HEMIFACIAL ASYMMETRIES IN AGE PERCEPTION: THE LEFT CHEEK LOOKS OLDER FOR FEMALES, BUT NOT MALES


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SUMMARY

Background: The left hemiface expresses emotion more intensely than the right. Because emotional expressions contract the facial muscles and wrinkle the skin, theoretically the left hemiface’s greater expressivity should prompt more pronounced expression lines and wrinkles on the left than right side of the face. As wrinkles are the most salient age cue, we investigated whether the left hemiface consequently appears older than the right.

Material/Methods: Two hundred and sixty participants (F=148; M=112) viewed booklets containing pairs of left-left and right-right chimeric faces of eight models (M=F). For each trial participants were asked to make a two alternative forced choice response indicating which image looked older.

Results: Results confirmed a left cheek bias, with participants more likely to select left-left than right-right chimeras. Whilst participant gender did not influence perceptions, model gender predicted cheek selections; responses to female models drive the overall left cheek bias. The left cheek (56.8%) appeared older than the right cheek (43.2%) for female models, whereas there was little difference in perceived age between male models’ left (50.8%) and right (49.2%) cheeks.

Conclusions: Given that youth influences perceptions of female beauty, these findings complement previous research and offer a potential explanation for why the left side of females’ faces are judged less attractive: the right cheek appears younger.

Key words: emotion; asymmetry; hemisphere; laterality; age
INTRODUCTION

The two sides of the face look superficially similar but express emotion asymmetrically (Lindell, 2013). The left side of the face is typically more emotionally expressive because it is predominantly controlled by the right hemisphere; the lower two-thirds of the face is contralaterally innervated (Patten, 1996). As the right hemisphere is dominant for emotion processing (Demaree et al., 2005), the left hemiface expresses emotion more intensely (see Lindell, 2013, for review).

Studies assessing muscle movements during emotional expression confirm that the left cheek is anatomically more expressive. For example, electromyography can be used to measure spontaneous facial muscle contractions whilst participants view stimuli. Results reveal that viewing both emotional faces (Dimberg & Petterson, 2000) and emotional pictures (Reminger et al., 2000) produces larger muscle movements in the left than right hemiface. Nicholls et al.'s (2004) findings are congruent. They asked participants to make happy, neutral and sad facial expressions and measured the facial movements precisely using 3D image analysis. Results confirmed greater movement in the left hemiface, irrespective of the valence of the expression. Such findings indicate that the left side of the face is anatomically more expressive.

Given the left hemiface’s greater physiognomic expressivity, viewers perceive the left cheek as being more emotive. For example, chimeric faces composed of a mirrored left hemiface (left-left chimera) are judged more expressive than a mirrored right hemiface (right-right chimera; e.g., Sackeim et al., 1978; Indersmitten & Gur, 2003; Bourne, 2010). Similarly, ¾ view portraits featuring the left side of a model’s face are judged more emotive than identical portraits featuring the right side (e.g., Harris & Lindell, 2011; Nicholls et al., 2002). Thus something as seemingly inconsequential as a 15˚ head turn left or right influences perceived emotionality. Critically, the left cheek bias for emotional expressivity is evident even when the portraits have been mirror-reversed, making a left cheek pose look like a right cheek pose and vice versa (e.g., Harris & Lindell, 2011; Nicholls et al., 2002). The fact that the left cheek appears more expressive despite being digitally reversed confirms that there are genuine physiognomic differences in the hemifaces’ expressivity. Moreover, these findings indicate that the anatomical differences in hemifacial expressivity influence perception.

Emotional expressions result from the contraction of the underlying facial musculature and the consequent wrinkling of the superficial facial skin. Expressing happiness, for example, involves contracting the zygomaticus major muscles, elevating the lips into a smile, whereas anger is expressed by contracting the corrugator supercilii muscles, knitting the eyebrows into a frown (e.g., Achaibou et al., 2008; Dimberg, 1990). These temporary muscular contractions influence the patterns of wrinkles and lines on the face as we age, resulting in permanent expression lines such as crow’s feet and frown lines (Ascher et al., 1995; Hillebrand et al., 2010). Research confirms that smiling faces appear older than neutral faces (Ganel, 2015; Ganel & Goodale, 2017), presumably because the increased wrinkling around the eyes and mouth that produce a smiling expres-
sion render age cues more prominent. As the left hemiface produces greater muscular contractions and thus more intense emotional expressions than the right hemiface (Nicholls et al., 2004), theoretically this should prompt deeper expression lines and other age cues on the left side of the face; research has yet to determine whether the left cheek appears older than the right.

