The left side of the face may be fixated on more often than the right side: visual lateralization in recognizing own- and other-race faces

Jialin Ma a,1, Bo Yang b,1, Yongxin Li a,*

a Institute of Psychology and Behavior, Henan University, Kaifeng, China
b Department of Psychology, Sun Yat-Sen University, Guangzhou, China

ARTICLE INFO

Keywords: Race; Face; Eye tracker; Facial feature; Left visual lateralization

ABSTRACT

Studies have found that Westerners recognize own-race faces with left visual lateralization (from the viewer’s perspective), but whether subjects recognize own- and other-race faces with similar degrees of left visual lateralization is unclear. In the present study, two experiments were conducted to clarify this issue. In Experiment 1, faces were divided into left and right sides to ascertain whether Chinese subjects scanned the left side of Chinese and Western faces more often than the right side. In Experiment 2, facial features were divided into six areas of interest along the midline of the face (specifically, the left and right eyes, sides of the nose, and sides of the mouth) to determine whether Chinese subjects scanned facial features on the left side of Chinese and Western faces more often than on the right side. The results of Experiment 1 showed that the fixation counts and scanning duration for the left side of the face were greater than those for the right side of the face, with no significant effect from the race of the face. The results of Experiment 2 showed that the fixation counts and scanning duration of the left eye and left side of the mouth were greater than those of the right eye and right side of the mouth, respectively, whereas no significant effect was found between the left and right sides of the nose for either Chinese or Western faces. The results indicate that Chinese subjects recognize own- and other-race faces with similar left visual lateralization, which is mainly reflected in scanning of the eyes and mouth.

1. Introduction

Why do we often feel that foreigners look the same? When watching foreign war movies, we often cannot accurately identify which person is the protagonist when the characters are all dressed the same. Questions such as the following may arise: “Is he Mike or Kevin?” “Mike has been killed; why did he appear again?” “Which one is Mike?” In fact, this phenomenon is a cross-race effect whereby subjects recognize own-race faces more accurately than other-race faces (Malpass and Kravitz, 1969). Cross-race differences in recognizing faces have been examined in behavioral research (Gobel et al., 2017), and some studies have also compared the cognitive processes of individual recognition of own-race faces and other-race faces using event-related potentials (ERPs) and fMRI (Li et al., 2015; Wiese, 2012).

1.1. Eye movement research on cross-racial face recognition

However, as ERPs and fMRI cannot intuitively reflect how subjects scan own-race and other-race faces, some researchers use eye tracking to study how East Asian and Western subjects scan own-race faces and other-race faces by dividing faces into different areas of interest. Generally, there are three ways to divide facial areas of interest: (1) divide the face into eye, nose and mouth areas of interest (Kelly et al., 2010; Miellet et al., 2013); (2) divide the face into upper-half and lower-half areas of interest (Liu et al., 2011; Wheeler et al., 2011); and (3) divide the face into left and right areas of interest (Butler et al., 2005; Cangöz et al., 2013; Jansari et al., 2011). Using different areas of interest to explore the characteristics of subjects’ gaze at own-race and other-race faces could better reveal the reasons for the other-race effect.

First, some researchers mapped three areas of interest (eyes, nose, and mouth), asked subjects to complete a face learning and recognition task, which revealed that East Asian subjects fixated on the nose more often than the eyes and mouth when they recognized both the Western and East Asian faces (Kelly et al., 2010; Miellet et al., 2013), whereas Western subjects fixated on the eyes more often than the nose and mouth when they recognized both Western and East Asian faces (Brielmann et al., 2014; Wang et al., 2015). The reason for this difference is that Westerners...
recognize faces via the feature processing strategy, which enables Western subjects to obtain more information from the eyes than from the other face features; therefore, Western subjects fixate on the eyes more often than on other face areas (Briemann et al., 2014). In contrast, the social norms of East Asian groups emphasize that it is impolite to look at others in the eyes. Therefore, East Asians do not look at the eyes for extended periods when processing faces (Kelly et al., 2010) but adopt a holistic processing strategy, which enables them to process the whole face from the center of the face to the surrounding area (Chua et al., 2005). Therefore, the nose, which is located in the center of the face, is fixated on more often than other face areas (Wang et al., 2013).

