The group’s gazes engages: Culture moderates the effect of

interdependent primes on joint attention mechanisms

Abstract

People reflexively orient their attention in response to other peoples’ gazes. Culture, however, has been shown to exert an influence on how joint attention mechanisms operate (Cohen, Sasaki, Kim, & German, 2017). In the current paper, we examine whether activating culturally-relevant representations of the self can further modulate joint attention mechanisms in directing attention across social contexts in both European (Study 1) and East Asian Canadians (Study 2). Participants were primed to think of themselves as independent or interdependent. We then administered a multi-gaze cueing task where a central foreground face gazed to the left or right before a target appeared in either direction. Multiple faces in the background either matched the foreground gaze cue direction, or mismatched. European Canadians (Study 1) were not influenced by the prime, and showed largely typical cueing effects from the foreground gaze cues, while being able to ignore the matching or mismatching background gaze cues. Only East Asians (Study 2), when given the interdependent prime, failed to show cueing effects, suggesting that they integrated both foreground and background gaze cues. These results reflect that activating interdependent meaning systems can modulate joint attention mechanisms but only for those whom activating these meaning systems have adaptive significance.

Keywords: culture, social attention, gaze cueing, Posner cueing task, independence, interdependence, priming

The capacity to engage in social learning from others is thought to be one of the reasons why human beings have been successful as a species (Dean, Kendal, Schapiro, Thierry, & Laland, 2012; van Leeuwen, 2018). One such way human beings have developed specialized mechanisms to engage in social learning is the ability to infer intent and emotion from processing and integrating information from the eyes (Adams & Kleck, 2005; Baron Cohen, Wheelwright, & Jolliffe, 1997; Huang, Andrist, Sauppe, & Mutlu, 2015). Gaze, the direction someone is looking, can indicate information of interest – [opposite of threat] or threat – in the environment, and research has shown that people are particularly attuned to, and even reflexively orient towards, where other people are looking, known as joint attention (Friesen & Kingstone, 1998; Frischen, Bayliss, & Tipper, 2007). These mechanisms are attuned to specific social stimuli in the environment, and culture has been shown to moderate the extent to which gazes are reflexively oriented to (Cohen, Sasaki, Kim, & German, 2017). In the current paper, we examine how culturally relevant constructs of independence and interdependence can exert influence on joint attention mechanisms in directing attention across social contexts.

The robust effects of joint attention have long been established in the attention literature and central to this literature is the Posner cueing paradigm; cues can facilitate reaction times to perceiving targets when the cues physically highlight a space where a target eventually appears (i.e., congruent cueing), or can hinder reaction times when the cues physically highlight a space where the target does not appear in (i.e., incongruent cueing; Posner, 1980). Joint attention research adapts this cueing paradigm by using gaze direction as a cue by simply directing a central face’s gaze towards the space where the target may appear (Friesen & Kingstone, 1998), resulting in a strong orientation towards that space regardless of whether the target appears there. Importantly, this cueing effect persists even when participants are informed that the gaze cues are uninformative for perceiving where the target appears, suggesting that gaze cues trigger an automatic shift of attention in response to another’s gaze direction. The cueing effect depends on the stimulus onset asynchrony (SOA), or the time interval between when the cue appears and when the target appears. The cueing effect is triggered as early as 200 ms after the gaze cue is presented and the target onsets, persists until 600-700 ms, and dissipates towards the 1000 ms SOA mark, which suggests that the cueing effect is an automatic process that top-down processes can interfere with after a minimum period of time.

There is some evidence, however, that top-down processes can interfere with reflexive orienting even during the automatic interval of cueing. Gazes that belonged to higher status people elicited stronger cueing effects than lower status gazes (Dalmaso, Pavan, Castelli, & Galfano, 2012). Faces that were associated with negative, norm-violating behaviours elicited stronger cueing effects than faces associated with positive behaviours, especially among participants who perceive the norm-violating behaviours as particularly more negative than the positive behaviours. Cueing effects were also stronger for familiar face gazes vs. unfamiliar face gazes, but only for female participants (Deaner, Shepherd & Platt, 2007). Importantly, these studies also show top-down effects at 200-600 ms SOAs, suggesting that information about the social environment can penetrate the automatic cueing interval to influence otherwise bottom-up cueing effects.

