spread more broadly across both focal entities and the context that the entity appears in.

While a great deal of progress in exploring and outlining cultural variation in psychological processes has resulted from studying North Americans and East Asians, this has also resulted in an overreliance on the West vs. East dichotomy, or a West vs. "the rest" dichotomy (e.g., WEIRD vs. non-WEIRD dichotomy; Henrich et al., 2010) to study culture. This dichotomy comes at a critical cost: the perceived homogeneity of interdependent cultures, or the assumption that all non-Western cultures are similarly interdependent. Independence and interdependence, however, are not monolithic constructs. Vignoles and colleagues (2016) demonstrated that independence and interdependence can be broken down into different dimensions, such as self-containment vs. connection to others, or self-expression vs. harmony. Across Western Europe, Eastern Europe, Africa, Middle East, East and Southeast Asia, Sub-Saharan Africa, Latin America, Vignoles and colleagues (2016) did not observe any region that endorsed all independent or interdependent dimensions; in fact, some regions (e.g., Middle East) endorsed a social orientation that have both independent and interdependent qualities. What are the cognitive consequences of a social orientation that has both independent and interdependent qualities? We will briefly review the social orientation and cognition literature for two regions that may demonstrate such mixed independent and interdependent qualities: the Middle East and South Asia.

Middle Eastern Interdependence and Cognition

Middle Eastern interdependence shares some qualities with East Asian interdependence. For example, Vignoles and colleagues (2016) found that people from both Middle Eastern and East Asian regions endorsed social harmony over self-expression. However, unlike East Asians, they also found that individuals from the Middle East region were characterized by a sense of self-reliance and perceived self-consistency across different contexts, compared to the global

average. This may be related to other important cultural values found in the region. A culture of honour, documented in the Middle East and Mediterranean regions, consists of a need for assertion to defend one's reputation and honour for close others and ingroup members (Leung & Cohen, 2011; Uskul & Cross, 2020). In a related manner, Arab culture (as a part of Middle East culture) has also been described as interdependent, with an emphasis on commitment to ingroup members, and self-assertion in service of ingroup members (Kitayama et al., 2022; San Martin et al., 2018). Altogether, evidence suggests that individuals from the Middle East region may display a sense of both independence (through self-assertion) and interdependence (through acting in service for ingroup members).

Evidence for whether individuals from Middle Eastern regions will display context-dependent social attention is unclear. San Martin and colleagues (2018) demonstrated that Arabs from Saudi Arabia and Lebanon exhibited greater context-dependent cognition on both visual and verbal tasks that require attention to contextual information. Further evidence from Turkey also suggests Turkish individuals exhibit context-dependent cognition on other visual tasks (Uskul et al., 2008). However, emerging evidence has also suggested that individuals from Middle Eastern cultures (i.e., consisting of Turkish, Lebanese, and Egyptian individuals) tend to exhibit context-independent cognition, using some of the same tasks described (e.g., verbal task), suggesting that their cognitive tendencies are similar to North Americans, and dissimilar to East Asians (Uskul et al., 2023). Altogether, past research suggests that individuals from Middle East may exhibit both context-independent and context-dependent cognition, so Middle Easterners in the current study may also exhibit a mode of social attention that is "intermediate" between context-independent cognition (i.e., like North Americans) and context-dependent cognition (i.e., like East Asians).

South Asian Interdependence and Cognition

At first glance, evidence suggests that cultural interdependence is deeply embedded within South Asian[3] cultural norms, and this is reflected in South Asians' sensitivity to the social context. Compared to Americans, Indians perceived the obligation of helping others in need as moral obligations, regardless of closeness with the person in need and regardless of how serious their need was (Miller et al., 1990), suggesting they have a broader sense of social duty towards others. Indians are also sensitive to the presence of other people, and their social evaluations, in the context of charitable giving; Indians (and Chinese) were more likely than Americans to donate money in the presence of other people vs. being alone (Medvedev et al., 2023). Indians were also more likely to use contextual information to explain others' behaviours compared to Americans, thus exhibiting greater attention to social context (Miller, 1984). In a set of studies by Savani and colleagues, Indians were less likely than Americans to construe actions as choices, and less likely to construe choices as preferences, suggesting Indians are less biased towards the self and more sensitive to situational or contextual reasons for one's actions (Savani et al., 2008, 2010). Altogether, evidence largely suggests that Indians, compared to Americans, are more socially sensitive towards others and their circumstances, with some evidence that their social sensitivity may be similar to that of East Asians.

Emerging evidence, however, has demonstrated that Indians also have a culture of argumentativeness, manifest in their preference to engage in analytic arguments and employing verbal assertiveness (Kitayama et al., 2022; Ren & Kuai, 2023; Savani, 2020), and to a greater extent than other interdependent cultures (e.g., East Asians; Lu et al., 2020). They have also

[3] Although we describe cited research as about South Asian, we acknowledge that all research about cultural differences involving South Asians reviewed here has been conducted on Indians.

exhibited context-independent cognition on visual tasks, similar to Americans and dissimilar to Japanese or Chinese (Ren & Kuai, 2023; Savani, 2020). Given past research on South Asians' attention to social contexts yet also exhibiting a pattern of context-independent cognition, South Asians in the current study may also exhibit an "intermediate" mode of social attention relative to East Asians and North Americans, similar to Middle Easterners.

Current Study

In the current study, we sought to test whether there is regional cultural variation across individuals from North America (e.g., United States), Middle East (e.g., Iran), South Asia (e.g., India), and East Asia (e.g., China) in gaze cueing behaviour using a multi-gaze cueing task, which measures gaze cueing from a central, focal gaze, in the context of multiple background gazes. We had two hypotheses. Our first hypothesis was to test that regions with largely interdependent social orientations should exhibit context-dependent gaze cueing compared to regions with largely independent social orientations. Specifically, we hypothesized that participants from the Middle East, South Asia, and East Asia would experience stronger gaze cueing effects from the foreground gaze at 200 ms SOA that weakens at 600 ms SOA because they experience greater interference from the background gazes at 600 ms SOA. North Americans, however, would experience consistent gaze cueing effects from the foreground gaze at both 200 ms and 600 ms SOA. Our second hypothesis was to test for heterogeneity between regions with largely interdependent social orientations. Given that past research has shown that Middle Easterners exhibit independent social orientations and South Asians exhibit context-independent cognition, we hypothesized that South Asians and Middle Easterners would experience less interference from the background gaze cues compared to East Asians.

Specifically, East Asians should show a greater decrease in gaze cueing effects from 200 ms to 600 ms SOA, compared to Middle Easterners and South Asians.

Although Cohen and colleagues (2017) observed cultural influences at 600 ms SOA when foreground and background gazes were mismatched, we did not have a strong theoretical expectation that background faces had to be gazing in a mismatched direction to interrupt gaze cueing from the foreground gaze. This is because the very presence of background faces, whether or not they are providing incongruent social cues with the foreground face, may be sufficient in interfering with gaze cueing effects. We included matching condition as an experimental factor to ensure trial diversity, and we did not have any explicit hypotheses about matching condition interacting with culture or SOA.

We also included self-report measures of social orientation to explore whether cultural variation at the automatic gaze cueing behaviour level match with explicitly held beliefs of social orientation. Given that prior theorizing suggests interdependent social orientation underlies context-dependent cognition, regional cultural groups hypothesized to exhibit the strongest context-dependent cognition (i.e., East Asians) should also exhibit the strongest explicitly held interdependent social orientation.

Method

Participants and Design

The sample size goal was to recruit a minimum of 50 participants for each regional[4] cultural group: North America, Middle East, South Asia, and East Asia. This sample size goal

[4] We acknowledge that the use of the term regional cultural group tends to refer to individuals living in different regions. Although all Middle Eastern, South Asian, and East Asian participants in the current study were living in

was chosen to match previous studies' sample sizes (Cohen et al., 2017; Lo et al., 2021). A priori power analysis was conducted to detect an effect size of $f = 0.17$ (approximately $\eta_p^2 = 0.031$, drawn from Lo et al., 2021) with 95% power, .05 error rate, for a repeated-measures design (2 groups, 4 measures). We estimated this power for two groups in anticipation that key analyses would only require comparing two cultural groups at a time.

We recruited participants using three sources: (1) York University's research pool, from which we recruited mostly first year undergraduate students for course credit; (2) Prolific, a crowdsourcing platform, from which we recruited our paid U.S. American participants; and (3) an online advertisement board (Kijiji), from which we recruited paid participants from Middle East, South Asia, and East Asia. Most participants from Kijiji were living in Toronto, Canada. Paid participants were compensated with $10 CAD, or the equivalent of $10 CAD (e.g., £6 GBP).

