■研究速報（VISION Vol. 25, No. 1, 1–7, 2013）

# Adding Vertical Lines to a Face Increases Perceived Sadness

Takeharu SENO*,**,***, Sayako UEDA****, Masaru TAKEICHI*****, Stephen PALMISANO****** and Satoko OHTSUKA*******

* Faculty of Design, Kyushu University,
4–9–1 Shiobaru, Minami-ku, Fukuoka, Fukuoka 814–8540, Japan
** Japan Society for Promotion of Science
***Institute for Advanced Study, Kyushu University,
6–10–1 Hakozaki, Higashi-ku, Fukuoka 812–8581, Japan
**** Faculty of Integrated Arts and Social Science, Japan Women's University,
1–1–1 Nishi-ikuta, Tama-ku, Kawasaki, Kanagawa 214–8564, Japan
***** Faculty of Political Science and Economics, Kokushikan University,
4–28–1 Setagaya, Setagaya-ku, Tokyo 154–8515, Japan
****** School of Psychology, University of Wollongong,
Wollongong, NSW 2522, Australia
******* Department of Psychology, Saitama Institute of Technology,
1690 Fusaiji, Fukaya, Saitama 369–0203, Japan

（Received 25 March 2012; Accepted 9 December 2012）

Adding vertical lines to a face is often used in Japanese MANGA to represent emotion. In this experiment such vertical face lines were found to enhance perceptions of sadness in young Japanese subjects. However this effect was not present in either young Australian or old Japanese subjects.

## 1. Introduction

By definition, Japanese MANGA comics or cartoons have no dynamic component. They are also typically printed in black and white. Thus, many techniques have been developed to represent the facial expressions of MANGA characters. These techniques appear to be quite intuitive and empirically effective for MANGA's prime target audience. However, it is not known whether this MANGA visual language or iconography is culturally specific, learnt or ecological in origin. In this study, we focused on one particular MANGA technique, known as "face lines". These face lines are drawn in the upper part of the face as shown in **Fig. 1** and are thought to enhance perceptions of the characters' sadness and sometimes shock, i.e. negative emotions. While the exact date of their first appearance is not known, these face lines were used in Japanese MANGA in 1960s. This

**Fig. 1.** An example of the vertical lines on face used in Japanese MANGA.

technique then quickly became a popular way to represent sadness in the character's face.

One perceptual explanation for the effectiveness of these face lines is that they partially occlude and darken the upper part of the face. It is possible that this region of the face may be particularly effective for cueing sadness, shock and other negative emotions. For example, Hanawalt[1] appeared to find that the lower half of the face was more important than the upper half for the identifying happiness. Eyes and eyebrows are necessary for the identification of a sad face, whereas the mouth and cheeks are important for identifying a happy face[2] Boucher and Ekman[3] reported that the brow and forehead are also important for identifying sad faces. Another possible perceptual explanation is based on the fact that these face lines alter the luminance and contrast of the face. However, to our knowledge there is no previous study that reports the relationship between the face luminance/contrast and perceived sadness, shock and negative emotions. A third possibility is that these face lines may increase the likelihood of the face appearing to be tilted/bowed. Consistent with this notion, Mignault and Chaudhuri[4] report that a bowed face which has a neutral emotional state tends to be perceived as being sad. However, in another study by Lyons et al.,[5] a bowed Noh mask was perceived as being more positive than the normal oriented mask (possibly because the mouth of the bowed mask displayed a smile).

In this study, we first examined whether these face lines enhance the perceived sadness of the character in young Japanese participants (since sadness is the most commonly reported emotion in MANGA faces with vertical lines). We also examined whether this perception could obtained with groups that differed either in terms of age or culture (i.e. old Japanese and young Australians). The goal of these comparisons is to see if the effect of the face lines on perceived emotion is restricted to young Japanese people.

## 2. Method

On each trial, one of eight different drawn human faces was presented. Four of these face stimuli (2 males and 2 females) were drawn a more realistic in style, which the remainder (2 males and 2 females) were drawn in a MANGA style. These realistic and MANGA faces represented both Caucasian and Asian people. Every face had three different emotional expressions, i.e. sad, happy and neutral (**Fig. 2**). In addition, three types of face line condition were used: (i) MANGA face lines: vertical lines on the upper right on the face; (ii) 90 degree rotated face lines: horizontal lines which covered the same upper right face location; and (iii) a no face line control condition. 72 trials (8 faces$\times$3 emotions$\times$3 types of the face lines$=$72) were conducted.

This between-subject experiment examined three different groups of subjects. Group 1 consisted of 22 young Japanese volunteers who were undergraduate and graduate students aged 21 to 29 (mean age was 23.25 years). Group 2 consisted of 22 old Japanese volunteers aged 78 to 87 (mean age was 81.55 years). Group 3 consisted of 22 young Australian volunteers who were undergraduate students at the University of Wollongong aged 18 to 28 (mean age was 22.31 years).

