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Hemifacial differences in the in-group advantage in emotion recognition

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Some researchers have interpreted findings of in-group advantage in emotion judgements as ethnic bias by perceivers. This study is the first linking in-group advantage to subtle differences in emotional expressions, using composites created with left and right facial hemispheres. Participants from the USA, India, and Japan judged facial expressions from all three cultures. As predicted, in-group advantage was greater for left than right hemifacial composites. Left composites were not universally more recognisable, but relatively more recognisable to in-group members only. There was greater pancultural agreement about the recognition levels of right hemifacial composites. This suggests the left facial hemisphere uses an expressive style less universal and more culturally specific than the right, and that bias alone does not cause the in-group advantage.

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Rather than debating whether emotions are universal versus culturally specific, to the exclusion of the other, psychologists have recently attempted to integrate evidence for both perspectives (e.g., Ekman, 1994; Elfenbein & Ambady, 2002a; Fiske, Kitayama, Markus & Nisbett, 1998; Markus & Kitayama, 1991; Mesquita & Frijda, 1992; Mesquita, Frijda, & Scherer, 1997; Scherer & Wallbott, 1994). Because emotional expressions are public displays that are relatively available to researchers for study, several decades of work in this area extensively documents both cultural similarities and differences. Cross-cultural judgement studies of emotional expressions have been one of several central sources of evidence in favour of emotional universality, particularly classic research demonstrating across a range of literate and preliterate cultures the better-than-chance recognition of facial photographs of basic emotions (e.g., Ekman, 1972; Izard, 1971). These same studies also provided evidence for cultural differences, in the form of variability in the accuracy levels across cultural groups. Specifically, American samples generally achieved greater accuracy levels than others when viewing these American stimuli. For example, Ekman and colleagues reported accuracy rates ranging from 86% for participants from the United States (Ekman, 1972) down to 52% for members of the Borneo Sadong tribe (Ekman, Sorensen, & Friesen, 1969) when viewing American emotional expressions. Izard (1971) reported results from a large-scale study in which US participants correctly identified 83% of the facial photographs, European groups 75–83%, Japanese 65%, and Africans 50% of the photographs. Thus, there appears to be both universality as well as cultural variability in accuracy at recognising emotional expressions.

Explaining the in-group advantage

Theorists have proposed a range of explanations for this variability in emotion recognition levels documented across cultural groups, for example translation difficulties (e.g., Mesquita & Frijda, 1992) and *decoding rules* (Buck, 1984)—norms about preserving social order that may govern the acknowledgement of emotional expressions (e.g., Matsumoto, 1989; Schimmack, 1996). The goal of the present article is to provide further evidence to evaluate one particular explanation for the variability, *in-group advantage* (Elfenbein & Ambady, 2002a, 2002b), whereby emotion judgements are generally more accurate when the perceiver is a member of the same cultural group as the emotional expressor. In the context of a study using a factorial design balanced $n \times n$ across cultural groups, in which each cultural group in a study judges stimuli equally from each other group, the in-group advantage is an interaction effect of expressor culture $\times$ perceiver culture. In studies larger than 2×2, the in-group advantage is the specific contrast predicting larger interaction residuals for same-culture judgements, and smaller interaction residuals for different-culture judgements. That is, the relative ability to understand emotions is greater when judging members of one's own cultural group. Note that this interaction effect is overlaid on main effects that may also exist in emotion judgements across expressor and perceiver groups. For example, certain stimuli may be universally more clear, and some judges more accurate overall in emotion recognition. However, in such cases, the interaction effect characterising the in-group advantage would still have an impact on the degree of cultural differences.

Although there are differing opinions about the optimal methodology for testing the in-group advantage (Elfenbein & Ambady, 2002b, Matsumoto, 2002), a recent meta-analysis (Elfenbein & Ambady, 2002a) showed that the effect appears to be reliable across a range of experimental methods, positive and negative emotions, and nonverbal channels of communication. One area of consensus about methodology is that in-group advantage is best established using balanced designs (Elfenbein & Ambady, 2002a, 2002b; Matsumoto, 2002). Balanced studies control for possible static effects in emotional expression and judgement accuracy across cultures, while examining the distance effect of cultural match versus mismatch in terms of the interaction effect. The in-group advantage replicated when examining only these balanced studies, with results that matched those using unbalanced designs (Elfenbein & Ambady, 2002a, 2002b; Elfenbein, Mandal, Ambady, Harizuka, & Kumar, 2002). Thus, there is evidence for an in-group advantage in emotion even after controlling for fixed differences across cultures in expression and decoding tendencies.

