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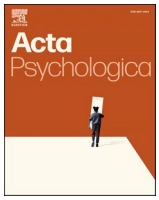

How head posture affects perceived cooperativeness: A cross-cultural perspective

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ABSTRACT

Previous research has tested whether culture moderates the relationship between head tilt and perceptions of a cooperation-relevant construct. In this paper, we replicated the effects of head posture on perceived traits and compared Chinese and American participants to explore whether difference in cultural background (collectivist and individualist) affects perceptual attribution. Specifically, we investigated how head posture (level, up or down) affects perceptions of cooperativeness. In Experiment 1, Chinese and American participants rated Asian and Caucasian faces in three postures for perceived cooperativeness on a seven-point Likert scale. In Experiment 2, participants ranked the cooperativeness of the three postures of the same faces. In Experiment 3, participants scrolled through face images and manually manipulated vertical head angle to maximise apparent cooperativeness. We found that for both Chinese and American participants a neutral head level posture was perceived as more cooperative than head up and down postures. The optimal head posture for maximised apparent cooperativeness was close to level but with a slight downward rotation. While there was cross-cultural consistency in perceptions, Chinese participants exhibited greater sensitivity to postural cues in their judgments of cooperation compared to American participants. Our results suggest a profound effect of posture on the perception of cooperativeness that is common across cultures and that there are additional subtle cross-cultural differences in the cues to cooperativeness.

1. Introduction

Many cultures share beliefs about the human face being a window to a person's character. People frequently make personality judgments based on a stranger's facial cues, such as whether he or she is trustworthy or cooperative, despite the limited evidence of validity of judgments. Previous studies have shown the possible existence of facial traits used in detecting cooperativeness (Brown et al., 2003; Mehu, Grammer, & Dunbar, 2007). It indicates that clues to the propensity to cooperate may exist. This point of view—the possible existence of cooperative propensity clues—is consistent with some theories of cooperativeness. For example, the cooperative altruism hypothesis assumes the tendency of people to prefer more cooperative social partners (Roberts, 1998). Indeed as a species, humans are highly cooperative and, unlike other species, cooperation is not restricted to relatives (Boyd & Richerson, 2009). Yet, given that not all humans are benevolent all of the time, there is a great need for us to evaluate the behaviour of others in terms of fairness in order to differentiate altruists from egoists. Equally there is a need for humans to be tuned to (or to learn to recognise) any physical clue (including facial cues) that predicts behaviour and can therefore help identify who is a cooperator and who is not (Tognetti et al., 2013).

Emotional expressivity and facial structure seem to be the important traits contributing to the detection of cooperativeness. Studies have indicated that cooperators show a larger number of facial expressions of positive emotion than non-cooperators (Mehu, Little, & Dunbar, 2007; Reed et al., 2012). Particularly, genuine (Duchenne) smiles, which are related to the contraction of the orbicularis occuli muscles, can be seen more on the faces of cooperators than on those of non-cooperators (Oda et al., 2009). In addition, cooperativeness-relevant judgments of faces are linked to the structure of particular facial features, such as facial width. Facial width-to-height ratio (fWHR) is related to bone structure, and is measured as the width of the face from left to right zygomatic arch divided by mid-face height (Carré & McCormick, 2008). Many studies have shown that males with high fWHRs are perceived to have negative

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traits, such as aggressiveness (Geniole et al., 2012), untrustworthiness (Stirrat & Perrett, 2010) and racial prejudice (Hehman, Leitner, Deegan, & Gaertner, 2013). Compared to people with narrow faces, individuals with wide faces are more likely to have deceptive (Geniole et al., 2014; Haselhuhn & Wong, 2012) and less interpersonally cooperative behaviour (Haselhuhn et al., 2014), although they might be more cooperative with members of their own group in the context of competition with other groups (Stirrat & Perrett, 2012).