The final sample size was 210 participants: 50 North Americans (M_{age} = 29.14 years, SD_{age} = 7.32), 54 Middle Easterners (M_{age} = 21.74 years, SD_{age} = 4.44), 56 South Asians (M_{age} = 21.55 years, SD_{age} = 3.81) and 50 East Asians (M_{age} = 23.78 years, SD_{age} = 6.00). Participant inclusion criteria required all participants to be born and raised for 16 years in the region they were recruited for (see Cohen et al., 2017); their parents also had to be native to their region. North Americans also had to be of Western European descent (see Table 1 for a full breakdown of demographics by region).

Canada, we used specific criteria (e.g., number of years living in the region of interest) to ensure participants were as representative of individuals living in those regions as possible.

Table 1

Demographics by Region

Variable	North America	Middle East	South Asia	East Asia
Sample size – *n*	50	54	56	50
Data Source – %	24% Students	93% Students	79% Students	68% Students
	0% Paid	7% Paid	21% Paid	32% Paid
	76% Prolific	–	–	–
Top two source countries – %	76% U.S.	74% Iran	71% India	66% China/H.K
	24% Canada	7% Syria	14% Pakistan	26% South Korea
Gender – %	54% Female	59% Female	64% Female	70% Female
	42% Male	39% Male	36% Male	28% Male
	4% Other	2% Other	0% Other	2% Other
Age – *M* (*SD*)	29.14 (7.32)	21.74 (4.44)	21.55 (3.81)	23.78 (6.00)
Age of arrival to Canada – *M* (*SD*)	–	19.11 (4.30)	18.29 (2.99)	19.24 (4.17)
Years in Canada – *M* (*SD*)	–	2.63 (2.17)	3.27 (3.07)	4.54 (3.45)
% of life in Canada	–	12%	14%	18%
SES – *M* (*SD*)	5.88 (1.65)	7.09 (1.61)	6.55 (1.56)	6.06 (1.54)
Religiosity – *M* (*SD*)	2.48 (1.85)	2.93 (1.67)	4.40 (1.95)	2.36 (1.65)
Top religion %	Christian 44%	Muslim 85%	Hindu 43%	Atheist 24%

Note. SES (socioeconomic status) was measured with one item that ranged from 1 (worst off) to 10 (best off) in one's country. Religiosity was measured with one item that ranged from 1 (not religious at all) to 7 (very religious).

The full design was a 4 (Culture: North America vs. Middle East vs. South Asia vs. East Asia) × 2 (Matching Condition: Matched background and foreground gazes vs. Mismatched background and foreground gazes) × 2 (SOA: 200 ms vs. 600 ms) mixed design, with repeated measures on the last two factors.

Multi-Gaze Cueing Task

Face stimuli were adapted from Cohen and colleagues (2017). There were 12 unique faces, six female and six male faces that varied in ethnicity. Each face was equally and randomly likely to appear as a foreground face or as one of five background faces.

There were 384 trials in total, consisting of 256 test trials, 64 filler trials, and 64 catch trials. Trials were evenly distributed across 4 blocks (96 trials per block). On test trials, foreground and background faces gazed equally and randomly to the left and right, and the target appeared equally and randomly to the left and right of faces. Stimulus onset asynchrony (SOA), the amount of time between gaze cue onset and target onset, was selected randomly between 200 ms or 600 ms without replacement. The central cue was congruent with the target on half the trials and incongruent on the other half. In filler trials, foreground and background faces gazed forward, rather than left or right; they were included to create stimulus diversity, so that participants could not easily predict gaze direction on each trial. On catch trials, no target appeared to ensure participants were paying attention to the onset of the target and not making anticipatory responses.

Each trial had three phases (see Figure 1 for a timeline of the phases). In the closed phase, all faces appeared with eyes closed for 500 ms, and the fixation cross was positioned on the foreground face between the eyes. In the cue phase, foreground and background faces gazed either left or right. All background faces gazed in the same direction and were just as likely to be congruent as incongruent with the foreground face's gaze direction. In the target phase, cues remained on-screen while the target appeared to the left or right of the faces after 200 ms or 600 ms, from cue onset. Trials ended if participants responded with a spacebar press or if there was no response after 2,000 ms from target onset. Participants' reaction times (RTs) were recorded from target onset to the spacebar response. RT data were processed by removing all filler and

catch trials, followed by anticipation, expiration, and outlier trials. See Table 2 for explanation of the trials and percentage of trials removed.

Figure 1

Timeline for Test Trials

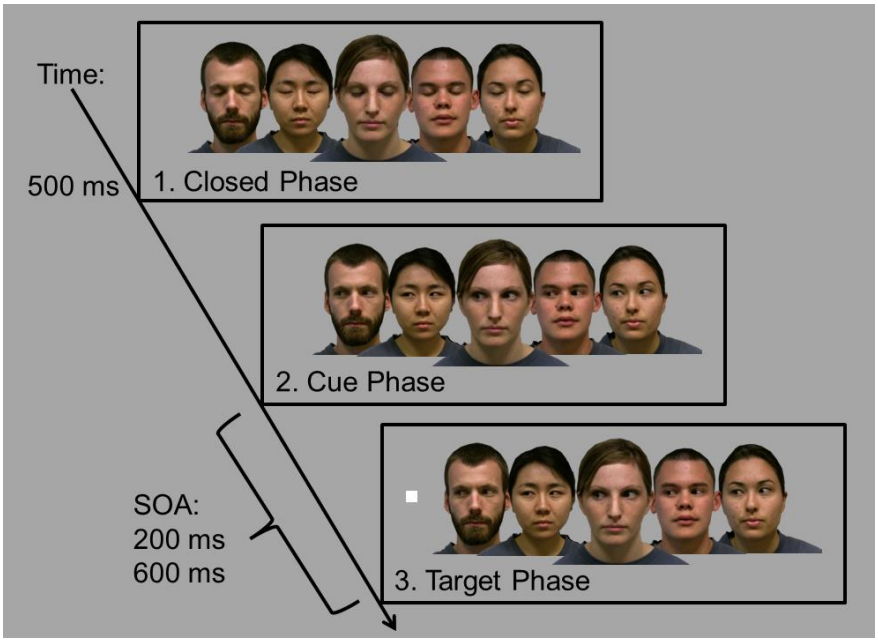


Table 2

Percentage of Anticipation, Expiration, and Outlier Trials Removed by Region

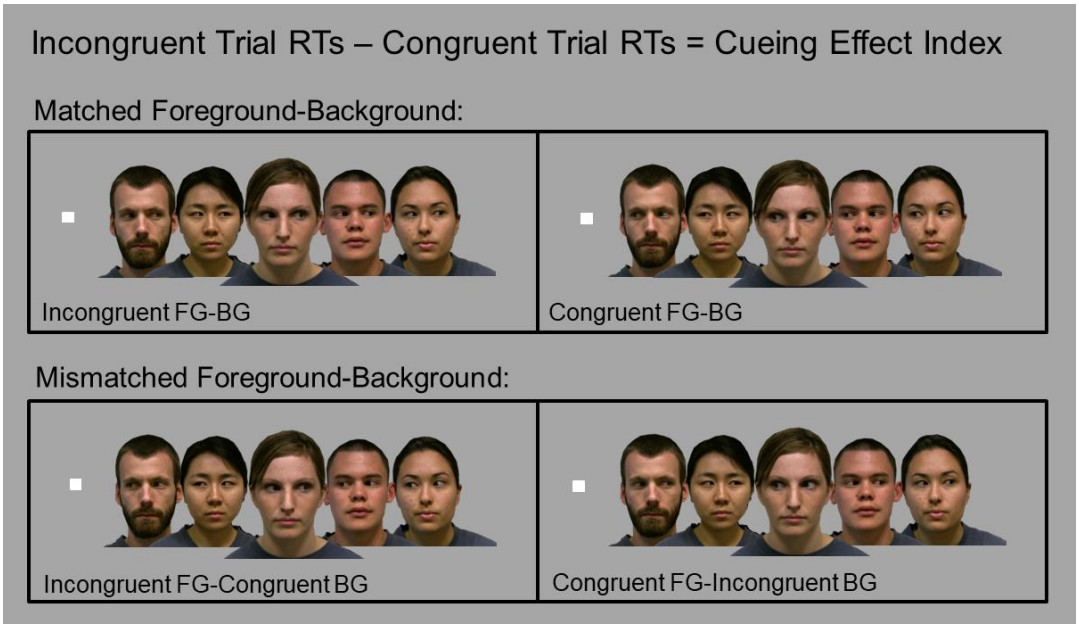
Type of Trial	Description of Trial	North America	Middle East	South Asia	East Asia
Anticipation	Reaction time to detect target was less than 100 ms, suggesting an anticipatory response not reflective of attention to target onset.	0.12%	0.09%	0.14%	0.09%
Expiration	No response, indicating failure to detect target within 2,000 ms.	0.10%	0.17%	0.35%	0.14%
Outlier	Reaction time to detect target was 2 SD above or below the grand mean across all trials per participant at each SOA. Note that the grand means by participant were computed after anticipation and expiration trials were removed.	3.95%	4.38%	4.46%	4.33%

In Figure 2, we illustrated how the dependent variable, cueing effect index, was computed. RTs on congruent trials (i.e., when foreground gaze predicted target location) are subtracted from RTs on incongruent trials (i.e., when foreground gaze did not predict target location). This resulted in four cueing effect indices per participant (one for each combination of Matching Condition × SOA). Cueing effect indices under matched conditions are computed for trials where foreground and background gazes are looking in the same direction, whereas cueing effect indices under mismatched conditions are computed for trials where foreground and background gazes are looking in different directions. A positive cueing effect index indicates a stronger shifting of attention in the direction of the foreground gaze vs. background gazes (i.e., gaze cueing effect). A cueing effect index not different from zero indicates no particular shifting

of attention in the direction of the foreground gaze. A negative cueing effect index indicates a stronger shifting of attention in the direction of the background gazes vs. foreground gaze.