One area of theoretical—and consequently methodological—disagreement is that of ''stimulus equivalence'': For instance, Matsumoto (2002) states that ''the characteristics of the face related to the emotion must be exactly the same between both cultures' expressors. This means that the same facial muscles must be innervated, with no extraneous muscle movements, and they must be at the same intensity levels''. (p. 237). He argued that ''to test adequately the in-group advantage hypothesis, or any cultural difference in judgment of emotional stimuli . . . the characteristics of the face related to the emotion must be exactly the same between both cultures' expressors'' (p. 237). For example, this would include removing the spontaneous differences that might arise across cultures in the style and appearance of emotional expression. Otherwise, he argues, studies are ''inherently confounded'' (p. 237). By contrast, Elfenbein and Ambady (2002b) argue that cultural differences in the manner of expressing spontaneous emotion are important to include in such studies because they are likely central to understanding the in-group advantage in emotion. Thus, they argued, a valid test of the in-group advantage cannot forcibly erase cross-cultural differences in the expression of emotion.

There is not yet an authoritative explanation to account for the empirical finding of in-group advantage. Initially, researchers who found this effect often referred to it as *ethnic bias* (Kilbride & Yarczower, 1983; Markham & Wang, 1996), with the term *bias* suggesting that higher accuracy when judging in-group members results from greater motivation, attention, or preference when perceivers interpret emotional expressions from members of their own versus visibly different cultures. For example, Hess, Senecal, and Kirouac (1996) found differences in judgements based on whether they told participants that emotional expressions came from members of their own versus a different ethnic group. By contrast, other theorists have connected the in-group advantage to attributes of both the stimuli and the judges together, rather than the judges alone. Elfenbein and Ambady (2002a, 2002b) used a speculative metaphor of *emotional dialects*, whereby emotion is expressed using a universal language that has subtle differences in expressive style across cultures. Thus, perceivers can more easily and accurately understand expressions in a familiar style. Likewise, Matsumoto (2002) argued that differences in emotion signal properties—such as muscle movements and intensity levels—across expressor cultures can lead to the in-group advantage in recognition.

In order to distinguish among explanations, it is important to test for predicted cultural differences in settings that cast doubt on possible alternatives. In particular, it would be worthwhile to demonstrate the presence of in-group advantage in situations not plausibly explained by perceiver bias against out-group members. Elfenbein and Ambady (2002a) found that the in-group advantage replicated in many studies with stimuli so minimal that it is implausible for participants to have known the cultural group membership of the emotional expressors, for example, filtered vocal tones, and facial photographs among multiple Caucasian groups. However, the present article aims to provide a stronger test that bias alone does not cause the in-group advantage in emotion. We use a mixed within-subjects design in which perceivers judge two subtly different types of emotional expressions created using the same group of expressors—but different facial hemispheres, as described in detail below. The study is balanced $n \times n$ across cultural groups—from India, Japan, and the United States—that are visibly different from each other. Any bias against members of outgroup cultures should be present equally when judging either hemisphere of their faces. However, differences in the in-group advantage across hemispheres are consistent with an explanation that the in-group advantage results from subtle cross-cultural differences in emotional expressive style.

Thus, our hypothesis is that cultural differences in expressive style have a greater influence on one hemisphere of the face than the other. Accordingly, the present study tests whether there is a difference across hemifacial composites in the degree of in-group advantage, which is the extent to which the magnitude of cultural differences in emotion recognition accuracy varies along with the culture of the expressor being judged.[1] Because the in-group advantage is an interaction effect that is overlaid on top of main effects in emotion recognition

[1] The authors thank David Matsumoto for this method of articulating the hypothesis tested in this study.

accuracy across expressor and perceiver cultural groups, the present study tests a specific contrast on the interaction residuals, after controlling for main effects, which is described in greater detail below.

