Evaluating Past Emotions in Changing Facial Expressions: The Role of Current Emotions and Culture

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Facial expressions in daily life typically change from one emotional state to another. To understand how people process emotions, it is important to know not only how *current* facial expressions are interpreted but also recent *past* expressions. While researchers have recently focused on perceptions of current expressions, little is known about how past expressions are gauged and about cultural differences in this process. The present research investigated whether and how evaluations of past facial expressions are influenced by subsequent expressions, and whether this process varies across East Asian and Western cultures. Specifically, Chinese and Canadian participants judged the degree of positivity/negativity of past expressions after viewing expressions that changed from past emotions—low-intensity smiles (Experiment 1), high-intensity smiles (Experiment 2), and anger (Experiment 3)—to current positive or negative emotions (collected between 2019 and 2020). All three experiments consistently found an assimilation effect, whereby past expressions were rated more positively when the current expression was positive than when the current expression was negative. Moreover, this assimilation effect was consistently greater in Chinese than in Canadian participants. Together, these findings suggest that the interpretation of past facial expressions assimilates toward the valence of subsequent expressions and that the impact of this temporal emotional context is more pronounced in Eastern relative to Western cultures.

Keywords: facial expressions, culture, temporal emotional context, assimilation

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The past, present, and future fold backward and forward like Japanese origami. They collapse onto each other, emerge from each other, and constantly determine each other. (Johnson & Sherman, 1990)

During interpersonal interactions, facial expressions are constantly changing, moving from one expression to another. Compared to static facial expressions that occur in isolation (e.g., a single expression of happiness or anger), changes in expressions (e.g., from anger to happiness or from happiness to anger) convey richer social information and provide an emotional context for current and past expressions.

Although a number of studies have investigated changing expressions, these studies have focused mainly on examining the effects of changing versus static emotions on expression perception (Krumhuber et al., 2013). For example, studies have compared the recognition accuracy of expressions that change from neutral to subtle anger with that of a single static subtle anger expression (Bould et al., 2008).

Notably, research has yet to fully examine and understand how changing emotions impact the perception of each other. How past expressions (i.e., initial start expressions) influence the perception of current expressions (i.e., subsequent expressions after the change) and how current expressions influence the perception of past expressions. Although a few studies have investigated this initial process—how past expressions impact current expressions (Fang et al., 2021; Jellema et al., 2011), no studies to date have examined this second process—whether and how current expressions affect the evaluation of past expressions. The goal of the present research was therefore to investigate this process. Furthermore, given that current expressions may create a context for evaluating past expressions, and that Easterners are more sensitive to emotional contexts than Westerners (Fang et al., 2021; Masuda et al., 2008), we also explored whether culture moderates the effect of current expressions on the evaluation of past expressions.

Evaluating Facial Expressions Over Time

Knowing how past expressions are interpreted helps us understand the expressor's current emotional state, thoughts, and behavioral intentions (Shariff & Tracy, 2011). It also allows us to identify the

origin of the expressor's emotion, to understand the trajectory of emotional development, and to predict the direction of future emotional change (Van Kleef, 2016). However, our construals of past expressions are often biased. Rather than objectively recalling and interpreting past emotional expressions, when we evaluate another person's past expressions, we evaluate the past expressions in our memory. Importantly, the past emotions that we remember are not exact replicas of the original emotions but are influenced by the current situations and motivations (Levine et al., 2009). Because of the importance of our construals of past expressions for understanding expressors and for predicting their future emotions and behavior, it is critical to acknowledge and identify how these construals can be impacted. In the present research, we extend findings on changing emotional expressions by investigating the effect of current expressions on the evaluation of past expressions.

Since no study has yet examined how observers evaluate others' recent past expressions in changing displays of emotion, we first explore how people recall their more distant past in general. This research indicates that the recollection of past events and how they are reconstructed is strongly influenced by current thoughts and perceptions (Ross & Shulman, 1973; Ross et al., 1981) and that people may alter their memories of the past to be in accordance with the present (Johnson & Sherman, 1990). For example, men who had developed more negative attitudes toward their spouses over time recalled earlier marital interactions as having evoked less positive feelings than they initially reported (Holmberg & Holmes, 1994).

With regard to the recall of past emotions, in particular, a substantial body of research suggests that people construe their own past emotions to be more consistent with their current emotional states (Eich et al., 1985; Levine, 1997; Levine et al., 2018; see Levine & Safer, 2002 for a review). For example, in a study by Safer et al. (2001), widows and widowers were asked to rate the intensity of their grief 6 months following the death of their spouse. After 5 years, the same participants were asked to rate their grief as well as to recall what they had previously experienced at 6 months. Results showed that the recalled intensity of grief was more highly correlated with their current level of grief than the actual grief reported at 6 months. Likewise, in another study (Safer & Keuler, 2002), students who learned that they had done well on an exam underestimated their pre-exam anxiety 1 week later, while students who learned that they had done poorly overestimated their pre-exam anxiety.

In addition to the recall of these more distant past emotions, researchers have found that a similar reconstruction process occurs when individuals recall their own emotional experiences from the recent past. Specifically, in an experiment by Van Boven et al. (2009), a negative picture (e.g., rats and spiders) was first presented on the screen for 2 s, followed by a 2 s blank screen, and then another negative picture for 2 s. Immediately afterward, participants reported how intense their emotions were while viewing the first (previously presented) picture and while viewing the second (currently presented) picture. The results showed that participants consistently rated their emotional reactions to the first picture lower than the second picture, despite each picture appearing randomly in the first or second position. The authors suggest that one reason for these changes in ratings is that current emotions are more salient and available, resulting in current emotions being perceived as more intense than previous emotions.

Overall, previous research indicates that judgments of one's own emotional experiences that occurred in the relatively distant past (years) to recent past (seconds) are reconstructed and that past emotions are construed to be more consistent with current ones. We propose a similar process will occur when perceiving others' changing facial expressions. In particular, we suggest that evaluations of past expressions will be construed through the lens of current expressions. An example of this process is depicted in Figure 1 in which an individual may first show a low-intensity smile (past expression) that changes to an angry expression or a high-intensity smile (current expression). Because current expressions act as filters to reshape the observer's evaluation of the individual's past expression, evaluations of past low-intensity smiles are likely to be more positive when they change to high-intensity smiles than when they change to angry expressions. In short, we predict an assimilation effect when evaluating past momentary facial expressions, whereby the judgment of the emotional valence of the past expression assimilates to the valence of the current expression, becoming more positive if the current expression is positive than negative.