The subject's task on each trial was to rate the perceived sadness or happiness of the target face via the method of magnitude estimation. In order to make these estimations we provided them with 11 pointed scales ranging $-5$ (very sad) to 5 (very happy).

**Fig. 2.** Examples of the stimuli used in this experiment.

The experiment was conducted using the slide-show function of PowerPoint (Microsoft). The stimuli were projected on a large screen by a color data projector. The viewing distances were less than 2 m for young Japanese and Australian participants, and 7 to 15 m for old Japanese participants. However, the stimulus size was always at least 40 deg × 30 deg, which was sufficient for the faces to be easily and fully recognized. At least two subjects participated in the experiment simultaneously. The order of the stimulus presentation was fully randomized.

## 3. Results

The results of the three groups were shown in **Fig. 3**. In most cases, the expected emotional rating values were obtained, with the sad, happy and neutral faces being perceived as sad, happy and neutral, respectively.

In the young Japanese subjects, the presence of horizontal face lines tended to enhance the perceived sadness of the target face (i.e. they produced more negative ratings of emotion). This effect was found to be larger for the MANGA face stimuli (compared to the realistic face stimuli). Neutral faces with the horizontal lines were perceived as sad for the MANGA drawings but not for the more realistic face drawings.

In this same young Japanese group, vertical face lines were found to enhance the perceived sadness of the target face to an even greater extent than the horizontal face lines. Thus, the vertical face lines were found to have the expected effect. It is noteworthy that even the happy faces were perceived to be sad when the vertical lines were superimposed onto them. In subjective reports these young Japanese subjects said that the happy face "appeared to be a forced-smile".

In old Japanese and young Australian groups, no effects of either vertical or horizontal face

lines were found. This suggests that the effects of vertical and horizontal lines on a face are restricted only to young Japanese people. Thus, these effects appear to be either cultural or learnt, but not ecological, in origin.

We first conducted a three-way analysis of variance on the perceived face emotion data for only the young Japanese subjects. It revealed significant main effects of line type (Nothing, Horizontal and vertical lines) ($F(2, 42)=122.82$, $p<0.01$), picture type (MANGA vs. real) ($F(2, 21)=28.40$, $p<0.01$) and facial expression type (Sad, Happy and Neutral) ($F(2, 42)=607.18$, $p<0.01$). These results indicated that: (i) vertical and horizontal lines both had significant effects on participants' emotion ratings; (ii) MANGA faces were more effective at conveying emotions than the more realistic faces; and (iii) the three different facial expressions tended to be correctly rated as being different. All of the interactions between these three factors were significant. Tukey's HSD revealed significant differences between all combinations in three face types and between all combinations in three line types ($p<0.05$). While all faces with vertical lines tended to be perceived as being sad (irrespective of face for all expression types), horizontal lines had lesser effects on faces (perceived sadness/happiness depended on the picture and expression type).

We then pooled the MANGA and realistic face conditions and conducted a three-way analysis of variance for the three different participants groups. This revealed significant main effects of participant type (Young