Second, some researchers divided the face into the upper half and the lower half to explore the gaze differences of subjects when they recognize their own-race and other-race faces (Liu et al., 2011; Wheeler et al., 2011). For example, a study by Liu et al. (2011) asked Chinese subjects to scan Chinese and Western faces without any specific task in mind and found that Chinese subjects gazed at the upper half of the face more than the lower half; this tendency was not affected by the race of the face. However, Wheeler et al. (2011) employed this task and obtained different results. Although the study found significantly greater fixation on the upper half than on the lower half of the face, Western subjects fixated significantly more on the upper half of own-race faces than that of African faces and fixated on the lower half of African faces significantly more than that of own-race faces. Wheeler et al. (2011) believed that this outcome was due to the differences in face processing between Eastern and Western subjects. Eastern subjects processed faces from the center to the periphery and used the same processing method for Eastern and Western faces. There was no difference in gaze at the upper and lower parts of the own-race and other-race faces. Western subjects paid more attention to the processing of the eyes (belonging to the upper half of the face), and Western subjects focused on the upper half of faces significantly more than the lower half of the faces. However, there are significant differences in the structure of Western and African faces, mainly in the lower half of the face. African faces have wider noses and mouths than Western faces and are more likely to attract individual attention (Farkas et al., 2000; Wheeler et al., 2011). Thus, Western subjects fixated less on the lower half of own-race faces than on the lower half of African faces, while they fixated more on the upper half of own-race faces than on that of African faces. Wheeler et al. (2011) argued that the differences in how Western subjects gazed at Western and African faces were due to differences in the face structure of the two races.

1.2. The left lateralization of cross-racial face recognition

In summary, the above studies mainly explored the cross-racial differences of subjects scanning different facial areas of interest (eye, nose, and mouth areas of interest and upper and lower areas of interest). However, it is unclear whether there are cross-ethnic differences in subjects’ gazes at the left- and right-lateral areas of interest on faces of their own race and other races. This is also the main question that the present study explored. Analysis of existing studies found that right-handed Western subjects have left lateralization when recognizing their own-race faces (Innes et al., 2016). Experimental studies using an eye tracker confirmed that right-handed Western subjects prefer to extract information from the left side of the face (Butler et al., 2005; Cangoz et al., 2013; Jansari et al., 2011). For example, some researchers divided Western faces into left and right areas of interest and asked right-handed Western subjects to scan those faces without any specific task in mind; the results showed higher fixation counts on the left side than on the right side of the face (Everdell et al., 2007; Cangoz et al., 2013). There are two main reasons for right-handed Western subjects’ left-lateralized recognition of faces. First, it may be universal that subjects scan all visual information in a left-lateralized manner (Davies-Thompson et al., 2016). Numerous studies have found that subjects process words (Asanowicz et al., 2017) or images (Verleger and Smigasiewicz, 2015) with left visual lateralization. Face images, being a type of visual information, are also subject to this rule. Second, compared to the right side of the face, the information viewed by the subjects on the left side of the face is closer to the information obtained from the whole face (Wolff, 1933). A chimeric face constructed with the left side (from the viewer’s perspective) of a face and its mirror image is usually rated as more similar to the original face than a chimeric face constructed with the right side of the same face (Brady et al., 2005; Gilbert and Bakan, 1973; Li and Cao, 2017; Proietti et al., 2015). These results all indicate that individuals are more inclined to process the left side of the face than the right side. Notably, the lateralization of face recognition may be affected by left- and right-handedness. Bukowski et al. (2013) found opposite lateralization of face recognition in left-handed and right-handed subjects, with right-handed subjects processing more of the left side of the face, while left-handed subjects processed more of the right side. Similarly, Bulf et al. (2016) reported an effect of handedness on visual bias; left-handed subjects processed the right side of the image significantly more than the left side of the image. Therefore, the left lateralization of face recognition is mainly applicable to the right-handed population.

Although previous studies have found that right-handed Western subjects have left lateralization when scanning faces, it is not clear whether this lateralization also exists in the recognition of faces by Chinese subjects (the Chinese subjects mentioned below are all right-handed) and whether this lateralization is affected by the race of faces. Therefore, the current study explored whether Chinese subjects (right-handed subjects) have the same left visual lateralization when recognizing own-race and other-race faces. Previous studies found that both Eastern and Western subjects processed visual information on the left significantly more than visual information on the right when inspecting words and images (Davies-Thompson et al., 2016). Scanning individual faces in images may be subject to similar lateralization. Therefore, in Experiment 1 of the current study, in accordance with previous studies (Cangoz et al., 2013), all the faces were divided into left and right sides, two areas of interest separated by the midline of the face, as shown in Figure 1, and we hypothesized that the fixation counts and scanning duration would be significantly greater on the left side than on the right side of the face when Chinese subjects inspected both Chinese and Western faces.