Notably, studies on the effect of past expressions on the perception of current expressions have shown a different pattern. In an early study by Russell and Fehr (1987), participants were presented with two images of static facial expressions in sequence and asked to judge the emotion in the second image. Results indicated that a neutral face was perceived as happy when presented after a sad face, but as sad when presented after a happy face, suggesting a contrast effect in which the valence of current expressions is evaluated in the opposite direction of past expressions. More recent studies have presented facial expressions that reflect a more natural unfolding of expressions by gradually morphing between neutral and emotional expressions (Jellema et al., 2011; Palumbo & Jellema, 2013) or between two distinct emotional expressions (e.g., anger and happiness, Fang et al.,

Figure 1

How Current Emotions Can Influence Evaluations of Past Emotions Through Assimilative Processes
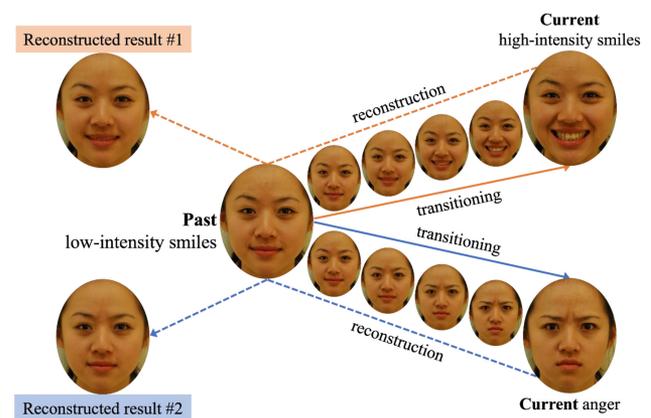
Note. We propose that the current expression acts as a filter to reshape the observer's evaluation of the individual's past expression. For example, when a low-intensity smile transitions to a high-intensity smile or transitions to anger, we predict that current high-intensity smiles compared to current anger expressions will result in more positive ratings of past low-intensity smiles. Images of faces are from the Taiwanese Facial Expression Image Database (Chen and Yen, 2007). See the online article for the colour version of this figure.

2021; e.g., see https://osf.io/6dt3e), providing further evidence for contrast effects. For example, Fang et al. (2021) showed Chinese and Dutch participants' facial expressions that changed from anger to low-intensity smiles or from high-intensity smiles to low-intensity smiles in video clips. Both groups of participants rated current low-intensity smiles more positively when changing from angry expressions than when changing from high-intensity smiles. Moreover, the difference between the two conditions was larger for Chinese compared to Dutch participants.

Although evaluations of current versus past facial expressions in changing facial expressions entail construals of objectively similar targets, the processes are distinct in that current expressions are immediately perceived, while past expressions are retrieved from memory and reconstructed (Barrett et al., 2007; Levine, 1997; Levine & Safer, 2002). Specifically, the effect of past expressions on evaluations of current expressions act on perceptual processes potentially related to adaptation aftereffects (Hsu & Young, 2004; Webster et al., 2004), representational momentum (Hubbard, 2005; Yoshikawa & Sato, 2008), and anticipation effects (Jellema et al., 2011; Palumbo & Jellema, 2013). The effect of current expressions on evaluations of past expressions, however, acts on memory processes. In particular, people appear to use their current feelings about and appraisals of past events to infer how they felt when these events first took place (Levine & Safer, 2002). In the present research, we propose a similar process occurs when construing other people's past emotions. In particular, we predict that recall and evaluations of past expressions will be biased toward the evaluations of current emotions perhaps because current emotions are more salient and available than past emotions (Van Boven et al., 2009) and the current emotions provide a filter for the reconstruction of past emotions.

Although further research examining the mechanisms associated with assimilation effects related to impact of changing emotions on evaluations of past emotions is critical, the aim of the present research is to initially demonstrate that the assimilative impact of current expressions on construals of past expressions. A further aim of the present research is to test whether the influence of this emotional context on evaluations of past emotions is moderated by culture (Masuda, 2017; Nisbett et al., 2001).

The Impact of Culture

Research has provided abundant evidence that whereas individuals from Western cultures exhibit a more analytical pattern of attention, focusing primarily on the focal object and paying relatively little attention to its context, Easterners exhibit a more holistic pattern of attention, perceiving objects in terms of their relationship to their surroundings (Masuda, 2017; Nisbett & Masuda, 2003; Nisbett et al., 2001). This differential sensitivity to context in Eastern and Western individuals has been found to influence the perception of facial expressions of targets in social surroundings (Masuda et al., 2008, 2012). Specifically, in studies by Masuda et al. (2008, 2012), both American and Japanese participants were presented with cartoons or photographs of a target person surrounded by others expressing either the same or a different emotion as the target person. Notably, Japanese, but not American, participants' judgments of the focal person's emotions were assimilated toward the expressions of the surrounding people. These differences in perceptual judgments reflect differences in attention. In particular, Japanese participants attended more to the surrounding people than American participants and were, therefore, more influenced by

the expressions of this social background when evaluating the expressions of targets than American participants.

Given that not only other people but also temporal events can create a context against which current expressions are perceived and that Easterners are more sensitive to these emotional contexts than Westerners, Fang et al. (2021) proposed and found that perceptions of current expressions by Chinese perceivers were more influenced by past expressions than Canadian and Dutch perceivers. Specifically, their results indicated that when judging current expressions, past expressions produced larger contrast effects on the perception of current expressions for Chinese than Canadian and Dutch participants.

In accordance with these initial findings, we propose that current emotional expressions create a context for reconstructing past expressions, and that Easterners will be more sensitive to emotional contexts than Westerners. Specifically, we predict that Easterners will be more likely than Westerners to be influenced by current expressions when evaluating past expressions. Based on previous findings that judgments of past emotions are reconstructed to be more consistent with current emotional experiences (Levine, 1997; Levine et al., 2001, 2018; Levine & Safer, 2002), we expect that Easterners will assimilate others' past facial expressions to be more consistent with their current expressions than Westerners.

The Current Research

The present research aimed to investigate the impact of current expressions on evaluations of past expressions and whether this process is moderated by culture in three experiments. Participants from Canada and China were asked to make positive and negative judgments of past expressions in the context of changing emotions for both White and Asian actors. Building on previous studies related to the recall of past emotions (Levine & Safer, 2002), we expected that past expressions would be evaluated as more positive when followed by positive current expressions than by negative current expressions, reflecting the assimilation effect of current expressions on the perception of past expressions. Furthermore, we expected that this assimilation effect would be culturally moderated, with Chinese participants showing greater assimilation effects than Canadian participants. Specifically, we predicted that Chinese participants would show larger differences than Canadian participants in their ratings of past expressions when followed by two current expressions that varied in valence.