Are the underlying mechanisms of social attention that generate the cueing effect the same everywhere? Research on cognition has demonstrated cultural differences in aspects of perception and attention. It is well established, for example, that East Asians have been shown to pay more attention to and remember more details of background and contextual information, relative to North Americans (Chua, Boland, & Nisbett, 2005; Masuda & Nisbett, 2001; Masuda & Nisbett, 2006; Nisbett, Peng, Choi, & Norenzayan, 2001). These attention differences are also found in social contexts, where social information (e.g., faces in the background) has been shown to influence East Asians’ overall appraisals of social scenes to a greater extent than North Americans (Masuda et al., 2008). A recent study demonstrated that the extent to which cueing effects from a central, foreground face surrounded by background faces is elicited depended on cultural background (Cohen et al., 2017). Although both East Asians and Americans, when background gazes were cued in a different direction than the foreground gaze, experienced cueing effects from the foreground gaze when the SOA was 200 ms, East Asian participants experienced interference from the incongruent background gazes, interrupting the automatic reflexive orienting from the foreground gaze, but only during a relatively late SOA (600 ms SOA) within the automatic cueing interval period. It was proposed that culture, among other social environmental factors, can calibrate social attention mechanisms to highlight social cues in the environment that are valued in the cultural and social context in which these mechanisms develop. East Asian culture emphasizes attending to relationships and the social context, and developing a sense of self rooted in interdependence with close others, compared to North American culture emphasizing an independent sense of self (Markus & Kitayama, 1991). These aspects of East Asian culture may shape the development of joint attention mechanisms, calibrating them to attend broadly to social context information (i.e., background gazes, as it is part of the broader social environment).

Despite East Asians being more interdependent than North Americans, research on independence and interdependence suggest that these systems of self-construal (and related thinking patterns) co-exist to varying levels in individuals of all cultural contexts that may be emphasized more or less in different social domains or activated by specific social cues. For example, priming American participants (who are thought to be independent) to think of themselves as interdependent made them more attentive to changes made in the background than those who were primed with thinking of themselves as independent (Choi, Connor, Wason & Kahan, 2016). There is also evidence that priming affects attention shifting by allowing concepts that are stored in a semantic network to be more easily accessible and activate related cognitive mechanisms associated with processing that concept. For example, priming participants of “God” and “Devil” related words activated spatial processing related to direction such that “God” related words shifted attention upwards, and “Devil” related words shifted attention downwards (Chasteen, Burdzy, & Pratt, 2010). Priming has also been shown to penetrate the automatic cueing interval for joint attention. Participants that were primed with a low subjective sense of social power had stronger cueing effects than those primed with high social power at 200 ms SOA (Cui, Zhang & Geng, 2014), suggesting that priming can quickly activate feelings of low social power that lead to prioritizing others’ (relatively higher status) gaze cues.

The current paper examines how activating independent and interdependent meaning systems can penetrate the automatic cueing interval to produce theoretically related processing in European Canadians (Study 1) and East Asian Canadians (Study 2). When the direction of the foreground gaze cue matches the direction of the background gaze cues, cueing effects should occur in the automatic cueing interval (200 ms and 600 ms SOA), regardless of which meaning system is primed since joint attention mechanisms are facilitated by all of the gaze cues looking in the same direction. Under mismatching conditions (i.e., the background gazes are in the opposite direction of the foreground gaze), priming independent construal of the self should activate prioritization of the central foreground gaze cue only. Priming interdependent construal of the self, however, should activate prioritization of both foreground and background gazes in the broader social context, such that incongruent gazes in the background should interfere with processing foreground gazes. Although we predict that the priming effects should penetrate the automatic cueing interval to facilitate (independent prime) or hinder (interdependent prime) cueing effects, we do not have any specific predictions as to whether the priming effect should take place as quickly as 200 ms SOA, or later on in the automatic cueing interval such as 600 ms SOA. Some evidence has shown priming effects occurring as early as 200 ms SOA (Cui, Zhang & Geng, 2014; Dalmaso, Pavan, Castelli, & Galfano, 2012), although they often do not test for priming effects at later SOAs as well, so the relation between priming effects at an early and medium SOA is unknown. Recent research also found that the cueing effect for East Asians dissipated as late as 600 ms SOA when background gazes did not match the same direction as the foreground gaze, suggesting interference from related socio-cultural factors may need a minimum amount of time to pass before being able to penetrate the automatic cueing interval (Cohen et al., 2017).