Moreover, it is not clear whether the left lateralization of facial information processing by Chinese subjects is applicable to all facial features (eyes, nose, and mouth) when these subjects inspect both Chinese and Western faces. In Experiment 2, we overlapped the left and right areas of interest with the eye, nose, and mouth areas of interest, dividing the facial features (eyes, nose, and mouth) along the midline of the face to define a total of six areas of interest (specifically, the left and right eyes, the left and right sides of the nose, and the left and right sides of the mouth), as shown in Figure 2. According to Kelly et al. (2010), East Asian subjects process the face from the center of the facial area to the

Figure 1. Areas of interest in Experiment 1 (left and right side of the face).
of Chinese Han, Hui and Tibetan people. The Chinese facial images were obtained from the Cohn-Kanade Dataset (Lucey et al., 2010), and 48 Western faces were obtained from the HAPPY facial-expression database (Langlois et al., 2013) and a large majority of individuals are right-handed, only right-handed subjects were selected for this study.

All subjects had normal vision or corrected-to-normal vision, provided informed consent, and had no history of mental illness. This research was approved by the Institutional Review Board of Henan Provincial Key Laboratory of Psychology and Behavior (20221026007).

2.2. Materials

A total of 96 faces were used in Experiment 1: 48 Western facial images were obtained from the Cohn-Kanade Dataset (Lucey et al., 2010), and 48 Chinese facial images were obtained from the “facial-expression database of Chinese Han, Hui and Tibetan people” (Ma et al., 2020). Photoshop CS6 was used to remove the hair, ears, and other irrelevant factors from these faces, and all the faces were converted to grayscale images with a resolution of 640 × 480 pixels. The EyeLink® 1000 Plus eye tracker was used to record the fixation count and fixation duration for each area of interest on these faces. The sampling rate was 1000 Hz, the screen resolution was 1024 × 768 pixels, the subjects were 65 cm away from the screen, the visual angle of the screen was 15.5° × 11.7°, and the visual angle of the face pictures was 9.85° × 7.5°. The area of the whole face was approximately 8 cm², meaning that the left and right areas of interest measured approximately 4 cm² each.

2.2.1. Equipment

Eye movement data were measured by the EyeLink® 1000 Plus eye tracker in binocular tracking recording mode. In the study, the subjects were asked to perform a nine-point calibration task. To maintain the subjects’ attention during the experiment, a one-point calibration was also performed before the start of each trial. The next face image was presented only to subjects who completed the one-point calibration. The sampling rate of the eye positions was 1000 Hz.

2.2.2. Procedure

Before the start of Experiment 1, instructions were presented on the screen, and once the subjects understood them fully, they pressed a key on the keyboard to start the experiment. First, one face picture was presented at the center of the EyeLink® 1000 Plus screen and shown for 5 s. This was followed by the presentation of one fixation point “+”, which was shown for 1 s. This constituted one trial, and another 95 trials were presented one by one. All the subjects were asked to study the 96 randomly presented face images and were also told that there would be a recognition task after the learning task was completed. In fact, there was no recognition task; the purpose of the instruction was to ensure that the subjects scanned the faces intently.

2.3. Results

Repeated-measures ANOVAs with race of face (Chinese and Western) and area of interest (left or right side of the face) as within-subjects variables were conducted on the fixation counts and duration. The result of Mauchly’s sphericity test showed that the data did not satisfy the assumption of sphericity (p > .05); therefore, the ANOVA was corrected using the Greenhouse–Geisser correction.

2.3.1. Fixation counts for areas of interest

The corrected results showed that the main effect of facial area of interest was significant for the fixation count, F(1, 49) = 35.08, p < .001, η² = .42, with the fixation counts for the left side of the face (M = 8.82, SD = 2.40) being greater than those for the right side of the face (M = 5.81, SD = 1.65). The race of the face was not found to have any significant effect (all p > .05).

