



Reviews and perspectives

Laterality effects in normal subjects' recognition of familiar faces, voices and names. Perceptual and representational components

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ABSTRACT

A growing body of evidence suggests that a different hemispheric specialization may exist for different modalities of person identification, with a prevalent right lateralization of the sensory-motor systems allowing face and voice recognition and a prevalent left lateralization of the name recognition system. Data supporting this claim concern, however, much more disorders of familiar people recognition observed in patients with focal brain lesions than results of experimental studies conducted in normal subjects. These last data are sparse and in part controversial, but are important from the theoretical point of view, because it is not clear if hemispheric asymmetries in the recognition of faces, voices and names are limited to their perceptual processing, or also extend to the domain of their cortical representations. The present review has tried to clarify this issues, taking into account investigations that have evaluated in normal subjects laterality effects in recognition of familiar names, faces and voices, by means of behavioural, neurophysiological and neuroimaging techniques. Results of this survey indicate that: (a) recognition of familiar faces and voices show a prevalent right lateralization, whereas recognition of familiar names is lateralized to the left hemisphere; (b) the right hemisphere prevalence is greater in tasks involving familiar than unfamiliar faces and voices, and the left hemisphere superiority is greater in the recognition of familiar than unfamiliar names. Taken together, these data suggest that hemispheric asymmetries in the recognition of faces, voices and names are not limited to their perceptual processing, but also extend to the domain of their cortical representations

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1. Introduction

Recognition of familiar people is a fundamental biological function for the human species, because it allows to distinguish persons with whom we have a large variety of personal experiences, ranging from feelings of warm and tender acquaintance, to a simple professional knowledge, to displeasing, nasty or mad interpersonal relationships. A complex, multimodal recognition system based on visual (face), auditory (voice) and verbal (name) recognition channels has, therefore, evolved in the brain, to quickly and efficiently allow the recognition of known people. [Bruce and Young \(1986\)](#) model of familiar faces recognition has been the first cognitive model that has tried to analyse the stages involved in recognition and identification of familiar people. According to this model, the first cognitive step of familiar faces recognition is the formation of a view independent structural description of a seen face, which can be compared with all the known faces stored in the Face Recognition Units (FRUs). A similar process has afterwards been hypothesized for other sources of person recognition, such as voices and names by [Burton, Bruce, and Johnston \(1990\)](#), [Burton, Bruce, and Hancock \(1999\)](#), [Brédart, Valentine, Caldor, and Gassi \(1995\)](#) and [Valentine, Brennen, and Bredart \(1996\)](#), who assumed that the outcome of the corresponding perceptual processing could be matched with information stored in the corresponding voice (VRU) or name recognition units (NRU). According to all these models, the second step of the people identification process requires the convergence of information stored in these modality-specific units into person-identity nodes (PINs), allowing identification of a particular person and retrieval of the corresponding semantic (biographical) information. A growing body of evidence suggests that a different hemispheric specialization exists for different modalities of person identification, with a prevalent right hemisphere (RH) lateralization of the sensory-motor systems allowing face and voice recognition and a prevalent left (LH) lateralization of the verbal name recognition system.

Data supporting this claim concern, however, much more disorders of familiar people recognition observed in patients with focal brain lesions than results of experimental studies conducted in normal subjects. In brain-damaged patients familiar face recognition disorders have been frequently described in a condition called 'prosopagnosia' by [Bodamer \(1947\)](#), whereas voice recognition disorders have been more rarely described in a condition called 'phonagnosia' by [Van Lancker and Canter \(1982\)](#). The former are provoked either from bilateral or from right-sided lesions ([De Renzi, 1986](#); [Sergent & Signoret, 1992](#); [De Renzi, Perani, Carlesimo, Silveri, & Fazio, 1994](#); [Gainotti & Marra, 2011](#)), whereas the latter are usually due to bilateral or right temporal lesions ([Van Lancker & Canter, 1982](#); [Van Lancker, Kreiman, & Cummings, 1989](#); [Gainotti, 2011](#)).