Both facial expressions of emotion and apparent fWHR, however, are likely to associate with head posture. For example, down-tilted faces have been related to such emotions as sadness (Ekman & Friesen, 1976), shame (Ekman & Oster, 1979; Keltner & Harker, 1998) and embarrassment (Keltner & Anderson, 2000). Conversely, up-tilted faces have been linked to such emotions as pride (Wallbott, 1998) and contempt (Rosenberg & Ekman, 1995). In addition, there are two aspects of fWHR, one is the three-dimensional bone structure of the head and is unrelated to head posture (Weston et al., 2007); the second is apparent fWHR (Hehman, Leitner, & Gaertner, 2013), which is affected by head posture (Kramer, 2016). For example, when individuals rotate their heads up and down, the perceived upper facial height will change while the perceived bizygomatic width is likely to remain the same; the perceived fWHR, therefore, will be enhanced (see Fig. 1). Given that human perception of two-dimensional facial images does not allow full appreciation of the three-dimensional structure of faces, perception of facial structure, including width-to-height ratio, can be biased by head tilt such that the structural width ratio is misinterpreted as increasing as the head is rotated up or down relative to the neutral posture. Hence postural change induces a spectrum of changes in appearance including facial expression and apparent structure. Each change is likely to impact on the attribution of cooperativeness.

Past research has tested whether culture moderates the relationship between head tilt and perceptions of a cooperation-relevant construct. Notably, Lyons et al. (2000) show that there is an effect of head tilt on perceptions of happiness, and that this effect inconsistently varies for Japanese versus British participants. Toscano et al. (2018) show slightly different effects than Lyons et al. (2000), however, this could be due to eye gaze. Head tilt has also been shown to be related to cross-cultural perceptions of facial traits such as dominance (Bente et al., 2010; Rule et al., 2010), attractiveness (Cunningham et al., 1995), facial maturity (McArthur & Berry, 1987), extraversion and agreeableness (Albright et al., 1997). In addition, some researchers have argued that children appear to have similar abilities in attributing cooperativeness across cultures (Nielsen & Haun, 2016). For example, young children across different cultures show highly similar performance in the completion of collaborative tasks (Callaghan et al., 2011). Since cooperation is needed by all during early life (Nowak, 2006), adults are likely to be in agreement cross-culturally as well. We, therefore, hypothesis that there is a high degree of agreement on perception of cues to cooperativeness between Asian and Western cultures.

Differences in cooperativeness are likely to arise from differences between collectivist and individualist cultures, which eastern and western countries, respectively, seem to view very differently. For example, Asians live in collective societies and are likely to emphasise group dynamics rather than individual prowess. This is reflected by the old Chinese saying, “xiān tiān xià zhī yōu ér yōu, hòu tiān xià zhī lè ér lè”, which can be translated as “the first concern is affairs of state, enjoying pleasure comes later”. The expression reflects both the sentiments of “putting own enjoyment in second place” and the sense of duty to the collective group or state. As the backbone of Chinese culture, Confucianism claims that people should make personal sacrifices for the group's benefits (Wilhelm, 2013). Chinese people, therefore, might be more cooperative compared to people in a more individualist culture, which might enhance their sensitivity of perceived cooperativeness. Yet one can also hypothesise the converse. If western society is indeed less cooperative, then western people might need to be more sensitive to cues to cooperation to avoid exploitation. Along these lines Stirrat and Perrett (2010) found that vulnerable women (low in social dominance) were particularly sensitive to the facial width cue to trustworthiness. We therefore adopt the non-directional hypothesis that there may be cross-cultural agreement on judgments but difference in cultural sensitivity regarding perceptions of cooperativeness.

1.1. Current study

We are interested in how head posture (level, up, or down) affects cross-cultural perception of cooperativeness. We examined (a) whether the perception of cooperativeness is linked to variations in posture, which is under voluntary control, and (b) whether the perception of variation in posture in terms of perceived cooperativeness is culturally specific. We also postulated that that there will be a high degree of cross-cultural agreement on perception of cooperativeness with changes in head posture between Asian and Western cultures but that the two cultures could be subtly distinct in judgments reflecting cultural differences in collectivism.

2. Methods

This research was given Ethical Approval through the ethical approval process of the University of St Andrews (PS12531) in the UK. Prior to participation, all participants provided an online consent form and consented to take part in the study. They were debriefed after taking part in the experiments.

Fig. 1. Illustration of the variation of facial width-to-height ratio (fWHR) with changes of head posture.

