In-Group Advantage Effect in Cross-Cultural Facial Expression Recognition: The Influence of Spontaneity and Presentation Mode on Anger and Disgust Expression Recognition

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Abstract

As globalization accelerates, cross-cultural communication has become increasingly important. In exchanges between different linguistic and cultural groups, non-verbal channels such as facial expressions play a vital role in conveying emotions and intentions. Previous research has found that recognizing facial expressions of individuals from the same cultural background is more accurate than those from different cultural backgrounds, a phenomenon known as the in-group advantage effect. However, prior studies have primarily focused on static posed expressions, with little known about the in-group advantage effect in the recognition of dynamic and spontaneous expressions. To investigate whether the in-group advantage effect is moderated by expression spontaneity (posed vs. spontaneous) and presentation mode (static vs. dynamic), this study recruited Chinese and Canadian/Dutch participants to identify posed and spontaneous anger and disgust expressions of Chinese and Dutch models (Experiment 1), as well as static and dynamic posed anger and disgust expressions (Experiment 2). The results demonstrated that in most cases, both posed and spontaneous expressions exhibited an in-group advantage effect, with the in-group advantage effect for posed expressions being significantly greater than that for spontaneous expressions; recognition of both static and dynamic posed expressions also showed an in-group advantage effect, but no significant difference was found between the two overall. These findings indicate that the in-group advantage effect in expression recognition is moderated by expression spontaneity but may not be influenced by presentation mode. This study is the first to examine the in-group advantage effect in expression recognition under the moderation of these two important characteristics—expression spontaneity and presentation mode, which holds significant implications for expanding research on the in-group advantage effect and deepening understanding of cross-cultural

expression recognition.

Full Text

The Ingroup Advantage in Cross-Cultural Facial Expression Recognition: The Effects of Spontaneity and Presentation Mode on the Recognition of Anger and Disgust Expressions

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Abstract

As globalization accelerates, cross-cultural communication has become increasingly important. In interactions between individuals from different linguistic and cultural backgrounds, nonverbal cues such as facial expressions play a crucial role in conveying emotions and intentions. Previous research has found that people are more accurate at recognizing facial expressions from individuals of their own cultural background than from those of different cultural backgrounds, a phenomenon known as the ingroup advantage effect. However, most prior studies have focused on static, posed expressions, leaving the ingroup advantage in dynamic and spontaneous expression recognition poorly understood.

To investigate whether the ingroup advantage is moderated by expression spontaneity (posed vs. spontaneous) and presentation mode (static vs. dynamic), we recruited Chinese and Canadian/Dutch participants to recognize posed and spontaneous anger and disgust expressions (Experiment 1), as well as static and dynamic posed anger and disgust expressions (Experiment 2), displayed by Chinese and Dutch models. Results showed that ingroup advantage emerged for both posed and spontaneous expressions in most conditions, with posed expressions demonstrating significantly stronger ingroup advantage than spontaneous expressions. Both static and dynamic posed expressions also exhibited ingroup advantage, though no significant overall difference was found between them. These findings indicate that the ingroup advantage in facial expression recognition is moderated by expression spontaneity but not by presentation mode. This study is the first to examine how these two important characteristics—spontaneity and presentation mode—modulate the ingroup advantage, offering significant contributions to expanding ingroup advantage research and deepening our understanding of cross-cultural expression recognition.

Keywords: facial expression recognition, ingroup advantage, posed and spontaneous expressions, static and dynamic expressions, cultural differences
Classification Code: B842

1 Introduction

In today' s era of globalization, cross-cultural interactions are becoming increasingly frequent. Accurately interpreting nonverbal behaviors, particularly facial expressions, is essential when communicating across cultures and languages (Fang, Rychlowska, et al., 2022; Van Kleef & Côté, 2022). However, recognizing facial expressions accurately is challenging, especially when interpreting expressions from other cultures. Previous research has shown that nonverbal emotional communication is compromised when it occurs between individuals from different cultural groups compared to within-group communication (Elfenbein & Ambady, 2002). Specifically, people are more accurate at recognizing facial expressions from individuals sharing their own cultural background than from those of different cultural backgrounds (Elfenbein & Ambady, 2002; Zhang et al., 2011), a phenomenon termed the ingroup advantage effect.

Most prior research on the ingroup advantage in expression recognition has focused on posed and static facial expressions (Elfenbein & Ambady, 2002). Posed expressions are those deliberately produced to convey specific emotions (Elfenbein & Ambady, 2002), while static expressions are captured at a single moment in time. In reality, however, facial expressions are often spontaneous —naturally occurring during social interactions (Matsumoto, Olide, Schug, et al., 2009)—and dynamic, evolving over time (Krumhuber et al., 2023; Zhang et al., 2015). Recent studies have revealed differences in how individuals produce and perceive posed, spontaneous, static, and dynamic expressions (Kang & Lau, 2013; Krumhuber et al., 2021; Matsumoto, Olide, & Willingham, 2009; Valente et al., 2018), necessitating an investigation into whether the ingroup advantage is moderated by expression spontaneity and presentation mode.

This paper first reviews the ingroup advantage effect and the related dialect theory of emotion, then discusses potential differences between posed and spontaneous expression recognition and between static and dynamic expression recognition. Finally, we present two laboratory studies examining whether expression spontaneity and presentation mode moderate the ingroup advantage in recognizing anger and disgust expressions. This research is the first to investigate how these two important characteristics—spontaneity and presentation mode—modulate the ingroup advantage, making significant contributions to expanding research on the ingroup advantage and deepening our understanding of cross-cultural expression recognition.

1.1 The Ingroup Advantage Effect and the Dialect Theory of Emotion

Although early research suggested that emotional facial expressions (at least for basic emotions) are culturally universal (e.g., Ekman et al., 1969), an increasing number of researchers now argue that emotional expressions exhibit both universality and cultural specificity (Elfenbein et al., 2007; Fang et al., 2021). One perspective holds that while individuals from different cultures can recognize expressions from other cultures at above-chance levels, recognition accuracy is

higher for same-culture expressions (Elfenbein & Ambady, 2002).

The dialect theory of emotion (Elfenbein, 2013; Elfenbein et al., 2007) has been proposed to explain this ingroup advantage. This theory analogizes emotion to a universal language used globally, but suggests that people from different cultural backgrounds exhibit slight variations in emotional expression and perception, forming so-called "emotion dialects" (Elfenbein & Ambady, 2002). Within-culture emotion recognition benefits from better matching with these dialects, whereas poorer dialect matching between cultural groups reduces recognition accuracy.

