Pergamon

PII: S0028–3932(96)00111–X

Neuropsychologia, Vol. 35, No. 5, pp. 685–693, 1997
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Printed in Great Britain
0028–3932/97 $17.00+0.00

Perceptual asymmetries in judgements of facial attractiveness, age, gender, speech and expression

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(*Received* 13 *March* 1996; *accepted* 8 *October* 1996)

Abstract—Lateralization of perception of various facial attributes (age, attractiveness, gender, lip-reading and expression) was studied using chimaeric faces in which the sides of the face differed along one dimension (e.g. the left side was male and the right side female). Computer graphics were used to eliminate naturally occurring physical asymmetries (e.g. those present in the mouth during speech and spontaneous smiles) and obvious vertical mid-line joins in the photo-realistic chimaeric stimuli. Following previous studies, we found that subjects' judgements of gender and expression were influenced more by the left than the right side of the face (viewer's perspective). This left of face stimulus bias extended to judgements about facial attractiveness and facial age. This was not true of lip-reading stimuli; for these stimuli subjects were influenced more by the right than the left side of the face. Thus using free fixation, it appears possible to demonstrate in normal subjects that brain processes underlying judgements of facial speech display different lateralization from the judgements of other facial dimensions. © 1997 Elsevier Science Ltd.

Key Words: face; hemisphere; lateralization; free vision; chimaeric; lip-reading.

Introduction

It has long been part of folklore that the side of the face to the viewer's left looks more like the owner than the side to the viewer's right. This bias was first investigated scientifically by Wolff [25] who observed that chimaeric face stimuli produced by combining the left and mirror left of peoples' faces were thought by subjects to look more like the original people than chimaeric faces produced by combining the right and mirror right (Fig. 1, Normal Condition). This bias was first thought to arise as a property of the face owner rather than a property of the viewer. It was speculated that the left side of a person's face was more 'public' in character; i.e. more representative of the individual. Gilbert and Bakan [10] dispelled this speculation by training subjects to name unfamiliar faces, some of which had been mirror reversed (Fig. 1, Reversed Condition). They found that judgements of likeness of chimaeric stimuli to training stimuli depended on which side of the face was on the observer's left side during training. Thus Gilbert and Bakan found the bias in facial likeness was due to asymmetries in the perception of faces rather than arising from physical asymmetries expressed by individual faces. Several authors define the sides of a person's face with respect to the face owner [10, 25, 27] but since the perceptual bias described above is due to asymmetries in the viewer we will refer to the sides of face stimuli from the viewer's perspective (except where stated explicitly otherwise).

Visual perceptual asymmetries may be due to the predominance of the right hemisphere in facial identification since it is more intimately connected to primary visual areas responsible for the processing of visual information from the left hemifield [10]. Experiments using chimaeric stimuli have also shown that the observer's right hemisphere is not only more influential in processing facial identity than the left but also predominates in other areas of facial processing including perception of facial expression [6, 18, 21] and gender [14].

Why the right hemisphere predominates in the processing of facial identity, expression and facial gender is unclear. Neurological evidence implicates the right hemisphere in the processing of faces. For example, most, if not all, prosopagnosic patients have sustained damage to their right hemisphere [7]. The selective attention to the left of faces found when testing facial chimaeras may be a reflection of the right hemisphere being more efficient than the left hemisphere at the processing of facial material *per se*. Alternatively, the right hemisphere may be better at the analysis of the spatial configuration of *any* visual pattern and, because of this, predominates

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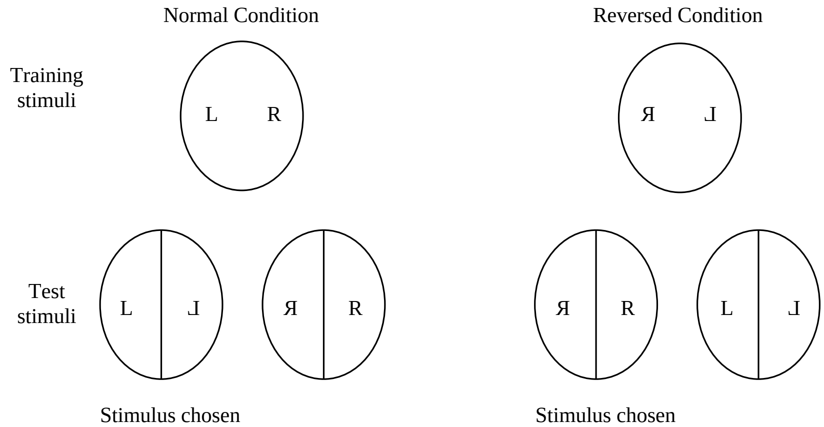