2.1. Experiment 1

2.1.1. Stimuli

Students (age 18–24, mean = 20.85, SD = 2.15 years) from the University of St Andrews were photographed with their heads in three different poses: neutral, up and down. Participants were instructed to hold their heads level, up or down and look at the centre of the camera lens with neutral expressions, hair pulled back, and no adornment. They were photographed under standardised lighting conditions with a fixed camera distance. These face photographs were delineated with 190 landmark points using Psychomorph, a digital software for face processing (Tiddeman et al., 2001) and aligned according to interpupillary distance (Rowland & Perrett, 1995). Photographs were resized and cropped to ensure equal proportions of neck and hair were displayed. Composite stimuli of three faces were then created (each averaging the shape, colour and local texture of three original faces) (Tiddeman et al., 2001), in each of the three different poses (see Fig. 1). This process resulted in a set of 144 images of 48 identities (12 of each sex and ethnicity) in three postures. In Experiment 1, we randomly used 72 images of 24 identities (six of each sex and ethnicity) (Fig. 2).

2.1.2. Participants and procedures

A total of 146 Chinese and American participants were recruited for the experiment. Amazon Mechanical Turk (Mturk) is a popular online American residential workforce provider, which allows rating results to be collected within hours, hence, we chose Mturk to collect the data from Americans. Previous research has shown that data collected by the use of MTurk were of good or better validity than data collected by the use of survey methods (Behrend et al., 2011). For Chinese evaluators, because there is no equivalent service to Mturk for online ratings, we used online advertisements to recruit participants who might be interested in this experiment providing them with an online experimental link.

Our study was restricted to comparing East Asian Chinese with white (Caucasian) Americans since ethnicity could be an important factor regarding cross-cultural studies. We therefore excluded all participants except white (Caucasians) from USA and East Asians from China across three experiments. After exclusions there were 65 East Asian Chinese (age 27.36 ± 6.45, mean ± SD; 31 male, 34 female) and 52 white Americans (age 40.65 ± 13.06, mean ± SD; 31 male, 21 female). The same participants were used across all three experiments to ensure the