Elfenbein et al. (2007) provided empirical support for dialect theory. In their study, Canadian and Gabonese participants posed expressions of anger, disgust, fear, surprise, sadness, and happiness. Researchers analyzed the action units (AUs) in these expressions using the Facial Action Coding System (FACS; Ekman et al., 2002). Results showed that although expressions from both cultural groups contained AUs specified in the FACS manual for standard expressions, stable differences (i.e., emotion dialects) existed. A new group of Canadian and Gabonese participants then recognized these expressions. Consistent with dialect theory, more pronounced emotion dialect differences predicted stronger ingroup advantage effects.

1.2 Posed vs. Spontaneous Expressions and the Ingroup Advantage

While the ingroup advantage has been demonstrated across many studies, most have focused on posed expressions, with less attention to spontaneous expressions (see meta-analysis by Elfenbein & Ambady, 2002). Recent research has found significant differences in AUs between posed and spontaneous expressions when conveying the same emotion (Namba, Kagamihara, et al., 2017; Namba, Makihara, et al., 2017). Fang et al. (2022) found that posed expressions activated more AUs than spontaneous expressions. These findings collectively suggest that posed and spontaneous expressions may differ in their facial muscle movement patterns.

Do expressions of different spontaneity levels show different ingroup advantage effects? Previous research suggests that posed expressions may be more susceptible to cultural influences than spontaneous expressions (for a review, see Valente et al., 2018). Both early observational studies and standardized facial movement measurements have found that congenitally blind individuals produce spontaneous expressions similar to sighted individuals, but their posed expressions differ significantly. This indicates that posed expressions may be more influenced by social learning than spontaneous expressions. We therefore hypothesized that posed expressions might contain more culture-specific emotion dialects than spontaneous expressions, resulting in a larger ingroup advantage for posed expression recognition. This prediction received preliminary support from Matsumoto et al. (2009), who found no ingroup advantage when American and Japanese participants recognized spontaneous happiness and sadness

expressions from Olympic athletes. This suggests the ingroup advantage may not exist for spontaneously produced expressions.

However, Kang and Lau (2013) reported different findings. They asked European-American and Asian-American participants to recognize standard expressions (prototypical expressions created according to FACS manual standards) and spontaneous expressions from European-American and Asian-American models. Standard expressions were taken from the Japanese and Caucasian Facial Expressions of Emotion (JACFEE; Matsumoto & Ekman, 1988), while spontaneous expressions were dynamic video clips obtained by asking participants to recount personal experiences. Results showed that Asian-Americans exhibited ingroup advantage for both standard and spontaneous expressions. Notably, this study presented standard expressions statically and spontaneous expressions dynamically, and the emotion categories differed between the two (posed: sadness, surprise, fear, anger, disgust, happiness; spontaneous: sadness, surprise, frustration, anger, happiness). Therefore, whether expression spontaneity moderates the ingroup advantage remains inconclusive.

On the other hand, posed expressions have higher intensity and prototypicality than spontaneous expressions (Krumhuber et al., 2021; Tcherkassof et al., 2007). These characteristics may lead to higher recognition rates for posed expressions. Consistent with this prediction, previous research shows that both humans and machines recognize posed expressions better (Fang, Sauter, et al., 2022; Krumhuber et al., 2021). We therefore predicted that this high recognition characteristic might reduce differences in recognition rates between cultural groups, resulting in a smaller ingroup advantage for posed expressions compared to spontaneous expressions.

1.3 Static vs. Dynamic Expressions and the Ingroup Advantage

The second goal of this study was to investigate whether presentation mode influences the ingroup advantage in expression recognition. Compared to static expressions, dynamic expressions contain unique dynamic information such as the direction, quality, and speed of facial movements (Bould & Morris, 2008; Cunningham & Wallraven, 2009; Jack et al., 2014). This dynamic information initiates higher-level cognitive processes that support social and emotional inference, thereby facilitating facial expression recognition (Blais et al., 2017; Sato et al., 2008).

Nevertheless, it remains unclear whether the facilitative effect of dynamic information is specific to particular cultural perceiver groups or universal across all cultural groups. In other words, does dynamic information in dynamic expressions encompass culture-specific emotion dialects? If dynamic information contains emotion dialects, this additional information should further enhance the ingroup advantage. We therefore expected the ingroup advantage to be larger for dynamic expressions than for static expressions. This hypothesis re-

ceived preliminary support from Elfenbein and Ambady' s (2002) meta-analysis, which found that studies using dynamic expressions (43 studies) revealed larger ingroup advantage effects than those using static expressions (79 studies). However, this moderating effect of presentation mode was only marginally significant. Moreover, the studies included in this meta-analysis differed in many aspects beyond presentation mode, such as expression spontaneity, culture, and emotion categories. Without controlling for these other differences, we cannot determine whether presentation mode alone moderates the ingroup advantage.

If dynamic information does not contain culture-specific emotion dialects but instead universally facilitates emotion recognition across all cultural perceivers, then no difference in ingroup advantage should exist between dynamic and static expression recognition. We therefore hypothesized that presentation mode would not moderate the ingroup advantage.

1.4 The Current Research

In summary, existing research on whether the ingroup advantage in cross-cultural expression recognition is moderated by expression spontaneity has several limitations. Some studies have included only spontaneous expression recognition tasks without posed expression tasks (Matsumoto, Olide, & Willingham, 2009), preventing direct comparison of ingroup advantage between posed and spontaneous expressions. Other studies have mismatched emotion categories and presentation modes between posed and spontaneous expressions (Kang & Lau, 2013), making it impossible to rule out confounding effects. Additionally, findings regarding whether expression spontaneity moderates the ingroup advantage are inconsistent. Regarding whether presentation mode moderates the ingroup advantage, no systematic research has been conducted.