Figure 2

Trials Types and Cueing Effect Index



Note. FG = foreground, BG = background.

Procedure

We designed a novel, online version of the multi-gaze cueing task and experimental procedure to allow for the completely remote data collection of reaction time data. The multi-gaze cueing task was programmed on PsychoPy (version 2021.2.3) using the Builder interface, with Python and JavaScript code snippets. The task was then compiled entirely into JavaScript and hosted on Pavlovia that is accessible by any internet browser. This was a necessary development given that data collection occurred when COVID-19 lockdown restrictions were still in place in the location where in-laboratory data collection was originally going to take

place. The added benefit of designing a completely remote multi-gaze cueing task and experimental procedure was the improved accessibility for participants to participate without physical location limitations. It also eased the otherwise difficulty task of recruiting cultural minority groups from the community (i.e., Middle Eastern, South Asian, and East Asian participants living in Canada).

The online version of the multi-gaze cueing task was programmed with extra tasks to ensure a consistent viewing condition across participants' monitors. Firstly, the online version required participants to complete a card re-sizing task. Participants take a standard sized card (e.g., credit card) and resize an image on their monitor to the exact size of their card. This task has been used to estimate current monitor resolution, allowing for the re-sizing of all images to a consistent size across various monitor resolutions (Morys-Carter, 2021). Second, the online version instructed participants to measure and sit 60 cm away from their monitor. Third, participants centered their desktop monitor and laptop in front of them. This was to ensure, with a realistic amount of individual variability, that images are displayed at a relatively consistent visual angle[5] for all participants.

To sign up for the online study, participants had to meet the following requirements: (1) ability to log into Zoom with a webcam and audio turned on with screen share; (2) login using a laptop or desktop computer with a minimum monitor size of 13 inches; (3) use a full-sized keyboard with access to the spacebar and arrow keys; 4) access to a ruler or tape measure; 5) access to a standard-sized card (i.e., 3.38 × 2.13 inches, e.g., credit card).

[5] Visual angle refers to the angle at which images subtend at the eye. Visual angle is a function of both physical image size and distance from which the image is viewed. To ensure consistent visual angles for all stimuli presented in the multi-gaze cueing task, these tasks control both the physical image size and viewing distance between stimuli and participant.

Participants met the experimenter in a Zoom room. The experimenter provided the link to a Qualtrics survey in the Zoom chat, and participants were told to open the webpage and share their screen through Zoom. Participants were told to use a Google Chrome internet browser if it was already installed, with Firefox and Safari as a second choice if they had a Windows or Mac operating system, respectively. The experimenter guided participants to open a new window to the multi-gaze cueing task hosted on Pavlovia. They then made sure the participant hid their Zoom webcam's self-view and experimenter view to not distract them during the study.

After completing the tasks designed to correctly display the multi-gaze cueing task, the experimenter then pretended to set up a webcam-based eye-tracking calibration device to encourage participant adherence to instructions. Before starting the multi-gaze cueing task, participants were given a practice block of 20 trials, after which they completed four blocks of real trials. Participants were provided with a 40 second break between blocks. After completing the multi-gaze cueing task, the experimenter guided the participant back to the Qualtrics webpage to complete self-report measures. After completing the measures, participants were debriefed and compensated. Six different undergraduate research assistants and the first author acted as experimenters.

Measures

Two measures examined cultural variation on self-reported social orientation, operationalized as self-construal, and perceived self-other overlap.

Independent and Interdependent Self-Construal

The Singelis Self-Construal Scale (Singelis, 1994) is a 30-item scale used to measure independent and interdependent self-construal. Items were rated on a 7-point Likert scale, from

Strongly Disagree to *Strongly Agree*. Reliabilities of independent ($\alpha = 0.76$), and interdependent ($\alpha = .77$) self-construals were acceptable[6], so mean scores were computed for each subscale. The correlation between independent and interdependent self-construal was negligible, across the entire sample, $r = .01$. The correlation between independent and interdependent self-construal differed by region (note that correlations by region are computed with small sample sizes); North America: $r = -.35$, $p = .013$; Middle East: $r = .38$, $p = .005$; South Asia: $r = -.16$, $p = .248$; East Asia: $r = .09$, $p = .536$.

Self–Other Overlap with Friends and Family

The Inclusion of the Other in the Self (IOS) scale (Aron et al., 1992) is a single-item pictorial measure of how close the respondent feels to a target. The item uses seven pairs of gradually overlapping circles, one labelled with "self" and the other labelled with the target name. Respondents select the pair of overlapping circles that best represents the perceived self–other overlap, or connectedness, with the target. Two versions of this item were included to measure self-other overlap with close friends and family (see Appendix A). The correlation between the two items was modest ($r = .22$, $p = .002$) across the entire sample, and variable within regions: North America: $r = .43$, $p = .002$; Middle East: $r = .04$, $p = .757$; South Asia: $r = .20$, $p = .144$; East Asian: $r = -.01$, $p = .960$. As expected, across the entire sample self–other overlap with friends was associated with interdependent self-construal ($r = .18$, $p = .009$), and unexpectedly, independent self-construal ($r = .16$, $p = .020$). Self–other overlap with family was also associated with interdependent self-construal ($r = .34$, $p < .001$), and not at all with independent self-construal ($r = .02$, $p = .927$). The positive correlations of interdependent self–

[6] Reliabilities were also run by cultural group but note that sample sizes are small. Independent self-construal; North America: .72, Middle East: .78, South Asia: .78, East Asia: .75. Interdependent self-construal; North America: .78, Middle East: .72, South Asia: .80, East Asia, .78.

construal with self–other overlap with friends and family provides some evidence of convergent validity for the self–other overlap items as a proxy for interdependence with close others.

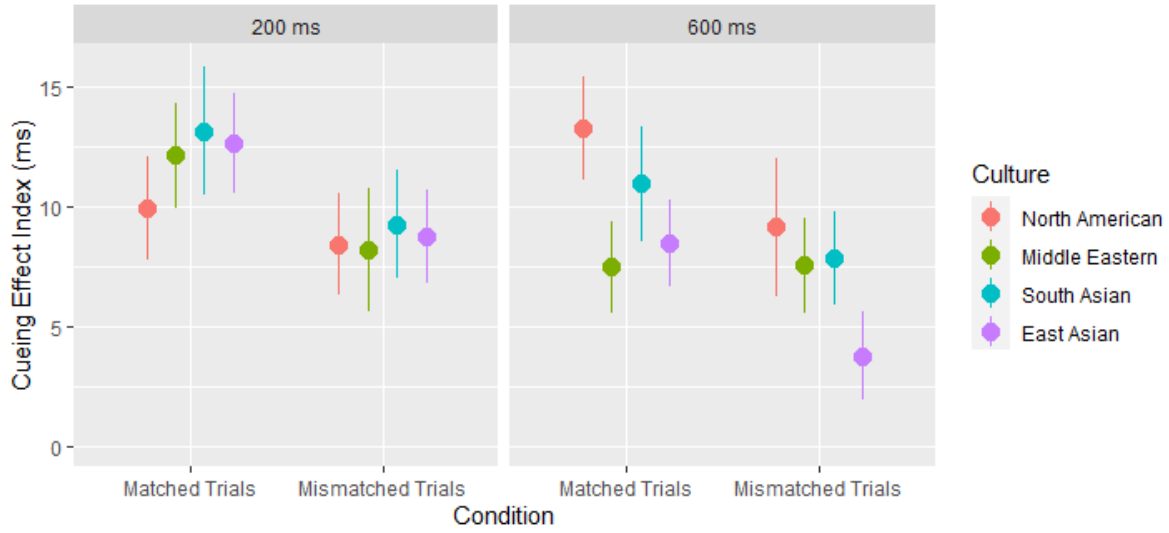
Results

Descriptive Statistics

All cueing effect indices were greater than 0, indicating that participants' attention was shifted in the direction of the foreground gaze (see Figure 3 and Table 3 for mean cueing effect indices by all experimental factors). The magnitude of this effect, however, seemed to differ by culture, with East Asians under mismatched conditions at 600 ms SOA showing a relatively smaller cueing effect index and effect size (M = 3.82, d = 0.30) compared to all other cueing effect indices and effects sizes found for the other experimental factors and cultural groups (Ms = 7.50~12.70, ds = 0.45~0.87).