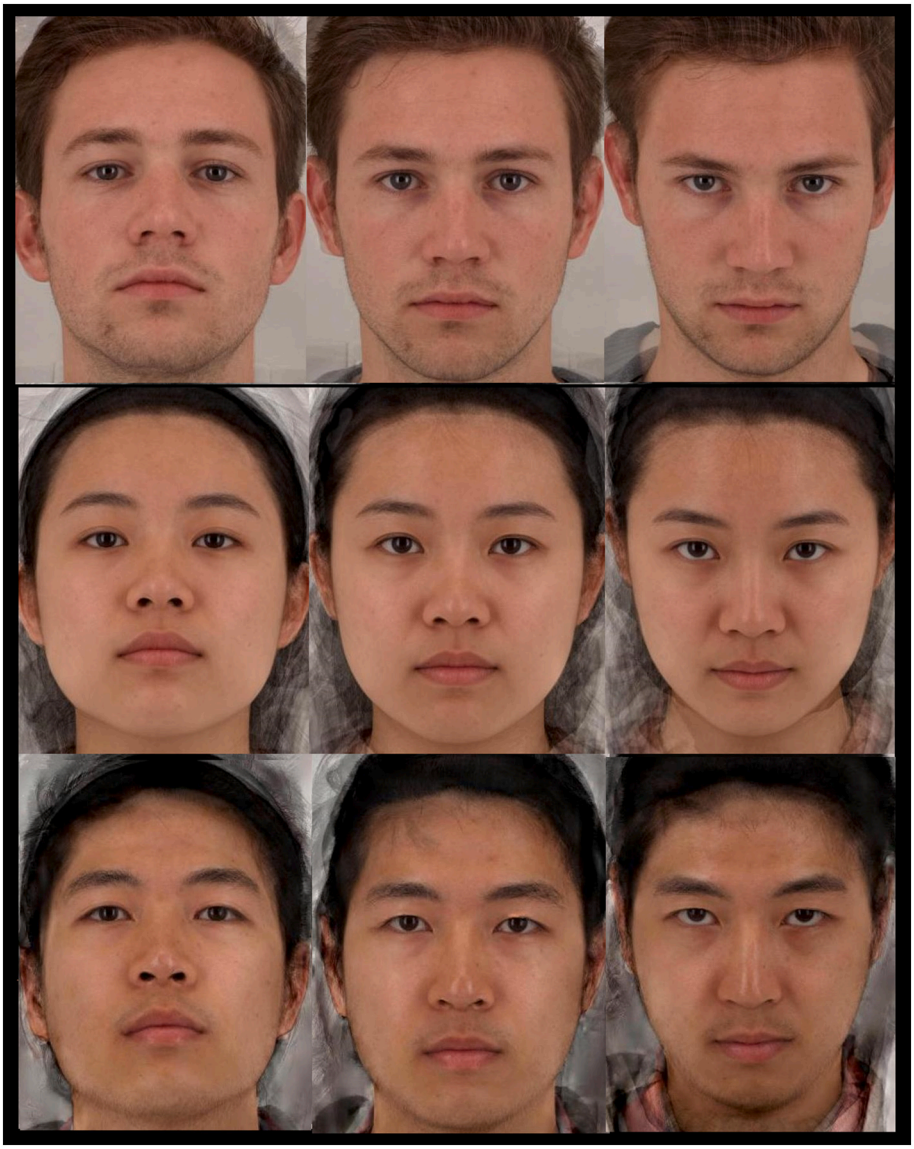

Fig. 2. Examples of stimuli used. Each line shows three images from left to right with up, level and down posture. The images on the first line are composite stimuli of three European male faces, the images on the second line are composite stimuli of three Asian females and the images on the third line are composite stimuli of three Asian males.

construct is being assessed across studies by the same participants.

US participants were recruited with payment by Mturk. Participants first reported their age, gender, country of birth, country of residence and ethnicity via a questionnaire. The set of stimuli for rating were 24 images (one third of the total test set but with no face identities repeated) with randomised allocation of different participants to different thirds. Each participant saw in random order three postures (each with four Asians—two males, two females—and four Europeans—two males and two females). The stimuli were first presented and rated for perceived cooperativeness on a seven-point Likert scale with the endpoints of very low cooperativeness and very high cooperativeness. In the rating task, one image was randomly displayed each time, which could vary in posture: head up, or down or level. Once the face was rated, the next image would be displayed.

Chinese participants were recruited by online advertisements (in Chinese). Prior to participation, all participants were required to be East Asian Chinese and provided an online form with their race information. All Chinese participants were instructed to rate cooperativeness using exactly the same stimuli and procedure; the only difference was that the Chinese translated version of the online experiment was used.

2.1.3. Analysis

A repeated measures ANOVA [(between subjects factors: participant culture (American vs Chinese); within subjects factors: face ethnicity (Caucasian and Asian faces) and posture (three levels: head-up, neutral and head-down), dependent variable: ratings averaged across 12 faces (six identities and two sexes of face)] was used to test the effects of posture and whether Chinese and Americans treat posture differently for own-ethnicity and other-ethnicity faces. Age of participants was not a variable of interest but was entered as a covariate to control for age differences between the Chinese and American samples. The data associated with this research are available as supplementary material.

2.1.4. Results

Posture was found to affect ratings of cooperativeness ($F(2, 208) = 6.011$, $p = 0.003$, *partial* $\eta^2 = 0.052$). Both head-down and head-up were rated less cooperative than the head-level posture (both Bonferroni corrected comparisons $p < 0.005$). The head-down posture was also rated as less cooperative than the head-up posture ($p < 0.005$, see Fig. 3). Participant culture (American vs Chinese) showed no impact on ratings ($F(1, 109) = 0.005$, $p = 0.942$, $\eta^2 < 0.001$). There was no interaction between participant culture and posture on cooperativeness ($F(2, 218) = 0.947$, $p = 0.389$, $\eta^2 = 0.009$). This suggests that Chinese and American ratings were affected equivalently by head posture.