This study aimed to investigate whether the ingroup advantage in cross-cultural expression recognition is moderated by expression spontaneity (posed vs. spontaneous; Experiment 1) and presentation mode (static vs. dynamic; Experiment 2). Specifically, Experiment 1 recruited participants from Eastern and Western cultures to recognize posed and spontaneous dynamic expressions from Eastern and Western expressers. Experiment 2 recruited Eastern and Western participants to recognize static and dynamic posed expressions from Eastern and Western expressers. Posed expressions were obtained by asking models to produce specific expressions so that "their friends could easily understand their feelings." Spontaneous expressions were obtained by asking models to recall and narrate personal experiences related to specific emotions. Compared to standard expressions used in previous research (e.g., Kang & Lau, 2013), the posed expressions in this study better conform to each culture' s emotion expression norms and avoid the problem of masking cultural differences through uniformly standardized expressions, which could eliminate the ingroup advantage (Elfenbein et al., 2007).

This study focused on anger and disgust expressions for three reasons. First,

anger and disgust are widely considered basic emotions (Ekman, 1992; Izard, 2007), expected to be universally present and common across Eastern and Western cultures. Second, although distinct, anger and disgust are conceptually related (Giner-Sorolla et al., 2018) and share morphological similarities (Cordaro et al., 2018; Fang, Sauter, et al., 2022). These similarities cause confusion between the two expressions (Fang et al., 2018, 2019; Jack et al., 2009; Pochedly et al., 2012). Using these confusable expressions can better elicit the ingroup advantage. In contrast, when using clearly distinct expressions such as anger and happiness, discrimination is good regardless of cultural origin, making ingroup advantage unlikely to emerge. Third, existing expression databases primarily depict static posed expressions, with few depicting dynamic or spontaneous expressions (see reviews by Dawel et al., 2022; Krumhuber et al., 2017), and even fewer cross-cultural databases containing both spontaneity levels or both presentation modes. To our knowledge, only one cross-cultural emotion expression study includes all four conditions: static/dynamic posed and spontaneous anger and disgust expressions from Chinese and Dutch models (Fang, Sauter, et al., 2022). This study utilized these materials to examine whether the ingroup advantage in anger and disgust expression recognition is moderated by expression spontaneity and presentation mode.

2 Experiment 1: The Effect of Expression Spontaneity on the Ingroup Advantage

2.1.1 Participants

Following previous research (Elfenbein & Ambady, 2002; Kang & Lau, 2013), we planned to recruit 100 Canadian and 100 Chinese participants. We predetermined to stop data collection when participant numbers approached 100 (Simmons et al., 2013). Ultimately, we recruited 126 Canadian and 126 Chinese participants. Among them, 62 Canadian participants (52 female; mean age = 20.67 years, SD = 6.91) and 62 Chinese participants completed the posed expression recognition task (52 female; mean age = 20.18 years, SD = 1.29), while 64 Canadian participants (58 female; mean age = 20.89 years, SD = 6.07) and 64 Chinese participants (58 female; mean age = 20.03 years, SD = 1.33) completed the spontaneous expression recognition task. A sensitivity analysis using G*Power 3.1 (Faul et al., 2007) indicated that our final sample size (N = 252) could detect a key three-way interaction (expression spontaneity × expresser culture × perceiver culture) with an effect size of f = 0.21 (p^2 = 0.04; power = 0.80, α = 0.05). All participants were healthy with normal or corrected-to-normal vision, participated voluntarily, and provided informed consent. This experiment was approved by the York University Ethics Committee (e2018-028).

2.1.2 Design

Experiment 1 employed a 2 (expression type: anger, disgust) × 2 (expression spontaneity: posed, spontaneous) × 2 (expresser culture: Eastern, Western)

× 2 (perceiver culture: Eastern, Western) mixed design, with expression type and expresser culture as within-subjects factors and expression spontaneity and perceiver culture as between-subjects factors.

2.1.3 Materials

Materials were obtained from Fang, Sauter, et al. (2022), which collected both posed and spontaneous expressions. For posed expressions, participants were asked to pose specific expressions in front of a camera so that "their friends could easily understand their feelings."After posing each expression, participants viewed their video and selected the frame that best expressed the intended emotion as the static posed expression material (used in Experiment 2; see Figure 1 [Figure 1: see original paper] for examples). This method ensured that selected static expressions accurately conveyed intended emotions while avoiding experimenter bias (similar procedures see Cordaro et al., 2018; Elfenbein et al., 2007). Dynamic expression materials were created by extracting a 2-second video clip centered on the selected frame.[1] A total of 45 Chinese models (22 female) and 49 Dutch models (36 female) posed anger and disgust expressions, yielding 188 static/dynamic posed expression materials.

For spontaneous expressions, participants were told they would help develop a robot that understands human emotions. They recalled and narrated personal experiences related to anger or disgust while their facial expressions were recorded. Research shows this relived-emotion method effectively elicits spontaneous expressions (e.g., Siedlecka & Denson, 2019; Tsai & Chentsova-Dutton, 2003). Other procedures mirrored those for posed expressions. Thirty-five Chinese models (24 female) and 35 Dutch models (24 female) narrated anger and disgust stories, yielding 140 dynamic spontaneous expression stimuli. Because participants produced mouth movements while speaking during the spontaneous condition, we could not distinguish whether mouth movements in static spontaneous expressions resulted from speaking or from expression-specific actions. Therefore, this experiment focused on comparing dynamic posed and spontaneous expressions.

[Figure 1: see original paper]

2.1.4 Procedure

The experiment was conducted using PsychoPy (Peirce et al., 2019). Participants were randomly assigned to either dynamic posed or dynamic spontaneous expression recognition tasks. Each trial began with a 500 ms fixation point, followed by a 2000 ms dynamic expression video (18° × 12°). After the video, an emotion intensity rating scale appeared. Participants moved a slider to rate the intensity of anger, disgust, fear, sadness, and happiness in the preceding expression on a scale from 0 (not at all) to 100 (extremely).[2] We used rating scales because perceivers may identify multiple emotions in an expression (Fang et al., 2018, 2019; Hess et al., 2016). Unlike forced-choice methods, rating scales allow

participants to express the intensity of different emotions perceived, rather than selecting only one emotion.

The dynamic posed expression recognition task comprised 4 blocks of 47 trials each (188 total trials). The dynamic spontaneous expression recognition task comprised 140 trials. Each facial expression appeared only once in random order. All participants were tested in their native language.

