Threat advantage: Perception of angry and happy dynamic faces across cultures

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The current study tested whether the perception of angry faces is cross-culturally privileged over that of happy faces, by comparing perception of the offset of emotion in a dynamic flow of expressions. Thirty Chinese and 30 European-American participants saw movies that morphed an anger expression into a happy expression of the same stimulus person, or vice versa. Participants were asked to stop the movie at the point where they ceased seeing the initial emotion. As expected, participants cross-culturally continued to perceive anger longer than happiness. Moreover, anger was perceived longer in in-group than in out-group faces. The effects were driven by female rather than male targets. Results are discussed with reference to the important role of context in emotion perception.

Keywords: Threat advantage; Cross-cultural emotions; Need to belong; Gender differences; Dynamic stimuli.

The emotions of other people may contain important information. This is particularly the case when those emotions signal threat, as is the case for anger. Not surprisingly, then, there is evidence that anger expressions tend to be salient among other types of facial information.

For instance, studies on the “face-in-the-crowd effect” have shown that participants more readily identified an angry face shown among happy faces than vice versa (Hansen & Hansen, 1988; see also Gilboa-Schechtman, Foa, & Amir, 1999; Pinkham, Griffin, Baron, Sasson, & Gur, 2010). This has led the authors to conclude that angry faces pop out of a crowd. Consistently, Schupp and colleagues (2004) showed higher brain activity in individuals who were exposed to pictures of angry
faces, as opposed to friendly or neutral ones, which they interpreted as a sign of enhanced perceptual processing.

However, not all research has yielded support for the idea that angry faces are more readily perceived. For example, in the paradigmatic facial recognition studies (e.g., Ekman, 1982), happiness has been identified at higher rates than any other negative emotion, including anger. The possibility of a threat advantage, then, remains to be further explored: Recognition of anger is not consistently privileged over that of other emotional expressions.

The current study started from the idea that the perception of threat stimuli, such as anger expressions, is generally privileged over that of other, safe stimuli, such as happy faces. Previous studies have focused on a difference in the first detection, or onset, of threatening as opposed to non-threatening stimuli. The current study was concerned with the offset of threatening cues; it tested the idea that anger expressions may be so salient that they will be perceived longer than non-threatening expressions when fading.

Out-group versus in-group threat

It has been suggested that angry faces are more readily recognised because they signal threats of predators or competitors, and are thus essential for survival (Ohman, Flykt, & Esteves, 2001). Indeed, from an evolutionary point of view, people universally have had to be sensitive to the threats of predators from which they needed to defend themselves or with whom they needed to compete for food (Barrett, 2005). This could be one of the reasons for a sensitive detection system for threatening stimuli.

Yet, anger signals not only come from predators and competitors, but also from in-group members. In fact, anger experiences tend to be reported more often in the context of relationships with known people rather than with strangers (e.g., Babad & Wallbott, 1986). Anger expressions from in-group members would signal another type of threat that is equally critical for survival, namely potential social exclusion. Social exclusion deprives human beings of the protection and resources associated with group life (Baumeister & Leary, 1995). The sensitivity to signals of social exclusion may, therefore, have constituted an evolutionary advantage as well.

If anger is primarily a signal of social threat, the sensitivity to anger expressions might be higher when it is perceived in in-group rather than in out-group members. Applied to the case of anger offset, it may be expected that an angry expression would hold attention, particularly when it is expressed by an in-group face. On the other hand, if anger were primarily a signal of physical threat, it could be predicted to hold attention regardless of whether it is displayed by an in-group or an out-group member.