**Study 1**

**Method**

**Participants**

The final sample included 101 European Canadians undergraduates (Mage = 20.32 years, SDage = 4.76; 71.29% female) from York University, in Toronto, Canada. Participants must have been born in Canada, with at least one parent born in Canada. This was to ensure that our sample was relatively uniform in cultural background, as Toronto has a large proportion of 1st and 2nd generation European immigrants from Southern, Central, and Eastern Europe (e.g., Italy, Croatia, Russia) that are known to be interdependent cultures that share many similarities to East Asian cultures to the extent that those cultures seem to elicit similar psychological effects on beliefs and cognition (Lalonde, Cila, Lou, Giguere, 2013; Varnum, Grossmann, Katunar, Nisbett, & Kitayama, 2008). The initial sample size was 138 participants and was determined by however many participants that could be collected in the 2014 – 2015 school year. Thirty-seven participants were excluded from the data; 31 participants were removed for not meeting the inclusion criteria, and 6 participants’ data were noted to be unusable by the research assistants due to external circumstance (e.g., interruption during experiment, participant not following instructions, etc.).

**Apparatus and Stimuli**

The experiment was presented on a desktop computer, running Windows 7 64-bit, with an Intel Core i7-4770 Processor, at 3.40 GHz 4GB RAM with Service Pack 1. The computer monitor measured 47.5cm in length by 29.5 cm in width. The multi-gaze cue task was programmed on E-Prime Software, version 2.0.8.90. Monitors were positioned about 60 cm away from participants’ faces. A 7-inch ICU Personal Convex Mirror was attached to the top center of the computer monitor and angled downwards, so that the eye movements of participants sitting in front of the computer would be noticeable to the experimenter sitting behind the participant. This set up allowed the experimenter to check that the participant did not make eye movements. The foreground face was presented in the center of the screen, and two background faces flanked each side of the central face (four flanking background faces in total). Each of the five faces were randomly selected from 12 faces that varied in gender and ethnicity (Table 1). The target was a white square (see Table 1).

**Materials**

*Pronoun Circling Task.* Participants were randomly assigned to either the independent prime version of the Pronoun Circling Task (Gardner, Gabriel, & Lee, 1999) or the interdependent prime version. Four different versions of the Pronoun Circling Task were created for each prime for participants to complete (see Appendix A). Before each block of trials, participants would complete one randomly selected version of the assigned prime.

*Self-Construal Scale (SCS)*. The 24-item Self-Construal Scale (Singelis, 1994) measures the extent to which a person endorses an independent and interdependent self-construal. This scale was used to assess whether the prime manipulation was successful in shifting participant’s frame of mind to an independent or interdependent self-construal.

Other measures given to participants included the Analysis-Holism Scale (Choi, Koo, & Choi, 2007) and an adapted measure of Measure of Social Inference from Kitayama, Ishii, Imada, Takemura, & Ramaswamy, 2006. These were included for exploratory purposes but were not used in the current study’s analyses.

**Design and Procedure**

The current study was a 2 (Match condition: background gazes matched foreground gazes vs. background gazes mismatched foreground gazes) x 3 (SOA: 200 ms vs. 600 ms x 1,000 ms) x 2 (Prime: independent prime vs. interdependent prime) mixed design, with repeated measures on the first two factors.

The multi-gaze cue task was designed by the authors in a previous study (Cohen et al., 2017). There were 520 trials in total, with 240 test trials (40 trials in each match x 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 shape (see Table 1) appeared equally and randomly on the left and right of the face display. SOA condition was selected randomly without replacement. The central cue was congruent with the target on half the trials and incongruent on the other half. Congruency was pseudorandom. Filler trials were similar to test trials except the foreground and background face gazes were direct, rather than gazing to the 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 make sure participants were paying attention to when the target appeared and not just anticipating a left or right response from the gaze cues.