Figure 3

Mean Plots By Culture, Matching Condition, and SOA



Note. Points represent mean estimates, and error bars represent standard error of the mean.

Table 3

Mean Reaction Times and Cueing Effect Indices, and t-tests Against Zero

	North America	Middle East	South Asia	East Asia
Raw reaction times – *M* (*SE*)				
Matched Trials at SOA: 200 ms				
Incongruent FG-BG	413.49 (2.14)	404.48 (2.08)	414.28 (2.39)	394.71 (2.36)
Congruent FG-BG	404.45 (2.14)	393.65 (2.01)	400.47 (2.37)	381.19 (2.31)
Mismatched Trials at SOA: 200 ms				
Incongruent FG-Congruent BG	415.80 (2.12)	402.19 (2.04)	413.04 (2.40)	391.79 (2.33)
Congruent FG-Incongruent BG	406.94 (2.04)	394.20 (1.93)	404.13 (2.37)	382.99 (2.22)
Matched Trials at SOA: 600 ms				
Incongruent FG-BG	390.38 (2.16)	377.60 (1.81)	392.12 (2.15)	374.02 (2.28)
Congruent FG-BG	377.26 (2.07)	369.24 (1.75)	381.50 (2.27)	364.51 (2.28)
Mismatched Trials at SOA: 600 ms				
Incongruent FG-Congruent BG	386.41 (2.05)	376.19 (1.75)	388.80 (2.12)	372.01 (2.20)
Congruent FG-Incongruent BG	377.27 (1.91)	369.22 (1.73)	381.53 (2.17)	367.28 (2.20)
Cueing effect indices – *M* (*SE*)				
Matched Trials				
SOA: 200 ms	9.98 (2.14)	12.42 (2.16)	13.19 (2.64)	12.70 (2.08)
SOA: 600 ms	13.27 (2.17)	7.06 (1.91)	10.97 (2.41)	8.51 (1.78)
Mismatched Trials				
SOA: 200 ms	8.47 (2.15)	7.82 (2.54)	9.28 (2.25)	8.79 (1.96)
SOA: 600 ms	9.18 (2.87)	7.43 (2.01)	7.89 (1.96)	3.82 (1.81)
***t*-tests against zero – Cohen's *d* (*p*)**				
Matched Trials				
SOA: 200 ms	0.66 ($p < .001$)	0.75 ($p < .001$)	0.67 ($p < .001$)	0.86 ($p < .001$)
SOA: 600 ms	0.87 ($p < .001$)	0.54 ($p < .001$)	0.61 ($p < .001$)	0.68 ($p < .001$)
Mismatched Trials				
SOA: 200 ms	0.56 ($p < .001$)	0.44 ($p = .002$)	0.55 ($p < .001$)	0.63 ($p < .001$)
SOA: 600 ms	0.45 ($p = .002$)	0.51 ($p < .001$)	0.54 ($p < .001$)	0.30 ($p = .041$)

Primary Analyses

To test our first hypothesis that participants from the Middle East, South Asia, and East Asia would pay more attention to the social context than people from North America, at 600 ms SOA, a linear mixed effects models was conducted, with cueing effect indices nested within participant. An initial omnibus 4 (Culture: North America, Middle East, South Asia, East Asia) ×

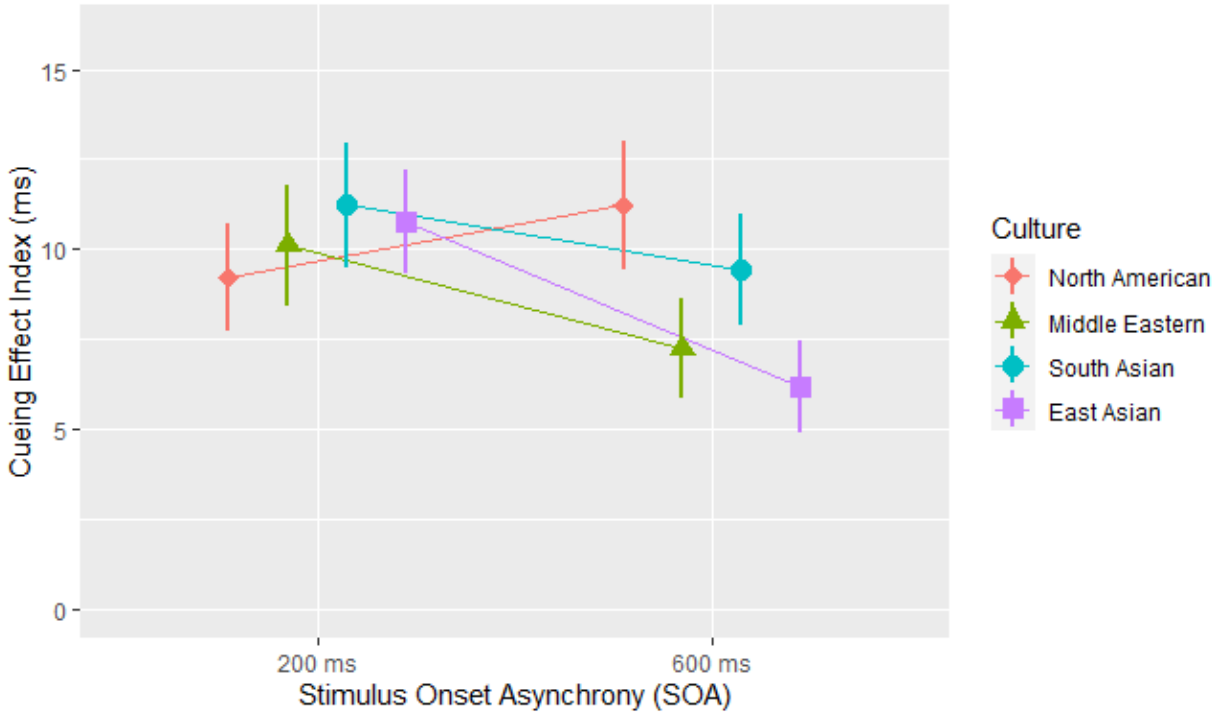
2 (Matching Condition: Matched, Mismatched) × 2 (SOA: 200 ms, 600 ms) model was specified, with North American as the reference group for the culture variable[7]. Two 2-way interactions between culture and SOA were observed, although neither were statistically significant: North America vs. Middle East × SOA: b = -7.95, p = .053; and North America vs. East Asian × SOA: b = -7.48, p = .075. Given that matching condition does not moderate the culture × SOA interaction, we re-specified the model with matching condition as a main effects term only, leaving a two-way Culture × SOA interaction term.

The simpler model revealed a consistent main effect of matching condition, with cueing effect indices larger in matched vs. mismatched trials, b = -3.12, 95% CI [-5.11, -1.12], p = .002. There was also a Culture × SOA interaction, with North America vs. East Asia as the comparison, b = 6.59, p = .026. Looking at just North American and East Asian samples, post-hoc t-tests revealed that the interaction occurred because North Americans' cueing effect indices did not differ by SOA, $t(297)$ = -1.11, p = .684, d = -0.16, 95% CI [-0.43, 0.12], but East Asians displayed higher cueing effect indices at 200 ms (M = 10.75, SE = 1.72) vs. 600 ms (M = 6.16, SE = 1.72) SOA, $t(297)$ = 2.54, p = .056, M_{diff} = 4.58, d = 0.36, 95% CI [0.08, 0.64], although this was not statistically significant. Although Figure 4 visualizes the notable difference between North Americans and East Asians under 600 ms SOA, their difference in cueing effects was not statistically significantly, $t(178)$ = 2.08, p = .163, M_{diff} = 5.06, d = 0.29. These results suggest partial evidence for our first hypothesis. We observed evidence of cultural variation at 600 ms SOA, as predicted, but only with respect to North American and East Asian participants.

