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FlashReport

Influences of culture and visual context on real-time social categorization

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HIGHLIGHTS

- Mouse-tracking was used to measure the time-course of context effects in social categorization.
- Comparison between American and Chinese participants
- Context systematically biased the categorization of a face's ethnicity.
- Categorization process was very sensitive to compatibility between face and context.
- Context effects occurred earlier in Chinese relative to American participants.

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ABSTRACT

Social categorization is often thought to be based on facial features and immune to visual context. Moreover, East Asians have been argued to attend to context more than Westerners. American and Chinese participants were presented with faces varying along a White-Asian morph continuum either in American, neutral, or Chinese contexts. American contexts made White categorizations more likely, and Chinese contexts made Asian categorizations more likely. Further, the compatibility between facial and contextual cues influenced the directness of participants' hand trajectories en route to selecting a category response. Even when an ultimate response was not biased by context, the trajectory was nevertheless partially attracted to the category response associated with the context. Importantly, such partial attraction effects in hand trajectories revealed that the influence of context began earlier in time for Chinese relative to American participants. Together, the results show that context systematically influences social categorization, sometimes altering categorization responses and other times only temporarily altering the process. Further, the timing of contextual influences differs by culture. The findings highlight the role of contextual and cultural factors in social categorization.

Introduction

A brief glance is all one needs to place another person into social categories, such as ethnicity (Freeman & Ambady, 2011a; Macrae & Bodenhausen, 2000). In most cases studied in the laboratory, the perception of ethnicity is straightforward. Faces are flashed on the computer screen, and categorization of ethnicity quickly ensues. One potential problem is that faces are rarely encountered in isolation. Instead, we typically encounter other people in the context of some larger scene. Although perhaps counterintuitive, there is good reason to suspect that such contexts could alter the processing of a face's ethnicity.

Recent studies have found that context can change the perception of a face's emotion (e.g., Barrett & Kensinger, 2010; Masuda et al., 2008; Righart & De Gelder, 2008). Indeed, it would make sense that we be attuned to context in perceiving emotion, given the malleable nature of emotion expressions (Russell, 1997). However, would a static category dimension, such as ethnicity, be fettered to context as well? Recent computational models predict a reliable role of visual context in making any type of face categorization, so long as it contains information associated with the categories in question (Freeman & Ambady, 2011a). According to such models, facial cues activate category representations, and a dynamic competition between partially-active categories ensues (e.g., between White, Black, and Asian). While the competition unfolds, context cues can also place excitatory and inhibitory pressures on those categories and bias the competition. Sometimes, the cues' bias would be so strong that the ultimate categorization is changed; other times, they would not be so strong and instead only temporarily alter the categorization process. In such cases, the competition would be continuously more "pulled" toward the category associated with the context (e.g., Asian), despite a different category (e.g., White) eventually winning out. One aim of the present work was to test this hypothesis: that facial and contextual cues together drive a dynamic social-category competition, and thereby influence both the outcomes and process of ethnicity perception.

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Interestingly, however, individuals of different cultures have been argued to process context cues in different ways. For instance, many studies have shown that individuals from Western cultures such as the U.S. tend to allocate attention onto focal stimuli ("analytically"), whereas individuals from East Asian cultures such as China tend to allocate attention onto the relationships between focal stimuli and their surrounding context ("holistically"; Masuda & Nisbett, 2001; Nisbett, Peng, Choi, & Norenzayan, 2001). Presumably, this is due to practices in Western cultures encouraging more independence versus practices in East Asian cultures encouraging more interdependence. In the domain of face perception, however, previous studies have been contradictory. In judging emotion, some studies have reported stronger context effects among East Asians (Masuda et al., 2008), whereas more recent studies have reported equivalent effects (Ito, Masuda, & Hioki, 2012; Ko, Lee, Yoon, Kwon, & Mather, 2011). One likely reason for the inconsistency is that these studies have measured perceptual outcomes (e.g., ratings or response times), and outcome-based measures may not be best to sensitively tap into the face-perceptual process. Based on the model described earlier, for example, there are many cases where a participant's ultimate perception is not predicted to be altered by context. Nevertheless, the model would predict that the process leading up to that response would be altered considerably. Previous studies' use of outcome measures potentially may have obscured the more subtle effects of context and culture taking place across the perceptual process. Here, therefore, we wanted to use a more process-sensitive methodology.