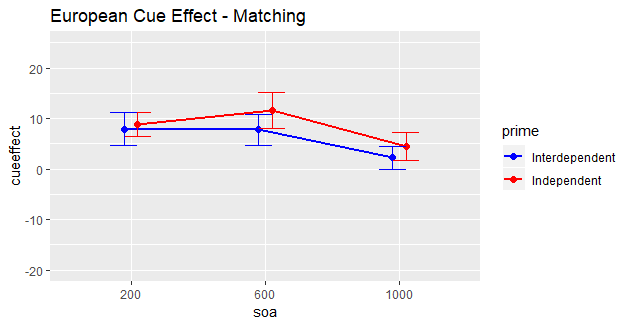
Participants were instructed to press a button on a keyboard as soon as they detected the target. We measured participants’ reaction times (RTs) from onset of target to the spacebar response. We processed the RT data by removing anticipation trials (defined as RTs less than 100 ms), expiration trials (RTs greater than 2,000 ms), and outliers (RTs that were beyond two standard deviations from the grand mean per participant at each level of SOA). Afterwards, we computed the cueing effect index variable by subtracting the RTs on congruent trials (where foreground gaze predicted target location) from the RTs on incongruent trials (where foreground gaze did not predict target location) for each SOA and match condition (whether foreground and background gazes looked in the same direction or not). A positive index indicates a stronger cueing effect, an index not different from zero indicates no cueing effect, and a negative index indicated a stronger reverse cueing effect.

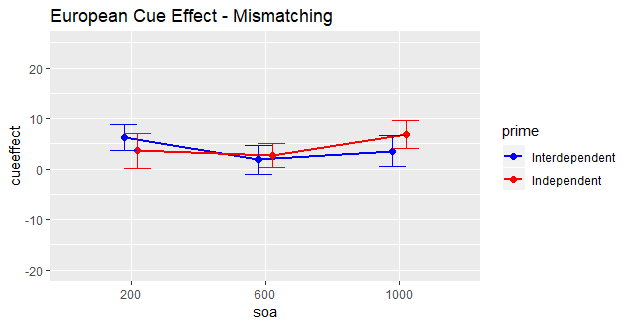
Participants were seated at the computer, while the experimenter gave the participants the following instructions: “In this task, all you have to do is to keep looking at the red dot at the center of the screen until the target appears. The target will be a white square and it may appear on the left side or the right side of the screen. When you see the target, press the spacebar as soon as possible no matter what side of the screen the target appears on”. They were told that sometimes the target would not appear, and so they did not have to respond on that trial. It was also noted to the participant the purpose of the mirror: “As you may have noticed that there is a mirror on top of the monitor. We use this to check where you are looking at from time to time. Please ignore this mirror and don’t look at it.” The purpose of the mirror was to encourage participants to keep their gaze on the fixation cross until the target appeared. Participants completed the entire experiment at the computer while the experimenter sat behind them to to keep track of participants’ gazing.

**Results**

The mixed 2 x 3 x 2 ANOVA revealed a marginally significant main effect of match condition, where the cueing effect under the matching condition (background gazes matched foreground gaze) was marginally larger than under the mismatching condition (see Table X), *F*(1, 99) = 3.73, *p* = .06, *p*2 = .005. The mixed ANOVA also revealed a marginally significant interaction between match condition and SOA, *F*(2, 198) = 2.83, *p* = .06, *p*2 = .009. No effect of independent and interdependent prime was observed, so the rest of the results will be presented with data collapsed between the independent and interdependent primed groups.

We analyzed the matching and mismatching conditions separately to examine the pattern of cueing effects across the SOAs. A 2 x 3(prime x SOA) mixed ANOVA under matching condition revealed a marginal main effect of SOA, *F*(2, 198) = 2.77, *p* = .06, *p*2 = .02. Visualizations (see Figure X) suggest that the cueing effects at 200 ms and 600 ms SOAs are marginally higher than at 1,000 ms SOA. One sample t-tests against zero suggest that these are typical cueing effects that occur in the automatic cueing interval, since the foreground gaze produced a cueing effect above zero for 200 ms SOA, *t*(100) = 4.28, *p* = < .01, *d* = 0.43, and 600 ms SOA, *t*(100) = 4.16, *p* < .01, *d* = 0.41, but dissipates at 1,000 ms SOA, *t*(100) = 1.87, *p* = .06, *d* = 0.19.





Under mismatching conditions (see Figure Y), a 2 x 3 (prime x SOA) mixed ANOVA revealed no significant main effects of interactions (all *p*’s > .51). One sample t-tests against zero revealed that the foreground gaze produced a cueing effect above zero for 200 ms SOA, *t*(100) = 2.22, *p* = .03, *d* = 0.22). At 600 ms SOA, the cueing effect was not significant above zero, *t*(100) = 1.24, *p* = .22, *d* = 0.12), and at 1,000 ms SOA, the cueing effect was significantly above zero once again, *t*(100) = 2.55, *p* = .01, *d* = 0.25. It was unexpected that the cueing effect would dissipate at 600 ms, as this looks similar to how East Asians under mismatched condition at 600 ms SOA looked in a prior study (Cohen et al., 2017). It suggests that the incongruent background gazes may have interfered with the task within the automatic cueing interval. The suprising cueing effect re-occuring at 1,000 ms SOA was unexpected, but as it occurs outside of the automatic cueing interval, it does not reflect any meaningful understanding of whether the primes penetrated the automatic joint attention mechanisms.