[7] We considered four covariates: gender, age, religiosity, and socioeconomic status. A four-sample equality of proportions test did not reveal cultural differences in gender distribution, but one-way ANOVAs revealed cultural differences in age, religiosity, and SES (ps < .001). Adding these variables as covariates separately or together did not change the observation of the main interactions, so we removed these covariates from subsequent analyses.

Figure 4

Plot of Culture x SOA Interaction



Note. Points represent mean estimates, and error bars represent standard error of the mean.

To test our second hypothesis that Middle Eastern and South Asian participants would show less attention to the social context than East Asians, we refit the same 4 × 2 × 2 linear mixed effects models, but with East Asian as the reference group for the culture variable, to allow for parsimonious testing of East Asian vs. other cultural groups, interacting with SOA. The only statistically significant comparison was again, East Asian vs. North American, with the same effects observed in the original model, $b = 6.59$, $p = .026$. There were no interactions between East Asian vs. South Asian × SOA, and East Asian vs. Middle Eastern × SOA.

Exploratory Analyses

Order of Regional Cultural Groups on Cueing Effect Indices

Visualization of the Culture × SOA interaction in Figure 4 suggests there may be greater cultural variation that was not detected by the linear mixed effects model. When examining mean differences between cueing effect indices at 200 ms and 600 ms SOA (i.e., reflecting whether cueing effect indices decrease at 600 ms SOA, relative to 200 ms SOA), the order of regions that exhibit least to most interference from the background gazes is North Americans, M_{diff} = -2.00, South Asians, M_{diff} = 1.80, Middle Easterners, M_{diff} = 2.88, and East Asians, M_{diff} = 4.58, with South Asians and Middle Easterners demonstrating an "intermediate" level of interference from the social context between North Americans and East Asians. Instead of testing for statistically significant differences between sets of regions, we tested for an underlying linear pattern of cueing effect indices across regions.

First, we computed the mean difference in cueing effect indices between 200 ms and 600 ms SOA for all participants. Next, participants' regions were coded with a number from 1 to 4 to test for the region's relative position within the order of least to most sensitive to background gazes. Simple linear regressions[8] were conducted with mean difference in cueing effect indices as the outcome variable, and region position as the predictor variable.

To test our first hypothesis that North Americans should experiece the least interference from background gazes compared to the other regions, we tested the order of (1) North Americans, (2) South Asians, (3) Middle Easterners, (4) East Asians, with 4 representing the region with the highest sensitivity to background gazes. The linear pattern analysis revealed a

[8] A linear mixed effects model, with participants nested within regions, and region position (1–4) as a region-level predictor is also possible but not necessary to conduct, given that region position explains all the variance region-level intercepts would explain. A linear mixed effects model is therefore equivalent to a simple linear regression model and produces identical regression estimates and significance tests.

statistically significant, positive association, b = 2.07, 95% CI [0.07, 4.08], p = .043, suggesting evidence for the order of effects being North Americans, South Asians, Middle Easterners, and East Asians. The linear pattern analysis testing an alternative order of effects by switching South Asians and Middle Easterners, (1) North Americans, (2) Middle Easterners, (3) South Asians, (4) East Asians, resulted in weaker evidence, b = 1.84, 95% CI [-0.17, 3.85], p = .073. Coding for an order of effects that considers North America to not be the least sensitive to background gazes, (1) South Asians, (2) North Americans, (3) Middle Easterners, (4) East Asians, results in no evidence, b = 1.26, 95% CI [-0.71, 3.23], p = .209. These analyses suggest that North America exhibited the smallest difference in cueing effect indices between 200 ms and 600 ms SOA.

The previous analyses also provided evidence for our second hypothesis that Middle Easterners and South Asians are less sensitive to the background gazes than East Asians. To further confirm this, we tested an order that puts both South Asians and Middle Easterners as more sensitive to background gazes than East Asians, (1) North Americans, (2) East Asians, (3) South Asians, (4) Middle Easteners, and found no evidence, b = 1.16, 95% CI [-0.83, 3.15], p = .250. We tested another order that puts East Asians between South Asians and Middle Easterners, (1) North Americans, (2) South Asians, (3) East Asians, (4) Middle Easterners, and also found no evidence, b = 1.70, 95% CI [-0.28, 3.68], p = .093.

Altogether, these exploratory linear pattern analyses provide evidence for our two hypotheses: (1) North Americans exhibit less interference from background gazes vs. Middle Easterners, South Asians, and East Asians, and (2) South Asians and Middle Easterners also show less interference from background gazes vs. East Asians. We also found evidence that within the context of our study, Middle Easterners exhibited more intereference from background gazes than South Asians.

Self-Report Analyses

Table 4 reports the mean scores of all self-report measures by cultural group, and statistically significant differences between cultural groups. We examined if there were any cultural differences in the self-reported social orientation measures, and if they resembled the pattern of effects observed in the multi-gaze cueing task. A one-way ANOVA revealed marginally statistically significant differences across cultures for independent, $F(3, 206) = 2.45$, $p = .064$, $\eta = 0.03$, and interdependent self-construal, $F(3, 206) = 2.23$, $p = .086$, $\eta = 0.03$, with all post-hoc *t*-tests indicating no statistically significant pairwise comparisons (*p*s > .080).

Table 4

Mean Scores of Self-Report Measures

	North America	Middle East	South Asia	East Asia
Self-construal – *M* (*SD*)				
Independent self-construal	4.96 (0.70) $_{a}$	5.08 (0.71) $_{a}$	5.09 (0.72) $_{a}$	4.76 (0.74) $_{a}$
Interdependent self-construal	4.72 (0.69) $_{a}$	4.93 (0.61) $_{a}$	4.95 (0.75) $_{a}$	4.66 (0.76) $_{a}$
Self-Other Overlap – *M* (*SD*)				
Self-other overlap with Friends	4.68 (1.52) $_{a}$	4.68 (1.70) $_{a}$	4.58 (1.58) $_{a}$	3.52 (1.62) $_{b}$
Self-other overlap with Family	4.90 (1.75) $_{ab}$	5.70 (1.42) $_{ac}$	5.11 (1.89) $_{ab}$	4.39 (1.66) $_{bd}$

Note. Means in the same row with the different subscripts differ at $p < .05$.

A one-way ANOVA revealed cultural differences for self-other overlap with friends, $F(3, 202) = 6.05$, $p = .001$, $\eta = 0.08$. North American, Middle Eastern, and South Asian participants all reported higher self–other overlap with friends than East Asian participants: North American vs. East Asian: $t(202) = 3.57$, $p = .003$, $d = 0.72$, 95% CI [0.31, 1.13]; Middle Eastern vs. East Asian: $t(202) = 3.62$, $p = .002$, $d = 0.72$, 95% CI [0.32, 1.12]; South Asian vs. East Asian: $t(202) = 3.34$, $p = .005$, $d = 0.66$, 95% CI [0.26, 1.06]. There were also cultural differences for self–other overlap with family, $F(3, 205) = 5.34$, $p = .001$, $\eta = 0.07$. The only difference was Middle

Eastern participants reporting greater self–other overlap with family vs. East Asian participants, $t(205) = 3.94$, $p < .001$, $d = 0.78$, 95% CI [0.37, 1.18]. These results suggest that Middle Eastern participants reported having greater self–other overlap with their friends and family (ingroup members), compared to East Asian participants, with North American and South Asian participants tending to score in-between Middle Easterners and East Asians.

In an exploratory manner, we tested if inclusion of the social orientation measures (i.e., self-construal and self-other overlap scores) in the original 4 × 2 × 2 linear mixed effects model (i.e., Matching Condition as a main effects term, and Culture × SOA interaction term) would predict cueing effect strength or change the observation of the Culture × SOA interaction. None of the social orientation measures predicted cueing effect strength, *p*s > .362. Inclusion of any of the social orientation measures as covariates did not change the observation of the Culture x SOA interaction (*p*s < .05). These results suggest that none of the self-report measures were associated with the observed gaze cueing effects.

Altogether, self-report measures did not show cultural differences in self-construal and showed Middle Easterners as endorsing the highest self-other overlap with family and friends compared with East Asians. The pattern of cultural differences in self-report measures was not consistent with the findings from the multi-gaze cueing task that suggested East Asians have the strongest context-dependent gaze cueing.

Discussion

The purpose of the current study was to test whether there is regional cultural variation in social attention with North Americans, Middle Easterners, South Asians, and East Asians. The multi-gaze cueing task measured whether gaze cueing effects from the foreground gaze were

interrupted by background gazes. Our first hypothesis was that Middle Easterners, South Asians, and East Asians would experience interference from the background gazes such that their gaze cueing effects would be greater at 200 ms vs. 600 ms SOA, compared to North Americans who would not experience interference from background gazes such that their gaze cueing effects would be similar across SOAs. In our second hypothesis, we hypothesized that compared to East Asians, Middle Easterners and South Asians would experience less interference from the background gazes such that the difference in gaze cueing effects between 200 ms and 600 ms SOA would be smaller than for East Asians.