One such methodology is mouse-tracking. In a previous study, participants were presented with a face and asked to move the mouse from the bottom-center of the screen to a "male" or "female" response in either top corner. Because the mouse was moving while a categorization response was still evolving, it was able to provide a "read-out" of how categorization was unfolding over time. When categorizing faces whose shape or pigmentation was made to be slightly sex-atypical, participants' mouse trajectories exhibited a partial attraction toward the opposite-sex response before settling into the correct response. Further, this attraction effect occurred earlier in time for atypical pigmentation relative to shape, indicating that pigmentation processing began earlier (Freeman & Ambady, 2011b). Thus, this paradigm can track how various cues drive categorization in real time and therefore reveal potentially subtle influences of context and culture, even when an ultimate response may not be affected.

In the present study, Americans and Chinese participants were asked to categorize faces in a White/Asian mouse-tracking paradigm. We predicted, overall, that an American context would increase White responses and a Chinese-typed context would increase Asian responses. Even when the context did not influence an ultimate categorization response, however, we predicted that it would still lead perceivers to partially integrate the opposite category (associated with the context) into the categorization process. This would be evidenced by a partial attraction in participants' mouse trajectories toward the opposite-category response before clicking their final response. Finally, we could use the timing of these attraction effects to examine the time-course of context processing in the two cultures. If Chinese participants have greater preparedness to attend to the context, we predicted that they might start processing the context and integrating it into the categorization process earlier.

Method

Participants were 22 Caucasian-American undergraduates at Tufts University (Medford, MA), and 22 native-Chinese undergraduates at Peking University (Beijing, China). Faces were composed of 16 computer-generated identities (8 male), morphed along a 9-point White-Asian continuum using FaceGen. Scene context stimuli (30 American-typed, 30 neutral, 30 Chinese-typed) were obtained from public-domain websites. A pretest confirmed that the scenes were perceived accordingly (see Supplementary material). Each face was presented three times and placed in the center location of a scene once for each context type. Face–scene pairings were counterbalanced across participants, yielding 432 trials per participant: 16 face-identities × 9 ethnicity-levels × 3 contexts. Participants were told that they would be presented with images of individuals in various settings, and were asked to categorize the faces' ethnicity as quickly and accurately as possible.

On every trial, participants clicked a "Start" button at the bottom-center of the screen, which was then replaced by a face–context pair. Face–context pairs were presented in randomized order, and faces were categorized by clicking a "White" or "Asian" response located in the top-left and top-right corners (counterbalanced across participants). See Fig. 1 for sample stimuli and a schematic description of the task. MouseTracker software was used to record and analyze trajectory data (Freeman & Ambady, 2010). In all regression analyses, we adopted a generalized estimating equation approach that can incorporate trial-by-trial data while accounting for the intracorrelations in repeated-measures designs (Zeger & Liang, 1986).

Results

Trajectories were time-normalized to permit averaging of their full length across multiple trials. To obtain a by-trial index of the degree to which the mouse was attracted toward the opposite category, we computed area under the curve (AUC): the area between the observed trajectory and an idealized straight-line trajectory. See Freeman and Ambady (2010) for further details on mouse-trajectory preprocessing and analytic techniques. Trials with response times exceeding 2*SD* from the mean were discarded (3.4%). Aberrant movements (e.g., looping) were detected in 3.8% of the trajectories, which were discarded. Across the two study sites, the trajectory-sampling sensitivities did not significantly differ (see Supplementary material).