Though cues to age in faces include factors such as loss of cheek volume and upper eyelid drooping (Forte et al., 2015), the most salient cue for age is the number and depth of wrinkles on the face (Aznar-Casanova et al., 2010). Anticipating that the greater expressivity of the left hemiface may lead to more (or more pronounced) wrinkling on the left side of the face, we examined whether people perceive the left side of the face as looking older than the right side of the face. Participants were presented with pairs of left-left and right-right chimeric faces of models expressing happiness (M=F), and made two alternative forced choice response judgements indicating which image in each pair looked older. Happy expressions were selected for investigation because a) happiness is a natural expression for photographs, b) previous research has found that smiling faces are perceived as older than neutral faces (e.g., Ganel, 2015), and c) the facial muscles involved in generating a happy expression are predominantly contralaterally controlled (Patten, 1996), maximising hemifacial differences. If, as predicted, left-left chimeras appear older than right-right chimeras, this will offer suggestive evidence that differences in the emotional expressivity of the two sides of the face influence how the human face ages.

METHOD

Participants
Two hundred and sixty participants (F = 148; M = 112), aged 18 to 89 (M = 33.32 years, SD = 15.88), were recruited from La Trobe University and via social networks. Participants were dominantly right-handed, as indexed by strongly positive FLANDERS handedness inventory scores (M = 9.72, SD = .89; Nicholls et al., 2013), and had normal or corrected vision.

MATERIALS
Chimeric face stimuli were generated using images of eight models expressing happiness from Ekman and Friesen’s (1976) Pictures of Facial Affect (M=F). Each model’s photograph was digitally manipulated to produce left-left and right-right chimeric faces by: a) splitting the full face image vertically through the centre of the model’s nose, producing a left half and a right half, and b) creating composites by mirroring the left half to produce a full face (left-left chimera) and the right half to produce a full face (right-right chimera). The face chimeras were then cropped into ovals that focussed solely on the face, removing hair and clothing information.

Each stimulus set contained eight pairs of left-left and right-right chimeras (one pair for each model). For each stimulus pair the 11.0 cm x 7.9 cm oval chimeras
were presented side by side, separated by a central gap of 1.2 cm, and printed in
greyscale on a standard white landscape A4 sheet. Two versions of the facial stim-
ulus booklet were generated using a pseudo-latin square design, counterbalancing
stimuli for side of sheet on which the left-left chimera appeared (half left side of
the sheet, half right side of the sheet), and model gender (male, female).

The FLANDERS handedness inventory (Nicholls et al., 2013) was used to
assess participants’ handedness. The inventory uses 10 self-report items that
ask participants to indicate the hand they prefer to use when performing every-
day activities: “left” (-1), “right” (+1) or “either” (0). FLANDERS handedness
scores thus range from -10, indicating strong left handedness, to +10, indicating
strong right handedness.

**Procedure**

Participants were tested individually in a quiet, well-lit location, and completed
a single experimental session lasting no more than 15 minutes. Participants com-
pleted two experimental tasks during this session, with order of administration
counterbalanced between participants (the other experimental task was for an
independent investigation and is not reported here).

For the chimeric face task each participant was allocated one of the two stim-
ulus booklets. For each stimulus pair the participant was asked to make a forced
choice decision, indicating which image appeared older. Participants recorded
their choices on a response sheet. The task was double-blinded such that both
the experimenters and the participants were naïve to which image in each pair
was the left-left or right-right chimera. After the experimental tasks were com-
plete, participants recorded their demographic information and completed the
FLANDERS handedness inventory (Nicholls et al., 2013). Finally, participants
were thanked and thoroughly debriefed.

**RESULTS**

Of the 260 participants tested, data from three participants were excluded be-
because they did not meet the handedness inclusion criterion (FLANDERS hand-
edness scores of +7 or greater, indicating strong right handedness; Nicholls et al.,
2013). The final sample of 257 participants (F = 145, M = 112) had a mean age of
33.47 (SD = 15.90; range 18-89), and mean FLANDERS handedness score of 9.79
(SD = .59). As anticipated, results confirmed that overall the left cheek appears older,
with participants more likely to select left-left than right-right chimeras (see Fig. 1).