Face culture (American vs Chinese) was not found to affect ratings of cooperativeness ($F(1,109) = 1.359$, $p = 0.246$, $\eta^2 = 0.012$). There was no interaction between ethnicity of face and posture on cooperativeness ratings ($F(2, 218) = 1.601$, $p = 0.204$, $\eta^2 = 0.014$). There was a non-significant trend for an interaction between ethnicity of face and participant culture ($F(1,109) = 3.582$, $p = 0.061$, $\eta^2 = 0.032$). This trend to interaction reflected higher cooperativeness ratings given to Caucasian faces, particularly by the Chinese evaluators. There was no interaction between ethnicity of face and posture on cooperativeness ratings ($F(2, 218) = 1.601$, $p = 0.204$, $\eta^2 = 0.014$). More importantly, there was no three-way interaction between participant culture, face ethnicity and posture ($F(2, 218) = 0.990$, $p = 0.373$, $\eta^2 = 0.009$).

These ratings indicate a marked change in perceived cooperativeness with change in posture of the head. The neutral head posture was seen as most cooperative. In particular, to the head-down orientation but also the head-up orientation decreased apparent cooperativeness. The ratings also indicate a high degree of cross-cultural agreement in the perception of cooperativeness between American and Chinese participants.

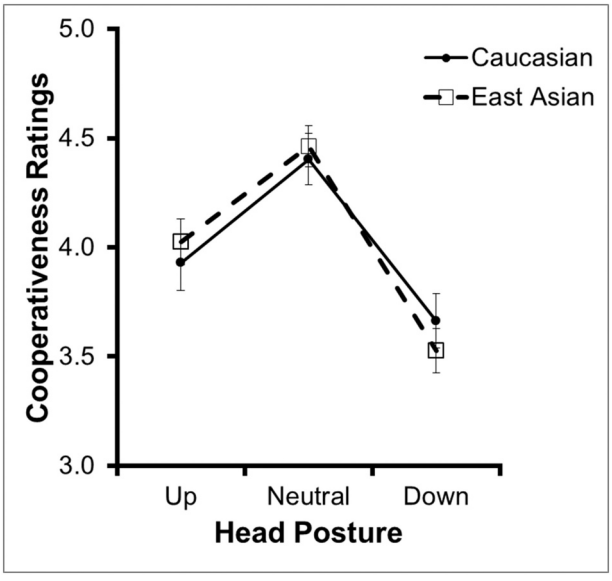

Fig. 3. The effect of head posture on cooperativeness ratings for Caucasian and East Asian participants.

2.2. Experiment 2

The rating task of Experiment 1 showed a clear pattern of results: faces with the neutral head posture were seen as more cooperative compared to the head-up or head-down postures. This effect of posture on apparent cooperativeness was equivalent for American and Chinese observers. The ethnicity of the face did not affect ratings of cooperativeness. Ratings are relatively coarse methods of differentiating attributions and therefore an additional ranking experiment was employed in Experiment 2. Ranking has the possibility of revealing differences in attributions that might be masked by independent cues across faces ratings.

2.2.1. Participants

One hundred and fifteen participants completed both Experiment 1 and Experiment 2. 63 East Asian Chinese (age 27.33 ± 6.49, mean ± SD; 29 male, 33 female, one participant did not report gender) and 52 White Americans (age 40.65 ± 13.06, mean ± SD; 31 male, 21 female).

2.2.2. Stimuli

We used the face identities that had not been shown in Experiment 1 but which were manufactured in the same manner. There were 72 images of 24 identities (six of each sex and ethnicity).

2.2.3. Procedure

The same American and Chinese participants were presented with three images together of each face (neutral, up and down). They ranked the three images of each of the 24 face identities. Participants were asked to make judgments regarding cooperativeness with the instruction "please rate three images on their cooperativeness". '1' represents the least cooperative; '2' represents a medium level cooperativeness; and '3' represents the most cooperative. Participants were presented with three faces of the same identity in three postures at the same time.

