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# Communicating without a functioning language system: Implications for the role of language in mentalizing

Roel M. Willems[a,*], Yael Benn[b], Peter Hagoort[a,c], Ivan Toni[a], Rosemary Varley[b]

[a] Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, P.O. Box 9101, 6500 HB Nijmegen, The Netherlands
[b] Human Communication Sciences, University of Sheffield, UK
[c] Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands

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ABSTRACT

A debated issue in the relationship between language and thought is how our linguistic abilities are involved in understanding the intentions of others ('mentalizing'). The results of both theoretical and empirical work have been used to argue that linguistic, and more specifically, grammatical, abilities are crucial in representing the mental states of others. Here we contribute to this debate by investigating how damage to the language system influences the generation and understanding of intentional communicative behaviors. Four patients with pervasive language difficulties (severe global or agrammatic aphasia) engaged in an experimentally controlled non-verbal communication paradigm, which required signaling and understanding a communicative message. Despite their profound language problems they were able to engage in recipient design as well as intention recognition, showing similar indicators of mentalizing as have been observed in the neurologically healthy population. Our results show that aspects of the ability to communicate remain present even when core capacities of the language system are dysfunctional.



## 1. Introduction

How language is related to thought is a key issue in the mind sciences. A much-debated issue is how language is linked to our capacity to understand other people's intentions, thoughts, and beliefs ('mentalizing'). It has been suggested that the language system is crucially involved in representing and understanding other people's mental states (e.g. Carruthers, 2002; Newton & de Villiers, 2007). An important theoretical reason for positing this relationship is that the recursive capacity of human language allows for representations in which one proposition is embedded inside of another (e.g. [She believes that [he is on his way to work]]; Carruthers, 2002; Pyers, 2006). Alternatively, it has been hypothesized that communicative and linguistic abilities are cognitively distinct (Bara, 2010; Levinson, 2000, 2006; Sperber & Wilson, 1986; Tomasello, 2008; Tomasello, Carpenter, Call, Behne, & Moll, 2005).

The empirical evidence on this issue is inconclusive (see Willems & Varley, 2010). On the one hand, there is evidence for a necessary role of language in intention understanding. For instance, it was found that performance on a false belief task (a standard indicator of mentalizing), was diminished when participants concurrently performed a verbal shadowing task (Newton & de Villiers, 2007). The rationale of that study was that verbal shadowing taxes the language system and that this leads to reduced performance on mentalizing tasks. On the other hand, findings from neuroimaging studies in healthy humans (Willems et al., 2010), as well as from mentalizing performance in aphasic patients (Varley & Siegal, 2000) seem to suggest that language and mentalizing are separable cognitive constructs. For instance, in an earlier study we found that parts of the cortical 'mentalizing network' (medial prefrontal cortex) were sensitive to a change in communicative effort, but not to a change in linguistic difficulty. Traditional language areas (e.g. left inferior frontal cortex) showed the opposite pattern of response: sensitivity to linguistic difficulty, but not to communicative effort.

These earlier results were obtained in young, healthy adults and the method of choice (fMRI) leads to correlational evidence for the involvement of a given brain area. In the current study we aimed at furthering our understanding of the relationship between mentalizing and language capacities by investigating how severe and irreversible damage to the language system impacts performance on a non-linguistic communication paradigm that forces participants to generate and interpret new intentional behaviors. Four severely aphasic participants took part in the Tacit Communication Game (TCG; de Ruiter, Noordzij, Newman-Norlund, Hagoort, & Toni, 2007; de Ruiter et al., 2010; Newman-Norlund et al., 2009; Noordzij et al., 2009), a task in which a Sender communicates a

* Corresponding author. Tel.: +31 24 3614793; fax: +31 24 3610989.
*E-mail address:* r.willems@donders.ru.nl (R.M. Willems).