To test these hypotheses, in Experiment 1, we first examined whether Canadian and Chinese participants' evaluations of past expressions were affected by different current expressions when the meaning of the past expression was ambiguous. Although the smile is a simple and highly recognizable expression (Ekman, 2003), it can be interpreted in many ways and its meaning is often considered ambiguous (Niedenthal et al., 2010; Rychlowska et al., 2015). This is especially true when the intensity of the smile is low (Ambadar et al., 2009). In the first study, we focused on low-intensity smiles and expected that they would be judged more positively when followed by current expressions reflecting high-intensity smiles compared to anger. In Experiment 2, we examined whether participants' evaluations of past expressions were also affected by different current expressions when the meaning of the past expressions was less ambiguous and less moderate. Specifically, in the second study, we focused on high-intensity smiles and expected that they would be judged as more positive when followed by current

expressions reflecting low-intensity smiles compared to anger. While the previous two experiments examined the impact of current expressions on the evaluation of positive past expressions, Experiment 3 examined their impact on the evaluation of unambiguous negative past expressions. In particular, in this study, we focused on anger and once again predicted assimilations effects in which this expression would be judged more negatively when followed by current expressions reflecting fear compared to high-intensity smiles. Importantly, in all three experiments, we predicted that the proposed assimilation effects would be larger for participants from Eastern than Western cultures.

Creation of Stimuli

Before conducting the experiments, we created clips of changing emotional expressions. To create these clips, we first selected photographs of four Asian actors (two males: m12, m13; two females: f20, f21) displaying facial expressions of anger, fear, low-intensity smiles, and high-intensity smiles from the Taiwanese Facial Expression Image Database (TFEID; Chen & Yen, 2007) and photographs of four White actors (two males: m04, m06; two females: f01, f04) displaying expressions changing from neutral to anger, fear, and high-intensity smiles from the Amsterdam Dynamic Facial Expression Set (ADFES; Van Der Schalk et al., 2011). Actors were instructed to display these facial expressions on the basis of action units in the facial action coding system (FACS; Ekman et al., 2002). All stimuli were selected by the first author (a certified FACS coder), resulting in comparable muscle movements between these two groups for each expression (see coded action units for each facial expression in Table S1 in the online supplemental materials). Based on a pilot study (see Fang et al., 2021), we chose the frame of each ADFES stimulus that best matched the intensity of the corresponding Asian stimulus.

To further examine whether the stimuli were perceived similarly by Chinese and Canadian observers, 84 Asian Chinese participants ($M_{age} = 20.46$; 43 women) and 69 White Canadian participants ($M_{age} = 21.62$; 43 women) judged the perceived positivity and negativity (*How positive/negative does the person feel?*) of the four emotions (anger, fear, low-intensity, and high-intensity smiles) for all actors (Fang et al., 2021). No differences were found between Chinese and Canadian participants' evaluations of any of the emotions except anger; with anger being rated more positively by Chinese than Canadian participants (we return to this point in the General Discussion). See Table S2 in the online supplemental materials for an Emotion × Target Race × Participant Culture mixed-design analysis of variance on positivity ratings (the mean of both positivity and negativity [reversed-scored] items) and Table S3 in the online supplemental materials for Chinese and Canadian participants' positivity ratings on each emotion. Together these findings indicate, for the most part, that the evaluative judgments of the stimuli did not differ across Chinese and Canadian groups.

To create clips of expressions changing from one emotion to another, the selected static emotional expressions for each actor as past and current emotions were imported in Fantamorph5 (http://www.fantamorph.com) to simulate natural changes in facial expressions. Each morphed clip consisted of 26 frames that were presented at the speed of 30 frames per second (Ambadar et al., 2005; Sato & Yoshikawa, 2004), with a 600 ms exposure time of the past emotion and current emotion frames (Hoffmann et al., 2010). Each clip lasted 2,000 ms. This methodology was used to create 16 clips for

Experiment 1 with four Asian and four White actors each displaying low-intensity smiles transitioning to anger or high-intensity smiles; 16 clips for Experiment 2 with four Asian and four White actors each displaying high-intensity smiles transitioning to anger or low-intensity smiles; and 16 clips for Experiment 3 with four Asian and four White actors each displaying anger expressions transitioning to fear or high-intensity smiles. See Figure 2 for an illustration. Examples of these changing emotional expressions are available at https://osf.io/px7zn/.

Experiment 1

In Experiment 1, Chinese and Canadian participants were presented with Asian and White faces depicting expressions changing from low-intensity smiles to high-intensity smiles and from low-intensity smiles to anger. We predicted an assimilation effect in which low-intensity smiles would be judged more positively when followed by high-intensity smiles than when followed by anger expressions. Furthermore, we predicted that the impact of current emotional expressions on the evaluation of past expressions would be greater for Chinese than Canadian participants.

Method

Participants and Design

To maximize power, we used a 2 (Target Race: Asian vs. White) × 2 (Current Emotion: High-intensity Smiles vs. Anger) × 2 (Participant Culture: Chinese vs. Canadian) mixed design, with the first two variables as within-subjects factors and participant culture as a between-subjects factor. Based on the sample sizes of previous studies examining cultural differences in sensitivity to context (see Masuda, 2017, for a review), we sought to recruit approximately 70 participants from each culture. The final sample consisted of 72 White Canadian-born students ($M_{age} = 18.86$, $SD = 3.01$; 61 women, 11 men) recruited from a university in Canada who received

Figure 2

Examples of Facial Expressions Changing From (a) Low-Intensity Smiles to Anger and (b) Low-Intensity Smiles to High-Intensity Smiles

a) Low-intensity smiles–to–anger

b) Low–to–high-intensity smiles

0	26 frames	2000 ms
Past Emotion		Current Emotion
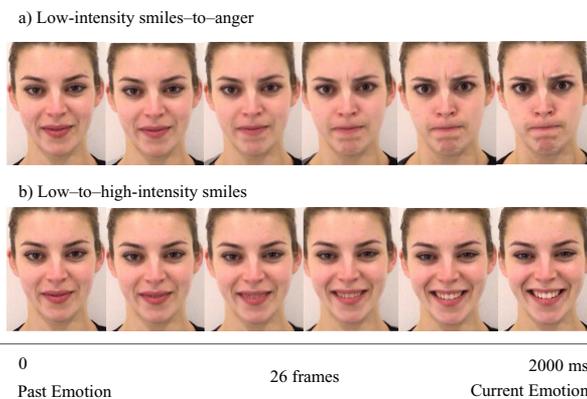
Note. Although each clip included 26 frames of expressions morphing from past to current expressions, only four midrange expressions are presented in this figure for demonstration purposes. Images of faces are taken with permission from the ADFES database (Van Der Schalk et al., 2011). See the online article for the colour version of this figure.

course credit for their participation and 72 Asian Chinese-born students ($M_{age} = 19.72$, $SD = 1.08$; 61 women, 11 men) recruited from a university in China who received CAD \$2 (CNY ¥10) for their participation (collected in 2019). A sensitivity analysis using G*Power (Faul et al., 2007) showed that our final sample could detect effects of $f = .236$ ($\eta_p^2 = .053$) for the critical Current Emotion × Participant Culture interaction with .80 power ($\alpha = .05$).