2.2.4. Results

Analysis showed a main effect of posture (head-up, neutral and head-down) on rankings of cooperativeness ($F(1, 112) = 6.884$, $p = 0.002$, $\eta^2 = 0.058$). Again the neutral head posture was seen as most cooperative, and head-up or head-down less cooperative. Both head-down and head-up were ranked less cooperative than the head-level posture (both Bonferroni corrected comparisons $p < 0.005$). The head-down posture was also not ranked differently in cooperativeness to the head-up posture ($p = 1.000$, see Fig. 3). There was an interaction between

participant culture and posture on cooperativeness rankings ($F(1, 112) = 5.570$, $p = 0.006$, $\eta^2 = 0.047$, see Fig. 4). East Asian participants showed a greater sensitivity to head posture, ranking the neutral posture as more cooperative than the Caucasian participants (independent samples t-test $t(1, 113) = 3.762$, $p < 0.001$) and conversely the head-up and head-down postures as less cooperative than the Caucasian participants ($t(1, 113) = -2.444$, $p = 0.016$, $t(1, 113) = -2.256$, $p = 0.026$, respectively).

Face ethnicity was not found to affect rankings of cooperativeness ($F(1, 112) = 3.241$, $p = 0.075$, $\eta^2 = 0.028$). Participant culture (American vs Chinese) showed no impact on rankings ($F(1, 112) = 0.255$, $p = 0.614$, $\eta^2 = 0.002$). There was no interaction between ethnicity of face and posture on cooperativeness rankings ($F(1, 112) = 1.334$, $p = 0.265$, $\eta^2 = 0.012$), neither was there an interaction between ethnicity of face and participant culture (American vs Chinese) ($F(1, 112) = 0.759$, $p = 0.385$, $\eta^2 = 0.007$). More importantly, there was no three-way interaction between participant culture, face ethnicity and posture ($F(1, 112) = 0.263$, $p = 0.757$, $\eta^2 = 0.002$). The lack of effect of face ethnicity suggests that both American and Chinese participants treated faces with diverse ethnicities equally.

The ranking task showed the same pattern of results as the rating task: the neutral head posture was seen as most cooperative by both Caucasian and East Asian participants. The ranking task also revealed subtle cultural differences with the effect of head posture more pronounced in the Chinese participants. The ranking task is potentially a more sensitive task because participants are required to differentiate stimuli that might on certain trials be allocated the same seven-point rating. One stimulus could be consistently ranked higher but yet not receive reliably higher ratings on a seven-point scale. With a larger sample size, one would expect ratings as revealed by ranking to demonstrate a significant difference with the same small effect size.

2.3. Experiment 3

While Experiments 1 and 2 show that the neutral posture is perceived to be the most cooperative in comparison to head-up and down postures, it is not clear that the neutral head is the 'optimal' configuration to maximise apparent cooperativeness. In Experiment 3, participants were presented with a range of stimuli and asked to choose the most cooperative configuration.

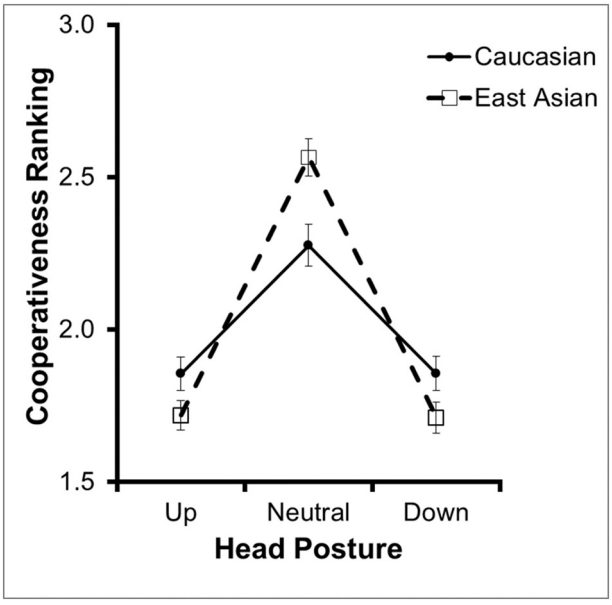

Fig. 4. Head posture affects cooperativeness ranking differently for Caucasian and East Asian participants. The average rank across participants and faces is displayed (±the standard error of the rank).