2.2 Results and Discussion

Recognition accuracy was calculated as follows: If a participant' s rating on the target emotion dimension was greater than or equal to ratings on other dimensions and not equal to 0, the response was coded as 1 (correct); otherwise, it was coded as 0 (incorrect). To examine ingroup advantage more intuitively, we calculated the difference between recognition accuracy for same-culture expressions and other-culture expressions for each presentation mode and expression type. A difference significantly greater than 0 indicated ingroup advantage; significantly less than 0 indicated better recognition of other-culture expressions; and no significant difference indicated equivalent recognition across cultures. Results showed that Western perceivers exhibited ingroup advantage for both posed and spontaneous expressions, while Eastern perceivers showed ingroup advantage for posed but not spontaneous expressions. Further discussion of these results appears in the General Discussion section. Means, standard deviations, and one-sample t-test results for ingroup advantage across conditions are presented in Table 1 . Recognition accuracy means, standard deviations, and one-sample t-test results appear in Supplementary Table 1.

A three-way mixed ANOVA on ingroup advantage with expression type (anger, disgust), expression spontaneity (posed, spontaneous), and perceiver culture (Eastern, Western) revealed significant effects (see Table 2).

The main effect of expression type was significant, $F(1, 248) = 6.54$, $p = 0.011$, $p^2 = 0.03$, with larger ingroup advantage for disgust ($M = 0.06$, $SD = 0.11$) than anger ($M = 0.04$, $SD = 0.12$). The main effect of perceiver culture was significant, $F(1, 248) = 27.18$, $p < 0.001$, $p^2 = 0.10$, with larger ingroup advantage for Western perceivers ($M = 0.08$, $SD = 0.07$) than Eastern perceivers ($M = 0.03$, $SD = 0.09$).

Critically, the main effect of expression spontaneity was significant, $F(1, 248) = 31.34$, $p < 0.001$, $p^2 = 0.11$, with larger ingroup advantage for posed expressions ($M = 0.08$, $SD = 0.08$) than spontaneous expressions ($M = 0.03$, $SD = 0.09$). Additionally, the two-way interaction between expression spontaneity and perceiver culture, $F(1, 248) = 57.08$, $p < 0.001$, $p^2 = 0.19$, and the three-way interaction between expression type, expression spontaneity, and perceiver culture, $F(1, 248) = 57.08$, $p < 0.001$, $p^2 = 0.19$, were significant (see Figure 2 [Figure 2: see original paper]). To decompose this three-way interaction, we first split by perceiver culture. Results showed that the expression type × expression spontaneity interaction was significant for both Eastern and Western

perceivers (Eastern: F(1,124) = 15.23, p < 0.001, p^2 = 0.11; Western: F(1, 124) = 46.20, p < 0.001, p^2 = 0.27). Because we were interested in whether expression spontaneity moderates ingroup advantage, we further split this two-way interaction by expression type. For Eastern perceivers, ingroup advantage for posed anger and posed disgust was significantly larger than for spontaneous anger and spontaneous disgust (anger: t(124) = 6.98, p < 0.001, Cohen' s d = 1.24, 95% CI = [0.86, 1.62]; disgust: t(124) = 2.09, p = 0.039, Cohen' s d = 0.37, 95% CI = [0.02, 0.72]). For Western perceivers, ingroup advantage for posed disgust was also significantly larger than for spontaneous disgust, t(124) = 5.66, p < 0.001, Cohen' s d = 1.01, 95% CI = [0.64, 1.38]. However, Western perceivers showed greater ingroup advantage for spontaneous anger than posed anger, t(124) = 3.82, p < 0.001, Cohen' s d = 0.68, 95% CI = [0.32, 1.04].

[Figure 2: see original paper]

In summary, Experiment 1 demonstrated that the ingroup advantage in dynamic expression recognition is moderated by expression spontaneity. Overall, posed expressions showed stronger ingroup advantage than spontaneous expressions. This may be because posed expressions are more susceptible to social learning (Matsumoto & Willingham, 2009; Rinn, 1991) and thus contain more emotion dialects. These additional dialects may amplify differences in recognizing posed expressions from own-culture versus other-culture individuals, thereby strengthening ingroup advantage. The sole exception was that Western perceivers showed greater ingroup advantage for spontaneous anger than posed anger. Further discussion of this issue appears in the General Discussion section.

3 Experiment 2: The Effect of Presentation Mode on the Ingroup Advantage

3.1.1 Participants

Participants who completed the dynamic posed expression task came from Experiment 1. Similar to Experiment 1, Experiment 2 planned to recruit approximately 60 Dutch and 60 Chinese participants for the static posed expression recognition task. We predetermined to stop data collection when participant numbers approached 60 (Simmons et al., 2013). Ultimately, Experiment 2 recruited 75 Dutch participants (59 female; mean age = 21.53 years, SD = 4.15) and 82 Chinese participants (58 female; mean age = 24.16 years, SD = 5.10). A sensitivity analysis using G*Power 3.1 (Faul et al., 2007) indicated that our final sample size (N = 283) could detect a key three-way interaction (expression spontaneity × expresser culture × perceiver culture) with an effect size of f = 0.19 (p^2 = 0.03; power = 0.80, α = 0.05). All participants were healthy with normal or corrected-to-normal vision, participated voluntarily, and provided informed consent. This experiment was approved by the University of Amsterdam Ethics Committee (2018-SP-9379).

3.1.2 Design

Experiment 2 employed a 2 (expression type: anger, disgust) × 2 (presentation mode: static, dynamic) × 2 (expresser culture: Eastern, Western) × 2 (perceiver culture: Eastern, Western) mixed design, with expression type and expresser culture as within-subjects factors and presentation mode and perceiver culture as between-subjects factors. Materials were obtained as described in Experiment 1.

3.1.3 Procedure

The static posed expression recognition task was conducted on the Qualtrics online survey platform (https://www.qualtrics.com/). Each trial presented a static facial expression image of anger or disgust with intensity rating scales for anger, disgust, fear, and sadness below the image. Given that happiness clearly differs in valence from these negative emotions and participants rarely identified target expressions as happy in Experiment 1 (approximately 14.84% of trials), happiness was not included as a rating option in Experiment 2. Other procedures mirrored those of Experiment 1.

3.2 Results and Discussion

Static posed expression recognition data came from this experiment; dynamic posed expression data came from Experiment 1. Recognition accuracy and ingroup advantage were calculated as in Experiment 1. Results showed that both Eastern and Western perceivers exhibited ingroup advantage for static and dynamic posed expressions. Means, standard deviations, and one-sample t-test results for ingroup advantage across conditions are presented in Table 3 . Recognition accuracy means, standard deviations, and one-sample t-test results appear in Supplementary Table 3.