Stimuli and Procedure

The stimuli consisted of 16 clips of emotional transitions described in the Creation of Stimuli section with four Asian and four White actors depicting expressions changing from low-intensity smiles to high-intensity smiles and from low-intensity smiles to anger. Participants were tested on computers in individual cubicles with a custom-written PsychoPy program (Peirce, 2007).

Each trial started with a fixation cross displayed in the center of the screen for 500 ms, followed by a clip of emotional transitions for 2,000 ms. Participants were seated approximately 60 cm from the screen, and the clips subtended 8° × 12° of their visual angles. After the clip (including the last frame) disappeared from the screen, participants were instructed to judge the positivity or negativity of the past expression shown in the clip (*How positive/negative did this person feel at the beginning of the clip*?). They had to complete a total of 32 trials (16 clips × 2 judgments), divided into two blocks. Trials were presented in a random order for each participant. Half of the participants completed positivity judgments first while the other participants completed negativity judgments first. Participants were instructed to provide their response by moving a slider ranging from 0 (*not at all*) to 100 (*extremely*). Participants initially completed four practice trials.

In all three experiments, instructions were presented in English for the Canadian participants and translated into Mandarin for the Chinese participants by means of a standard translation/back-translation procedure. The measures and procedures were approved by the ethics committees at York University and Anshun University, respectively.

Transparency and Openness

For all experiments, we report how we determined our sample size, all manipulations, and all measures. All data, analysis code, and research materials are available at https://osf.io/px7zn/. Data were analyzed using R, Version 4.1.0 (R Core Team, 2020), the package ggplot2, Version 3.3.5 (Wickham, 2016), and the package ez, Version 4.4-0 (Lawrence, 2016). This study's designs and their analyses were not preregistered.

Results

First, all responses to the negative ratings were reverse scored before computing a composite score by taking the mean of positivity and recoded negativity items,[1] with higher scores indicating greater positivity. A 2 (Target Race: Asian vs. White) × 2 (Current Emotion: High-intensity Smiles vs. Anger) × 2 (Participant Culture: Chinese vs. Canadian) mixed-design ANOVA was conducted on these composite scores, see Table 1. Target race and current emotion were within-subjects variables and participant culture was a between-subjects variable.

The main effects of target race, $F(1, 142) = 41.25$, $p < .001$, $\eta_p^2 = .225$, 90% CI [0.131, 0.317] and participant culture,

$F(1, 142) = 77.16$, $p < .001$, $\eta_p^2 = .352$, [0.249, 0.440] were significant. Low-intensity smiles of White targets ($M = 60.98$, $SD = 10.48$) were rated more positively than those of Asian targets ($M = 57.25$, $SD = 9.81$) and Canadian participants ($M = 64.76$, $SD = 8.38$) evaluated low-intensity smiles more positively than Chinese participants ($M = 53.47$, $SD = 6.97$). Furthermore, the main effect of current emotion was significant, $F(1, 142) = 83.16$, $p < .001$, $\eta_p^2 = .369$, 90% CI [0.267, 0.456]. In accordance with the predicted assimilation effect, past low-intensity smiles were evaluated more positively when followed by current high-intensity smiles ($M = 68.64$, $SD = 12.11$) than when followed by current anger expressions ($M = 49.59$, $SD = 19.81$).

Importantly, this assimilation effect was qualified by the predicted two-way interaction of current emotion and participant culture, $F(1, 142) = 20.38$, $p < .001$, $\eta_p^2 = .125$, 90% CI [0.052, 0.211], see Figure 3. Chinese participants rated low-intensity smiles more positively when followed by high-intensity smiles ($M = 67.72$, $SD = 13.51$) than when followed by anger expressions ($M = 39.23$, $SD = 17.66$), $t(71) = 8.58$, $p < .001$, Cohen's $d = 1.01$, 95% CI [0.72, 1.29]. Although Canadian participants also rated low-intensity smiles more positively when followed by high-intensity smiles ($M = 69.57$, $SD = 10.54$) than when followed by anger expressions ($M = 59.94$, $SD = 16.15$), $t(71) = 3.79$, $p < .001$, Cohen's $d = 0.45$, 95% CI [0.20, 0.69], this effect was considerably smaller. As expected based on the significant interaction of current emotion by participant culture, an independent t-test indicated that the difference score related to ratings of low-intensity smiles-to-anger and low-intensity smiles-to-high-intensity smiles for Chinese participants ($M_{diff} = 28.49$, $SD = 28.18$) was larger than that for Canadian participants ($M_{diff} = 9.62$, $SD = 21.52$), $t(142) = 4.51$, $p < .001$, Cohen's $d = 0.75$, 95% CI [0.42, 1.09]. These findings suggest that Chinese compared to Canadian participants showed larger assimilation effects. Furthermore, although the interaction of current emotion and participant culture can also be decomposed by current emotion, because it was not central to our primary hypotheses, we reported analyses related to the influence of different participant cultures on the perception of current emotions in the online supplemental materials.

In summary, the results of Experiment 1 provide initial support that perceivers assimilate evaluations of past expressions to match the valence of subsequent emotional expressions, even in relatively short emotional transitions. In particular, past low-intensity smiles were judged more positively when followed by current high-intensity smiles than when followed by current anger expressions. Furthermore, this effect was larger for Chinese than Canadian perceivers.

Experiment 2

Our primary goal in Experiment 2 was to conceptually replicate the results of Experiment 1 using past positive expressions with less ambiguous connotations (i.e., high-intensity smiles). In accordance with our initial results, we expected that high-intensity smiles would be judged more positively when followed by low-intensity smiles than when followed by anger expressions and that these assimilation effects would be larger for Chinese than Canadian perceivers.

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[1] In all three experiments, separate analyses for positivity and negativity ratings were conducted and described in Table S4 in the online supplemental materials. The pattern of results for all studies was conceptually similar to the findings reported in the main text.