A new way to test perceptual sensitivity to angry faces

Most research on threat advantage has made use of still pictures of actors posing emotion expressions. Yet, emotional encounters in everyday life are dynamic, ongoing processes (Marinetti, Moore, Lucas, & Parkinson, 2011; Mesquita, 2010). Consistently, compared to static or slow-moving expressions, dynamic facial expressions have been judged as more naturalistic (Sato & Yoshikawa, 2004). Moreover, brain regions concerned with the processing of facial affect show greater responses to dynamic than static emotional expressions (LaBar, Crupain, Voyvodic, & McCarthy, 2003). The employment of dynamic, rather than static, stimuli in emotion research would be, therefore, more ecologically valid.

Furthermore, static images lack valuable information on the possible direction in which an emotion signal may develop (cf. Hugenberg & Bodenhausen, 2003). They fail to provide the context cues that make it possible to infer if the person displaying anger is starting to calm down, or, on the contrary, if the anger is going to increase, thus augmenting the chances of an attack. Naturally, this type of information may greatly affect the perception of, and attention to, a specific stimulus.
In the current study we tested a specific aspect of threat advantage, namely the power of threat signals to sustain attention. We used morphing movies depicting faces that changed from a threatening to a non-threatening emotion and vice versa. In particular, we examined how long it took until anger and happiness ceased to be recognised in a dynamic flow of emotional expressions. This methodology allowed us to test the perception of a “dynamic facial event which preserved the natural and complex elements of a changing facial display in a nevertheless controlled procedure” (Niedenthal, Halberstadt, Margolin, & Innes-Ker, 2000, p. 219).

**Study overview and hypotheses**

The aim of this study was to assess whether anger expressions would cross-culturally be seen longer than happiness expressions. In particular, Chinese and European-American participants were exposed to short movies depicting a person whose face gradually changed from expressing happiness to expressing anger, and vice versa. Participants were asked to press a stop button the moment they ceased to see the original emotion. The frame number at which the movie was stopped was recorded and used as the dependent variable in subsequent data analyses.

Our main prediction concerned the perceptual advantage of anger expressions. We expected anger expressions to be cross-culturally more salient than happiness expressions, and predicted that, across cultures, participants would continue seeing fading expressions of anger longer than fading expressions of happiness.

Furthermore, we explored the effect of the group identity of the poser. On one hand, if angry expressions are signals of physical threat, we would expect anger expressions to be more salient than happiness expressions, regardless of the group identity of the poser. On the other hand, when anger primarily signals the risk of social exclusion, the perception of anger would be most privileged when it is displayed by a member of the in-group. In sum, a secondary aim of this study was to explore how the group identity of the poser differentially affects threat advantage.

A final goal of the research was to explore gender differences in the perception of threatening and non-threatening expressions.

**METHOD**

In this study, a 2 (Participant Culture: Chinese vs. European American) × 2 (Initial Emotion Expressed: anger vs. happiness) × 2 (Target Group Identity: Asian vs. Caucasian) × 2 (Target Gender: female vs. male) mixed design was employed; participant’s culture was a between-participants factor, and the other three within-participants factors.

**Participants**

Participants were 30 Chinese students (15 males and 15 females; average age = 20.23 years, $SD = 1.43$) at the Hong Kong University of Science and Technology and 30 European-American students (16 males and 14 females; average age = 18.97 years, $SD = 0.96$) at Wake Forest University in the United States. Both Chinese and European-American students received credit towards their introductory psychology course requirement.

**Materials**

Two sets of emotional facial displays were selected from The Montreal Set of Facial Display of Emotion (MSDFE; Beaupré, Cheung, & Hess, 2000) to be used as visual stimuli. The first set, that was used in the trial session, included two female faces (Asian and Caucasian) and two male faces (Asian and Caucasian), all posing a neutral expression. For the experimental phase, a second set of stimuli was selected that contained faces displaying happiness and anger from one Asian male, one Asian female, one Caucasian male, and one Caucasian female (see Figure 1).