2.3.2. Duration of fixation on areas of interest

The corrected results showed that the main effect of facial area of interest was significant for the fixation duration, F(1, 49) = 34.01, p < .001, η² = .41, with longer total fixation on the left side of the face than on the right side. The race of the face was not found to have any significant effect (all p > .05). The means and standard deviations of the fixation counts and durations for the areas of interest are presented in Table 1.

3. Experiment 2

3.1. Method

3.1.1. Participants

Fifty-eight Han Chinese subjects (29 males), with an average age of 23.20 years (range 21–26 years), were included in this experiment. The inclusion criteria for subjects were right-handedness, normal or corrected-to-normal vision, informed consent, and no history of mental illness.

3.2. Materials and procedure

The materials and procedure were the same as those used in Experiment 1. The areas of interest for the left and right eyes were approximately

| Area of interest | Fixation count | Fixation duration (ms) |
|------------------|----------------|------------------------|
| Left side of the face | 8.82 ± 2.40 | 2750.41 ± 670.00 |
| Right side of the face | 5.81 ± 1.65 | 1798.15 ± 556.65 |
0.85 cm² each, the areas of interest for the left and right sides of the nose were approximately 0.9 cm² each, and the areas of interest for the left and right sides of the mouth were approximately 0.8 cm² each.

### 3.3. Results

Repeated-measures ANOVAs with the race of the face (Chinese and Western) and the area of interest (left eye, right eye, left side of the nose, right side of the nose, left side of the mouth, and right side of the mouth) as within-subjects variables were conducted on the fixation counts and duration. The result of Mauchly’s sphericity test showed that the data did not satisfy the assumption of sphericity (p > .05); therefore, the ANOVA was corrected using the Greenhouse-Geisser correction.

#### 3.3.1. Fixation counts for areas of interest

The corrected results showed that the main effect of facial area of interest was significant for the fixation count, F(5, 53) = 35.67, p < .001, η² = .39. The fixation counts for the left eye were greater than those for the right eye, and the fixation counts for the left side of the mouth were greater than those for the right side of the mouth; in contrast, no significant effect was found between the left and right sides of the face. There was also a significant interaction between area of interest and the race of the face, F(5, 111) = 23.41, p < .001, η² = .29. We ran a simple effect analysis for both Chinese and Western faces; the fixation counts for the left eye were greater than those for the right eye, and the fixation counts for the left side of the mouth were greater than those for the right side of the mouth. As within-subjects variables were conducted on the fixation counts and duration. The result of Mauchly’s sphericity test showed that the data did not satisfy the assumption of sphericity (p > .05); therefore, the ANOVA was corrected using the Greenhouse-Geisser correction.

#### 3.3.2. Duration of fixation on areas of interest

The corrected results showed that the main effect of facial area of interest was significant for fixation duration, F(5, 53) = 17.99, p < .001, η² = .12. The fixation duration was longer for the left eye than for the right eye, and the fixation duration was longer for the left side of the mouth than for the right side of the mouth; in contrast, no significant effect was found between the left and right sides of the face.

A significant interaction between the area of interest and the race of the face was also found, F(5, 111) = 22.00, p < .001, η² = .28. After a simple effect analysis, we found that for both Chinese faces and Western faces, the fixation duration for the left eye was longer than that for the right eye, F(5, 53) = 39.00, p < .001, η² = .79; the fixation duration for the left side of the mouth was longer than that for the right side of the mouth, F(5, 53) = 42.94, p < .001, η² = .80; and no significant effect was found between the left and right sides of the nose, P > .05. We also found that the duration of fixation on the left eye was longer for Chinese faces than for Western faces, F(1, 57) = 15.7, p < .001, η² = .21. Similarly, the duration of fixation on the right eye was longer for Chinese faces than for Western faces, F(1, 57) = 27.08, p < .001, η² = .24, and a similar pattern was observed for the right side of the nose, F(1, 57) = 16.88, p < .001, η² = .79. The duration of fixation on the left side of the mouth was longer for Chinese faces than for Western faces, F(1, 57) = 14.21, p < .001, η² = .18, and a similar relationship was observed for the right side of the mouth, F(1, 57) = 6.21, p < .05, η² = .08. The means and standard deviations of the duration of fixation on areas of interest for faces of different races are presented in Table 2.