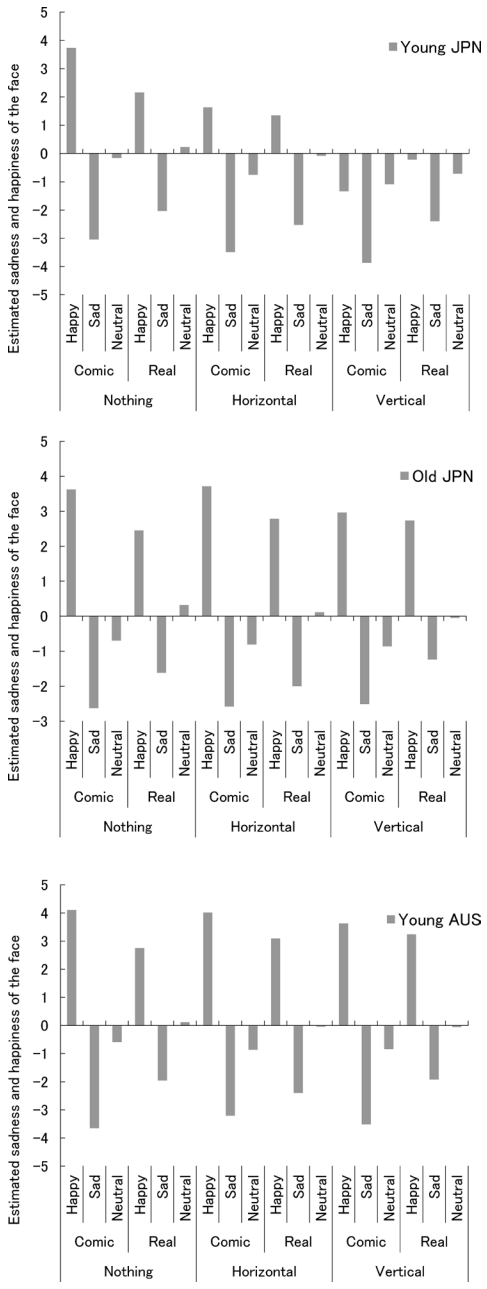


**Fig. 3.** The results of the estimated sadness and happiness of the face.

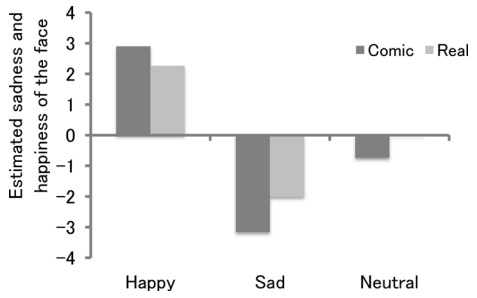


**Fig. 4.** The results of comic and realistic face conditions.

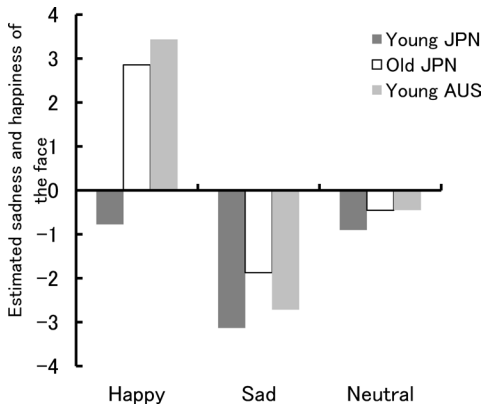


**Fig. 5.** The results of the vertical line conditions for the three participants groups.

Japanese, Old Japanese and Young Australian) ($F(2, 42)=32.53$, $p<0.01$), line type (Nothing, Horizontal and vertical lines) ($F(2, 42)=81.47$, $p<0.01$), and facial expression type (Sad, Happy and Neutral) ($F(2, 42)=867.27$, $p<0.01$). All interactions between these factors were also significant. Tukey's HSD revealed significant differences between Young and Old Japanese, between Young Japanese and Australian, between all combinations in three face types and between all combinations in three line types. Importantly, these analyses revealed that while vertical face lines dramatically enhanced the perceived sadness for all expression types (e.g. compared to the no lines condition) for young Japanese participants, they had little/no effect for the old Japanese and young Australian participants.

We also pooled the three line type conditions and conducted a three-way analysis of variance (corresponding to **Fig. 4**). It revealed significant main effects of participant type (Young Japanese, Old Japanese and Young Australian) ($F(2, 42)=32.53$, $p<0.01$), picture type (MANGA vs. real) ($F(2, 21)=45.04$, $p<0.01$) and facial expression type (Sad, Happy and Neutral) ($F(2, 42)=867.27$, $p<0.01$). All interactions were also significant. Taken together, these results again demonstrate that the ratings of the young Japanese participants were quite different from those of the other groups of participants. Overall, the MANGA pictures were found to convey facial emotions more effectively than the realistic pictures.

Next we conducted a three-way analysis of variances only for the vertical line conditions of the three participants groups (corresponding to **Fig. 5**). It revealed significant main effects of participant type (Young Japanese, Old Japanese and Young Australian) ($F(2, 42)=98.80$, $p<0.01$), picture type (MANGA vs. real) ($F(2, 21)=32.14$, $p<0.01$) and facial expression type (Sad, Happy and Neutral) ($F(2, 42)=324.51$, $p<0.01$). All interactions were also significant. Taken together, these results indicate that the ratings of the young Japanese participants were quite different to those of the other two groups. While the MANGA pictures produced stronger perceptions of facial emotion for all three groups of participants and for all facial expression types, happy facial expressions were only correctly rated as "happy" by the old Japanese and young Australian subjects.

Additionally, a four-way analysis of variances revealed that significant main effects of subject groups, line types, picture types and facial expression types and all interactions in all combinations were significant ($p<0.05$).

## 4. Discussion

We compared the MANGA comic and realistic face drawings by pooling three participants groups and three face line conditions. We found that the MANGA comic faces clearly enhanced the character's perceived emotions compared to the realistic face drawings. This is perhaps not surprising given

that MANGA tends to utilize exaggerated facial expressions. This feature of MANGA may be related to the fact that the caricatures of faces are easy to recognize than photos of the same face[6]. Adding to the face recognition, the recognition of facial emotions can be also easily done in MANGA rather than in realistic face.