Face–context compatibility

We regressed categorization responses (0 = White, 1 = Asian) onto morph values (−4 = most-White, 4 = most-Asian), scene context (−0.5 = American, 0 = neutral, 0.5 = Chinese), participant culture (−0.5 = U.S., 0.5 = China), and their interactions (using logistic regression). For face–context compatibility analyses, effects involving culture are reported in the Supplementary material. As a face's morph value rose from White (−4) to Asian (4), the likelihood of an Asian categorization increased, $B = 0.69$, $Z = 36.28$, $p < .0001$, confirming our morphing manipulation. More importantly, there was a significant effect of scene context, $B = 0.15$, $Z = 3.77$, $p < .001$. An Asian categorization was most likely when given a Chinese context; it was least likely when given an American context; and it had an intermediary likelihood when given a neutral context (see Fig. 2A). The morph-value × context interaction was not significant, $B = -0.01$, $Z = 0.42$, $p = .67$. Thus, as predicted, the scene context influenced categorization responses.

Next, we regressed AUC values onto the same predictor variables (using normal regression). The effects of morph value [$B < 0.01$, $Z = 0.49$, $p = .62$] and scene context [$B = -0.01$, $Z = 0.36$, $p = .72$] were not significant. More importantly, there was a significant morph-value × context interaction, $B = -0.03$, $Z = 3.37$, $p < .001$ (Fig. 2B). As the morph value rose from White (−4) to Asian (4), a Chinese context led to decreases in AUC (i.e., more direct trajectories), whereas an American context led to increases in AUC (i.e., more curved trajectories). Specifically, on the White side of the continuum, AUC was lower for American contexts but higher for Chinese contexts relative to neutral. Conversely, on the Asian side of the continuum, AUC was higher for American contexts but lower for Chinese contexts relative to neutral. Thus, as the face and context became more compatible, trajectories became more direct en route to the selected response. When they became more incompatible, trajectories showed an increasing partial attraction toward the opposite-category response.

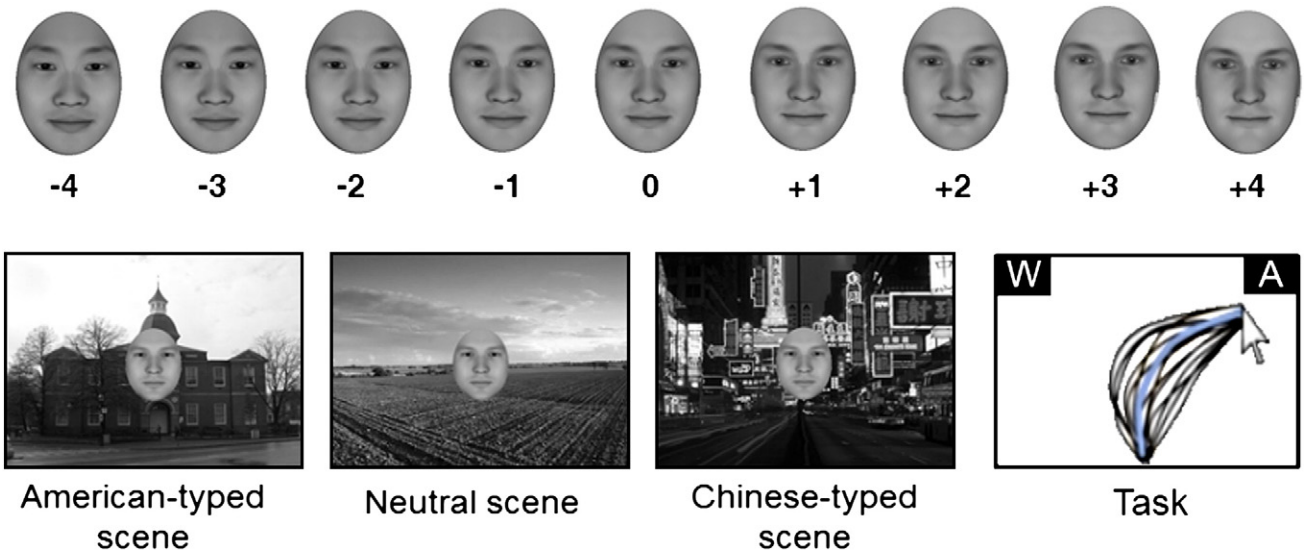

Fig. 1. At the top is a sample morph continuum, from White (−4) to Asian (+4). At the bottom are sample American-typed, neutral, and Chinese-typed scene contexts (with face stimulus at the center). Also at the bottom is a depiction of the mouse-tracking categorization task (in the actual task, "White" and "Asian" appeared at the top corners). Schematic trajectories are depicted, including a mean trajectory (in blue), as an example.