Table 1

Target Race × Current Emotion × Participant Culture Mixed-Design Analysis of Variance for Perceived Positivity of Past Expressions in Experiments 1, 2, and 3

Experiment	Effect	F	df	p	η_p^2
Experiment 1	Target race (T)	41.25	(1, 142)	**<.001**	0.225
Low-intensity smiles as past emotion	Current emotion (C)	83.16	(1, 142)	**<.001**	0.369
	Participant culture (P)	77.16	(1, 142)	**<.001**	0.352
	T × C	0.14	(1, 142)	.706	0.001
	T × P	0.11	(1, 142)	.746	0.001
	C × P	20.38	(1, 142)	**<.001**	0.125
	T × C × P	0.33	(1, 142)	.567	0.002
Experiment 2	Target race (T)	1.39	(1, 120)	.241	0.011
High-intensity smiles as past emotion	Current emotion (C)	52.42	(1, 120)	**<.001**	0.304
	Participant culture (P)	95.59	(1, 120)	**<.001**	0.443
	T × C	0.64	(1, 120)	.426	0.005
	T × P	14.76	(1, 120)	**<.001**	0.110
	C × P	14.89	(1, 120)	**<.001**	0.110
	T × C × P	0.50	(1, 120)	.480	0.004
Experiment 3	Target race (T)	6.23	(1, 118)	**.014**	0.050
Anger as past emotion	Current emotion (C)	21.83	(1, 118)	**<.001**	0.156
	Participant culture (P)	88.28	(1, 118)	**<.001**	0.428
	T × C	0.41	(1, 118)	.523	0.003
	T × P	22.79	(1, 118)	**<.001**	0.162
	C × P	16.76	(1, 118)	**<.001**	0.124
	T × C × P	2.84	(1, 118)	.095	0.023

*Note.* Bold font indicates that the effect was significant at the $p < .05$ level.

Method

Participants and Design

Based on the effect size of the Current Emotion × Participant Culture interaction in Experiment 1 ($\eta_p^2 = .125$), a priori power analysis using G*Power (Faul et al., 2007) indicated that only 30 participants from each culture were needed to achieve .80 power ($\alpha = .05$).

Figure 3

Perceived Positivity of Past Low-Intensity Smiles as a Function of Current Expression and Participant Culture in Experiment 1
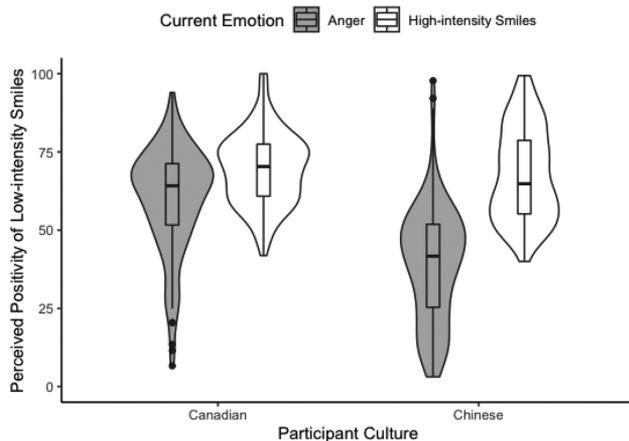
Note. The violin plot outlines illustrate kernel probability density, with the width of the outlined area representing the proportion of the data at a given value. The boxplots indicate the median and quartiles with whiskers marking 1.5 times the interquartile range.

However, given available research resources and our goal to run a highly powered replicable study, we planned to recruit 60 participants from each culture. The final sample consisted of 62 White Canadian-born students ($M_{age} = 19.76$, $SD = 3.32$; 45 women, 17 men) recruited from a Canadian university who received course credit for their participation and 60 Asian Chinese-born students ($M_{age} = 19.90$, $SD = 0.92$; 41 women, 19 men) recruited from a university in China who received CAD \$2 (CNY ¥10) for their participation (collected in 2020).

Stimuli and Procedure

The stimuli consisted of 16 clips of emotional transitions described in the Stimuli Creation section, with four Asian and four White actors providing expressions that changed from high-intensity smiles to low-intensity smiles or from high-intensity smiles to anger. In accordance with the procedure in Experiment 1, participants completed four practice trials, followed by 32 trials in which they rated the positivity and negativity of the past expression in 16 clips.

Results

In accordance with the analyses in Experiment 1, we computed a composite score by taking the mean of both positivity and reverse-scored negativity items, with higher scores indicating greater positivity. Next, we conducted a 2 (Target Race: Asian vs. White) × 2 (Current Emotion: Low-intensity Smiles vs. Anger) × 2 (Participant Culture: Chinese vs. Canadian) mixed-design ANOVA on these composite scores. Target race and current emotion were within-subjects variables and participant culture was a between-subjects variable, see Table 1.

Although the main effect of target race was not significant, $F(1, 120) = 1.39$, $p = .240$, $\eta_p^2 = .011$, 90% CI [0.000, 0.061], the main effect of participant culture was significant, $F(1, 120) = 95.59$, $p < .001$, $\eta_p^2 = .443$, 90% CI [0.334, 0.529]. Canadian participants ($M = 78.59$, $SD = 15.62$) evaluated past high-intensity smiles more positively than Chinese participants ($M = 53.37$, $SD = 12.65$). Furthermore, the main effect of current emotion was significant, $F(1, 120) = 52.42$, $p < .001$, $\eta_p^2 = .304$, 90% CI [0.194, 0.401]. In accordance with the predicted assimilation effect, past high-intensity smiles were rated more positively when followed by current low-intensity smiles ($M = 72.45$, $SD = 15.01$) than when followed by current anger expressions ($M = 59.93$, $SD = 26.54$).

Importantly, this effect was qualified by the expected current emotion by participant culture interaction, $F(1, 120) = 14.89$, $p < .001$, $\eta_p^2 = .110$, 90% CI [0.037, 0.201], see Figure 4. In accordance with the analytic strategy in Experiment 1, we examined the effect of current emotion in each culture. Chinese participants rated high-intensity smiles more positively when followed by low-intensity smiles ($M = 63.05$, $SD = 13.07$) than when followed by anger expressions ($M = 43.70$, $SD = 19.75$), $t(59) = 6.83$, $p < .001$, Cohen's $d = 0.88$, 95% CI [0.58, 1.18]. Although Canadian participants also rated high-intensity smiles more positively when followed by low-intensity smiles ($M = 81.54$, $SD = 10.52$) than when followed by anger expressions ($M = 75.64$, $SD = 22.57$), $t(61) = 2.86$, $p = .006$, Cohen's $d = 0.36$, 95% CI [0.10, 0.62], this effect was considerably smaller. As expected based on the significant interaction of current emotion by participant culture, an independent t-test indicated that the difference score related to ratings of high-intensity smiles-to-anger and high-intensity smiles-to-low-intensity smiles for Chinese participants ($M_{diff} = 19.36$, $SD = 21.96$) was larger than that for Canadian participants ($M_{diff} = 5.90$, $SD = 16.23$), $t(120) = 3.86$, $p < .001$, Cohen's $d = 0.70$, 95% CI [0.33, 1.07]. These findings suggest that Chinese compared to Canadian participants showed larger assimilation effects. We also decomposed the current emotion and participant culture