Fig. 1. Training stimuli: ovals represent facial stimuli, L and R denoting the sides of the face to the *left and right for the viewer*, *as originally photographed*. Test stimuli: split ovals represent chimaeric faces made from one half of the training face and its mirror reflection joined at the vertical midline. Wolff (1933) found that subjects trained on the Normal Condition thought that the chimaeric stimulus made from the side of the face falling to the left (L) looked more like the training face than the chimaeric made from the side of the face falling to the right (R). In the Reversed Condition subjects were trained with a mirror image of the whole training face. Note that reversed L and reversed R denote the sides of the training stimulus in relation to the *original photographic image*. Gilbert and Bakan (1973) showed that the bias in matching identity was due to perceptual asymmetries in the viewer because subjects trained on the Reversed Condition still chose the chimaera made from the half face which was on their left during training (denoted by a reversed R).

in face processing [18]. A different explanation is that asymmetrical patterns of eye scanning from left to right (arising from reading habits) may result in the left hemifield receiving more attention than the right hemifield (see Rhodes [19] for review). This scanning bias should result in preferential attention to the left-hand side of all visual stimuli.

Judgements on facial dimensions could also be biased by inspection of the side of the owner's face which normally portrays more physical information relevant to a given judgement. Facial movements made both during spontaneous expressions and during talking are asymmetrical in the amount of information portrayed (Fig. 2a, b). Facial expressions are more intense on the lower left half of emitters' faces [2] and the right side of the brain has been argued to play a greater part in the control of emotional expression [2]. Indeed it may be through the stronger contralateral motor outputs that the right hemisphere predominates in influencing the lower left half of the owner's face (see Fig. 2a). Since posed smiles tend to be symmetric and spontaneous smiles asymmetric, the left side of the owner's face will also be informative as to whether a smile is genuine [23]. So from a viewer's perspective the right half of face images should be more important in the judgement of real emotions. Previous studies [6, 18, 21] have, however, found that perception of facial expression is biased towards information occurring on the left side of face images (see Fig. 2c).

Facial movements during talking are biased to the right side of the owner's face (Fig. 2b). Most people (76%) tend to talk with a greater amplitude of mouth movements on the right side of their mouth than on their left. This is presumably due to the greater involvement of the speaker's left hemisphere in language production and the stronger connection between left hemisphere motor control systems and the musculature of the left side of the speaker's face [11, 24]. As the speaker's right falls to the left of the viewer, the left side of the face images should be more informative about speech sounds when talking and it may be expected that viewers would attend more to the left side of stimuli when lip-reading.

This idea is supported to some extent by the results of one previous paper investigating the laterality of lip-reading. In two experiments, Campbell [5] demonstrated a right hemisphere advantage (left visual hemifield) for lip-reading. In both experiments tachistoscopic presentation was used (200 msec stimulus duration in the first experiment and 100 msec in the second). The right hemisphere bias found in this experiment, could, however, have been due to other factors. Sergent has claimed that the use of fast presentations with visually complex stimuli that are hard to discriminate favours right hemisphere visual processing strategies [22]. The relationship between presentation time and hemispheric bias is, however, complicated and other researchers have suggested the opposite (see Nicholls [16]).

Neuropsychological evidence suggests a critical role for the left hemisphere in the perceptual aspects of lip-reading. Campbell *et al.* [4] investigated two individuals with lateralized posterior brain lesions. Mrs D had right occipito-temporal lesions and severe face recognition problems (prosopagnosia). The other individual, Mrs T, had left occipito-temporal lesions and severe reading deficits (alexia). Campbell *et al.* found that the right hemisphere lesioned patient was able to lip-read normally but that the left hemisphere lesioned patient was unable to lip-read. This evidence, combined with the finding that fast presentation of stimuli may itself cause right hemisphere bias in normal viewers [22], raises the possibility

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