Hemispheric differences in emotional processing

Physiological differences between the two sides of the human face provide an opportunity to explore cultural differences in the communication of emotion. Evidence suggests that the two facial hemispheres differ in the degree of muscular activity (Asthana & Mandal, 1997; Borod & Koff, 1984). The left hemiface is relatively more mobile than the right during facial expressions, and therefore emotions expressed on the left hemiface are perceived as more intense. Support for this finding comes from a variety of techniques (for a review, see Mandal, Bulman-Fleming, & Tiwari, 2001), such as symmetrical composite photographs of faces (Sackeim, Gur, & Saucy, 1978), electromyography (Schwartz, Ahern, & Brown, 1979), examining facial muscle activation in photographs using the Facial Action Coding System (Hager & Ekman, 1985), and slow motion replay of videotaped faces (Borod, Caron, & Koff, 1981). Further, a meta-analysis of 14 studies on facial asymmetry documents this greater intensity of emotions expressed by the left hemiface rather than its right counterpart (Skinner & Mullen, 1991). The greater intensity and control of left hemifacial expressions has been attributed to the dominance of the right hemisphere for emotion processing (Borod, 1992, 1993). Experimental evidence from nonclinical subjects (Campbell, 1986) as well as from focal brain damaged patients (Mandal, Tandon, & Asthana, 1991) supports of this right hemisphere hypothesis. Hemifacial asymmetry appears to vary across emotions, and is more intense for negative expressions. In her review of the literature in this area, Borod (1993) found unanimous evidence of greater intensity in the left hemisphere for negative emotions. However, the evidence for greater left-side intensity was less consistent for positive emotions, with 76% rather than 100% of prior studies showing greater intensity in this direction.

Posed and spontaneous facial expressions use separate neuroanatomical pathways (see Borod & Koff, 1991), and it has been observed that posed or voluntary expressions are guided by the pyramidal tracts of the facial nerves that descend from the cerebral cortex. Spontaneous expressions, in contrast, are guided by the extrapyramidal tract of subcortical origin (Van Gelder, 1981). The posed expressions yield clear evidence for hemifacial asymmetry because the left side of the face as compared to the right side is more richly innervated by the fibre projections of the right hemisphere, which is considered superior for emotion processing (Asthana & Mandal, 1997; Leventhal & Tomarken, 1986). Thus, the hemifacial bias is typical for posed facial expressions of emotion. However, there is little evidence for hemifacial asymmetry of spontaneous expressions. Methodological factors have limited the attempt to study such asymmetry for spontaneous expressions, because spontaneous expressions are difficult to elicit and validate for scientific purposes.

Overall, the evidence suggests differential involvement of the two hemifaces during emotional expression and, as a consequence, in social communication. As early as 1933, Wolff speculated that the right side of human face offers public expressions, whereas the left side of face reveals personalised feelings. Empirical evidence that the right side of the face is under greater conscious voluntary control as compared to the left has suggested support for this observation (Sackeim et al., 1978). One possible explanation for such evidence is that the right side of the face is under the motor control of the more cognitively controlled left hemisphere (Rinn, 1984), which can exert greater inhibitory effect on the expression of facial emotion (Gainotti, 1983). This suggests greater opportunity for right hemifacial expressions to be moderated by the public intent of social communication. By contrast, the left hemifacial expression is more automatic, less inhibited, and more characteristic of individualised or culturally acquired style of expression.

Thus, hemifacial differences in emotion expressions present a unique opportunity to test possible explanations of cross-cultural phenomena in emotional communication. For example, Mandal, Harizuka, Bhushan, and Mishra (2001) used hemispheric differences to test for cultural differences in emotional expressions. The current article uses hemifacial differences in order to test possible explanations for the in-group advantage. As discussed above, the left hemisphere of the face has greater intensity and is more automatic and individualised. Thus, we expect that cultural differences in the appearance of facial expressions will be more intense with left hemifacial composite expressions. These cultural differences in style of emotional expression are the likely cause of the in-group advantage in judgements. Therefore, the hypothesis of this study is that the in-group advantage in emotion is larger for judgements of left hemifacial composite expressions than for right hemifacial composite expressions.

If the in-group advantage in emotion differs significantly across expressions created from different hemispheres of the face, then the mixed within-subjects design and $n \times n$ balance across cultural groups in this study suggest that the only plausible explanation is subtle differences in the appearance of stimuli. Bias on the part of judges should be equal when judging the two facial hemispheres, as should other attributes of judges, such as relative skill levels and possible use of decoding rules. Likewise, translation difficulties should be equal when judging the two hemifaces. Differences between participant groups based on their language abilities—influencing emotion recognition accuracy in previous work (e.g., Matsumoto & Assar, 1992)—are also held constant in this design. Any differences across individual posers should also be equal, because the same posers' expressions yielded both hemifacial composites. The current article does not argue that these other factors do not contribute to in-group advantage, but rather suggests that the in-group advantage can vary substantively in their absence. To find differences in judgments when facial expressions, but no other factors, vary demonstrates that subtle differences in facial expressions can lead to the in-group advantage in emotion recognition.