On the other hand, experimental studies dealing with laterality effects in face, voice and name recognition in normal subjects are sparse and in part controversial. Thus, even if most authors agree that in normal subjects familiar proper names are mainly processed by the left hemisphere, [Van Lancker and Ohnesorge \(2002\)](#) presented experimental evidence in favour of a right hemisphere ability in the recognition of famous proper names. Analogously, contrary to current thought assuming a right hemisphere superiority in the recognition of familiar faces, [Marzi and Berlucchi \(1977\)](#) and [Fairweather, Brizzolara, Tabossi, and Umiltà \(1982\)](#) reported behavioural data suggesting a right visual field (left hemisphere) superiority in recognition of famous faces in normals. These conflicting results are probably due in part to methodological and in part to theoretical reasons. Thus, for instance, authors who believe that the RH has a special role in establishing, maintaining, and processing personally relevant aspects of the

individual's world (e.g. [Van Lancker, 1991](#)) tend to assume that this hemisphere must be involved in different aspects of personally "familiar" people, including their names. On the other hand, authors who think that the inter-hemispheric differences substantially concern the superiority of the RH for non-verbal (sensory-motor) and of the LH for linguistic meaningful stimuli (e.g. [Gainotti, 2012](#)) tend to predict a prevalence of the RH in the treatment of familiar faces and voices and of the LH in the treatment of familiar names. Results of experimental studies which have investigated laterality effects in face, voice and name recognition in normal subjects are, therefore, important from the theoretical point of view, because they can confirm or cast doubts on general models concerning the role of the right and left hemisphere and the meaning of hemispheric asymmetries.

Since, at our knowledge, no systematic attempt has hitherto been made to summarize behavioural, neurophysiological and neuroimaging studies conducted in normal subjects, to investigate laterality effects in recognition of familiar faces, voices and names, this will be aim of the present survey. To better define the goals of our research, we have not taken into account data generically concerning hemispheric asymmetries in the processing of faces, voices and names, but only those specifically concerning laterality effects in the recognition of faces, voices and names of famous or personally familiar people. This was made because it is now well known that structures involved in the processing of faces, such as the fusiform face area ([Kanwisher, McDermott, & Chun, 1997](#); [Yovel & Kanwisher, 2004](#)) and of voices, such as the superior temporal sulcus ([von Kriegstein, Eger, Kleinschmidt, & Giraud, 2003](#); [von Kriegstein & Giraud, 2004](#); [Dubois et al., 2010](#)) are more developed in the right than in the left hemisphere. It is not known, however, if hemispheric asymmetries in the recognition of faces, voices and names are limited to their perceptual processing, or also extend to the domain of their representations (i.e. to the corresponding stored memories). A hint in this direction could be provided if data of our review would show that the right hemisphere prevalence is greater in tasks involving familiar than unfamiliar faces and voices (namely in the recognition of famous faces and voices), whereas the left hemisphere is more involved in the recognition of familiar than unfamiliar names. Recognizing faces and voices of familiar people should, indeed, rely on the co-activation of visual/face and acoustic/voice areas and of the cortical networks involved in person identity retrieval and autobiographical memory, whereas recognizing non-familiar faces or voices should rely essentially on perceptual steps of face and voice processing. In an attempt to clarify these issues, the present review will consider sequentially investigations that have tried to evaluate in normal subjects laterality effects in (implicit or explicit) recognition of familiar names, faces and voices, by means of behavioural, neurophysiological and neuroimaging techniques.

2. Investigations conducted in normal subjects, to evaluate laterality effects in recognition of familiar personal names

[Table 1](#) reports results of behavioural, neurophysiological and neuroimaging investigations aiming to assess laterality effects in recognition of familiar personal names.

2.1. Behavioural studies

Investigations based on the 'divided visual field technique', in which the superiority of the right or left hemisphere is assessed by presenting separately the stimuli to the left or right hemifield, have been conducted with contrasting results by [Ohnesorge and Van Lancker \(2001\)](#), [Schweinberger, Landgrebe, Mohr, and Kaufmann \(2002a\)](#), [Van Lancker and Ohnesorge \(2002\)](#) and

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