Repeated measures binary logistic regression analysis was used to model
the relationship between left cheek selections and the predictor variables model
gender (male, female), and participant gender (male, female). The model controlled
for the repeated measure of participant identity and assumed an unstructured
correlation matrix. Results revealed that participant gender did not influence
cheek selections \[ \chi^2 (1) = .112, p = .738 \ (CI .862 – 1.310); \ \text{Exp} (\beta) = 1.040 \],
however model gender proved a significant predictor \[ \chi^2 (1) = 4.278, p = .039
\ (CI 1.012 – 1.553); \ \text{Exp} (\beta) = 1.253 \].
As illustrated in Figure 2, for female models the left side of the face appears older: consistent with prediction participants made more left (N = 584) than right (N = 444) cheek selections for female models. For male models however, there was no difference in cheek selections: left (N = 522) and right (N = 506) cheek choices were similarly frequent, indicating a gender difference in the perception of age in human faces. Finally, the interaction between participant gender and model gender was not significant [$\chi^2 (1) = .114, p = .736 (CI .765 – 1.460); \text{Exp}(\beta) = 1.057]$. 

![Fig. 1: Percentages of overall left and right cheek selections](image1)

![Fig. 2: Percentages of left and right cheek selections as a function of model gender (male, female).](image2)
DISCUSSION

It is well established that the left hemiface, predominantly controlled by the emotion-dominant right hemisphere, expresses emotion more intensely than the right hemiface (e.g., Nicholls et al., 2004). We reasoned that this greater expressivity would theoretically prompt deeper expression lines, wrinkles, and other age cues on the left side of the face, making it appear older than the right side of the face. Results supported this prediction. When asked to determine which image looked older participants were more likely to select left-left than right-right chimeras. Whilst participant gender had no influence on cheek selections, results revealed that model gender predicted the likelihood of left cheek selections: the left cheek bias was driven by responses to female models, with little difference in perceived age between male models’ left and right cheeks. Overall, these findings support the proposition that the right hemisphere’s emotional dominance influences the way the two sides of the face age.

As predicted, when asked to select which face appeared older left-left chimeras were selected more frequently than right-right chimeras. Such findings are novel as to date, no other researchers have investigated hemifacial differences in age perception. The results are, however, theoretically consistent with the notion that the left hemiface’s greater anatomical expressivity leads to the development of more, or more prominent, expression-related wrinkles (e.g., crow’s feet, nasolabial folds). As the number and depth of wrinkles are the most salient cues to age in human faces (Aznar-Casanova et al., 2010), smiling faces appear older than neutral faces (Ganel, 2015). Given that the temporary muscular contractions generated during facial expressions influence the patterns of wrinkles and lines on the face as we age (Ascher et al., 1995; Hillebrand et al., 2010), one would anticipate that the side of the face that is anatomically more expressive would appear older. The results of the present study are thus in line with expectation.

However, results revealed that a gender difference underlies the overall left cheek bias for age perception. Participants perceived female models’ left cheeks (56.8%) as older than their right cheeks (43.2%), whereas for male models there was little difference in perceived age between left (50.8%) and right (49.2%) cheeks. Though this finding was not anticipated, differences in females’ and males’ levels of emotional expressivity offer potential clues. Because societal emotion display rules typically conform to gender stereotypes (Brody, 2000), females express emotion more often (e.g., McDuff et al., 2017), more openly (e.g., Kring et al., 1994), and more intensely (e.g., Fujita et al., 1980) than males. As females are more inclined to express emotion, and do so more frequently and more intensely than males, it appears plausible that females would consequently develop more pronounced expression-related wrinkles than males. This may be exacerbated by sex differences in skin thickness that alter males’ and females’ propensity to develop wrinkles: females typically have thinner skin and more numerous wrinkles than males whose skin tends to be thicker (e.g., de Maio & Rzany, 2009). Consequently, differences in the left and right hemifaces’ expres-
sion lines are likely to be more prominent in females, resulting in the observed bias. As research has yet to measure hemifacial differences in the number, depth, and location of wrinkles for males and females, further investigation is needed to confirm this speculation.