### 4. Discussion

To explore the lateralization characteristics of Chinese subjects’ behavior when scanning Chinese and Western faces, Experiment 1 divided faces into two areas of interest, namely, the left and right sides of the face, to explore whether Chinese subjects scanned Chinese and Western faces in a left-lateralized manner. The results showed that Chinese subjects used left-lateralized pattern when scanning faces of their own and other races, and this lateralization was not affected by the race of the faces. To further explore whether this left lateralization is applicable to all facial features, Experiment 2 divided the face into 6 areas of interest: left eye, right eye, left nose, right nose, left mouth, and right mouth. The experimental results showed that there was left lateralization when Chinese scanned the eye and mouth areas of own-race and Western faces, and this lateralization was also not affected by the race of the faces.

#### 4.1. Consistent lateralization of viewing patterns for faces of different races

In Experiment 1, we found that the fixation counts and duration for the left side of the face exceeded those for the right side of the face when Chinese subjects scanned both Chinese and Western faces, which supported our first hypothesis. There are two explanations for this outcome. First, Harrison and Strother (2020) found that recognition accuracy was higher for the left field of view than for the right field of view. Accordingly, subjects are more effective at recognizing the side of the face that is in the left side of their field of view; therefore, focusing on that side of the face could increase the efficiency of facial recognition. Second, left visual lateralization may also be a general human processing habit, and some studies have found that both Chinese and Western subjects process visual information, such as words and images, in the left side of the visual field more than in the right side (Davies-Thompson et al., 2016). Face images, as a type of visual information, are also subject to this rule. Research on face recognition also supports this idea; the information viewed by the subjects on the left side of the face is closer to the information obtained from the whole face (Wolff, 1933), and subjects prefer to extract information from the left side of the face compared to the right side of the face (Prouietti et al., 2015). Notably, Bukowski et al. (2013) found that not all subjects used left visual lateralization when recognizing faces. Right-handed subjects fixated on the left side of the face more often than the right side, whereas left-handed subjects did not show the same pattern. This finding also corroborates the results of the current study because all subjects in this study were right-handed. The results of Experiment 1 indicate that the left side of the face may be more important to viewers than the right side during facial processing, and left visual lateralization in scanning faces may not be affected by the race of the faces.

| Area of interest | Fixation count | Fixation duration (ms) |
|------------------|----------------|------------------------|
| Chinese faces | Western faces | Chinese faces | Western faces |
| Left eye | 2.99 ± 1.44 | 2.65 ± 1.50 | 897.85 ± 402.46 | 833.85 ± 431.72 |
| Right eye | 1.89 ± 1.10 | 1.43 ± 1.04 | 558.61 ± 311.22 | 446.20 ± 237.37 |
| Left nose | 2.82 ± 1.30 | 2.54 ± 1.10 | 925.82 ± 480.64 | 804.09 ± 438.27 |
| Right nose | 3.04 ± 1.07 | 2.88 ± 0.96 | 974.66 ± 429.40 | 855.08 ± 347.85 |
| Left mouth | 1.63 ± 1.02 | 1.35 ± 1.06 | 504.36 ± 285.85 | 426.41 ± 287.43 |
| Right mouth | .93 ± 0.65 | .80 ± 0.64 | 301.63 ± 219.27 | 272.78 ± 234.19 |
4.2. Consistently lateralized viewing of facial features for faces of different races

Although Experiment 1 showed that Chinese subjects scanned Western and Chinese faces with similar left visual lateralization, it was not clear whether all the facial features were subjected to left-side visual lateralization when Chinese subjects scanned both Chinese and Western faces. Therefore, in Experiment 2, the facial features (eyes, nose, and mouth) were divided into six areas of interest along the midline of the face to explore this matter. The results showed the following: (1) Left lateralization is not applicable to all facial features but only to the eyes and mouth; there is no left lateralization for gazes directed at the nose. (2) The left lateralization of areas of interest, including the eyes and mouth, is not affected by the race of the faces. These results support our second hypothesis. Next, we analyzed the reasons for the abovementioned results in detail.