Facial stimuli were digitally morphed using Abrosoft Fantamorph 3 to create 200-frame movies. For the trial session, a movie was prepared
in which a face morphed from female to male, and vice versa. For the experimental phase, the movies showed either a face initially expressing happiness that gradually morphed into the same face expressing anger, or a face initially expressing anger that gradually morphed into the same face expressing happiness. This design was chosen over a movie that changed from an emotional to a neutral face, because of a potential bias towards judging neutral faces as negative (see Arce et al., 2009).

The morphing movies obtained were 13.33 seconds in duration at 15 frames per second, and were displayed at a size of 800 x 560 pixels. The resulting clip showed a natural looking, dynamically moving face. The order of the eight morphing movies was counterbalanced.

Procedure

Each participant reported to a lab room where they were seated in front of an R52 IMB Thinkpad. After participants had read and signed an informed consent document, the experimenter gave them verbal instructions.

First, participants viewed the trial series of gender-morphing movies. Participants viewed each morphing movie twice. The first time, participants saw the whole morphing movie in order to become familiarised with the full range of facial movements. The second time, participants were instructed to press the stop button to indicate the moment at which they no longer saw traces of the original gender.

Once the trial phase was over, participants viewed a second series of morphing movies, this time showing faces morphed from one emotion (i.e., either anger or happiness) to the other (i.e., either happiness or anger). Again, participants viewed each emotion-morphing movie twice. The first time, participants viewed the full morphing movie. The second time, participants were instructed to press the stop button to indicate the moment at which they no longer saw traces of the original emotional expression. The frame number at which the morphing movie was stopped was recorded. Participants were then asked to rate the degree of anger and happiness expressed in this frame (0 = not at all; 100 = extremely).

Finally, participants completed a brief demographic questionnaire asking for gender, age, ethnicity and college grade, after which they were thoroughly debriefed about the purpose and procedures of the study.

RESULTS

Manipulation check

We checked that the movies were stopped at a frame where the intensity of the initial emotion
was lower than the intensity of the final emotion, by performing a $2 \times 2 \times 2$ (Participant Culture) $\times$ (Initial Emotion Expressed) $\times$ (Target Group Identity) $\times$ (Target Gender) mixed ANOVA. A main effect of Initial Emotion suggested that, indeed, happiness ratings were lower for movies morphing from happiness to anger ($M = 20.29, SD = 19.57$) than for movies morphing from anger to happiness ($M = 68.29, SD = 20.56$); $F(1, 58) = 172.98, \ p < .001, \ \eta^2_p = .75$. Conversely, lower levels of anger were perceived in the frame the movie was stopped, when it morphed from anger to happiness ($M = 19.88, SD = 22.82$) than vice versa ($M = 68.96, SD = 24.56$); $F(1, 58) = 185.71, \ p < .001, \ \eta^2_p = .76$. Taken together, these results show that the meaning of the frame at which the movies were stopped was as expected.  

### Ceasing to see the target emotion

Our main prediction was that cross-culturally there would be a perceptual advantage for angry faces over happy faces. Thus, it was expected that both Americans and Chinese would cease seeing anger later than happiness. In order to test this, a $2 \times 2 \times 2$ (Participant Culture) $\times$ (Initial Emotion Expressed) $\times$ (Target Group Identity) $\times$ (Target Gender) mixed ANOVA was conducted, with participants’ culture as between-participants factor and repeated measures on the last three, within-participants factors. The dependent variable was frame count. A graphical representation of mean ratings for this dependent variable is shown in Figure 2. The higher the value, the higher is the frame at which the participants stopped the movie, and thus the longer participants saw the initial emotion. A main effect of Initial Emotion, $F(1, 58) = 13.65, \ p < .001, \ \eta^2_p = .19$, provided support for our first prediction. In most cases, fading anger was cross-culturally perceived longer than fading happiness; exceptions will be discussed.

Moreover, a three-way interaction between Culture, Target Group Identity, and Initial Emotion, $F(1, 58) = 11.60, \ p = .001, \ \eta^2_p = .17$, showed that both Americans and Chinese tended to see fading anger expressions longer when displayed on an in-group than an out-group face. The pattern for happiness was different: Both groups perceived this emotion longer on Asian than on Caucasian faces.

