Combining EEG and virtual reality to investigate the processing of quantifiers and scalar implicatures in the context of partial information

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The goal of the collaboration is to combine immersive virtual reality and electroencephalography to investigate the role of perspective taking in the processing of sentences with quantifiers. We test whether listeners take speaker's or egocentric perspective in dyadic, communicative situations in which the listener's and the speaker's information about the context model diverge. We contrast sentences that are unambiguously true or false with respect to context models with those that are underinformative by violating the scalar implicature. Virtual reality is used to create an ecologically valid, naturalistic experimental scenario, while still retaining the required experimental control to reliably record electrophysiological brain activity.

The experimental design consists of a language-learning card game with a virtual speaker, represented in the form of a virtual 3-dimensional agent. Participants are informed that they deal with an artificial intelligence who wants to learn German. Whereas she already knows all the German nouns, she still struggles to correctly use quantifiers. In particular, she wants to use them not only in cases, where she can see all the cards, but also in cases where she doesn't see all the cards. In all target trials, four cards are dealt on the table (and are seen by both the virtual speaker and the subject) and two additional cards are dealt as "subject's cards", whose content is visible to the subject but not to the virtual speaker. Once the cards are dealt, the speaker utters a quantified sentence referring to the whole set of cards. Participants are asked to assign points to the speaker, to indicate how good was their sentence as a description of the dealt cards.

The target sentences are of form *some/all cards show Xs*. By manipulating the number of presented objects, we compare conditions where (i) the speaker knows that the sentence with *some* is felicitous (the *not all* implicature is satisfied about the visible cards and hence the face-down cards do not affect the evaluation), with cases where the speaker does not know the whether the *not all* implicature holds but, from the egocentric perspective of the subject, the sentence is (ii) infelicitous; or (iii) felicitous. For sentences with the quantifier *all* we contrast conditions where (i) the speaker knows the sentence to be false, with cases where she does not know sentence truth-value, but the sentence is either (ii) true, or (iii) false from the egocentric perspective of the subject.