A three-way mixed ANOVA on ingroup advantage with expression type (anger, disgust), presentation mode (static, dynamic), and perceiver culture (Eastern, Western) revealed significant effects (see Table 4).

The main effect of expression type was significant, $F(1, 277) = 13.25$, $p < 0.001$, $p^2 = 0.05$, with larger ingroup advantage for disgust ($M = 0.10$, $SD = 0.12$) than anger ($M = 0.07$, $SD = 0.11$). The main effect of perceiver culture was significant, $F(1, 277) = 18.87$, $p < 0.001$, $p^2 = 0.06$, with larger ingroup advantage for Western perceivers ($M = 0.11$, $SD = 0.08$) than Eastern perceivers ($M = 0.07$, $SD = 0.07$).

Importantly, the main effect of presentation mode was not significant, $F(1, 277) = 2.52$, $p = 0.113$. However, the two-way interaction between presentation mode and perceiver culture, $F(1, 277) = 7.44$, $p = 0.007$, $p^2 = 0.03$, and the three-way interaction between expression type, presentation mode, and perceiver culture, $F(1, 277) = 4.81$, $p = 0.029$, $p^2 = 0.02$, were significant (see Figure 3 [Figure 3: see original paper]). To decompose this three-way interaction, we first split

by perceiver culture. The expression type × presentation mode interaction was not significant for Eastern perceivers, $F(1,142) = 1.44$, $p = 0.233$, but marginally significant for Western perceivers, $F(1, 135) = 3.55$, $p = 0.062$, $p^2 = 0.03$. Further splitting this interaction by expression type for Western perceivers revealed that ingroup advantage for static anger expressions was significantly larger than for dynamic anger expressions, $t(135) = 3.60$, $p < 0.001$, Cohen' s $d = 0.62$, 95% CI = [0.27, 0.96], while no significant difference existed between static and dynamic disgust expressions, $t(135) = 0.66$, $p = 0.513$.

[Figure 3: see original paper]

In summary, Experiment 2 showed that ingroup advantage in posed expression recognition was not moderated by presentation mode in most conditions. The sole exception was that Western perceivers showed greater ingroup advantage for static anger expressions than dynamic anger expressions. These findings are discussed further in the General Discussion section.

4 General Discussion

As globalization increases opportunities for cross-cultural interaction, understanding how individuals from different cultural backgrounds perceive each other' s emotions becomes increasingly important. Previous research has consistently demonstrated the ingroup advantage effect, where recognition of same-culture facial expressions is more accurate than recognition of other-culture expressions (Elfenbein, 2013; Elfenbein et al., 2007). However, most studies have used static, posed expressions, with few examining whether ingroup advantage exists for spontaneous and dynamic expressions. In daily life, expressions are typically dynamic and less intense and prototypical than posed expressions in laboratory settings (Dawel et al., 2022; Krumhuber et al., 2021; Scherer et al., 2011). Therefore, whether findings based on static, posed expressions generalize to real-world contexts remains questionable.

This study compared Chinese and Canadian/Dutch perceivers' recognition of anger and disgust expressions from Chinese and Dutch expressers, examining for the first time whether expression spontaneity (posed vs. spontaneous) and presentation mode (static vs. dynamic) moderate the ingroup advantage. Results showed that overall, ingroup advantage was moderated by expression spontaneity but not by presentation mode. Posed expressions demonstrated stronger ingroup advantage than spontaneous expressions, while no significant difference existed between static and dynamic expressions. These findings are discussed in detail below.

4.1 Ingroup Advantage for Posed and Spontaneous Expression Recognition

This study revealed that in most cases (expression type × perceiver culture), ingroup advantage was stronger for posed than spontaneous expressions. This

may be because consciously produced expressions are more shaped by socialization, whereas spontaneously occurring expressions are less influenced by social learning (Matsumoto & Willingham, 2009; Rinn, 1991). Therefore, posed expressions may contain more emotion dialects than spontaneous expressions. It is worth noting that both posed and spontaneous expression materials in this study came from Fang, Sauter, et al. (2022), which showed that except for Dutch expressers' posed anger expressions (which used fewer AUs than spontaneous anger), posed expressions generally contained more AUs than spontaneous expressions. These additional muscle movements suggest that posed expressions contain more information and are more likely to embed culture-specific emotion dialects, resulting in stronger ingroup advantage for posed expressions.

However, one exception emerged in Experiment 1: Western perceivers showed greater ingroup advantage for spontaneous anger than posed anger. This may be because Dutch expressers' posed anger expressions used fewer AUs than their spontaneous anger expressions, and the two shared low similarity (only 2 of 5-6 AUs). Specifically, Dutch posed anger commonly used AUs 4 (brow lowerer), 7 (lid tightener), 23 (lip tightener), 54 (head down), and 63 (eyes up), whereas spontaneous anger commonly used AUs 1 (inner brow raise), 2 (outer brow raise), 4, 7, 61 (eyes left), and 64 (eyes down). These results indicate substantial differences between Dutch spontaneous and posed anger expressions. Dutch spontaneous anger expressions may contain more culture-specific emotion dialects, leading to stronger ingroup advantage.

Additionally, although ingroup advantage existed in most conditions (expression type × expression spontaneity × perceiver culture), Eastern perceivers did not show ingroup advantage for spontaneous anger and disgust expressions. This may result from two factors. First, beyond emotion dialects, historical heterogeneity is another important influence on cross-cultural emotion communication (Niedenthal et al., 2018). Historical heterogeneity refers to the number of source countries contributing to a nation' s current population over the past 500 years (Rychlowska et al., 2015; Wood et al., 2016). More heterogeneous societies have more diverse values and beliefs, requiring individuals to communicate emotions and intentions directly and accurately to survive in such diverse environments. Consequently, individuals from historically heterogeneous societies (e.g., United States, Canada) express emotions more clearly than those from homogeneous societies (e.g., China, Japan), making their expressions easier to recognize (Fang, Rychlowska, et al., 2022; Wood et al., 2016). In this study, historical heterogeneity may have had greater impact on spontaneous than posed expressions. For Chinese perceivers, while emotion dialects enabled better recognition of Chinese spontaneous expressions (vs. Dutch spontaneous expressions), historical heterogeneity enabled better recognition of Dutch spontaneous expressions (vs. Chinese spontaneous expressions). These opposing effects may have canceled each other out, eliminating ingroup advantage for Chinese perceivers recognizing spontaneous anger and disgust.