Figure 4

Perceived Positivity of Past High-Intensity Smiles as a Function of Current Expression and Participant Culture in Experiment 2
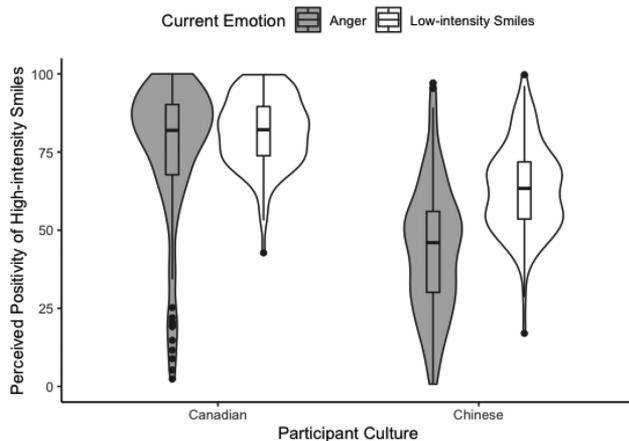
Note. The violin plot outlines illustrate kernel probability density, with the width of the outlined area representing the proportion of the data at a given value. The boxplots indicate the median and quartiles with whiskers marking 1.5 times the interquartile range.

interaction by each current emotion and reported these effects in the online supplemental materials. Furthermore, although the target race by participant culture interaction was also significant, because it was not central to our primary hypotheses, we also reported and decomposed this interaction in the online supplemental materials.

In summary, the pattern of results in Experiment 2 conceptually replicated our initial findings even though an alternative past emotion with a less ambiguous meaning was used. Specifically, participants rated past high-intensity smiles more positively when they were followed by current low-intensity smiles than by current expressions of anger. Furthermore, these assimilation effects were again more pronounced for Chinese compared to Canadian participants.

Experiment 3

Our primary goal in Experiment 3 was to extend these initial findings by examining Canadian and Chinese participants' evaluations of past negative rather than positive expressions. Once again, we predicted an assimilation effect in which past expressions of anger would be judged more negatively when followed by current expressions of fear than when followed by current high-intensity smiles. Furthermore, Chinese perceivers were expected to show larger assimilation effects than Canadian perceivers.

Method

Participants and Design

Using the smallest effect size of the Current Emotion × Participant Culture interaction in the previous two experiments (i.e., $\eta_p^2 = .110$ in Experiment 2), a priori power analysis indicated that 34 participants from each culture were needed to achieve .80 power ($\alpha = .05$). Given available research resources and our goal to conduct a high-powered replication study, we planned to recruit 60 participants in each culture. The current final sample consisted of 60 White Canadian-born students ($M_{age} = 20.55$, $SD = 4.62$; 51 women, nine men) recruited from a university in Canada who participated for course credits and 60 Asian Chinese-born students ($M_{age} = 19.92$, $SD = 1.05$; 51 women, nine men) recruited from a university in China who received CAD \$2 (CNY ¥10) for participation (collected in 2020).

Stimuli and Procedure

The stimuli consisted of 16 clips of emotional transitions described in the Creation of Stimuli, with four Asian and four White actors depicting expressions changing from anger to fear or from anger to high-intensity smiles. Participants first completed four practice trials, followed by 32 trials in which they rated the positivity and negativity of the past expression in each clip.

Results

In accordance with the earlier experiments, we computed the mean of all positivity and reverse-scored negativity items, with higher scores indicating greater positivity. A2 (Target Race: Asian vs. White) × 2 (Current Emotion: High-intensity Smiles vs. Fear) × 2 (Participant Culture: Chinese vs. Canadian) mixed-design ANOVA was conducted on these composite scores. Target race and current

emotion were within-subjects variables and participant culture was a between-subjects variable, see Table 1.

The main effects of target race, $F(1, 118) = 6.23$, $p = .014$, $\eta_p^2 = .050$, 90% CI [0.006, 0.126] and participant culture, $F(1, 118) = 88.28$, $p < .001$, $\eta_p^2 = .428$, [0.316, 0.516], were significant. Past expressions of anger were evaluated more positively on White targets ($M = 37.27$, $SD = 16.86$) than Asian targets ($M = 35.51$, $SD = 14.51$), and Chinese participants ($M = 46.27$, $SD = 9.43$) evaluated anger expressions more positively than Canadian participants ($M = 26.51$, $SD = 13.27$). Furthermore, the main effect of current emotion was significant, $F(1, 118) = 21.83$, $p < .001$, $\eta_p^2 = .156$, 90% CI [0.067, 0.253]. The pattern of results supports the predicted assimilation effect, with past expressions of anger being evaluated more positively when followed by current high-intensity smiles ($M = 40.18, SD = 21.06$) than when followed by current fear expressions ($M = 32.60, SD = 13.97$).

In accordance with the results of Experiments 1 and 2, this assimilation effect was qualified by participant culture. The current emotion by participant culture interaction was significant, $F(1, 118) = 16.76$, $p < .001$, $\eta_p^2 = .124$, 90% CI [0.045, 0.218], see Figure 5. Chinese participants evaluated past expressions of anger more positively when followed by current high-intensity smiles ($M = 53.38$, $SD = 16.44$) than when followed by current expressions of fear ($M = 39.15$, $SD = 12.35$), $t(59) = 4.98$, $p < .001$, Cohen's $d = 0.64$, 95% CI [0.36, 0.92], see Figure 5. Notably, Canadian participants did not differ in their evaluations of past expressions of anger when followed by current high-intensity smiles ($M = 26.98$, $SD = 16.43$) or by current expressions of fear ($M = 26.04$, $SD = 12.40$),

$t(59) = 0.61$, $p = .544$, Cohen's $d = 0.08$, 95% CI [−0.18, 0.33]. Analyses examining the effect of culture for each current emotion separately are reported in the online supplemental materials. We also reported and decomposed a significant target race by participant culture interaction that was not central to our primary hypotheses in the online supplemental materials.

In summary, despite the use of past negative (anger) rather than positive (low- and high-intensity smiles) expressions, the pattern of findings in Experiment 3 conceptually replicated the earlier effects. In general, past expressions of anger were judged as more negative when followed by current expressions of fear than when followed by high-intensity smiles. Furthermore, these assimilation effects were once again larger for Chinese compared to Canadian participants. It is notable, however, that this effect was not significant for Canadian participants. Although the absence of an assimilation effect in Canadian participants was unexpected (to be discussed further in the General Discussion), these findings provide additional evidence that Chinese participants are more influenced by temporal emotional contexts than Canadian participants.

