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Impairment of speech-reading in prosopagnosia

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Abstract

The face is a source of information processed by a complex system of partly independent subsystems. The extent of the independence of processing personal identity, facial expression and facial speech remains at present unclear. We investigated the speech-reading ability of a prosopagnosic patient, LH, who is severely impaired on recognition of personal identity and recognition of facial expressions. Previous reports of such cases raised the possibility that speech-reading might still be intact, even if almost all other aspects of face processing are lost. A series of speech-reading tasks were administered to LH including still photographs, video clips, short-term memory tasks for auditory and speech-read materials, and tasks aimed at assessing the impact of the visual input on auditory speech recognition. LH was severely impaired on these tasks. We conclude that in LH there is a strong association between severe face processing deficits and loss of speech-reading skills. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: Prosopagnosia; Speech-reading; Face processing

1. Introduction

The human face is a very rich source of information. Personal identity, age, gender, emotion, as well as speech can all be perceived from the face. The face is not the exclusive bearer of all these types of information. The voice, for example, can be equally informative about the gender, identity, or emotion of a speaker. Moreover, the information conveyed by the face is combined with that contributed by other sources. Speech is a particularly striking example of such multimodal information processing as it is conveyed by the voice as well as the face. The evidence about the combination of the two sources in a single percept is

overwhelming. Seeing the face and watching the movements of the mouth are helpful for understanding speech, even in perfectly healthy individuals (e.g., Summerfield, 1991). The ability to speech-read is thus part of face processing skills, but its study belongs equally to the domain of speech processing as to that of inter-sensory integration. If so, an impairment in speech-reading ability may result either from a face processing deficit, a speech processing deficit, or a problem with inter-sensory integration.

The present report concerns the speech-reading skills of LH, a well-known prosopagnosic patient whose various face processing abilities have been documented by several researchers over the last two decades (e.g., Etcoff et al., 1991; Farah et al., 1995a; Levine and Calvanio, 1989). The main goal of our study is to investigate the extent to which LH's prosopagnosia has left intact his speech-reading ability.

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1.1. Autonomy of different face processing abilities

Models of normal face processing such as the widely quoted model of Bruce and Young (1986) picture different kinds of facial information as so many separate processing routes, all taking off from the stage after which a face is recognized as such, sometimes called the structural face processing stage. The issue of the autonomy of these routes is not one that is well investigated. Recent evidence suggests that this autonomy might not be as radical as previously assumed. For example, a behavioral study by Walker et al. (1995) found that subjects who are familiar with a face are less susceptible to McGurk effects than subjects who are unfamiliar with it.

A strong impetus to the notion of autonomous subsystems for different face processing abilities came from the study of brain-damaged and other neurologically impaired patients, most importantly patients impaired in face processing (prosopagnosics). Such reports have raised the question whether all kinds of information carried by the face would be impaired in these cases (see (Damasio et al., 1990) for an overview). The currently available evidence points either way. Cases of dissociation between the various subcomponents of face recognition have been observed, most notably between personal identity and facial expression recognition. Other cases of prosopagnosia suggest, rather, an association of various face deficits and show that brain-damage affecting one component does not leave intact other face processing abilities.

1.2. Dissociation between face recognition and speech-reading

The issue of spared lipreading in prosopagnosics is particularly intriguing. Intuitively, it seems relatively straightforward to lump together various aspects of face processing that concern the major semantic components of information provided by the face such as personal identity, age or gender and contrast them all with speech-reading ability.

Over the last decade, the fate of speech-reading when a prosopagnosic disorder occurs, has been the topic of strong predictions. These were based

on state of the art knowledge about the lateralization of face processes and of language processing skills. Given the dominance of the right hemisphere for the former and the left hemisphere for the latter, patients with impaired face processing skills were expected to have intact lipreading skills. This was indeed observed by Campbell et al. (1986) in a report about a double dissociation between lipreading and personal identity recognition in two brain-damaged patients.

The first report of just such a dissociation was offered by Campbell et al. (1986). Patient Mrs. D was highly agnostic with profound prosopagnosia, yet could sort pictures of faces according to speech sound and was sensitive to the effects of seeing the speaker in reporting heard speech (McGurk effects). She could speech-read silent spoken numbers as well as discriminate lipspoken vowels and consonants. By contrast, patient Mrs. T was unable to perform such tasks, although she had no difficulty recognizing faces or facial expressions or other visual objects, even though she was alexic. Mrs. T's lesion was unilateral and affected the left hemisphere, Mrs. D's only affected the right. However, more recently, a study of HJA (Campbell, 1992), who is a patient with prosopagnosia and visual agnosia with bilateral lesions of occipito-temporal areas, showed that he could not classify photographs of speaking faces. He was however completely normal with dynamic speech-reading stimuli. In bimodal speech tasks (in which visual and auditory input are provided simultaneously) he had normal audio-visual integration. The critical dissociation in this case thus seems not to be between speech versus non-speech aspects of face processing, but between recognizing information provided by still versus dynamic displays.

The importance of visual movement pathways for speech-reading is illustrated by patient LM (Campbell, 1996a). LM's lesion affected only the cortical visual movement areas, including area V5, and sparing areas V1-V4 which are all damaged in HJA. LM could only classify still photographs and did not show McGurk effects. This dissociation between static and dynamic inputs to speech-reading would imply that at least in some basic

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