To summarise, we expect that ratings of left hemifacial composites demonstrate clearly the in-group advantage, whereas ratings of right composite show it to a lesser degree or not at all. Thus, the hypothesis of this study is that the in-group advantage in emotion recognition is larger for left hemifacial composite expressions than for right hemifacial composite expressions. This hypothesis tests the interaction of hemifacial composite, judge culture, and expressor culture, with the specific prediction that the in-group advantage contrast has a greater magnitude for left versus right hemifacial composites. Given the use of a balanced design with three cultures, the in-group advantage takes the form of interaction residuals with contrast weights (Rosenthal & Rosnow, 1991) of *lambda* = +2 for in-group judgements and *lambda* = −1 for out-group judgements, as per the prediction that residuals show higher accuracy for judging members of one's own cultural group. Thus, the current study tests whether the size of this contrast is greater for left than right hemifacial composite photographs.

METHOD

Emotional expressions

Black-and-white photographs of facial expressions served as experimental stimuli. Each set of photographs was developed by researchers residing in the nation from which the posers originated. The set of photographs used included one man and one woman from each cultural group, of similar age, posing each of: anger, disgust, fear, happiness, neutral, sadness, and surprise.

India. Mandal (1987) developed the set of Indian photographs. He instructed 29 posers to imagine an emotional situation and to pose an appropriate expression for each emotion. They were not coached as to appropriate appearance of emotional expressions, and they were permitted to practise alone before the photography session began. Two separate consensus samples of Indian judges with at least 70% agreement validated recognition levels. Photographs passing the consensus criterion were further rated for intensity, by 100 observers selected with recognition accuracy levels of at least 70% on Ekman and Friesen's (1976) Pictures of Facial Affect. These observers were asked to rate each Indian photograph on a scale from 0 (neutral or no emotion) to 7 (intense) once for each possible emotion. The judgement for a particular photograph was derived from the highest rating the observer gave for any emotion. However, if that was not discriminated by at least 3 points from the rest of the responses to the photo, the judgement was deleted from the subject's data. Photographs were retained only if they passed these criteria with a minimum of 70% of the observers. The procedure was adapted from Ekman and Friesen (1976). In the final step, 50 observers were asked to make pairwise comparison for five photographs of each emotion ($5 \times 6 = 30$) in terms of the degree of expressiveness within the photographs of each emotion. Through a standard pair comparison technique (Guilford, 1954), the expressions in each facial emotion were located on a scale of extremeness. This standardisation process has been reported in Mandal (1987).

Japan. Mandal et al. (2001) developed the set of Japanese photographs. They used the same technique and validation methods as were used for the Indian set, with Japanese participants, with the exception of the pairwise comparison procedure.

United States. Ekman and Friesen's (1976) Pictures of Facial Affect (PFA) collection provided the photographs from the United States. This set was created with the goal of portraying expressions consistent with Ekman and Friesen's theoretical model for the appearance of prototypical facial expressions of emotion, using the Facial Affect Coding System (FACS; Ekman & Friesen, 1978). Caucasian participants from the United States were instructed to move specific facial muscles rather than to pose specific emotions. These PFA photographs were judged by a consensus sample from the United States, which recognised each photograph used in the current study, with the exception of neutral, with accuracy of 88% or greater.

We used the Pictures of Facial Affect due to their wide popularity in emotion recognition research, despite the methodological difference from the Japanese and Indian sets. Because Ekman and Friesen (1978) developed their model for prototypical expressions within the United States, it can be argued that it is consistent with norms for appropriate facial expressions in the United States. Thus, each of the three sets of photographs portrays facial expressions based on the norms of the culture in which they originated. However, one should interpret any main effects in the recognition levels of expressions from the three cultural groups only with extreme caution, because such effects also reflect differences in the methodology used to create the sets of stimulus photographs.