In the introduction we proposed several perceptual explanations why face lines might alter perceived emotion. It was proposed that the addition of these face lines might increase participant's ratings of the character's sadness by: (i) partially occluding and darkening the upper part of the character's face; (ii) altering the luminance and contrast of this region of the face; or (iii) increasing the likelihood that the whole face appeared to be bowed. However, one major difficulty for all three of these perceptual explanations is that the effects of face lines on perceived emotion appeared to be restricted to only the young Japanese group of participants.

For young Japanese people, superimposing vertical lines onto a drawn face was found to increase perceptions of the character's sadness. However, as was stated above, this manipulation was found to have no such effect on groups consisting of old Japanese or foreign people. The results of the vertical line conditions on the ratings of the three different groups of participants were shown in Fig. 5. The results of the young Japanese participants clearly showed different tendency from the other two participant groups. These findings may represent an example of how culture and drawing conventions can alter human visual perception/cognition.

It is well known that face perception is highly dependent on configural/holistic processing[7]. Superimposing lines onto a face could alter the available configural face information, as well as obscuring featural information, which in turn might alter the perceptions of facial expressions. For example, superimposing vertical lines might alter the balance between the eyes and other facial components, which could have biased some participants' towards perceptions of sadness. If this was the case, then an inverted face with the vertical lines might appear to be less sad than an upright face[8], as the inversion is known to impair the observer's ability to holistically process a face. We also conducted an informal observation of the inverted face with the vertical lines on young Japanese subjects. We confirmed that these inverted faces appeared less sad. This interesting observation suggests that there might be a perceptual component to the face-line phenomenon, although why their effects appear to be restricted to young Japanese subjects is not known (possibly because they were more familiar with the configural layouts of typical MANGA faces).

It is well known that there is an own race advantage in recognizing faces[9,10]. This advantage has even been obtained with caricature faces[9]. Thus one possibility is that the MANGA faces in this experiment were recognized as Asian faces by the young Japanese participants. There is also mounting evidence that face perception and recognition are both heavily based on prior experience/expertise[11]. Our young Japanese participants would have all been heavily exposed to MANGA and due to this exposure would have had a much deeper understanding of its style conventions and techniques than the other two participant groups. These are two possible reasons why the results of the young Japanese participants were quite different from those of the other two groups who had much less exposure to either MANGA faces or to both Japanese and MANGA faces.

Further examinations should be conducted in the future to test these own-race and experience/expertise based hypotheses. In order to determine the extent to which our current results were modulated by culture, we plan to conduct an experiment using the same stimuli on Japanese and Australian children who have no (or at least similar) exposure to MANGA yet.

## Reference


1) N. G. Hanawalt: The rôle of the upper and the lower parts of the face as a basis for judging facial expressions: II. In posed expressions and "candid-camera" pictures. *Journal of General Psychology*, **31**, 23–36, 1944.
2) M. Nusseck, D. W. Cunningham, C. Wallraven and H. H. Bulthoff: The contribution of different facial regions to the recognition of conversational expressions. *Journal of Vision,* **8**, 1–23, 2008.
3) J. D. Boucher and P. Ekman: Facial areas and emotional information. *Journal of Communication*, **25,** 21–30, 1975.
4) A. Mignault and A. Chaudhuri: The many faces of a neutral face: Head tilt and perception of dominance and emotion. *Journal of Nonverbal Behavior*, **27**, 111–132, 2003.
5) M. J. Lyons, R. Campbell, A. Plante, M. Coleman, M. Kamachi and S. Akamatsu: The Noh mask effect: vertical viewpoint dependence of facial expression perception. *Proceedings of Royal Society London B,* **267**, 2239–2245, 2000.
6) R. Mauro and M. Kubovy: Caricature and face recognition. *Memory & Cognition*, **20**, *433–440, 1992.*
7) H. Leder and C. C. Carbon: Face-specific configural processing of relational information. *British Journal of Psychology*, **97**, 19–29, 2006.
8) P. Thompson: Margaret Thatcher: A new illusion. *Perception*, **9**, 483–484, 1989.
9) G. Byatt and G. Rhodes: Implications for models of face recognition. *Vision Research*, **38**, 2455–2468, 1998.
10) G. Rhodes, W. Hayward and C. Winkler: Expert face coding: Configural and component coding of own-race and other-race faces. *Psychonomic Bulletin & Review,* **13**, 499–505, 2006.
11) J. J. Richler, M. L. Mack, T. J. Palmeri and I. Gauthier: Inverted faces are (eventually) processed holistically. *Vision Research,* **51**, 333–342, 2011.