The results were further qualified by a four-way interaction between all factors, $F(1, 58) = 7.63, \ p = .008, \ \eta^2_p = .12$. Pairwise comparisons showed that both the main effect of Initial Emotion and the interaction effect of Culture, Target Group Identity, and Initial Emotion on frame count were driven by the female targets. In particular, compared to Chinese participants, American participants continued to perceive fading anger expressions longer on Caucasian females, $F(1, 58) = 4.71, \ p = .034, \ \eta^2_p = .08$, but compared to American participants, Chinese participants continued to perceive anger expressed by Asian females longer, $F(1, 58) = 17.29, \ p < .001, \ \eta^2_p = .23$. Thus, consistent with the idea that anger signals the threat of social exclusion, fading anger on a female face was

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1The main effect of target emotion was qualified by an interaction with participant’s culture, $F(1, 58) = 5.64, \ p = .021, \ \eta^2_p = .09$ for attributed happiness and $F(1, 58) = 7.51, \ p = .008, \ \eta^2_p = .12$ for attributed anger. When the initial emotion was happiness, Chinese attributed more happiness to the face at which the movie was stopped ($M = 27.50, SD = 20.61$ vs. $M = 13.08, SD = 15.03$), $F(1, 58) = 13.69, \ p < .001, \ \eta^2_p = .19$, and less anger ($M = 61.48, SD = 22.55$ vs. $M = 76.45, SD = 21.21$), $F(1, 58) = 10.12, \ p = .002, \ \eta^2_p = .15$, than Americans. Moreover, the difference in happiness and anger ratings in the happy to anger and the angry to happy conditions respectively were larger for Americans, $F(1, 58) = 120.50, \ p < .001, \ \eta^2_p = .68$ for attributed happiness and $F(1, 58) = 134.01, \ p < .001, \ \eta^2_p = .70$ for attributed anger, than for Chinese, $F(1, 58) = 58.07, \ p < .001, \ \eta^2_p = .50$ for attributed happiness and $F(1, 58) = 59.29, \ p < .001, \ \eta^2_p = .51$ for attributed anger. This finding possibly reflects a larger tolerance for ambiguity among Chinese, and a tendency for categorisation in the American group (e.g., Peng & Nisbett, 1999). These cultural differences in intensity ratings did not affect the results described in the next section.

2Participants’ gender was initially included as a between-participants factor. Since gender differences were unsystematic and fewer than could have been expected by chance ($p < .05$), we will not report the participant gender results.
perceived longer by in-group than out-group members. Also consistent with this idea was the finding that both participant groups saw anger longer on in-group than on out-group female faces, $F(1, 58) = 22.72, p < .001, \eta_p^2 = .28$ for Americans and $F(1, 58) = 24.32, p < .001, \eta_p^2 = .30$ for Chinese. The pattern for happiness was very different: Both Chinese, $F(1, 58) = 28.55, p < .001, \eta_p^2 = .33$, and Americans, $F(1, 58) = 11.94, p = .001, \eta_p^2 = .17$, saw fading happiness longer on Asian than on Caucasian female faces.

There were a number of interaction effects, such that, consistent with our first hypothesis that the perception of fading anger would be privileged over the perception of fading happiness, Chinese showed the expected pattern of seeing anger longer than happiness on female faces,
Asian faces, and Americans saw anger longer than happiness on Caucasian female clips, \( F(1, 58) = 23.51, p < .001, \eta^2_p = .29 \). Contrary to our hypothesis, however, Chinese did not see fading anger longer than fading happiness on male faces, and Americans saw happiness even longer than anger on female Asian faces, \( F(1, 58) = 5.18, p = .027, \eta^2_p = .08 \).