Hemispheric images

Mandal et al. (2001) created hemifacial composites for each photograph. They created a mirror image (LR) from each original photograph (RL), and bisected each vertically through the midpoint of the line between the internal canthi of the eyes and the central vertex of the upper lip (Rhodes & Lynskey, 1989). The left hemifacial (LL) and right hemifacial (RR) composites utilized the lateralised half of one side of the face and its mirror image (Sackeim, Gur, & Saucy, 1978), using digital image-processing software. This process yielded a total of 84 photographs (2 hemifacial composites × 3 cultures × 7 emotional states × 2 genders).

Participants

Judges were 25 male and 25 female university students from each country represented in the stimulus materials, for a total of 150 participants. United States participants had non-Asian ancestry, and identified their ethnic background as African American ($n = 2$; 4%), Hispanic ($n = 4$; 8%), Native American ($n = 2$; 4%), or Caucasian, non-Hispanic ($n = 42$; 84%). All participants in India were Indian in ethnicity, and all participants in Japan were Japanese in ethnicity.

Judgement tasks and procedure

Participants each viewed all 84 photographs of facial expressions on a computerised task programmed using *SuperLab* (1997). Photographs appeared on the screen at 5 inches (12.7 cm) wide and 7.5 inches (19 cm) high, with a resolution of 72 pixels per inch (28.3 pixels per cm). Photographs were divided into two blocks. For each photograph, the left hemifacial composite randomly appeared in either the first or the second block, and the right hemifacial composite appeared in the other block. Thus, participants viewed one version of each photograph before they viewed the opposite hemifacial composite of any photograph. Within each block, photographs appeared in a randomised order differing for each participant. Participants viewed both blocks without a rest break. In order to become familiar with the experimental procedure before the period of data collection, participants first judged two sample photographs. The instruction for the task was to judge the emotion that the poser was expressing in the photograph. Each photograph remained on the screen until the participant entered a permitted response. Response choices used the language of instruction of the students' university, English in India and the United States and Japanese in Japan [translations: *ikari* (anger), *kyoufu* (fear), *kenno* (disgust), *yorokobi* (happiness), *chuurich* (neutral), *kanashimi* (sadness), and *odoroki* (surprise)]. The experimenter in each nation was a member of the same cultural group as the participants.

RESULTS

Mean percentage accuracy values by culture of judge, culture of expressor, facial hemisphere, and emotion appear in Table 1. Emotion recognition accuracy was calculated using Wagner's (1993) formula for unbiased hit rates and the confusion matrix for each individual participant. Wagner's unbiased hit rate is the proportion accuracy multiplied by (1 minus the rate of false alarms), normalised using an arcsine transformation. This correction is similar to signal

TABLE 1
Emotion recognition accuracy across culture of judge, culture of expressor, facial hemisphere, and emotion (percentage hit rate)

	Photographs								
	Left facial hemisphere				*Right facial hemisphere*				*Total*
	India	*Japan*	*US*	*Total*	*India*	*Japan*	*US*	*Total*	
Indian judges									
Afraid	39	24	70	44	41	18	80	46	*45%*
Angry	60	42	60	54	49	36	70	52	*53%*
Disgusted	91	77	40	69	76	75	67	73	*71%*
Happy	98	99	99	99	99	98	99	99	*99%*
Neutral	85	88	88	87	79	90	92	87	*87%*
Sad	49	32	36	39	41	35	43	40	*39%*
Surprised	45	25	79	50	57	33	77	56	*53%*
Total	*67%*	*55%*	*67%*	*63%*	*63%*	*55%*	*75%*	*65%*	*64%*
Japanese judges									
Afraid	26	13	44	28	19	16	55	30	*29%*
Angry	46	44	51	47	62	27	52	47	*47%*
Disgusted	32	62	11	35	24	64	29	39	*37%*
Happy	100	98	98	99	99	99	99	99	*99%*
Neutral	85	94	95	91	83	90	93	89	*90%*
Sad	43	47	68	53	31	57	69	52	*53%*
Surprised	35	17	98	50	53	17	87	52	*51%*
Total	*52%*	*54%*	*66%*	*57%*	*53%*	*53%*	*69%*	*58%*	*58%*
US judges									
Afraid	40	33	79	51	33	21	75	43	*47%*
Angry	66	40	82	63	58	37	76	57	*60%*
Disgusted	61	71	25	52	65	67	44	59	*56%*
Happy	94	93	93	93	94	94	94	94	*94%*
Neutral	84	93	82	86	83	91	85	86	*86%*
Sad	26	38	48	37	23	43	60	42	*40%*
Surprised	36	19	88	48	62	29	76	56	*52%*
Total	*58%*	*55%*	*71%*	*61%*	*60%*	*55%*	*73%*	*62%*	*62%*
Total	*59%*	*55%*	*68%*	*61%*	*59%*	*54%*	*72%*	*62%*	*61%*

detection methods except, unlike signal detection terms, it allows separate analyses for each stimulus category (Wagner, 1993). Values range from a minimum of 0 to a perfect score of 1.57, which is the arcsine of 1—the value obtained under complete detection along with zero false alarms. Traditional hit rate accuracy values by culture of judge, culture of expressor, facial hemisphere, and emotion appear in Table 2.