We found partial evidence for the first hypothesis: only East Asians exhibited lower cueing effect indices at 600 ms SOA, compared to North Americans, suggesting that background gazes interrupted East Asians' gaze cueing from the foreground gaze to a greater extent than for North Americans. However, background gazes did not seem to interrupt Middle Easterners' and South Asians' gaze cueing, so there was no statistical difference in gaze cueing patterns between Middle Easterners and South Asians, and North Americans. We also found partial evidence for the second hypothesis. Both Middle Easterners and South Asians did not show statistically different gaze cueing patterns compared to East Asians. However, the exploratory linear pattern analysis supports the inference that South Asians and Middle Easterners exhibit "intermediate" gaze cueing effects in-between North Americans and East Asians, with the analysis specifically supporting the following order of regions, from least to most sensitive to background gazes: (1) North America, (2) South Asia, (3) Middle East, (4) East Asia.

Overall, these results suggest that within the domain of automatic social attention, there is heterogeneity among "Eastern" cultures commonly thought to be interdependent, namely cultures from Middle Eastern, South Asian, and East Asian regions. Cultural psychological

research employing a two-culture comparison approach often uses a North America vs. Eastern culture group which can create a dichotomous perception of culture, and encourage assumptions that all "Eastern" cultural groups are similar. The results of this study reinforces a more realistic perception of culture as continuous in nature.

Although we did not observe that Middle Easterners were different from North Americans in their gaze cueing patterns, the exploratory linear pattern analysis confirmed that Middle Easterners exhibited the second smallest difference in cueing effects after East Asians. These results suggest Middle Easterners may exhibit an "intermediate" mode of social attention, between context-independent (similar to North America) and context-dependent (similar to East Asia) modes of social attention. This aligns with past research, which tends to be inconsistent in characterizing Middle Eastern groups as having context-dependent cognition like East Asians (San Martin et al., 2018; Savani, 2020) or context-independent cognition like North Americans or Western Europeans (Uskul, 2023).

Inconsistent findings with Middle Easterners have been explained by prior theorizing that Middle Easterners' (explicitly, Arabs') assertiveness may come from interdependence, in service of ingroup members (Kitayama et al., 2022; San Martin et al., 2018). In a sense, independent and interdependent qualities may be psychologically linked in the Middle Eastern psychological profile. San Martin and colleagues (2018) demonstrated this by priming interdependence and independence on Moroccans. Moroccans in the interdependence condition exhibited greater independent qualities (e.g., assertiveness) than those in the independence condition, suggesting that the activation of interdependence also co-activated independence (San Martin et al., 2018). In the current study, we also observed evidence of this: only Middle Easterners produced a positive correlation between their self-reported independent and interdependent self-construal

(i.e., $r = 0.38$, $p = .005$). Altogether, Middle Easterners may exhibit both context-dependent cognition (like East Asians) and context-independent cognition (like North Americans), and thus exhibit an "intermediate" mode of context-dependent cognition between North Americans and East Asians.

In the current study, South Asians were not different from North Americans or East Asians, but the exploratory linear pattern analysis revealed they had the second highest cueing effects after North Americans, suggesting South Asians also occupy an "intermediate" mode of context-independent cognition more than East Asians, but less than North Americans. Consistent with the current results, research has shown that South Asians exhibit context-independent cognition like North Americans on visual and verbal tasks (Savani, 2020), and on visual attention and emotion tasks where their evaluation of a central figure's emotional state was not influenced by the emotions from the social context (Nanakdewa, 2022). Past and current findings point to South Asians as having relatively context-independent cognition, but further research is needed.

We initially included self-report data to explore whether the pattern of cultural differences in the multi-gaze cueing task would match with the pattern of cultural differences observed for social orientation measures. The pattern of cultural differences for self-report data, however, did not theoretically match the pattern of cultural differences observed for the multi-gaze cueing task. Given that East Asians exhibited the greatest attention to context, theoretically they should have reported the highest on interdependent social orientation measures. Yet there were no cultural differences for interdependent self-construal, and in the opposite of what we expected, Middle Easterners endorsed greater self-other overlap for friends and family compared to East Asians. However, it is known that measuring cultural constructs using self-report measures have several methodological issues (Lo & Sasaki, in press), such as the reference group

effect, or who participants have in mind when they are evaluating themselves on self-report measures (Heine et al., 2001). It could be that East Asians rated themselves lower on interdependent social orientation measures because their reference group is other East Asians who they may perceive to be more interdependent. This tends to explain why previous research does not always observe differences in social orientation between North Americans and East Asians (Heine et al., 2001; Matsumoto, 1999), and why self-reported social orientation often does not match implicit measures of behaviour, like the multi-gaze cueing task (Lo et al., 2021) or other behavioural tasks (Kitayama et al., 2009; Na et al., 2010). It is perhaps unsurprising, then, that the current study's self-reported measures are not consistent with the behavioural data.

We hypothesized Middle Easterners and South Asians would exhibit more context-dependent cognition than North Americans. Why did we fail to observe this effect in the current research? There are several possible explanations, but the two most likely explanations are: A) East Asian culture uniquely encourages an attention to the context in a manner unlike South Asian and Middle Eastern culture, and B) the current sample's Middle Eastern and South Asian participants are international students and are uniquely independent. The latter possibility concerns Middle Eastern and South Asian samples, comprised mostly of international students (Middle Eastern: 93%, South Asian: 79%), because they may be more independently minded given that they were drawn to a highly urban city in Canada to obtain higher education (Sevincer et al., 2019). However, this possibility is less likely given that the East Asian sample in the current study was *also* mostly comprised of international students (albeit less than Middle Easterners and South Asians; East Asians: 68%). Previous research suggests that East Asian international students tend to exhibit similar context-dependent cognition with East Asians sampled from East Asia: both groups attended to the social context to a greater extent than

European Canadians (Masuda et al., 2012). This suggests that international students are not necessarily more independently minded than their non-immigrant counterparts. Given the lack of reasonable explanation to suggest why Middle Easterner and South Asian international students would be more independently minded than East Asian international students, it is a more likely possibility that there is an aspect of East Asian culture that uniquely encourages reflexive attention to the context.

Such specific aspects of East Asian culture that might encourage attention to the context may be related to self-effacement (Heine & Takumura, 2007; Kitayama et al., 2022), aspects of face culture (Leung & Cohen, 2011), rejection avoidance (Hashimoto & Yamagishi, 2013), or lower relational mobility (San Martin et al., 2019). These aspects might be strongly embedded in East Asian behavioural norms at an early age, and becomes highly automatized and hard to change, compared to other cultural regions. Evidence for this comes from research examining bicultural individuals who come from East Asian heritage. There is evidence that East Asian Canadians tend to exhibit context-dependent cognition, albeit in-between East Asians from East Asia and European Canadians (Masuda et al., 2012). South Asian Canadians, however, do not show the same context-dependent cognition, and exhibit similar attention tendencies to European Canadians (Masuda et al., 2022), just like in the current study's results. It is likely that despite Canadian acculturation, East Asian Canadians also learn culturally endorsed norms to attend to the context from their heritage cultural upbringing. Future research should test for potential culture-specific mediators, such as rejection avoidance or endorsement of face culture, that explains greater attention towards social context.

Future research should include greater diversity of social orientation measures. The current work included a self-construal scale that measured independent and interdependent social

orientation as two unidimensional constructs, which limited the rich data that could have been obtained had we used a multidimensional measure. For example, The Culture and Identity Research Network Self Construal Scale – Version 3 (CIRN-SCS-3; Krys et al., 2021; Uskul et al., 2023) has eight bipolar dimensions of independent-interdependent social orientation (e.g., connection to others vs. self-containment). It is possible that one such dimension is more relevant for predicting attention to social context, which may provide an explanatory mechanism for current observed cultural differences in social attention.

Cultural differences comparing Middle Easterners or South Asians with North Americans or East Asians may be smaller than traditionally observed when comparing North Americans and East Asians. If future work theoretically replicates the order of cultural effects for attention to the context, North America—South Asia—Middle East—East Asia, then future research can anticipate how large of a difference there is among other cultural group comparisons. For example, future research can make a priori assumptions that there may be bigger cultural differences between South Asia and East Asia, compared to South Asia and Middle East. This can result in better study planning (e.g., increasing sample size when a priori effect sizes are known to be small).