A manipulation check was conducted to see if the prime failed to induce any self-construal detectable on the related Self-Construal scale. There was no significant difference in independent self-construal scores between participants who were primed with the independent self-construal (*M* = 5.06, *SD* = 0.67) than those primed with interdependent self-construal (*M* = 4.94, *SD* = 0.58), t(98.27) = 0.92, *p* = 0.36, *d* = 0.18. Similarly, there was no significant difference in interdependent self-construal scores between participants who were primed with the independent self construal (*M* = 4.82, *SD* = 0.72) than those primed with the interdependent self-construal (*M* = 4.79, *SD* = 0.62), t(98.32) = 0.20, *p* = 0.84, *d* = 0.04.

**Discussion**

Results suggested that European Canadians generally demonstrated the typical cueing effect, in which the foreground gaze elicited joint attention to the extent that background gazes were less attended to. The surprising lack of cueing effect in the mismatched condition under 600 ms SOA was unexpected and suggests that the background gazes may have interfered with processing the foreground gaze when their gaze directions mismatched. Our European Canadians may have broadened their scope of attention to incorporate both foreground and background gaze cues, which would suppress the cueing effect. This may be a result of our European Canadians, despite our inclusion criteria, possessing a more broadly interdependent self-construal – and similar to the East Asians (Cohen, et al., 2017)– than initially hypothesized. Research using other Europeans from the local context (i.e., Toronto) has suggested that non-Western European culture is highly salient within the city, and that even European-descent individuals retain languages and cultural attitudes and beliefs from their own, or their parents’, culture (Lalonde, Cila, Lou, Giguere, 2013). Despite our attempts at recruiting European Canadians who were more Canadian-acculturated, some (30.69%) of our European Canadian participants had one parent who was born outside of Canada, which may have had an influence on participants’ own cultural identity.

Importantly, the European Canadians did not seem to be influenced by the independent and interdependent primes, demonstrated by the lack of interaction from the prime on cueing effects and self-construal scores. One reason why this may be is that independent and interdependent meaning systems that can penetrate the automatic cueing interval may only occur for individuals who have practice shifting between the two meaning systems because it allows for greater accessibility of cognitive processes associated with each meaning system. It has been shown that multicultural individuals can and do shift between meaning systems that are associated with their two or more cultural identities in response to specific social domains (e.g., family versus school) or environmental cues (e.g., different languages being spoken) (Hong, Morris, Chiu, & Benet-Martínez, 2000; West, Zhang, Yampolsky, & Sasaki, 2017). Specifically, East Asian Canadians may be more practiced at switching between these different frames of the self as demanded by the two vastly different cultural contexts they occupy – so the primes may successfully shift their self-construal and affect subsequent cognitive processes – whereas our European Canadians may not shift between different frames of the self as frequently, nor would they consider it necessary when living in the local context.

**Study 2**

In Study 2, we pre-registered (https://osf.io/yzvmt/) identical analyses from Study 1 to test bicultural East Asian Canadians. We hypothesized that under matching conditions, there would be the typical cueing effect occurring at 200 ms and 600 ms SOA, and priming would not have an effect. Under mismatching conditions, however, representations activated by the primes would penetrate mechanisms of social attention in the automatic cueing interval for East Asian Canadians, who would have higher familiarity with shifting between 2 different cultural meaning systems associated with independence (Canadian culture) and interdependence (East Asian culture). Under mismatching conditions, then, the independent prime would narrow the scope of attention so that the foreground gaze would elicit cueing effects in the automatic cueing interval (200 ms and 600 ms SOA). The interdependent prime, conversely, would broaden the scope of attention so that the background gaze cues would inhibit cueing effects in the automatic cueing interval, but whether it would happen earlier (i.e., 200 ms SOA) or later (i.e., 600 ms SOA) in the automatic cueing interval was unknown.