2.3.1. Participants

Eighty-eight participants in Experiment 3 had completed Experiment 1 and 2. They included 37 East Asian Chinese (age = 27.95 ± 7.87, mean ± SD; 14 male, 22 and female, one participant did not report gender) and 51 White Americans (age 40.96 ± 13.00, mean ± SD; 30 male, 21 female).

2.3.2. Stimuli

The images used as facial stimuli in the three different postures of Experiment 2 were transformed in apparent posture for use in Experiment 3. The original neutral face was transformed by ±100% of the shape difference between down to up for that face (Rowland & Perrett, 1995) to create head posture continua of 20 steps for each of the 24 face composites (used in Experiment 2). This rotation transformation resulted in a sequence of images spanning from a head 'down' to a head 'up' shape for each face (see Fig. 5). This transformation also maintained all other parameters such as facial texture and colour as constants. Progressing through the transform sequence gave the impression of a rotation of head angle with no change in identity.

2.3.3. Procedure

Participants were requested to scroll through the 24 images of each face identity and manipulate the apparent head angles to maximise apparent cooperativeness. Participants were presented with one single facial identity at a time and were allowed to change the apparent head posture (20 steps in the continuum) to maximise perceived cooperativeness. With the instruction on the top of each facial image "please make the face as cooperative as possible", participants controlled the face's appearance by moving the mouse cursor horizontally over the image (face and background). The direction of head rotation with mouse movement was randomised across trials. Participants pressed the left mouse button to show the next image when they found the most cooperative appearance. The 24 facial identities were presented in random order.

2.3.4. Results

Optimal head angle (mean = −27% transform, SE = 4.344, see Fig. 5) was found to be slightly lowered with respect to the level posture. This selected posture differs from a mean rotation angle of 0% under the null hypothesis where the choice is random across participants ($t(1, 86) = -6.612$, $p < 0.0005$). Repeated measures ANOVA was used to compare the average image in the sequence chosen by each participant; age was included as a covariate. The ethnicity of the faces was not found to affect optimal posture ($F(1, 85) = 0.096$, $p = 0.758$, $\eta^2 = 0.001$). Participant culture (American vs Chinese) showed no impact on optimal posture ($F(1, 85) = 1.625$, $p = 0.206$, $\eta^2 = 0.019$), neither was there an interaction between participant culture (American vs Chinese) and face ethnicity on optimal posture ($F(1, 85) = 2.890$, $p = 0.093$, $\eta^2 = 0.033$). The results showed that faces were rotated slightly down to maximise perceived cooperativeness and that both Chinese and US participants treated faces with different ethnicities equally. Further, the results suggest that Chinese and American observers chose an equivalent head rotation down as an optimally cooperative configuration.

3. General discussion

Previous studies have investigated how head tilt affects cooperation-relevant social perceptions. We replicated previous findings by demonstrating that rotating the head up or down through a large angle decreases the perception of cooperativeness, yet we also found that the optimal posture for conveying the impression of cooperativeness is one in which the head is turned slightly down. Our study also supports the possible existence of specific facial traits as cues to differentiate altruism from egoism. Furthermore, we gave due recognition to cultural context,

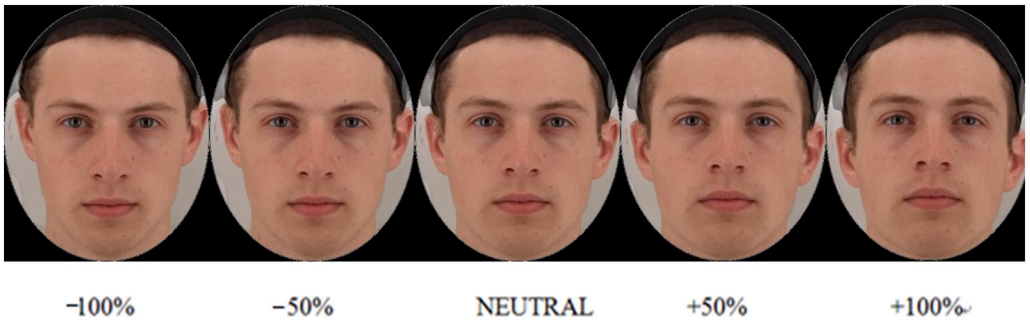

Fig. 5. Examples of the rotation-transformed stimuli used in Experiment 3. Participants could manipulate head angle to any value between ±100%. Transform angle level of ±50% and ± 100% are presented as examples.

which is often not studied. Our findings show a high degree of cross-cultural agreement on perception of cooperativeness yet our experiments also suggest that there are subtle differences in perceptual attributions that depend on culture.