(1) Left lateralization is not applicable to all facial features but only to the eyes and mouth, and there is no left lateralization for gazes directed at the nose. As we mentioned in the introduction, the social norms of East Asian groups emphasize that it is impolite to meet people’s eyes, and East Asian subjects often do not look directly in people’s eyes when interacting with them face to face (Kelly et al., 2010). These subjects usually process faces using a scanning pattern that moves from the center of the face to the surrounding area (Chua et al., 2005). Therefore, Chinese subjects gazed at own-race and other-race faces primarily around the center (nose) and gazed at the center of the face more often than other areas of interest (Chua et al., 2017). Because the nose is the center of the face, subjects gazing at the left and right sides of the nose may perceive no significant difference; therefore, left visual lateralization was reflected only in the viewing of the eyes and mouth and not the nose. This finding demonstrates that Chinese subjects processed information from the left side of faces significantly more often than information from the right side of faces and that this trend is also applicable to the eyes and mouth specifically. Furthermore, this outcome indicates that the left visual lateralization of face scanning in Experiment 1 was mainly caused by left-lateralized scanning of the eyes and mouth.

(2) The left lateralization of gaze directed at the eyes and mouth was not affected by the race of the faces. Eye-tracking studies have found that subjects process faces of their own and other races using the same scanning patterns (Liu et al., 2011; Wheeler et al., 2011). East Asians focus on the nose of the target face regardless of race, and Caucasians focus on the eyes regardless of race (Kelly et al., 2010). This left lateralization is unaffected by the race of faces in the sense that Chinese individuals adopted the same processing strategy to scan Chinese and Western faces.

Interestingly, the results of Experiment 2 also showed that the fixation counts and scan of the left and right eyes, nose, and mouth were greater for Chinese faces than for Western faces. That is, Chinese subjects paid more attention to the features of own-race faces than other-race faces (Goldinger et al., 2009). Unexpectedly, the study did not find any cross-race differences in lateralization of face scanning, which may be because Chinese subjects use the same processing strategy to scan own-race and other-race faces—subjects process the face from the center to the surrounding area. There are differences not only in fixation on facial features but also in the consistency of left visual lateralization for Chinese individuals scanning own-race and Western faces.

In conclusion, the current study showed that Chinese subjects scan faces of their own race and other races with a similar left-lateralized pattern, which is mainly reflected in the scanning of the eyes and mouth.

5. Limitations

Two aspects also need to be explored in the future. First, the current study merely provided evidence for left visual lateralization in Chinese subjects scanning faces of their own and other races. Therefore, future research should focus on comparing the visual lateralization of face recognition in subjects of different races. Second, the left visual lateralization of facial recognition in the current study was demonstrated on a mixed set of facial expressions and neutral faces. Previous studies have argued that fixation on facial features is significantly different when subjects scan facial expressions of different types, e.g., that they gaze at the eyes more often than other features for happy facial expressions and gaze at the mouth more often than other features for sad facial expressions (Schurgin et al., 2014). Therefore, visual lateralization in the viewing of different types of facial expressions must be explored in future work. Third, the subjects in this study were all right-handed. Since different hand dominance may have an impact on the lateralization of face recognition, subsequent research could focus on the effect of handedness on lateralized facial viewing patterns.

Declarations

Author contribution statement

Jialin Ma; Bo Yang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Yongxin Li: Analyzed and interpreted the data; Wrote the paper.

Funding statement

This study was supported by Science and technology projects in Henan Province [222102320175].

Data availability statement

Data associated with this study has been deposited at https://pan.baidu.com/s/14wXlfpYapFPH5_HUXLD99Q?pwd=1uwb, reference number [1uwb].

Declaration of interest’s statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

Asanowicz, D., Kruse, L., Śmigaszewicz, K., Verleger, R., 2017. Lateralization of spatial rather than temporal attention underlies the left hemifield advantage in rapid serial visual presentation. Brain Cognit. 118, 54–62.

Brady, N., Campbell, M., Flaherty, M., 2005. Perceptual asymmetries are preserved in memory for highly familiar faces of self and friend. Brain Cognit. 58 (3), 334–342.

Breitman, A.A., Bültthoff, H., Armann, R., 2014. Looking at faces from different angles: Europeans fixate different features in Asian and Caucasian faces. Vis. Res. 100 (6), 105–112.

Burks, H., Hevia, M., Cassia, V.M., 2016. Small on the left, large on the right: numbers in scene perception. Proc. Natl. Acad. Sci. U.S.A. 102 (35), 12629–12633.

Chuk, T., Chan, A.B., Hsiao, J.H., 2017. Is having similar eye movement patterns during face learning and recognition beneficial for recognition performance? Evidence from hidden Markov modeling. Vis. Res. 141, 204–216.