Second, collectivism/individualism also influences cross-cultural emotion com-

munication (Matsumoto et al., 2008). Eastern cultures are more collectivistic than Western cultures, emphasizing group harmony and stability, and may downplay negative emotion expression during communication (Ekman, 1971; Matsumoto et al., 2008). Fang, Sauter, et al. (2022) found that Chinese individuals used far fewer AUs when spontaneously expressing anger and disgust (2 AUs for anger, 3 for disgust) than Dutch individuals (6 AUs for anger, 7 for disgust). This attenuated emotion expression increases recognition difficulty. Therefore, even for Chinese perceivers, Chinese expressers' spontaneous negative expressions may be difficult to recognize, preventing ingroup advantage for spontaneous expression recognition. Future research should explore these possible explanations more deeply.

4.2 Ingroup Advantage for Static and Dynamic Expression Recognition

This study found that ingroup advantage in posed expression recognition was not moderated by presentation mode. Contrary to expectations, this was not because dynamic information universally facilitated expression recognition across all cultural groups. Instead, in most conditions (expression type × expresser culture), recognition accuracy did not differ significantly between static and dynamic expressions (see Supplementary Material 2). This suggests that dynamic information did not facilitate posed expression recognition in this study. Although many studies have shown superior recognition of dynamic expressions, others have found no difference (e.g., Fiorentini & Viviani, 2011; Wehrle et al., 2000). These inconsistent findings may relate to facial expression materials and viewing contexts. When facial expression information is limited—such as when expression authenticity is compromised (Kätsyri et al., 2008; Wehrle et al., 2000) or intensity is weak (Bould & Morris, 2008; Yitzhak et al., 2018)—dynamic information can compensate for insufficient static information and improve recognition. However, when facial expression information is abundant—such as when expressions are clear or intense—static expression recognition may already be at a high level, and additional dynamic information does not improve accuracy (Bould & Morris, 2008; Gold et al., 2013). Furthermore, when expression materials are presented briefly and response time is limited, static expressions may be processed more thoroughly than dynamic expressions, leading to higher recognition rates for static expressions (Jiang et al., 2014). In this study, comparisons between static and dynamic expressions were based on models posing specific emotions, which typically contain relatively intense emotional information (Kayyal & Russell, 2013). This intense emotional information may have resulted in equivalent recognition rates for static and dynamic expressions, preventing presentation mode from moderating ingroup advantage.

However, Experiment 2 revealed one exception: Western perceivers showed greater ingroup advantage for static than dynamic posed anger expressions. Further analysis indicated this difference arose because Western perceivers recognized Western expressers' static anger expressions better than dynamic anger

expressions, while showing no difference for Eastern expressers' static and dynamic anger expressions (see Supplementary Material 2). This finding contradicts previous research showing that dynamic information facilitates expression recognition (Ambadar et al., 2005; Krumhuber et al., 2023). Notably, unlike previous studies that used morphing software to generate dynamic expressions transitioning linearly from neutral to specific emotions (Krumhuber et al., 2023), this study used authentic dynamic video clips of individuals posing expressions. These clips were 2-second segments centered on frames selected as best representing specific emotions. Consequently, unlike the linear emotion changes in previous studies, emotion changes in this study may have been nonlinear and irregular. Such irregular dynamic information may lack clear emotional signals, resulting in recognition rates equivalent to or even lower than those for static expressions.

4.3 Limitations and Future Directions

This study has several limitations that future research should address to deepen understanding of cross-cultural emotion recognition.

First, this study examined only two negative emotions—anger and disgust—and only two cultures (China and the Netherlands). It remains unclear whether our conclusions apply to other emotions and cultural groups. Future research should investigate whether ingroup advantage exists for other emotions and cultural groups, and whether it is moderated by expression spontaneity or presentation mode, to provide a more comprehensive understanding of cultural similarities and differences in emotion communication.

Second, this study used only dynamic expressions when examining the effect of spontaneity (dynamic posed vs. dynamic spontaneous) and only posed expressions when examining the effect of presentation mode (static posed vs. dynamic posed). This was because spontaneous expressions were obtained during personal narrative recall, making it impossible to distinguish mouth movements due to speaking from those due to expression-specific actions. Future research could employ other spontaneous expression elicitation techniques, such as having models watch emotion-evoking film clips (Gross & Levenson, 1995) or smell specific odors (Zhang et al., 2014), to obtain static spontaneous expressions without mouth movement confounds.

Finally, although this study found that ingroup advantage is moderated by expression spontaneity and hypothesized that the number of activated AUs may correlate with ingroup advantage magnitude, the specific mechanisms require further empirical investigation. Additionally, while we found that ingroup advantage may not be moderated by presentation mode for posed expressions, this may be because recognition performance did not differ between static and dynamic expressions. Future research should examine whether dynamic information provides differential benefits for recognizing own-culture versus other-culture expressions when expression intensity is low, potentially producing dif-

ferences in ingroup advantage between static and dynamic expression recognition.

5 Conclusion

This study is the first to examine whether the ingroup advantage in anger and disgust expression recognition is moderated by expression spontaneity (posed vs. spontaneous) and presentation mode (static vs. dynamic). Overall, ingroup advantage was stronger for posed than spontaneous expression recognition, but was not moderated by presentation mode. These findings extend research in cross-cultural emotion recognition, revealing differences in ingroup advantage between posed and spontaneous expressions and providing new empirical insights into how individuals recognize expressions from different cultural backgrounds.

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Supplementary Materials

Supplementary Material 1: Analysis of Recognition Accuracy in Experiment 1

We conducted one-sample t-tests on recognition accuracy across conditions in Experiment 1 (see Supplementary Table 1) to test whether accuracy exceeded chance level (1/5 emotion dimensions = 0.2). Results showed that recognition accuracy in most conditions was significantly greater than 0.2, indicating above-chance recognition. However, when Western perceivers recognized Eastern expressers' spontaneous anger expressions, accuracy did not differ significantly from 0.2, suggesting Western perceivers may have difficulty recognizing Eastern expressers' spontaneous anger.