General Discussion

In summary, compared to when the current expression was negative, participants rated past low-intensity smiles (Experiment 1) and high-intensity smiles (Experiment 2) more positively when the current expression was positive. Likewise, compared to when the current expression was positive, participants rated anger (Experiment 3) more negatively when the current

Figure 5
Perceived Positivity of Past Anger Expressions as a Function of Current Expression and Participant Culture in Experiment 3
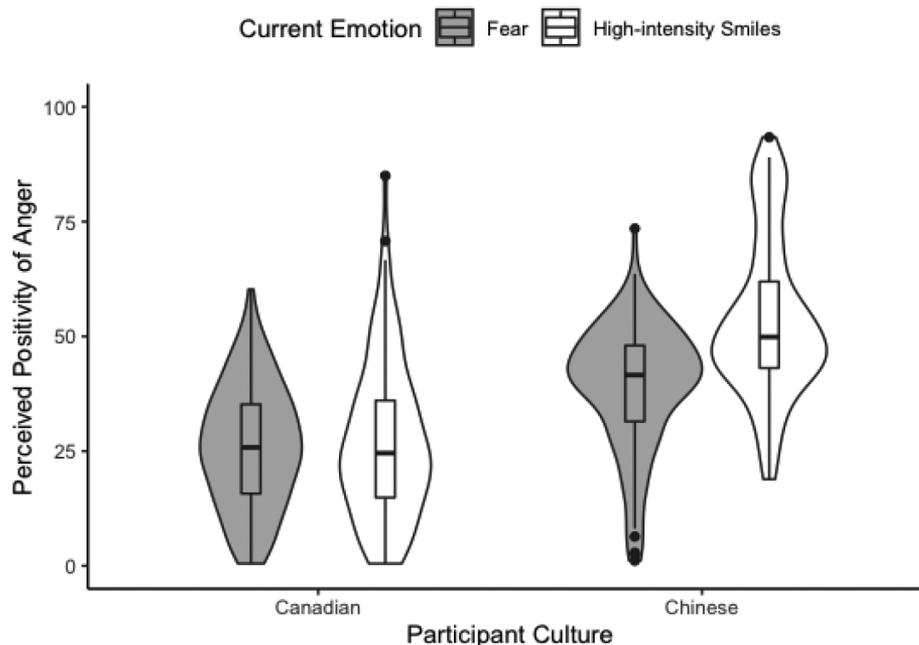
Note. The violin plot outlines illustrate kernel probability density, with the width of the outlined area representing the proportion of the data at a given value. The boxplots indicate the median and quartiles with whiskers marking 1.5 times the interquartile range.

expression was negative. That is, an assimilation effect was found in all three experiments—when presented with changing expressions, the evaluation of the valence of past emotions was shifted in the direction of the valence of current emotions.

It is notable that these cultural differences in assimilation effects cannot simply be attributed to cultural differences in the perception of different current expressions. As indicated in the section on the creation of stimuli, although Chinese participants rated static expressions of anger more positively than Canadian participants, the two groups did not differ in their ratings of any other emotions. The differences in the positivity ratings between the static anger expressions and the static high-intensity smiles (Experiment 1) and between the static anger expressions and the static low-intensity smiles (Experiment 2) were thus smaller for Chinese compared to Canadian participants. If cultural differences in assimilation effects were simply caused by perceptual differences between current high-/low-intensity smiles and current anger expressions across cultures, then smaller differences between the two changing expressions would be expected for Chinese compared to Canadian participants. Our findings, however, indicate larger assimilation effects by Chinese participants.

The current pattern of results is distinct from previous studies that have found a contrasting effect of past expressions on the perception of current expressions (Fang et al., 2021), suggesting that judging current and past facial expressions are distinct processes. Mechanisms driving the contrast effects of past expressions on evaluations of current expressions are likely related to perceptual processes (see Fang et al., 2021), whereas mechanisms driving the assimilation effects of current emotions on evaluations of past expressions are related to memory processes. To judge the valence of expressions that occurred in the recent past, participants first need to recall the past expressions. Previous work has shown that although memories for emotions are fairly accurate, they are also subject to systematic biases (Levine & Safer, 2002). In particular, people tend to use their current feelings about past events to infer what they must have felt when those events first occurred. This type of assimilation effect has been found not only in memories for emotions but also memories for attitudes (Ross et al., 1981), others' faces (Loftus & Greene, 1980), and factual events (Snyder & Uranowitz, 1978). Applying these findings to the evaluation of past emotions in changing facial expressions provide evidence that current emotions serve as a filter for observers to reconstruct the past emotions.

In addition, when viewing changing facial expressions, participants may be motivated to not simply rely on the target facial expressions but to also use additional information from the situation. In the present case, this information may be current or past expressions. Whereas participants who judge a current emotion might be motivated to confirm their judgment by comparing it with the past emotion (resulting in contrast effects), participants who judge a past emotion might be motivated to rely on the current emotion to retrieve and recognize the past emotion (resulting in assimilation effects). Although the purpose of the present experiments was not to investigate the underlying mechanisms of the assimilation effect, we recommend future research systematically examine the proposed possibilities.

More importantly, the present research did find that these assimilation effects were culturally moderated, with Chinese participants showing stronger effects than Canadian participants. These results are consistent with previous findings that Chinese participants were more susceptible to temporal emotional context than participants from Western cultures such as Canada (Fang et al., 2021), and suggest that cultural differences in attention to contexts may play an important role in the processing of changing expressions. Specifically, given that Easterners attend more to the context than Westerners (related to the more holistic thinking of Easterners and the more analytical thinking of Westerners; Choi et al., 2007; Cohen & Kitayama, 2019; Masuda et al., 2008), Easterners would take past and present temporal emotional contexts more into account than Westerners when judging facial expressions.

On the other hand, we are aware that cultural differences in tolerance of contradiction (related to the more dialectical thinking of Easterners compared to Westerners; Cohen & Kitayama, 2019; Peng & Nisbett, 1999) would have predicted a different pattern. In particular, given that Easterners are often characterized as dialectical thinkers and show more tolerance of contradictory thoughts, emotions, and behaviors and Westerners typically look to reconcile inconsistencies and are more disturbed by discrepancies (Ji et al., 2001; Peng & Nisbett, 1999; Spencer-Rodgers et al., 2004, 2010), one might expect that Westerners would be more likely to modify their construal of past emotions to be more in line with their current emotions. In contrast, Easterners might show less pronounced assimilation effects because they feel more comfortable with discrepancies between past and current emotional expressions. Although exploratory, the present findings do not provide evidence for this tolerance of contradiction account of the impact of current emotions on past emotion perceptions but rather for a context sensitivity account. Specifically, Chinese compared to Canadian participants consistently demonstrated *greater* assimilation effects in which distinct current emotions had a larger impact on the evaluation of past emotions. These findings suggest greater attention to temporal contexts by Easterners rather than greater tolerance of contradiction.