The patterns of results for male targets were in the same direction as those for female targets, but they did not reach significance. The only exception occurred for American participants, who continued to perceive fading anger longer than fading happiness in both Caucasian female and Caucasian male faces, \( F(1, 58) = 4.83, p = .032, \eta^2_p = .08 \).

Finally, a comparison of target’s gender revealed that Americans tended to see anger longer on female than on male Caucasian faces, \( F(1, 58) = 3.82, p = .056, \eta^2_p = .06 \), while they saw anger longer on male than on female Asian faces, \( F(1, 58) = 6.98, p = .011, \eta^2_p = .11 \). Chinese, on the other hand, saw happiness longer on male than on female Caucasian faces, \( F(1, 58) = 6.06, p = .017, \eta^2_p = .10 \), and on female than on male Asian faces, \( F(1, 58) = 4.56, p = .037, \eta^2_p = .07 \). Also, Chinese perceived anger longer on female than on male targets only when the poser was an in-group member, \( F(1, 58) = 26.42, p < .001, \eta^2_p = .31 \).

### DISCUSSION AND CONCLUSIONS

The main finding of this study was that participants, cross-culturally, tended to see anger longer than happiness. This finding might point to the relative importance of continued attention for threat. Moreover, people showed an in-group advantage, such that fading anger was perceived longer on in-group than on out-group faces.

Interestingly, these findings were strongly affected by the gender of the target face. Indeed, only in the case of American participants judging Caucasian faces, there was a threat advantage for male targets (i.e., did the attention for anger continue longer than for happiness). Moreover, the in-group advantage for anger (i.e., the fact that anger was seen longer on in-group than on out-group faces) was found for female target faces only. These target-gender effects could be explained by the fact that the female targets may be more expressive and less ambiguous in their expressions than men (e.g., Lang, Greenwald, Bradley, & Hamm, 1993). Another interesting finding in this study is that the anger advantage does not apply when American participants judge Asian faces. On the contrary, Americans ceased to see anger earlier than they did happiness on female Asian targets. Though we cannot be sure of the reason for this result, it is consistent with the American stereotype of the Chinese as being rather quiet and courteous (Madon et al., 2001). Preconceived notions of the characteristics of the out-group may thus attenuate the threat advantage. Finally, it cannot be ruled out that morphological differences of the out-group affect whether or not an in-group advantage can be found (cf. Richeson, Dovidio, Shelton, & Hebl, 2007).

Overall, this study suggests that threat advantage may not only apply to the first perception (cf. Öhman et al., 2001), but also to the offset of emotions. This is understandable from the idea that it is equally risky to mistakenly cease seeing an aggressive intention than to not perceive one in the first place. The fact that fading anger is generally better perceived in in-group than in out-group members also implies that the type of threat represented by angry faces may be social rather than purely physical: Anger expressions may convey potential exclusion from the group to which one belongs. It is important for future research, then, to focus on the moderating influence of the types of groups compared (e.g., ethnicity, quantity of contact, stereotype), and of the type of threat salient in different contexts (i.e., threat to the need to belong vs. immediate physical threat) on emotion perception.

Finally, the use of more ecological, dynamic emotion stimuli has led to results that would have been impossible to obtain with static stimuli. In a dynamically changing movie of faces, earlier faces...
appear to provide the perceptual context for the current face. In fact, people cross-culturally stopped the movie past its midpoint, meaning that very ambiguous faces were assimilated to earlier movie frames. Naturally, a full understanding of the perceptive qualities of dynamic threat stimuli will require further research.

In conclusion, the study suggests that angry faces may signal social in addition to physical threats. The implication is that emotional expressions are always imbued with social meaning, and thus informed by the social connotations of the face, whether in-group or out-group, male or female. The results are consistent with the view that emotion perception is always contextualised by situational cues (cf. Barrett, Mesquita, & Gendron, 2011); in this case cues about the identity of the sender.

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