It is interesting to note that the patterns of preferences found in the present study align well with previous research investigating which side of the face is more attractive. We found that females’ left cheeks appear older whereas there is no difference in perceived age between males’ left and right cheeks. Analogously, Zaidel et al. (1995) demonstrated that females’ right cheeks appear more attractive whilst there is no difference in the perceived attractiveness of the left and right sides of males’ faces. Taken together, these findings indicate that the older side of females’ faces is judged less attractive. Given the well-documented role of youth as a key factor influencing perceptions of female beauty (e.g., Furnham et al., 2004; Henss, 1991; Mathes et al., 1985), such a finding appears completely logical. From an evolutionary standpoint, youth indexes an increased likelihood of female reproductive success because female fertility decreases with age; age consequently plays a much greater role in females’ than males’ perceived attractiveness (e.g., Henss, 1991; Mathes et al., 1985). Assuming that other factors are equal, one would therefore predict that the side of the female face that appears older will be deemed less attractive. The present findings are thus completely congruent with previous attractiveness research (e.g., Zaidel et al., 1995), and may help explain the right cheek bias reported for print advertising (Burkitt et al., 2006).

Whereas the gender of the model had a significant effect on cheek selections, participant gender did not influence perceptions. Both male and female participants found that female models’ left cheeks appeared older, but distinguished no difference between male models’ left and right cheeks in terms of age. If, as we have argued, the left cheek’s greater anatomical expressivity causes more pronounced age cues (e.g., wrinkles) in the left hemiface, this physiognomic difference should be patent; the gender of the viewer should not influence perceived age. Previous research similarly indicates that participant gender does not influence age judgements for portrait (e.g., Matts et al., 2007) or full-face photographs (e.g., Porcheron et al., 2013). Such findings are consistent with the present research, indicating that because age perception is a basic perceptual judgement, it is not influenced by the gender of the viewer.

Though we are presumably not conscious of the difference in day-to-day life, the present study indicates that the left cheek looks older than the right for females, whereas hemifacial age differences are not apparent for males. As the left hemiface is predominantly controlled by the emotion-dominant right hemisphere (Patten, 1996), these findings imply that females’ greater propensity to express emotion influences how the two sides of the face age. Of course when we express emotion both sides of the face are involved, thus it is not surprising that even for females, the magnitude of the difference is small; differences between the hemifaces’ levels of expressivity are relative rather than absolute. Moreover, expression-related wrinkles are far from the only cues to age in human
faces and other such cues (e.g., age spots, loss of cheek volume, upper eyelid drooping, etc., Forte et al., 2015) are equally likely to asymmetrically affect one side of the face, influencing perceived age. As this is the first study to assess hemifacial differences in age perception further research is needed to confirm the present findings. Longitudinal investigation would be particularly beneficial, allowing determination of when differences in the perceived age of the two sides of the face arise. If, as we have argued, hemifacial differences in emotional expressivity cause more pronounced expression-related wrinkles on the left side of the face, such differences would not be evident in teenagers or young adults but would emerge as we age. In addition, they would be expected to be more pronounced in people who rate themselves more emotionally expressive. It may be that while keeping your emotions to yourself compromises your mental health (e.g., Hu et al., 2014), it offers unexpected benefits in terms of ageing.

However, it is worth paying attention to whether we express or suppress negative or positive emotions. Research using new neurotechnologies evaluating the work of the brain in milliseconds indicates that this remark concerns more negative emotions. Expression of the negative emotions may be met with a sharp reaction from other people, which will in return stimulate and strengthen the penaltsystem by weakening the reward system (see Fig. 3).

As a consequence, the negative facial expression will be intensify, which the authors associate with the weakening of serotonin secretion (Kropotov 2009, 2016;). As a consequence, the so called Language Interpreter of the World will change, which may cause the appearance of sadness and even depression (Gazzaniga 2011; Pąchalska et al. 2018). However, it is worth asking the question, will the mechanism presented be similar for people who express positive emotions?

Our article has application value because it takes up new, original, and extremely important topics from the perspective of neuroscience. Multidisciplinary research should explain the neuronal mechanisms underlying our discovery. It should be expected that a closer understanding of this mechanism will be useful on the one hand for modern evidence based medicine (e.g. understanding the mechanism of the appearance of a masked face symptom in people with Parkinson’s disease, which in women is more visible just on the left side of the face). It can therefore contribute to the introduction of more effective methods in aesthetic medicine, especially for women (as we know women more than men, have a need to look beautiful, desirable and attractive with the least signs of passing time), as well as for more effective strategies for the diagnosis and therefore neuropsychological rehabilitation of the brain damage patients (especially for those with facial symptoms).

REFERENCES


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