Altogether, East Asians experienced interference from the background gazes to a greater extent than North Americans, and possibly Middle Easterners and South Asians. The observed heterogeneity among “Eastern” cultures highlights the importance of studying cultural comparisons beyond West vs. “the rest” dichotomy, to understand how different cultural contexts can complexly shape psychological profiles of cognition and the self.

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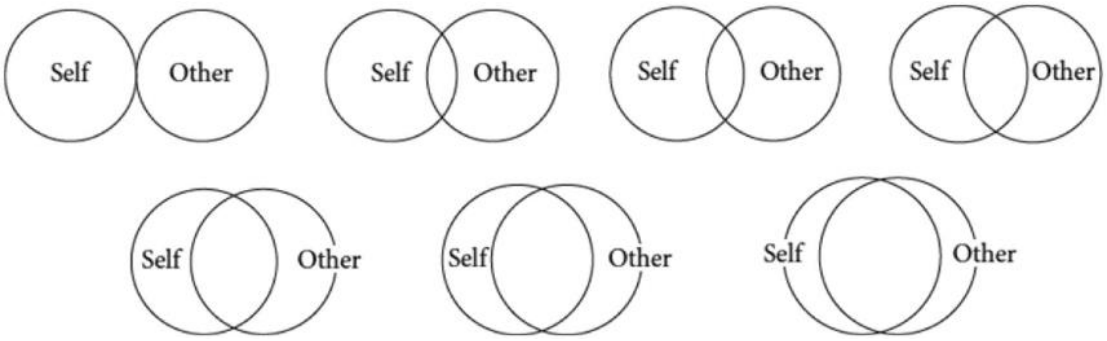
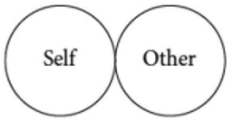
Appendix A

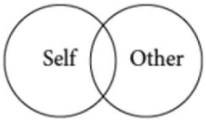
Self-Other Overlap Item Description

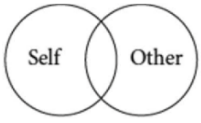
We are interested in the degree to which you feel personally connected to other people. Below are seven diagrams that express varying degrees of relatedness or connectedness with other people. For example, the first diagram on the top left indicates no relationship or connectedness, and the last diagram on the bottom right indicates complete connectedness.

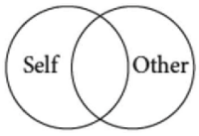


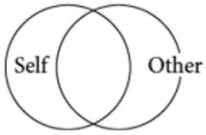
Select which diagram represents the degree of connectedness in your relationship with your [**family / friends**].

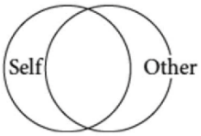
[ ] 

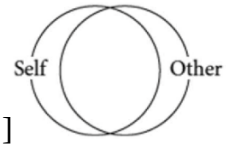
[ ] 

[ ] 

[ ] 

[ ] 

[ ] 

[ ] 

CHAPTER FIVE:

General Discussion

Social attention, like other social cognitive functions, does not develop and emerge in a vacuum. This dissertation aimed to provide evidence that sociocultural experiences play an important role in shaping social attention by investigating the influence of three sociocultural experiences: biculturalism, racial diversity, and regional culture. In the Priming Manuscript (Chapter Two), I show that being bicultural may prepare the social attention system to be flexible and responsive to varying cultural cues present in environmental history. In the Race Manuscript (Chapter Three), I show that individuals across cultures attend to race in social contexts and that attention to race may override cultural defaults for social attention. Finally, the Region Manuscript (Chapter Four) extends my findings beyond well-studied regions such as North America and East Asia to fully comprehend differences in social attention systems. I show there is cultural variability in social attention between individuals from North America, Middle East, South Asia, and East Asia, with individuals from East Asia exhibiting the most sensitivity to gazes in the social context.

The Role of Social Orientation

Although many theoretical accounts for cultural variation in cognition depend on social orientation as the explanatory mechanism (e.g., Varnum et al., 2010), results from the Priming and Region Manuscripts demonstrate that the association between social orientation and social attention is not straightforward. In the Priming Manuscript, findings revealed some evidence for social orientation as the explanatory mechanism, but with a caveat. Priming independent and interdependent self-construal seemed to influence gaze cueing effects very early on in the automatic cueing interval (i.e., 200 ms), and not later (i.e., 600 ms SOA). At 200 ms SOA, East Asian Canadians primed with independent self-construal exhibited strong gaze cueing effects, and those primed with interdependent self-construal had weakened gaze cueing effects

suggesting background gazes interrupted gaze cueing from the foreground. By 600 ms SOA, however, both prime groups experienced weakened gaze cueing. This suggests that the role of primed social orientation is somewhat transient, impacting the earliest stages of automatic cueing, but its effects may not persist over time. Therefore, social orientation does not sufficiently explain why there is typically cultural variation at only later stages of automatic cueing (i.e., 600 ms SOA). These findings suggest that the role of social orientation for influencing social attention may only be transient, and that social orientation does not fully explain cultural variation in social attention.

In the Region Manuscript, findings did not reflect social orientation as a potential mechanism at the region-level. If greater interdependent social orientation is associated with greater context-dependent cognition, then we would expect that at the regional culture-level, regions that exhibit the most interference from background gazes would also report greater interdependent social orientations. Yet, we do not observe this region-level association between gaze cueing effects and social orientation. East Asians exhibited the most interference from background gazes followed by Middle Eastern, South Asian, and North American. By that logic, East Asians, on average, should have also self-reported the highest interdependence on the three social orientation measures: self-construal, self-family overlap, and self-friend overlap. For reported both independent and interdependent self-construal, there was no difference among the cultural regions. However, for self-family overlap, Middle Easterners tended to self-report higher self-family overlap than East Asians. North American, Middle Eastern and South Asians also tended to self-report higher self-friend overlap than East Asians. Therefore, all three interdependent social orientation measures did not reflect an order of effects that resembled the

order from cueing effect indices, in which East Asians were the more sensitive to background gazes.

One reason why social orientation, as measured or manipulated in this dissertation, may not have sufficiently predicted social attention, is because the conceptualization of interdependence is a monolithic construct. The Priming Manuscript used the Pronoun Circling Task to prime interdependence, which has been described as priming a 'collective' interdependent self (Brewer & Gardner, 1996). The Region Manuscript's self-report measures for interdependence may have captured interdependence as both the 'collective' (i.e., self-other overlap) and 'relational' (i.e., interdependent self-construal measure) interdependent self. Vignoles and colleagues (2016) highlighted a variety of domains that independence and interdependence could vary on: difference vs. similarity, self-direction vs. receptiveness to influence, self-reliance vs. dependence on others, self-consistency vs. variability, self-expression vs. harmony, self-interest vs. commitment to others. One of these domains map onto the current dissertation's working definition of interdependence: self-containment vs. connection to others. It could be the case that another domain, rather than collective or relational interdependence, may better reflect interdependence that would be associated with context-dependent social attention. Receptiveness to influence, for example, may be more relevant to social attention, as it can capture the extent to which basic selective attention processes are influenced by social cues in the environment. Further research is required to examine if any of these other domains of social orientation, manipulated or measured, may be a more relevant mechanism that explains cultural variation in social attention.

Distal vs. Proximal Social Factors on Social Attention

Results from the Priming and Race Manuscripts also demonstrate that despite a lifetime of exposure to specific cultural environments, cultural default settings for social attention are not necessarily fixed or rigid to more proximal social influence. Critically, these manuscripts also demonstrate that the influence of proximal factors depends on long-term cultural experiences.

In the Priming Manuscript, we demonstrate that priming independence or interdependence to East Asian Canadian biculturals impacted their gaze cueing effects early on in the automatic cueing interval. However, European Canadian monoculturals did not exhibit different gaze cueing effects when they were primed with independence vs. interdependence. Specifically, the prime did not change their gaze cueing effects earlier or later on in the automatic cueing interval. These results suggest that proximal cultural information, such as self-construal primes, can override distal culture to influence social attention, but only for those who have long-term experience navigating between different social orientations and the associated modes of social attention. Otherwise, self-construal priming may not sufficiently shift the social attention system between different modes of attention. Such results suggest that proximal cultural information may interact with prior cultural experiences to shape gaze cueing behaviour.

Importantly, the Race Manuscript demonstrated that race is important, but the effects of race may also depend on long-term cultural experiences. In the manuscript, we theorized that prior research that did not find own-race gaze cueing biases with White Italians and Mainland Chinese resulted from their participants not having experience navigating racially diverse contexts that involved interacting with East Asian or White individuals, respectively (Zhang et al., 2020). In my manuscript, I explicitly tested individuals who *do* have experience interacting with East Asian or White individuals: European and East Asian Canadians. The participants in my manuscript demonstrated a type of own-race gaze cueing bias, albeit across trials rather than

trial-by-trial. Although we do not explicitly compare participants who did or did not grow up in a racially diverse context, findings suggest that proximal information, like race, influences gaze cueing. We observed these findings with participants who had long-term experiences navigating racially diverse contexts. We also hypothesized long-term cultural experiences influences whether race is perceived as a cue for ingroup membership, and current findings suggests it does not. The effectiveness of race as a proximal factor influencing social attention may depend on long-term experiences navigating racially diverse contexts, and not necessarily heritage cultural experiences.