**Methods**

**Participants**

The final sample included 102 East Asian Canadians (Mage = 19.70 years, SDage = 2.62; 55.88% female) from York University, in Toronto, Canada. Participants must not have lived in East Asia for more than 16 years, and both parents must have been born in East Asia. This was to ensure that our East Asian Canadians were sufficiently exposed to both their respective East Asian cultures and Canadian culture, and also to mirror the requirements Cohen and colleagues (2017) used for their East Asian sample who needed to live 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, Canada, *SD* = 4.50). The initial sample size was 164 participants, and we aimed to match the same number of participants from study 1, while oversampling to take into account that we would necessarily recruit many East Asian Canadians who would not meet our inclusion criteria. Sixty-two additional participants were excluded from the data; 47 participants were removed for not meeting the inclusion criteria, and 15 participants’ data were noted to be unusable by research assistants due to external circumstance (e.g., interruption during experiment, participant not following instructions, etc.).

**Apparatus and Stimuli**

The apparatus and stimuli are identical to Study 1.

**Design and Procedure**

The design was the same as Study 1, using a 2 (Match condition: matched vs. unmatched) x 3 (SOA: 200 ms vs. 600 ms x 1,000 ms) x 2 (Prime: independent prime vs. interdependent prime) mixed design, with repeated measures on the first two factors.

The design and procedure are identical to Study 1.

**Results**

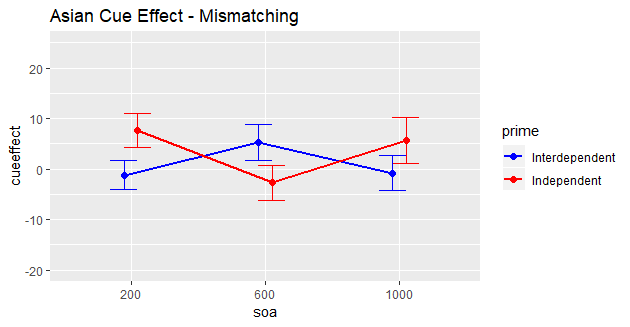
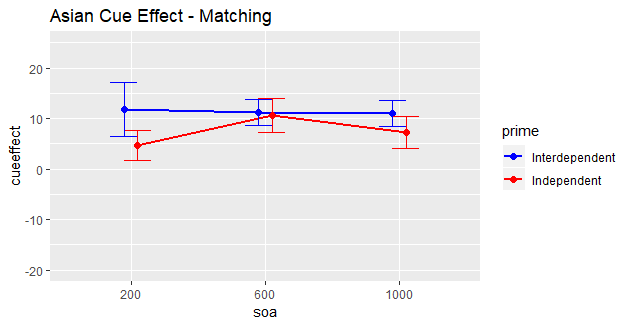
The mixed 2 x 3 x 2 ANOVA revealed a significant main effect of match condition, where cueing effects under the matching condition (background gazes matched foreground gaze) were significantly higher than mismatching condition (see Table), *F*(1, 100) = 20.02, *p* < .01, *p*2 = .02. The mixed ANOVA also revealed a significant interaction between match condition and prime, *F*(1, 100) = 3.84, *p* = .05, *p*2 = .004. This was, however, qualified by a marginally significant 3-way interaction between match condition, SOA, and prime, *F*(2, 200) = 2.94, *p* = .06, *p*2 = .01.

The data were analyzed separately by match condition. Under the matching condition, a 2 x 3 (prime x SOA) mixed ANOVA revealed no significant main effects or interactions (all *p*’s > .23). We collapsed across the independent and interdependent prime groups to conduct one-sample t-tests, which demonstrated significant cueing effects across 200 ms SOA, *t*(101) = 1.56, *p* < .01, *d* = 0.27, 600 ms SOA, *t*(101) = 5.03, *p* < .01, *d* = 0.50, and 1,000 ms SOA, *t*(101) = 4.23, *p* < .01, *d* = 0.42. This suggests the typical cueing effect pattern, in which foreground gaze elicited cueing effects throughout the automatic cueing interval, and was also found under matching condition with East Asians in prior research (Cohen et al., 2017). The persistent cueing effect at 1,000 ms SOA was unexpected, but again, cueing effects outside the automatic cueing interval are uninterpretable in the context of the current study’s research question.[[1]](#footnote-1)

Under mismatching condition, a 2 x 3 (prime x SOA) mixed ANOVA revealed a significant prime x SOA interaction, *F*(2, 200) = 3.09, *p* = .05, *p*2 = .02. For the independent primed group, one-sample t-tests showed that the foreground gaze produced a significant cueing effect at 200 ms SOA, *t*(56) = 2.27, *p* = .03, *d* = 0.30. The cueing effect dissipated by 600 ms SOA, *t*(56) = 0.79, *p* = .43, *d* = 0.11, and at 1,000 ms SOA, *t*(56) = 1.24, *p* = .22, *d* = 0.16. This pattern of results matches what was found with East Asians under mismatching condition previously (Cohen et al., 2017), suggesting that the independent prime did not narrow the scope of attention, and instead allowed background gazes to interfere with the cueing effect at 600 ms SOA.