TABLE 2
Emotion recognition accuracy across culture of judge, culture of expressor, facial hemisphere, and emotion (unbiased hit rate)

	Photographs								
	Left facial hemisphere				*Right facial hemisphere*				*Total*
	India	*Japan*	*US*	*Total*	*India*	*Japan*	*US*	*Total*	
Indian judges									
Afraid	0.444	0.236	0.554	0.411	0.376	0.177	0.657	0.403	*0.407*
Angry	0.754	0.411	0.432	0.533	0.596	0.328	0.675	0.533	*0.533*
Disgusted	0.861	1.052	0.384	0.766	0.663	0.965	0.788	0.805	*0.786*
Happy	0.957	0.732	1.366	1.018	1.033	0.760	1.495	1.096	*1.057*
Neutral	0.749	0.463	1.042	0.752	0.744	0.423	1.109	0.759	*0.755*
Sad	0.607	0.179	0.415	0.400	0.400	0.242	0.466	0.369	*0.385*
Surprised	0.322	0.210	0.907	0.480	0.409	0.311	0.902	0.541	*0.510*
Total	*0.671*	*0.469*	*0.729*	*0.623*	*0.603*	*0.458*	*0.871*	*0.644*	0.633
Japanese judges									
Afraid	0.292	0.131	0.519	0.314	0.192	0.146	0.604	0.314	*0.314*
Angry	0.277	0.391	0.250	0.306	0.301	0.234	0.278	0.271	*0.288*
Disgusted	0.268	0.635	0.092	0.332	0.187	0.712	0.172	0.357	*0.344*
Happy	0.899	0.982	1.491	1.124	1.092	0.758	1.466	1.105	*1.115*
Neutral	0.638	0.412	1.160	0.737	0.797	0.370	1.148	0.772	*0.754*
Sad	0.541	0.389	0.908	0.613	0.323	0.544	0.971	0.613	*0.613*
Surprised	0.188	0.135	0.853	0.932	0.274	0.128	0.930	0.444	*0.418*
Total	*0.433*	*0.439*	*0.754*	*0.545*	*0.452*	*0.413*	*0.796*	*0.554*	0.550
US judges									
Afraid	0.373	0.334	0.732	0.480	0.276	0.213	0.701	0.396	*0.438*
Angry	0.559	0.403	0.501	0.488	0.503	0.362	0.585	0.483	*0.485*
Disgusted	0.614	0.953	0.236	0.601	0.665	0.957	0.517	0.713	*0.657*
Happy	0.918	1.011	1.439	1.122	1.111	0.918	1.460	1.163	*1.143*
Neutral	0.570	0.383	1.102	0.685	0.646	0.360	1.054	0.687	*0.686*
Sad	0.308	0.240	0.563	0.370	0.260	0.341	0.730	0.444	*0.407*
Surprised	0.299	0.158	1.128	0.529	0.441	0.287	0.905	0.544	*0.536*
Total	*0.520*	*0.497*	*0.814*	*0.611*	*0.557*	*0.491*	*0.850*	*0.633*	0.622
Total	*0.545*	*0.469*	*0.766*	*0.593*	*0.538*	*0.454*	*0.839*	*0.610*	0.602

Note: Values above represent unbiased hit rate accuracy coefficients (Wagner, 1993).