Altogether, proximal social factors can override distal factors. The influence of proximal factors may emerge and dissipate early (i.e., cultural priming at 200 ms SOA), or may require more time to influence social attention (i.e., race at 600 ms SOA). Yet the influence of certain proximal social factors may also depend on specific long-term cultural experiences such as biculturalism or racial diversity.

Challenges of Studying Visual Attention Online

The Race and Region Manuscripts were conducted during the COVID-19 pandemic. This required pivoting to an online experiment format that somewhat differed from the in-laboratory format used in the Priming Manuscript. First, the experiments had to be re-programmed in software that could allow for an experiment to be hosted online. Therefore, all experiments were programmed into PsychoPy, which provided a convenient online hosting platform on Pavlovia.

Second, there was a large concern that collecting online reaction time data, which is highly sensitive to environmental conditions, would result in too much variance in the participant responses. Therefore, great efforts were made to mitigate this concern. Embedded in the online

experiments was a credit card task that participants could complete to adjust the presentation of stimuli to the same physical size, regardless of different monitor sizes. Instructions were included in the experimental procedure to encourage similar viewing distances for each participant. Keeping the viewing distance and physical dimensions of the stimuli consistent across participants ensured images were subtended at a consistent degree of visual angles (i.e., size of image on the retina), which is an important experimental parameter in visual cognition research.

Third, asynchronous online data collection may be subject to participant misbehaviour, especially because the required set up for the experiment was complex and the multi-gaze cueing task required completion of hundreds of trials. To limit misbehaviour, I implemented a synchronous Zoom design, in which experimenters meet face-to-face with participants on Zoom, in a manner akin to in-laboratory data collection experience to increase overall control of the testing conditions and to produce higher quality data.

Despite the many challenges, there were also advantages of the online, synchronous Zoom design, compared to testing in-laboratory. In the Priming Manuscript (before COVID-19), experimenters sat behind participants' chairs and used a mirror to observe eye gaze as the participant completed the experiment, so it was difficult for experimenters to observe whether participants made mistakes. In the Race and Region Manuscripts, however, experimenters had clear, visual access to participant's screens through Zoom's screen share function which provided an easy way to monitor participants' behaviour. Screen sharing also allowed experimenters to easily deceive participants into believing an eye-tracker set up could be implemented with their webcams which encouraged participants to adhere to instructions (e.g., fixating on the fixation cross at the beginning of each trial). Also, the online nature of the

experiments meant participation was more readily accessible. Given that data collection necessitated recruiting participants from varied cultural backgrounds, the online nature of the experiments facilitated data collection from these communities because it was easier to participate in such experiments.

Limitations and Future Directions

In the Priming Manuscript, evidence of the prime working for East Asian Canadian biculturals and not European Canadians monoculturals was interpreted as the prime working for biculturals. However, an alternative explanation may be that East Asian Canadians may primarily have access to interdependent self-construals and that those with interdependent self-construals may have an easier time frame-switching into an independent self-construal (vs. the other way around). A way to verify that the findings from the Priming Manuscript come from East Asian Canadians being *bicultural* as opposed to being *East Asian* would be to test another monocultural group that theoretically should hold interdependent self-construals, such as East Asians from East Asia. If East Asians from East Asia react similarly to European Canadians, such that they do not show a difference in their cueing effects between prime conditions, that would strengthen the interpretation that biculturals have access to independent and interdependent self-construals in a manner unlike monoculturals.

In the Race Manuscript, we found evidence of ensemble coding (Alt & Phillips, 2022; Phillips et al., 2014), in which participants across all trials attended to the foreground or background that contained own-race faces. These findings suggest that participants summarized information over many trials to infer foreground or background as a context in which own-race or other-race faces would appear. To further confirm ensemble coding processes about race, I should be able to predict and confirm findings using a different racial composition. For example,

a proposed follow up study is a multi-gaze cueing task in which the foreground gaze is consistently White, and the background gazes are either all-Asian or all-White. At a long enough duration (i.e., 600 ms SOA), European Canadians are predicted to persistently attend to the foreground gaze in which own-race face is always presented and East Asian Canadians are predicted to experience interference from the social context in which own-race faces are occasionally presented. These results should only occur if ensemble coding of race across trials is indeed occurring. It is also important to see whether ensemble coding would occur for different comparisons of races and cultural groups (e.g., White and South Asian faces).

Notably, participants in the Region Manuscript were recruited through convenience samples. Most of our Middle Eastern, South Asian, and East Asian samples were international students, whereas most of the North American sample was recruited from Prolific. I ruled out several demographic differences between the regional cultural groups that could have driven the observed results, and I went to great lengths to ensure individuals were born and raised in their respective regions. However, it is important to note that even after these methodological considerations, the samples I recruited may not be the most representative of individuals from those regions. Future replications and extensions of this work should aim to recruit individuals directly from those regions, and ideally from the community to get a diverse range of ages and socioeconomic statuses.

Given that the standard multi-gaze cueing task requires detection of the target, by simply indicating when the target appears, behavioural data in the form of accuracy was not obtained. Localization (e.g., where did the target appear, left or right) and identification (e.g., what shape was the target, square or diamond) tasks have also been used as a response format which can allow for accuracy data to be measured. Friesen and Kingstone's (1998) seminal work compared

the gaze cueing effect across detection, localization, and identification task types, and found that detection and localization retained a strong gaze cueing effect across short and medium SOAs. A meta-analysis of gaze cueing effects also observed that although all three task types retained significant gaze cueing effects, detection and localization tasks tended to retain a stronger gaze cueing effect than identification tasks, with localization tasks retaining the strongest gaze cueing effects (McKay et al., 2021). Computational modelling approaches, such as drift diffusion modelling (Ratcliff, 2008), combine both reaction time and accuracy data to model parameters that are important for decision making, such as drift rate, or how much information is required for an individual to make a decision. Such a computational modelling approach would allow for a richer understanding of social attention processes, and how factors such as culture and race can impact decision making in social attention. Future work with the multi-gaze cueing task may opt to include a localization or identification task as a response format, allowing for accuracy data to be measured.

Importance of Studying Social Cognition in Different Populations

One of the important contributions of this dissertation is the recognition of culture as a fundamentally important source of variation in psychological processes such as social cognition. Importantly, culture as studied in this dissertation was not limited to studying "Eastern" vs. "Western". Rather, each manuscript in the dissertation focused on different types of cultural experiences that could be found within and across regions. In the Priming Manuscript, for example, studying multiple populations was the only way to learn whether self-construal was a causal mechanism of gaze cueing. Without the inclusion of East Asian Canadian biculturals, I would have prematurely concluded that self-construal priming was not a causal mechanism of gaze cueing. Biculturals, or those who are part of multiple cultures, are an increasing population

around the world, and negotiating their multiple cultures may result in unique social cognitive processes (Hong et al., 2000; West et al., 2017). Biculturals form a distinct population within a region that are worth studying.

Although bicultural individuals may frequently navigate intercultural and interracial contexts, these experiences themselves may result in distinct social cognitive processes. East Asian Canadians, alongside European Canadians, may develop greater own-race gaze cueing biases through their experiences navigating racially diverse contexts and interracial relationships, in a manner that racial majority members living in racially homogenous contexts could not experience. My dissertation highlighted the importance of theorizing about racialized experiences as a form of long-term culture. This is especially true for racially minoritized individuals for whom the encounter of racial majority members is daily and life-long.

Lastly, the importance of studying regions beyond North America and East Asia cannot be understated. Although research using North America and East Asia comparisons have undoubtedly been the catalyst to the initial growth of cultural psychology, the field cannot grow further without studying other regions. This is why I undertook great efforts to include two understudied regions in my third manuscript, Middle East and South Asia, allowing for greater clarity about the role of culture on social cognition that would not have been possible without the inclusion of these groups.

Conclusion

Social cognitive systems, especially those that support the automatic processing of social cues, have long been presumed to be universal because of the shared importance of such functions in social interactions. This assumption is further underscored by the fact that the social

attention system has a neurobiological basis in the visual system, encouraging an assumption that visual attention operates in a universal manner. Yet the findings from this dissertation suggest that cultural experiences indeed shapes the social attention system so that it is functional in the cultural world of the perceiver.

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