CORTEX 64 (2015) 157–168

Available online at www.sciencedirect.com

ScienceDirect

Journal homepage: www.elsevier.com/locate/cortex

Research report

Perception of co-speech gestures in aphasic patients: A visual exploration study during the observation of dyadic conversations

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ARTICLE INFO

Article history:
Received 23 May 2014
Reviewed 11 Jun 2014
Revised 7 July 2014
Accepted 20 October 2014
Action editor Roberto Cubelli
Published online 4 November 2014

Keywords:
Gestures
Visual exploration
Dialogue
Aphasia
Apraxia
Eye movements

ABSTRACT

Background: Co-speech gestures are part of nonverbal communication during conversations. They either support the verbal message or provide the interlocutor with additional information. Furthermore, they prompt as nonverbal cues the cooperative process of turn taking. In the present study, we investigated the influence of co-speech gestures on the perception of dyadic dialogue in aphasic patients. In particular, we analysed the impact of co-speech gestures on gaze direction (towards speaker or listener) and fixation of body parts. We hypothesized that aphasic patients, who are restricted in verbal comprehension, adapt their visual exploration strategies.

Methods: Sixteen aphasic patients and 23 healthy control subjects participated in the study. Visual exploration behaviour was measured by means of a contact-free infrared eye-tracker while subjects were watching videos depicting spontaneous dialogues between two individuals. Cumulative fixation duration and mean fixation duration were calculated for the factors co-speech gesture (present and absent), gaze direction (to the speaker or to the listener), and region of interest (ROI), including hands, face, and body.

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http://dx.doi.org/10.1016/j.cortex.2014.10.013

Results: Both aphasic patients and healthy controls mainly fixated the speaker's face. We found a significant co-speech gesture × ROI interaction, indicating that the presence of a co-speech gesture encouraged subjects to look at the speaker. Further, there was a significant gaze direction × ROI × group interaction revealing that aphasic patients showed reduced cumulative fixation duration on the speaker's face compared to healthy controls. *Conclusion:* Co-speech gestures guide the observer's attention towards the speaker, the source of semantic input. It is discussed whether an underlying semantic processing deficit or a deficit to integrate audio-visual information may cause aphasic patients to explore less the speaker's face.

1. Introduction

Co-speech gestures can be defined as hand movements that accompany spontaneous speech and they are thought to have a nonverbal communicative function (Kendon, 2004). Nonverbal behaviour in humans is most often idiosyncratic, meaning that in contrast to verbal language no common lexicon for gestural expression exists. Therefore, a wealth of classification systems for co-speech gestures has emerged over time (Lott, 1999). Co-speech gestures can be redundant (e.g., pointing while naming an object), supplementary (e.g., shrug to express one's uncertainty), or even compensatory to direct speech (e.g., ok sign). In addition, they were also found to facilitate lexical retrieval (Krauss & Hadar, 1999) and to complement speech prosody (Krahmer & Swerts, 2007).

Aphasia is an acquired language disorder that occurs as a consequence of brain damage to the language dominant hemisphere. It is a disorder with supra-modal aspects that commonly affects both production and comprehension of spoken and written language (Damasio, 1992). The disorder may be explained from a language-based or from a cognitive processing view. The language-based, clinically oriented approach assumes that neural damage directly affects specific language functions causing linguistic deficits on the phonological, syntactical, and semantic level of language processing. The cognitive view suggests that aphasic symptoms are caused by impaired cognitive processes which support language construction. These cognitive processes can be understood as a specialized attentional or memory system which is vulnerable to competing input from other processing domains (Hula & McNeil, 2008).

Previous work in aphasic patients focused on gesture production and presented conflicting evidence. Some studies suggest that patients communicate better if they use gestures (Behrmann & Penn, 1984; Herrmann, Reichle, Lucius-Hoene, Wallesch, & Johannsen-Horbach, 1988; Lanyon & Rose, 2009; Rousseaux, Daveluy, & Kozlowski, 2010); others claim that the ability to use gestures and to speak breaks down in parallel in aphasia (Cicone, Wapner, Foldi, Zurif, & Gardner, 1979; Duffy, Duffy, & Pearson, 1975; Glosser, Wiener, & Kaplan, 1986). There are different explanations for the inconsistency of findings: Rimé and Schiaratura (1991) suggested that it is difficult to compare the results of different studies, because the authors provided their own solution to handle gesture classification. Furthermore, co-occurrence of apraxia, an impairment of the ability to perform skilled, purposive limb movements (Ochipa & Gonzalez Rothi, 2000), has often been neglected in studies on gesture production.

The analysis of visual exploration provides insights for the understanding of gesture processing. Moreover, the recording of eye movements has proven to be a valid and reliable technique to assess visual exploration behaviour (Henderson & Hollingworth, 1999). Previous studies analysed healthy subjects' visual exploration of co-speech gestures while observing an actor who was retelling cartoon stories. These studies found that gestures attract only a minor portion of attention (2–7%), while the speaker's face is much more fixated (90–95%) (Beattie, Webster, & Ross, 2010; Gullberg & Holmqvist, 1999, 2006; Gullberg & Kita, 2009; Nobe, Hayamizu, Hasegawa, & Takahashi, 2000). To the best of our knowledge the visual exploration behaviour of co-speech gestures has not been studied in aphasic patients.

In the present study, we were interested in the visual exploration of a dyadic dialogue condition. Dyadic dialogue can be defined as two people who are engaged in a conversation. In contrast to monologue, which can stand for itself, dialogue depends on the collaboration between the interlocutors (Clark & Wilkes-Gibbs, 1986) and requires processes such as the organization of turn taking (Sacks, Schegloff, & Jefferson, 1974). In this study, we presented spontaneous dyadic dialogues on video while visual exploration behaviour of aphasic patients and healthy controls was assessed by means of an infrared eye-tracking device. Previous research in multiparty conversations suggests that people most likely look at the person who is speaking or whom they are speaking to (Vertegaal, Slagter, van der Veer, & Nijholt, 2000). In addition, Hirvenkari et al. (2013) reported that after a turn transition the gaze is directed towards the speaking person. Therefore it could be assumed that non-involved observers are also inclined to look at the speaker, while following the dyadic conversation. Moreover, we were interested whether co-speech gestures have an additional influence on gaze direction. Thus, our first hypothesis is that co-speech gestures modulate gaze direction of the observer towards the speaking actor in the video. Since auditory speech perception can be affected in aphasia (Hickok & Poeppel, 2000) patients may rely more on other communication channels which results in a modified visual exploration pattern of face and hand region. Thus the second hypothesis is that aphasic patients