Response–context compatibility

We also wanted to compare the trajectories of trials whose responses were ultimately congruent/incongruent with the scene context. We regressed AUC values onto congruency (−0.5 = congruent, 0 = neutral, 0.5 = incongruent), participant culture, and the interaction. There was a significant effect of congruency, $B = 0.08$, $Z = 3.27$, $p = .001$. Congruent trials' trajectories exhibited a more direct approach toward the selected category ($M = 1.11$), while incongruent trials' trajectories exhibited a partial attraction toward the opposite category associated with the context ($M = 1.19$), relative to neutral trials which showed intermediary curvature ($M = 1.15$). There was also a significant effect of culture, $B = 0.11$, $Z = 2.34$, $p < .05$, with less curved trajectories for Chinese participants overall. The interaction was not significant, $B = 0.02$, $Z = 0.43$, $p = .67$. Thus, even when an ultimate categorization was not influenced by the context, participants were nevertheless partially attracted to select the opposite-category response associated with that context. Conversely, when an ultimate categorization was consistent with the context, participants exhibited an even stronger approach toward the context-associated category response.

Time-course analysis

To determine the time-course of context processing, we calculated *x*-coordinate difference scores at every time-step: [congruent − neutral] and [incongruent − neutral]. Positive scores thus indicate a stronger attraction toward the selected response (due to processing a congruent context), whereas negative scores indicate a partial attraction toward the unselected response (due to processing an incongruent context). Because we expected a roughly Gaussian shape for these effects (i.e., the attraction rising and falling with a peak in the middle), we fit them to Gaussian curves, consistent with previous work (Freeman & Ambady, 2011b). Three parameters of the fitted curves–time-position (M), duration (SD), and strength (maximum height)–were then averaged to generate mean curves (Fig. 3; Table 1). Each of the parameters was submitted

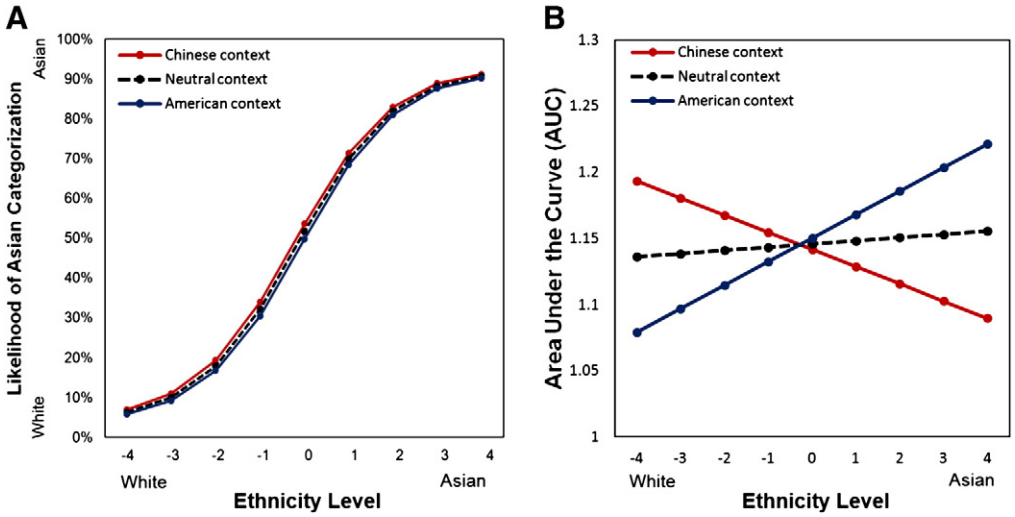

Fig. 2. (A) The likelihood of an Asian categorization is plotted as a function of morph level (from White to Asian) and scene context. (B) The mouse-trajectory curvature (indexed by AUC) is plotted as a function of morph level (from White to Asian) and scene context.