Supplementary Table 1. Means, standard deviations, and one-sample t-test results for dynamic expression recognition accuracy in Experiment 1

Perceiver Culture	Expression Spontaneity	Expression Type	Recognition Accuracy	Cohen's d	95% CI
Eastern	Posed	Anger	0.42 (0.14)	< 0.001	[1.18, 1.92]
Eastern	Posed	Disgust	0.33 (0.14)	< 0.001	[0.66, 1.27]
Eastern	Spontaneous	Anger	0.46 (0.16)	< 0.001	[1.25, 2.02]
Eastern	Spontaneous	Disgust	0.40 (0.15)	< 0.001	[0.98, 1.66]
Western	Posed	Anger	0.24 (0.11)	< 0.001	[0.09, 0.59]
Western	Posed	Disgust	0.29 (0.14)	< 0.001	[0.35, 0.88]

Perceiver Culture	Expression Spontaneity	Expression Type	Recognition Accuracy	Cohen' s d	95% CI
Western	Spontaneous	Anger	0.31 (0.14)	< 0.001	[0.49, 1.04]
Western	Spontaneous	Disgust	0.29 (0.13)	< 0.001	[0.42, 0.96]

Note: One-sample t-tests were two-tailed with H_0: = 0.2.

A four-way mixed ANOVA on recognition accuracy with expression type (anger, disgust), expression spontaneity (posed, spontaneous), expresser culture (Eastern, Western), and perceiver culture (Eastern, Western) revealed significant effects (see Supplementary Table 2). The main effect of perceiver culture was significant, $F(1, 248) = 21.08$, $p < 0.001$, $p^2 = 0.08$, with higher accuracy for Western perceivers ($M = 0.39$, $SD = 0.16$) than Eastern perceivers ($M = 0.34$, $SD = 0.10$). The main effect of expresser culture was significant, $F(1, 248) = 27.18$, $p < 0.001$, $p^2 = 0.10$, with higher accuracy for Western expressers ($M = 0.38$, $SD = 0.15$) than Eastern expressers ($M = 0.35$, $SD = 0.14$). The main effect of expression spontaneity was significant, $F(1, 248) = 295.42$, $p < 0.001$, $p^2 = 0.54$, with higher accuracy for posed expressions ($M = 0.46$, $SD = 0.12$) than spontaneous expressions ($M = 0.27$, $SD = 0.07$). The main effect of expression type was significant, $F(1, 248) = 8.87$, $p = 0.003$, $p^2 = 0.04$, with higher accuracy for disgust ($M = 0.38$, $SD = 0.17$) than anger ($M = 0.35$, $SD = 0.15$).

Supplementary Table 2. Four-way mixed ANOVA results for recognition accuracy in Experiment 1

Effect	df	F	p
Expression Spontaneity	1, 248	295.42	< 0.001
Expresser Culture	1, 248	27.18	< 0.001
Perceiver Culture	1, 248	21.08	< 0.001
Expression Type × Expression Spontaneity	1, 248	8.87	0.003
Expression Type × Expresser Culture	1, 248	6.54	0.011
Expression Type × Perceiver Culture	1, 248	4.02	0.046
Expression Spontaneity × Expresser Culture	1, 248	31.34	< 0.001
Expression Spontaneity × Perceiver Culture	1, 248	57.08	< 0.001
Expresser Culture × Perceiver Culture	1, 248	345.35	< 0.001

Note: Bold rows indicate significant effects ($p < 0.05$).

The hypothesized three-way interaction between expression spontaneity, expresser culture, and perceiver culture was significant, $F(1, 248) = 31.34$, $p < 0.001$, $p^2 = 0.11$, as was the four-way interaction, $F(1, 248) = 4.02$, $p = 0.046$, $p^2 = 0.02$. Further analysis revealed that Western perceivers showed higher accuracy for Western than Eastern expressers across all conditions (ps < 0.001). Eastern perceivers showed higher accuracy for Eastern than Western expressers for posed expressions (ps < 0.001), but lower accuracy for Eastern than Western expressers for spontaneous anger, $t(63) = 3.48$, $p < 0.001$, Cohen' s d = 0.44, 95% CI = [0.02, 0.08], with no difference for spontaneous disgust, $t(63) = 1.47$, $p = 0.147$.

Supplementary Material 2: Analysis of Recognition Accuracy in Experiment 2

One-sample t-tests on static expression recognition accuracy across conditions (see Supplementary Table 3) tested whether accuracy exceeded chance level (1/4 emotion dimensions = 0.25). Results showed that static expression recognition accuracy in most conditions was significantly greater than 0.25, indicating above-chance recognition.

Supplementary Table 3. Means and standard deviations for posed expression recognition accuracy in Experiment 2

Perceiver Culture	Presentation Mode	Expression Type	Recognition Accuracy	Cohen' s d	95% CI
Eastern	Static	Anger	0.44 (0.15)	< 0.001	[1.03, 1.63]
Eastern	Static	Disgust	0.38 (0.14)	< 0.001	[0.68, 1.21]
Eastern	Dynamic	Anger	0.46 (0.14)	< 0.001	[1.24, 1.88]
Eastern	Dynamic	Disgust	0.40 (0.17)	< 0.001	[0.65, 1.17]
Western	Static	Anger	0.42 (0.14)	< 0.001	[1.18, 1.92]
Western	Static	Disgust	0.33 (0.14)	< 0.001	[0.66, 1.27]
Western	Dynamic	Anger	0.46 (0.16)	< 0.001	[1.25, 2.02]
Western	Dynamic	Disgust	0.40 (0.15)	< 0.001	[0.98, 1.66]

Note: One-sample t-tests for static expressions were two-tailed with H_0: = 0.25; results for dynamic expressions are the same as posed expression accuracy

in Supplementary Table 1.

A four-way mixed ANOVA on recognition accuracy with expression type (anger, disgust), presentation mode (static, dynamic), expresser culture (Eastern, Western), and perceiver culture (Eastern, Western) revealed significant effects (see Supplementary Table 4). The main effect of perceiver culture was significant, $F(1, 277) = 99.74$, $p < 0.001$, $p^2 = 0.27$, with higher accuracy for Western perceivers ($M = 0.53$, $SD = 0.10$) than Eastern perceivers ($M = 0.41$, $SD = 0.09$). The main effect of expresser culture was significant, $F(1, 277) = 18.87$, $p < 0.001$, $p^2 = 0.06$, with higher accuracy for Western expressers ($M = 0.48$, $SD = 0.15$) than Eastern expressers ($M = 0.46$, $SD = 0.10$). The main effect of presentation mode was not significant, $F(1, 277) = 2.35$, $p = 0.126$. The main effect of expression type was marginally significant, $F(1, 277) = 3.77$, $p = 0.053$, $p^2 = 0.01$.