For the interdependent primed group, one-sample t-tests failed to produce a cueing effect above zero across all SOAs (all *p*’s > .14), suggesting that the interdependent prime facilitated the processing of background cues which interfered with and inhibited cueing effects throughout the entire automatic cueing interval.

Manipulation check of the independent and interdependent prime revealed that the independent prime group (*M* = 4.86, *SD* = 0.63) reported a significantly higher independent self-construal than the interdependent prime group (*M* = 4.49, *SD* = 0.76), *t*(85.42) = 2.59, *p* = .01, *d* = 0.53. There was no significant difference, however, in interdependent self-construal between the interdependent prime group (*M* = 4.80, *SD* = 0.60) and the independent prime group (*M* = 4.93, *SD* = 0.58), *t*(93.70) = 1.09, *p* = .28, *d* = 0.22.



**Discussion**

Results suggested that unlike for European Canadians, our East Asian Canadians were impacted by the prime. Under mismatching conditions, East Asian Canadians that were given the independent prime were predicted to have a narrower scope of attention, which would facilitate the foreground gaze cue and show cueing effects throughout the automatic cueing interval (200 and 600 ms SOA). Instead, we found that while the cueing effect occurred at 200 ms SOA, it dissipated at 600 ms SOA, which was the same pattern of effects found in previous research in an East Asian sample (Cohen et al., 2017), suggesting that the independent prime was not effective in changing the scope of attention for East Asian Canadians beyond what has typically been found. East Asian Canadians given the interdependent prime, however, failed to show any cueing effects from the foreground gaze throughout the entire automatic cueing interval, demonstrating that the interdependent prime influenced East Asian Canadians to broadly attend across the foreground and background gaze cues; since the background gaze cues mismatched with the direction of the foreground gaze cues, cueing effects from the foreground gaze was inhibited. Critically, the cueing effect was inhibited at not only 600 ms SOA, but at 200 ms SOA, suggesting that online cultural priming through interdependent primes impact joint attention mechanisms even earlier than distal cultural factors previously shown to affect foreground gaze cueing at 600 ms SOA (Cohen et al., 2017). This study demonstrated that highlighting meaning systems that are relevant to the social environment can activate quickly and automatically to influence attending to and integrating of multiple gaze cues.

Significant differences in self-report independent self-construal between independent and interdependent primed participants suggested that the prime manipulation worked to the extent that it influenced explicit beliefs about the self, even though it did not further impact our cognitive measure. This makes sense if we consider that highlighting an independent self-construal does not prime social attention mechanisms to pay any more particular attention to the foreground face. Conversely, there were no difference in self-report interdependent self-construal between independent and interdependent primed participants, despite the prime having an effect on our cognitive measure. If East Asian Canadians already have a relatively high interdependent self-construal, their interdependent self-construal scores may be less moveable. Highlighting interdependent self-construal, however, clearly modulates the cueing effect within the task, indicating that reported interdependent self-construal does not necessarily predict on-line interdependent self-construal effects on cognitive mechanisms.

**General Discussion**

These two studies demonstrated that activated independent and interdependent representations can penetrate joint attention mechanisms, but that this effect existed only for East Asian Canadians. This paper builds on current theory and research on joint attention mechanisms, and how the culturally relevant constructs of independence and interdependence shape how we integrate cues across social environments.

Our European Canadians showed the typical cueing effect from the foreground gaze under 200 ms SOA under both matching and mismatching conditions, and 600 ms SOA under matching condition. Despite the unexpected lack of cueing effect under mismatching conditions under 600 ms SOA, the overall results strongly suggest that the prime did not activate any independent or interdependent meaning systems to differentially influence the scope of attention from the foreground gaze to the background gazes.