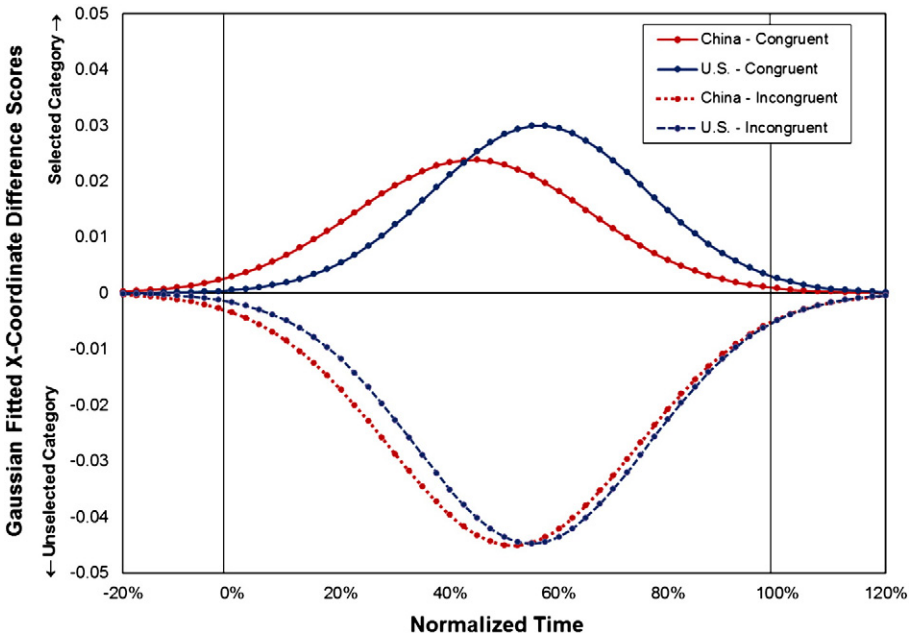

Fig. 3. Horizontal mouse-trajectory deviation toward the opposite category (*x*-coordinate difference scores) for face–context congruent trials [congruent − neutral] and incongruent trials [incongruent − neutral] plotted as a function of time and fit to Gaussian curves. The effects of context began earlier in Chinese relative to American participants.

to a 2 (effect-type: congruency/incongruency) × 2 (participant-culture: American/Chinese) mixed-model ANOVA. For time position, the congruent/incongruent effects did not differ, $F(1,42) = 1.02$, $p = .32$. More importantly, effects in Chinese participants occurred earlier than effects in American participants, $F(1,42) = 8.69$, $p < .01$ (Table 1). The interaction was not significant, $F(1,42) = 2.37$, $p = .13$. In the ANOVAs for duration and strength, no significant effects were seen (all $ps > .1$). Additional analyses converged on the finding of earlier onsets in Chinese participants (see Supplementary material). Together, this suggests that Chinese participants began utilizing context cues earlier in ethnicity categorization.

Discussion

The present results showed that an American context increased White categorizations, and a Chinese context increased Asian categorizations. Even when the categorization response was not biased by context, however, the trajectory leading up to that response nevertheless exhibited a parallel attraction to the category associated with the context. Thus, context information was represented in parallel and partially integrated into face categorizations, even when an ultimate perception was not altered. Such effects of the context biasing both the outcomes and process of face categorization were consistent across American and Chinese participants. Where cultural differences emerged, however, was in the time-course of categorization. Context cues began integrating into the categorization process earlier in Chinese relative to American participants.