Other Interesting Findings and Remaining Questions

Although the impact of current expressions on the evaluation of past expressions was significant in all three experiments, the size of the effects decreased in each subsequent study, from low-intensity smiles ($\eta_p^2 = .369$) to high-intensity smiles ($\eta_p^2 = .304$) to anger expressions ($\eta_p^2 = .156$). One potential reason for these decreasing effects may be related to the ambiguity of past expressions. When facial expressions are more ambiguous or less intense, contextual information or perceiver characteristics may have a larger impact (Hehman et al., 2017). While smiles may be ubiquitous in daily life, they can be interpreted in many ways and their meaning is often not obvious (Hess et al., 2002; Niedenthal et al., 2010; Rychlowska et al., 2017). Therefore, the interpretation of smiles, especially low-intensity smiles (Ambadar et al., 2005, 2009; Hess et al., 1997), may be more likely to be influenced by contextual information. In contrast, the meaning of anger expressions is relatively clear, unambiguously conveying negative feelings. Moreover, compared to smiles, anger may benefit from more efficient, rapid processing because of its biological significance as a threatening expression (Hansen & Hansen, 1988; Vuilleumier, 2002). Judgments of past anger may therefore be less influenced by subsequent expressions compared to past low-intensity smiles or past high-intensity smiles. Notably, while current expressions influenced Canadians' judgments of past smiles of both intensities, they did not impact their interpretation of past anger.

If the interpretation of past emotions with ambiguous meanings is indeed more influenced by current emotions, can we apply the same reasoning to stronger assimilation effects by Chinese participants when interpreting past emotions? That is, compared to Canadian individuals, are emotional concepts more ambiguous and less categorical for Chinese individuals, and therefore their construal of past expressions is more influenced by temporal emotional contexts? Recent research provides some evidence that this might be the case (Fang et al., 2018; Wood et al., 2016). In particular, Chinese compared to Dutch participants were more likely to perceive mixed emotions in facial expressions (Fang et al., 2019). For example, when viewing anger expressions, in addition to anger, Chinese observers tended to perceive fear and disgust to a greater degree than the Western observers. Furthermore, Chinese individuals also expressed emotions in less distinct ways than Dutch individuals (Fang et al., 2022). In particular, Chinese relative to Dutch participants used more similar facial movements to express different emotions and/ or used more variable facial movements to express the same emotion. In addition to facial expressions, East Asians also reported more complex emotional experiences in the same situation or during the same time period than Westerners (Grossmann & Ellsworth, 2017; Miyamoto et al., 2010). In the present research, because emotional expressions may be more ambiguous and less categorical for Chinese participants, they may take temporal contexts more into account in the present research when interpreting past emotions than Canadian participants. Future research, however, is necessary to more directly explore this possibility.

We also recommend two further avenues for future research. First, in addition to the perception of facial expressions, researchers might consider investigating whether people from Eastern cultures are also more impacted by temporal contexts in other domains, such as evaluating others' emotional experiences, attitudes, behaviors, and personalities. For example, do observers from China compared to Canada take people's present actions more into account when judging targets' past actions? Second, future research might extend the current work on the influence of current emotions on the reconstruction of past emotions by examining the influence of future expectations on the evaluation of current emotions. Would participants assimilate or contrast the interpretation of current emotions to a future scenario and would this effect be stronger for people from Eastern than Western cultures?

Constraints on Generality

In addition to the limitations already mentioned in the previous sections, we note two other limitations in the current research. First, although changing expressions generated using morph are considered natural and are often used in dynamic emotion studies (e.g., Sacharin et al., 2012; Sato & Yoshikawa, 2004), they do not necessarily accurately reflect natural changes in emotion. Specifically, changing expressions generated using morph involve the simultaneous movement of facial components, but different facial components of real-life changing expressions may change in different orders and speeds. Future research could further improve ecological validity by including spontaneous changing expressions.

Second, although we used facial expressions of actors from both cultures as experimental materials, the emotional expressions of actors in both cultures were based on Western prototypes. Furthermore, in the present research, we only studied two cultures, Chinese and

Canadian. Therefore, the current findings cannot necessarily be generalized to other facial expressions and other populations. Despite these limitations, the current results raise important questions about the influence of culture and current emotions on the evaluation of past emotions.

Implications

When interacting with others, we often need to not only pay attention to the current expression of our communication partners, but also to their past expressions. Evaluating past expressions can help us better understand the emotions, behaviors, and intentions of others, and can influence our response. For example, the negotiator determines the next round of bids based on whether the recipient's past expressions differ from their current expressions and the direction of such changes; the clinical psychologist is concerned with changes in the client's past and current expressions to assess the psychological impact of the conversation on the client. Notably, however, our memory for past expressions is not a direct reflection of those facial cues and as demonstrated in the current studies can be influenced by current emotional expressions. In particular, the assimilation effect produced by current expressions causes us to underestimate the heterogeneity of past and current expressions, which leads to biased evaluations of the changes. On the other hand, however, this assimilation effect may be an effective coping strategy that allows us to alter the past to fit the present (Johnson & Sherman, 1990; Levine et al., 2009). In particular, the bias in the recall of past emotions makes it possible for decisions to be guided by recent and relevant emotions and promote effective coping.

Deeply influenced by the philosophical ideas of Confucianism and Taoism, Chinese people understand the world as a swirl of Ying and Yang, and seek the best answers not through extreme statements but through emphasis on the Golden Mean (or zhong yong; Cohen & Kitayama, 2019; Peng & Nisbett, 1999). These principles encourage individuals to maintain an assimilating and harmonious attitudes toward their own judgments. We believe that these traditional Chinese philosophical ideas still influence the way contemporary members' attitudes toward judgment. As the present research shows, when evaluating past facial expressions, Easterners are more likely than Westerners to incorporate past emotions into current emotions. This stronger assimilation effect in Easterners may bring more benefits or risks in different contexts.

Conclusions

Complementing previous work on East–West differences on the impact of temporal emotional context on judgments of *current* expressions (Fang et al., 2021), the present findings suggest that Easterners are more likely than Westerners to incorporate information from temporal emotional context when judging *past* facial expressions as well. Extending previous work on cultural differences related to the impact of concurrent contexts (Masuda et al., 2008, 2012), these findings provide new evidence that Easterners' perceptions of others' emotional expressions are more strongly influenced by temporal context than Westerners' perceptions. Understanding how temporal emotional contexts can influence emotion perception in people from Eastern relative to Western cultures provide us with important baseline information on appreciating and improving communication across cultures.

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