Supplementary Table 4. Four-way mixed ANOVA results for recognition accuracy in Experiment 2

Effect	df	F	p
Expression Type	1, 277	3.77	0.053
Presentation Mode	1, 277	2.35	0.126
Expresser Culture	1, 277	18.87	< 0.001
Perceiver Culture	1, 277	99.74	< 0.001
Expression Type × Presentation Mode	1, 277	4.81	0.029
Expression Type × Expresser Culture	1, 277	13.25	< 0.001
Expression Type × Perceiver Culture	1, 277	7.44	0.007
Presentation Mode × Expresser Culture	1, 277	7.44	0.007
Presentation Mode × Perceiver Culture	1, 277	2.52	0.113
Expresser Culture × Perceiver Culture	1, 277	345.35	< 0.001

Note: Bold rows indicate significant effects ($p < 0.05$).

The hypothesized three-way interaction between presentation mode, expresser culture, and perceiver culture was not significant, $F(1, 277) = 2.52$, $p = 0.113$, $p^2 = 0.01$. However, the two-way interaction between expresser culture and perceiver culture was significant, $F(1, 277) = 345.35$, $p < 0.001$, $p^2 = 0.56$. Eastern perceivers showed higher accuracy for Eastern ($M = 0.45$, $SD = 0.10$) than Western expressers ($M = 0.38$, $SD = 0.10$), $t(143) = 10.64$, $p < 0.001$, Cohen' s d = 0.89, 95% CI = [0.69, 1.08]. Western perceivers showed higher accuracy for Western ($M = 0.59$, $SD = 0.12$) than Eastern expressers ($M = 0.48$,

SD = 0.10), t(136) = 15.31, p < 0.001, Cohen' s d = 1.31, 95% CI = [1.08, 1.54], indicating ingroup advantage for both groups.

To examine whether presentation mode affected recognition, we analyzed related effects. Although the main effect of presentation mode was not significant, F(1, 277) = 2.35, p = 0.126, p^2 = 0.01, the two-way interaction between presentation mode and expresser culture, F(1, 277) = 7.44, p = 0.007, p^2 = 0.03, and the three-way interaction between expression type, presentation mode, and expresser culture, F(1, 277) = 4.81, p = 0.029, p^2 = 0.02, were significant. Further analysis of the three-way interaction revealed no significant differences between static and dynamic expressions for Eastern anger, Eastern disgust, or Western disgust (ps > 0.200). For Western anger, static expression accuracy (M = 0.49, SD = 0.18) was significantly higher than dynamic expression accuracy (M = 0.42, SD = 0.17), t(279) = 3.11, p = 0.002, Cohen' s d = 0.37, 95% CI = [0.14, 0.61].

Supplementary Material 3: Ingroup Advantage Analysis After Excluding Participants with Low Recognition Accuracy

In Experiment 1, we excluded participants whose recognition accuracy fell below M - 2.5 SD, leaving 249 participants for analysis. A three-way mixed ANOVA on ingroup advantage with expression type, expression spontaneity, and perceiver culture yielded similar results before and after exclusion (see Supplementary Table 5).

Supplementary Table 5. Three-way mixed ANOVA results for ingroup advantage after participant exclusion in Experiment 1

Effect	df	F	p
Expression Spontaneity	1, 245	31.34	< 0.001
Perceiver Culture	1, 245	27.18	< 0.001
Expression Type × Expression Spontaneity	1, 245	6.54	0.011
Expression Type × Perceiver Culture	1, 245	13.25	< 0.001
Expression Spontaneity × Perceiver Culture	1, 245	57.08	< 0.001
Expression Type × Expression Spontaneity × Perceiver Culture	1, 245	57.08	< 0.001

Note: Bold rows indicate significant effects (p < 0.05).

In Experiment 2, we similarly excluded participants whose recognition accuracy fell below M - 2.5 SD, leaving 277 participants for analysis. A three-way mixed ANOVA on ingroup advantage with expression type, presentation mode, and

perceiver culture yielded similar results before and after exclusion (see Supplementary Table 6).

Supplementary Table 6. Three-way mixed ANOVA results for ingroup advantage after participant exclusion in Experiment 2

Effect	df	F	p
Expression Type	1, 273	13.25	< 0.001
Perceiver Culture	1, 273	18.87	< 0.001
Expression Type × Presentation Mode	1, 273	4.81	0.029
Expression Type × Perceiver Culture	1, 273	7.44	0.007
Presentation Mode × Perceiver Culture	1, 273	2.52	0.113
Expression Type × Presentation Mode × Perceiver Culture	1, 273	4.81	0.029

Note: Bold rows indicate significant effects ($p < 0.05$).

Footnotes

[1] In the posed condition, participants typically maintained the expression for some time (usually 3 seconds or longer) after posing, with varying intensity. In the spontaneous condition, expressions changed continuously as participants narrated emotional experiences. We selected a 2-second interval that allowed clear observation of expression changes while avoiding non-target expressions. Additionally, 2-second expression clips reflect relatively natural expression dynamics (Fang et al., 2018, 2019 used 2000 ms expression transitions; Hoffmann et al., 2010 used 1649-3108 ms from expression onset to offset).

[2] Our emotion rating dimensions covered most basic emotions recognized in the literature (Ortony, 2022). Given debates about whether surprise (Bain, 1859/2006; Oatley & Johnson-Laird, 1987) and contempt (Matsumoto & Ekman, 2004; Widen et al., 2011) are basic emotions, we excluded these from rating options.

[3] We repeated analyses after excluding participants with recognition accuracy below M - 2.5 SD. Results were similar to those reported in the main text (see Supplementary Table 5). We also conducted a four-way mixed ANOVA on recognition accuracy with expression type (anger, disgust), expression spontaneity (posed, spontaneous), expresser culture (Eastern, Western), and perceiver culture (Eastern, Western); see Supplementary Table 2.

[4] We repeated analyses after excluding participants with recognition accuracy below M - 2.5 SD. Results were similar to those reported in the main text (see Supplementary Table 6). We also conducted a four-way mixed ANOVA on recognition accuracy with expression type (anger, disgust), presentation mode (static, dynamic), expresser culture (Eastern, Western), and perceiver culture (Eastern, Western); see Supplementary Table 4.

Note: Figure translations are in progress. See original paper for figures.