Prior work has shown that Westerners attend more quickly to focal objects and East Asians more quickly to a scene (Chua, Boland, & Nisbett, 2005), presumably due to Western analytic and East Asian holistic tendencies (Nisbett et al., 2001). Neuroimaging work has also converged on greater sensitivity to context in East Asian participants (Jenkins, Yang, Goh, Hong, & Park, 2010). The present study demonstrates that such temporal differences in low-level attention to visual information cascade into analogous differences in when that information may build into social-category representations. Thus, analytic versus holistic tendencies appear to manifest at multiple levels of processing.

Previous studies have reported context effects in identifying facial emotions (e.g., Masuda et al., 2008), finding facilitated response times when the emotional content of the scene and face are congruent (Righart & De Gelder, 2008). In addition to examining a perceptual dimension beyond emotion, the present study is distinctive in a number of ways that allow it to provide novel insights into the cognitive basis of these effects. Specifically, we were able to provide evidence for facilitation effects (shown in previous work) as well as new evidence for parallel-competitive effects by using mouse-tracking with a neutral-context condition. Previous studies have used outcome-based measures and opted not to use neutral-context conditions due to definitional concerns of what constitutes emotional neutrality (Righart & De Gelder, 2008). By exploiting mouse-tracking with a neutral-context condition, the current study was able to show that an incongruent context leads to a parallel attraction to temporarily interpret the face as the other category associated with that context. Thus, incongruent contexts do not merely impair or slow down face perceptions; instead, the category information associated with the context is partially integrated into those perceptions.

Further, the present results show that the degree to which the context information is integrated into face perceptions is contingent on the strength of the facial cues. By continuously morphing, we showed that facilitation/competitive effects linearly increased as the face and context became correspondingly more congruent/incongruent. Thus, the category competition underlying social categorization is highly

Table 1
Means (and *SE*s) of the fitted Gaussian curve parameters for the horizontal-deviation time-course effects.

	Congruent effect		Incongruent effect	
	Chinese	Americans	Chinese	Americans
Time-position: *M*	44.103 (3.274)	56.504 (2.311)	51.591 (2.887)	54.958 (2.677)
Duration: *SD*	21.525 (2.405)	19.781 (2.123)	22.787 (2.628)	21.400 (2.061)
Strength: max height	0.024 (0.018)	0.030 (0.016)	0.045 (0.013)	0.045 (0.018)

sensitive to the compatibility among facial and contextual cues. This bolsters recent models of social categorization, which posit that facial and contextual cues weigh in on a dynamic competition between categories (e.g., White and Asian), which gradually resolves over time. This competition process is argued to allow facial and contextual information to dynamically integrate into stable person perceptions over time (Freeman & Ambady, 2011a). The results also extend classic work from the cognitive literature on contextual facilitation and interference (Flowers & Wilcox, 1982) by demonstrating that the timing of these effects is sensitive to social factors and cultural differences.

There are numerous implications of this work. From a theoretical standpoint, it contributes to recent perspectives on person perception, by highlighting how initial person perceptions are often compromises between the perceptual cues inherent to other people and the expectations held by perceivers (in this case, triggered by context; Adams, Ambady, Nakayama, & Shimojo, 2011; Freeman & Ambady, 2011a). From a practical standpoint, the results point to the malleable nature of ethnicity, such that its perception is readily pushed around by scene context. This is important because, once perceived, ethnicity categorization tends to powerfully affect social interactions by triggering a number of cognitive, affective, and behavioral effects (for review, Macrae & Quadflieg, 2010). Thus, if a scene can alter the ethnicity perception, even subtly, then this would also likely shape a number of downstream processes.

In sum, we found that the scene in which a face was encountered systematically altered ethnicity perception. In some cases, the influence of context was overt, driving ultimate perceptions. In other cases, it was more subtle, and the context only partially and temporarily influenced perceptions. Importantly, we were able to exploit these partial influences to measure the time-course of context processing, showing that individuals from a more holistic culture (China) began utilizing context cues earlier than individuals from a more analytic culture (U.S.). Together, the findings highlight the role of contextual and cultural factors in basic person perception.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jesp.2012.10.015.

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