In rating and ranking tasks we found that a neutral posture was perceived as most cooperative compared with head-up and head-down postures. Both rotating the head up and rotating it down produced quite similar decreases in perception of cooperativeness. These results were consistent with our original hypothesis that perception of cooperativeness is related to variation in posture. One possible explanation is that tilting the face induces negative apparent traits such as increased dominance (Mignault & Chaudhuri, 2003) or intimidation (Hehman, Leitner, & Gaertner, 2013). As a result, individuals having negative-related traits with upward and downward head postures might be perceived as less cooperative compared to individuals with neutral head positions.

As expected, we found there was a high degree of cross-cultural consensus between Chinese and American participants on judgments of cooperativeness with change of posture in the three (rating, ranking and optimisation) tasks that we employed. Previous research has shown cross-cultural agreement in judgments of warmth-related traits such as trustworthiness and likeability (Rule et al., 2010). We extended these findings by showing cross-cultural agreement on judgments of warmth-linked cooperativeness.

At the same time, a greater effect of posture variation was shown among Chinese participants than American participants in our ranking task. This result suggests that Chinese participants might be more sensitive than US participants on perceptions of cooperativeness. A possible explanation may be that Asians have a greater tendency to live in collective societies and are perhaps more likely to emphasise group dynamics rather than individual prowess. Chinese people, therefore, might be more cooperative or more sensitive to cues to cooperation compared to people in a more individualist culture. Alternatively, there may be cultural norms which amplify or diminish the extent of head-posture expressions in given contexts, leading to changes in reading these non-verbal signals (Van Osch et al., 2016).

It seems an intriguing finding that turning the head down just slightly makes the face appear more cooperative to both Chinese and American observers. One explanation might be that the sight of head down is associated with the head nodding, which has communicative functions indicating agreement, attention, interest, support, friendliness and consideration (Allwood, 1998; Andersen, 1985; Heintzman et al., 1993; McClave, 2000), all of which might be positively linked to intention and feedback of cooperation for both Chinese and American observers. An alternative explanation may be that a head tilted slightly down might be perceived as more cooperative because a tilted-down head might increase positively related cooperativeness traits such as femininity (Burke & Sulikowski, 2010) and facial positive expressions.

Surprisingly, there was no interaction between face ethnicity and participant culture on posture-influenced attributions. Chinese and Americans treated their own ethnicity and other ethnicity faces equivalently. This finding is inconsistent with many studies, which have shown own-ethnicity bias (Anthony et al., 1992; Stanley et al., 2011; Walker & Hewstone, 2006). It has been argued that individuals are more sensitive to faces of their own ethnicity than faces of other ethnicities (Ito & Urland, 2005; Elfenbein & Ambady, 2002; Stephen et al., 2012). The similarity in results for Asian and Caucasian faces in our experiments may indicate that change in head posture is a gesture that is globally understood and which therefore transcends ethnic appearance (Tracy & Matsumoto, 2008; Van Osch et al., 2016).

Given our findings that a slightly head-down posture is perceived as most cooperative, this study also has potential implications for the public. For example, with the explosive popularity of social media, portraits on social media sites are very important for creating an impression to make friends and building a public image. Our research may offer practical suggestions for optimising appearance in circumstances where portraits need to convey a willingness to cooperate. In addition, over the last few decades, research in Artificial Intelligence (AI) has made rapid progress in many fields such as computer face recognition and intelligent robot technology (Jain & Li, 2011; Zhang et al., 2020). While AI researchers have been trying to create intelligent machines to identify or simulate physical and social traits of human faces, few studies have focused on computational identification and simulation of head posture. With the recent increase in computational research into emotion detection, studies of the effects of combined head posture and facial expression will be important.

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Declaration of competing interest

The authors have declared that no competing interests exist.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2022.103602.

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