Results were analysed using a 3 (expressor culture) × 3 (perceiver culture) × 2 (hemifacial composite) × 7 (emotion) ANOVA. For reference, we begin by reporting results for terms in the ANOVA that are not the subject of the hypothesis of the study. There was no significant difference in accuracy across the two hemifacial composites, $F(1, 147) = 2.33$, $p = .13$, $r = .12$. Accuracy varied across judge cultures, $F(2, 147) = 3.87$, $p < .03$, $eta = .22$. Tukey post-hoc tests revealed that Japanese perceivers scored lower than Indian or US perceivers. Accuracy varied across expressor cultures, $F(2, 294) = 216.42$, $p < .01$, *eta* = .77. Tukey post-hoc tests revealed that American photographs were more accurately understood than Indian photographs, which were more accurately understood than Japanese photographs. Note that this effect does not necessarily reflect cultural differences, given the methodological differences described above in the development of the stimulus materials. The interaction between hemifacial composite and expressor culture was significant, $F(2, 294) = 6.21$, $p < .01$, *eta* = .20, indicating that pancultural agreement about the recognition levels of the three expressor cultural groups was greater for right than for left hemifacial composites. The extent to which this was the case varied across emotions (emotion × hemisphere × expressor culture interaction, $F(12, 1764) = 6.83$, $p < .001$, *eta* = .21). There was no interaction between hemifacial composite and judge culture, $F(2, 147) = 0.15$, $p = .86$, *eta* = .05.

Overall accuracy differed across emotions, $F(6, 882) = 235.93$, $p < .01$, *eta* = .78, such that happiness and neutrality were judged the most accurately, and fear and anger the least. Consistent with past findings of cultural differences in the emotions judged and expressed most accurately (e.g., Elfenbein et al., 2002), there were significant interactions of emotion × judge culture, $F(12, 882) = 17.02$, $p < .01$, *eta* = .43, and emotion × expressor culture, $F(12, 1764) = 105.00$, $p < .01$, *eta* = .65. Consistent with past findings that the in-group advantage varies in size across emotions (e.g., Elfenbein & Ambady, 2002a), there was a significant emotion × judge culture × expressor culture interaction, $F(24, 1764) = 3.21$, $p < .01$, *eta* = .20. Interactions were not significant for emotion × hemisphere, $F(6, 882) = 1.51$, $p = .17$, *eta* = .10, or emotion × hemisphere × judge culture, $F(12, 882) = 0.89$, $p = .56$, *eta* = .11.

Supporting the presence of an in-group advantage, there was an interaction between judge and expressor cultures, $F(4, 294) = 5.40$, $p < .01$, *eta* = .26. The in-group advantage is calculated using this interaction term along with contrast weights of *lambda* = +2 for in-group judgements and *lambda* = −1 for out-group judgements, as per the prediction that residuals show higher accuracy for judging members of one's own cultural group. The value of ''r_{alerting}'' (Rosenthal & Rosnow, 1991), the correlation between these contrast weights and the interaction residuals was .66, indicating a good fit for the predicted contrast. The contrast was significant, $F(1, 294) = 9.33$, $p < .01$, $r = .18$, indicating an overall in-group advantage.

The hypothesis of the present article is that the in-group advantage in emotion is larger for left hemifacial composite expressions than for right hemifacial composite expressions. An omnibus test providing initial support of this hypothesis showed a significant interaction among hemifacial composite, judge culture, and expressor culture, $F(4, 294) = 2.79$, $p < .03$, *eta* = .19. Conducting separate analyses of variance for each facial hemisphere, for left hemisphere facial expressions the interaction between judge culture and expressor culture,

$F(4, 294) = 7.54$, $p < .01$, $eta = .31$, and the in-group advantage contrast, $r_{\text{alerting}} = .69$, $F(1, 294) = 14.55$, $p < .01$, $r = .22$, were highly significant. However, for right hemifacial expressions, these values showed the same trends but did not reach conventional significance levels for the overall interaction, $F(4, 294) = 2.13$, $p < .08$, $eta = .17$, and was not significant for the in-group advantage contrast, $r_{\text{alerting}} = .43$, $F(1, 294) = 1.57$, $p = .21$, $r = .07$.

The hypothesis of the current study is that the size of the in-group advantage is larger for left versus right hemifacial expressions, and the test of this difference uses contrast weights consisting of the lambda values for the in-group advantage multiplied by +1 for left hemifacial composites and -1 for right hemifacial composites. This contrast is significant ($r_{\text{alerting}} = .68$, $F(1, 294) = 5.22$, $p < .03$, $r = .13$), providing evidence that the left hemiface is associated with a greater degree of in-group advantage. Table 3 illustrates this interaction by displaying the residual values after subtracting all main effects and lower-order interactions for expressor culture, perceiver culture, and hemifacial composite (Rosenthal & Rosnow, 1991; Rosnow & Rosenthal, 1995). Thus, this table allows an examination of the differences in in-group advantage across left and right hemifacial composites, not confounded by possible cultural differences in emotion recognition accuracy or expressive clarity. The planned contrast predicted that, for left hemifacial composites, the residuals for diagonal cells—representing in-group judgements—would be positive and the off-diagonal cells—representing out-group judgements—would be negative, with the