For our East Asian Canadians, we found a strong divergence from the typical cueing effect pattern based on prime. Under matching conditions, the prime did not have an effect, and we found the typical cueing effect from the foreground gaze under 200 ms and 600 ms SOA. Under mismatching conditions, the independent prime did not have an effect, as there was a cueing effect at 200 ms SOA that dissipated at 600 ms SOA, reflecting similar results from un-primed East Asians (Cohen et al., 2017). The interdependent prime under mismatching conditions, however, broadened the scope of attention such that background gaze cues were attended to and interfered with foreground gaze cueing, resulting in no significant cueing effects across 200 ms and 600 ms SOA.

The divergence in how the prime affected East Asian Canadians, relative to European Canadians, has implications for how activating meaning systems does not equally impact joint attention mechanisms; rather, the meaning systems that are cognitively activated must be easily accessible and somewhat well-practiced in order to impact bottom-up, reflexive orientation to foreground gazes. Although research on independence and interdependence suggest that these systems of self-construal co-exist to varying levels in either cultural group, interdependent self-construal is likely activated more often in East Asians by their different cultural and social domains they inhabit or activated by culture-specific social cues. These results demonstrate that the activation of interdependent meaning systems for East Asian Canadians is particularly well-practiced and suggests that activating a sense of interdependent self-construal has some adaptive significance in navigating their different cultural contexts. This was also shown in prior research where females, but not males, demonstrated cueing effects for familiar faces (colleagues) vs. unfamiliar faces, suggesting that for females, social knowledge of their colleagues had greater adaptive significance for navigating their social environment than for males (Deaner, Shepherd & Platt, 2007).

The results also demonstrate the rigidity of the role of sociocultural context in calibrating social attention mechanisms. Previously, it was demonstrated that for Americans, no matter if the background gazes were cueing in the opposite direction of the foreground gaze, they would experience cueing effects from the foreground gaze (Cohen et al., 2017). For East Asians, however, the incongruent background gazes interrupted the automatic reflexive orienting from the foreground gaze, during a relatively late SOA within the automatic cueing interval period. Those results suggest that long standing and repeated cultural inputs in the social environment can calibrate the social attention system to be sensitive to important information that is culture-specific. Although we hypothesized that highlighting meaning systems that people of all cultural groups should have (independent and interdependent self-construal) can modulate social attention mechanisms, it seems that these meaning systems still work within the boundaries of the culture-specific calibration of attention mechanisms. East Asian Canadians given the independent prime under mismatching condition also experienced interference from incongruent background gaze cues during a relatively late SOA within the automatic cueing interval period, demonstrating that East Asian Canadians may experience repeated cultural inputs that calibrate the social attention system in their East Asian cultural contexts, similarly to East Asians (Cohen, et al., 2017).

Some limitations in the study may explain some unexpected findings. Typically at 1,000 ms SOAs, the cueing effect either disappears, or reverses such that gaze cues facilitate detecting targets that appear in the opposite direction (Frischen & Tipper, 2004; Posner & Cohen, 1984). We tended to find significant cueing effects at 1,000 ms SOA through some of the conditions in Study 1 and 2, suggesting that the foreground gaze cue actually facilitated the correct target location when the target appeared 1,000 ms after the gaze cue. We gave verbal instructions to participants to keep their gaze on the central fixation cross until the target appeared, so that they would not prematurely shift their attention towards the direction of the gaze cue. It is possible that participants ended up orienting towards the direction of the gaze cue voluntarily just before the target appeared, so that they facilitated their own “cueing effect”. While our experimenters used the mirror to check participants’ gazes throughout the experiment, without eye-tracking equipment we could not reinforce these pre-mature gazes 100% of the time. At 1,000 ms SOA, however, is when voluntary attention shifting can occur, so the mixed results at 1,000 ms SOA should not impact the findings found within the automatic cueing interval.

Overall, these findings suggest how certain aspects of the cultural environment can shape social attention mechanisms to attune to specific stimuli in a complex social environment, and that highlighting interdependent meaning systems in the environment can further activate cognitive mechanisms associated with processing interdependence. In this case, we demonstrated that priming an interdependent self-construal activated mechanisms associated with broadening the scope of attention. Importantly, we also showed that these meaning systems have different downstream consequences for those who attach adaptive significance to them. It is imperative, then that research on the social attention system should be examined across many different populations who experience different social systems and societies since it is clear that these different sociocultural experiences not only calibrates the social attention system itself, but also bring with it the different ways the social attention system can be modulated.

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1. A 1000ms 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. [↑](#footnote-ref-1)