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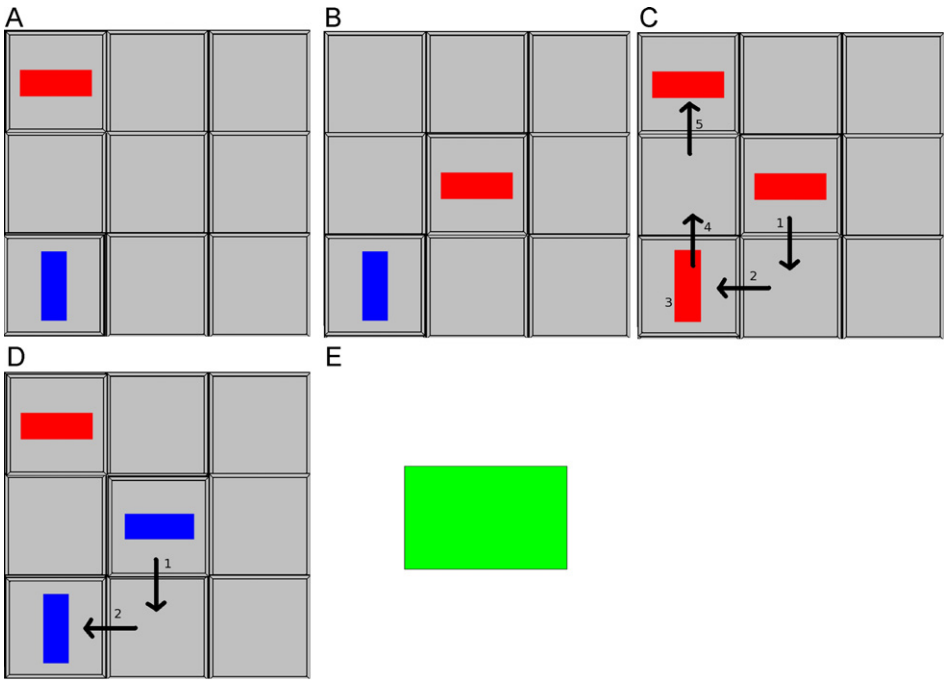


**Fig. 1.** The TCG playing board and tokens and sequence of events in a trial, viewed from the Sender's perspective. The Sender's token is in red, the Receiver's token is in blue. (A) The Sender sees the goal configuration. The Receiver does not see the goal configuration. (B) The Sender sees the start configuration. (C) The Sender moves his token around and gives the turn to the Receiver. (D) The Receiver moves her token into the position and rotation indicated by the Sender. (E) Both players get feedback (green square). The Sender's strategy illustrated in this figure (panel C) is strategy A, see Section 2. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

spatial configuration to another individual (Receiver) in a visuo-spatial setting. Importantly, the Sender knows the end-state of a trial, whereas the Receiver does not. This means that the Sender has to creatively use movement of his token across a playing board to signal where the Receiver has to move her token (Figs. 1 and 2 and Section 2). This paradigm taps into the ability to generate and understand a message signaling a communicative intention to someone else, while maintaining rigorous experimental control (see below and de Ruiter et al., 2007; Newman-Norlund et al., 2009; Noordzij et al., 2009). Specifically, depending upon the role one plays in the paradigm, the participant needs to generate a communicative message, taking knowledge of the other person into account (*recipient design*), or has to recognize the communicative message generated by the other (*intention recognition*). In the remainder of the manuscript we refer to these abilities as 'mentalizing' or 'communicative' abilities, although we are aware of the fact that recipient design and intention recognition are only part of mentalizing (see de Ruiter et al., 2007 for discussion).

If communicative message generation/understanding necessitates a functioning (syntactic) language system, individuals with severe aphasia (including agrammatism) should be unable to successfully convey the message needed to succeed on the TCG to another individual. By contrast, if communicative intention generation and understanding is cognitively distinct from language, our participants should fare well on this task.

Successful performance of the present task would constitute empirical evidence for the clinical observation that those with severe damage to the language system can retain a largely untapped communicative potential (e.g. Goodwin, 2006), a capacity that can be easily overlooked in clinical practice, particularly in the absence of methods to systematically evaluate this potential. Such evidence could provide an impetus for devising augmentative strategies for communication.

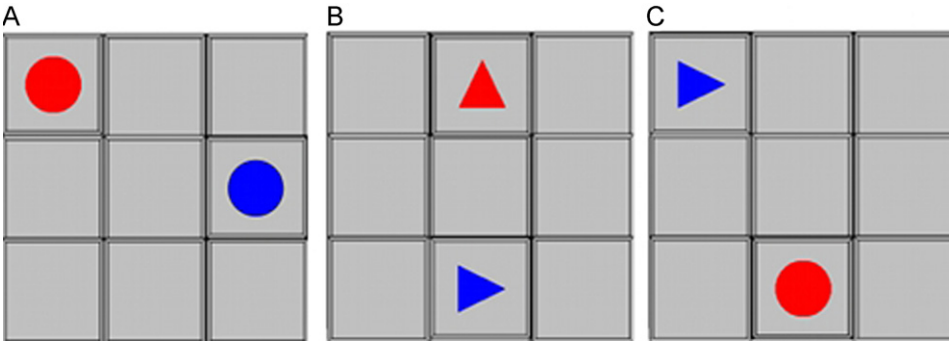


**Fig. 2.** Examples of trial types. Goal configurations for each of the trial types employed in the experiment. (A) An example of a no_OR trial (no orientation trial). Both players have a circle as their token and hence only location needs to be signaled. (B) Example of an OR trial ('orientation trial'). Here the Sender needs to signal both location as well as orientation (Receiver's triangle points rightwards). (C) OR_under trial ('orientation underspecified'). Here the Sender again needs to signal both location as well as orientation, but the Sender's token does not allow for signaling orientation by matching his token to the goal orientation of the Receiver.