TABLE 3
Interaction of emotion recognition accuracy across culture of judge, culture of expressor, and hemifacial composite (unbiased hit rate)

Perceiver	*Expressor*		
	India	*Japan*	*US*
Left hemifacial composite			
India	*.032*	.000	(.032)
Japan	(.012)	*.001*	.011
US	(.020)	(.002)	*.021*
Right hemifacial composite			
India	*(.032)*	(.000)	.032
Japan	.012	*(.001)*	(.011)
US	.020	.002	*(.021)*

Note: Numbers in italic indicate judgements of members of the same cultural group; Parenthesis indicate negative values.

opposite pattern for right hemifacial composites. Fourteen of the 18 residuals listed in Table 3 are consistent with this predicted contrast.

Because the interaction among emotion, hemifacial composite, judge culture, and expressor culture was not significant, $F(24, 1769) = 1.27$, $p = .17$, $eta = .13$, this larger extent of in-group advantage for left over right hemifacial composites does not appear to differ across emotions.

DISCUSSION

These results demonstrate that judgement of the left hemisphere of facial expressions shows a greater extent of cultural in-group advantage than judgement of the right hemisphere of facial expressions. Thus, it is the first study to connect the in-group advantage in emotion recognition to subtle differences in facial expressions, as recently speculated without direct empirical evidence (e.g., Elfenbein & Ambady, 2002a, 2002b). The design of this study held constant various factors other than the facial hemisphere, which suggests that the difference found in judgements did not result from ethnic bias against out-group members, other attributes of judges, such as their relative skill levels and possible use of decoding rules, translation difficulties, ability to speak multiple languages, or any differences across the posers of the emotional expressions.

Interestingly, there was no main effect for the accuracy of recognising right versus left hemifacial composites. That is, expressions using the left hemisphere were not universally more clear or easily recognised, but rather they were only relatively more recognisable to members of their own cultural in-group. In fact, the interaction of hemifacial composite and expressor culture suggests that the pancultural clarity of expressions actually had more agreement for right than for left hemifacial composites. This evidence suggests that the left facial hemisphere uses an expressive style that is less universal and more culturally specific than that of the right facial hemisphere. Future research should test this proposition directly, for example, using coding systems, such as Ekman and Friesen's (1978) Facial Affect Coding System (FACS), and a larger collection of facial photographs.

Important concerns limit the findings of the present study. First, the methods of creating stimuli varied. Although all were matched across age, gender, and other attributes, the Indians and Japanese attempted to pose emotions whereas those from the United States posed specific muscle movements. Posing likely accounts for more intense photographs and therefore higher recognition rates of the US photographs. However, the method of creating stimuli was one of many factors that remained constant when evaluating the primary hypothesis of the study, regarding whether the in-group advantage differed across judgements of hemifacial composites. Nonetheless, as illustrated by the large main effect in accuracy across expressor cultural groups, these photograph sets are not directly comparable to each other. There were also some differences across the participant groups serving as judges in the study. Although all were matched for gender, age, as well as education level, they differed in their religious backgrounds, native languages, whether or not they were multilingual, and the level of prestige of their university. As with the method of creating stimuli, these differences across judges were also factors remaining constant when evaluating the primary hypothesis of the study in terms of an interaction effect. Further, the current study used only symmetrical composites of the left and right hemifaces. Future research should additionally include the asymmetrical normal and mirror-reversed orientations of the original photographs, in order to balance for visual field asymmetry.[2] Like much research on emotion recognition, the present study also examined the skill of emotion recognition outside of its social and functional context, using static, posed black-and-white photographs that do not capture the dynamic, full-colour, full-channel nature of natural emotional expression.

Making the connection between subtle differences in emotional expressions and resulting cultural differences in judgements is an important step in research on emotion recognition across cultures. However, this should be followed by work specifying in greater detail the particular elements of expressive style that vary across cultures, and linking these variations to the emotion recognition process. The current study represents one step towards expanding the empirical basis for theory that can integrate evidence for differences in emotional communication across cultures.

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