

When perspective taking takes place – evidence from the referential communication game

The referential communication game paradigm has been used in a number of previous eye-tracking studies to investigate the time-course of the influence of common ground (CG) information on listeners' real time sentence interpretation. A major feature of this paradigm is to manipulate the conditions of perceptual access between interlocutors by occluding certain objects in a grid to which only the participant has privileged access. Previous studies have proposed conflicting accounts^{[1][2][3]}. The Egocentrism Account^[3] assumes that listener's initial interpretation is not restricted by CG information; rather, CG is only optionally used to detect/correct errors. The Autonomous Activation Account^[1] suggests that listeners actively attempt to take a speaker's perspective into account, but only in anticipation prior to receiving the critical linguistic stimuli; during online linguistic processing, they still fail to fully integrate CG information due to autonomous activation of privileged information. In the Constraint-based Account^[2], listeners can make rapid use of CG on their online utterance interpretation and reference resolution.

In order to explore the exact temporal dynamics of the underlying mechanisms of perspective taking during online utterance processing, we combined the referential-communication-game with a cross-modal priming paradigm in a reaction-time study. In addition, we adapted the referential communication game to a computer game, in which an avatar served as the director and provided the auditory instruction. As shown in Fig. 1, a virtual 4x4 grid array contained two sets of different sized objects and two single distractors. Each set had a small, a medium, and a large object. All objects were visible to the listener; the grey background slots were indicated as invisible to the avatar. In critical trials, for example, the big star was visible to the participants but hidden to the avatar while the small and the medium stars were in CG. When the avatar said "Move the small star to the top", it would be referring to the medium star (i.e., the medium star is the target), as the avatar couldn't know there was a bigger star that was occluded from its view. However, if CG was not taken into account, the listener would consider the hidden big star (i.e., the competitor) as intended referent initially. Additionally, there are no-conflict filler trials, in which the medium star instead of the big star was hidden. The big star would then be the target, regardless of CG information. Either the target, the competitor, or the control slots (a non-star object) was highlighted by a flash on the frame of the slot. These flashes were time-locked to the onset (early flash) or the offset (late flash) of the critical word "star". Participants' response times (RT) were measured. If participants integrate pragmatic CG information into their incremental sentence processing in a relatively early stage, shorter RTs are expected when the target is flashed compared to when hidden competitors or control objects are flashed.

We found a reliable main effect of FLASHED OBJECT (target/competitor/control; *subject* $p < .005$; *item* $p < .005$) and a significant interaction between FLASHED OBJECT and FLASHING TIME (early/late; *subject* $p < .01$; *item* $p < .02$), but no main effect of FLASHING TIME. Pairwise t-tests further showed that the interaction came from the fact that RTs were significantly shorter when the target was flashed in the early flash condition than when the hidden competitor or the control object was flashed. By contrast, in the late flash condition, there were no differences in RTs between the target, competitor, and control flashing (see Fig. 2). In addition, across all conditions, RTs in conflict trials were longer than in no-conflict trials. Contra the Egocentrism Account, our results reveal that CG has a rapid influence on a listener's initial utterance interpretation and processing of reference.

Our next step is using event related potentials (ERPs) to better characterize the dynamics of the interaction of pragmatic and linguistic information in adults. The first ongoing EEG study investigates the neuronal correlates of participants' online reference

resolution. More specifically, we currently examine if and how the processing of conflict vs. no-conflict trials shapes the ERP responses differently in order to reveal distinct neuronal patterns of the processing of pragmatic information. Another EEG study will have a similar design to the behavioral RT study. In this study, ERPs will be analyzed time-locked to the flashes in purpose of finding out 1) if and when the hidden locations/objects were activated, 2) when exactly CG information will be taken into account and 3) when it interacts with the given lexical-semantic information. In addition, we will measure participants' working memory capacity and inhibitory control ability in both EEG studies to investigate how working memory and executive functions moderate people's integration of pragmatic information during their online utterance interpretation.

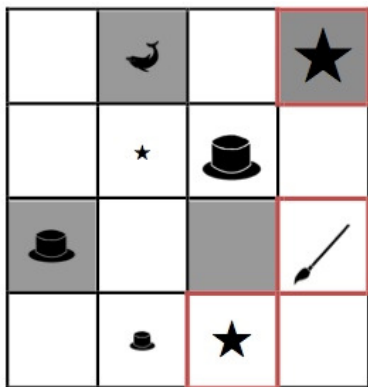


Fig. 1. Example item display

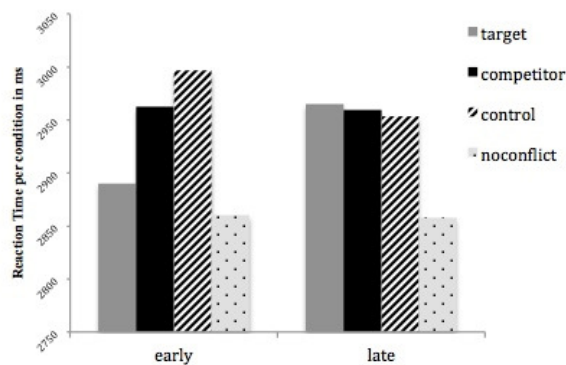


Fig. 2. Response latency per condition

In the developmental literature, there is a similar conflict between studies that find immediate online effects of CG information on eye-movements in children^[4] and those that demonstrate activation of privileged information in eye-movements in both children and adults.^[5] The discrepancy across results may be due to methodological differences between these studies, such as the size of the critical set of objects (two vs. three objects) and the distinguishing feature of the target vs. the alternative(s) in the set (simple occlusion vs. physical size as indicated by a size adjective). In an ongoing study with four- and five-year-old children, we are investigating the developmental trajectory of adult-like sensitivity to CG information in online processing of reference. In this study, we use a 3x3 grid in a design otherwise similar to Fig. 1, and pre-recorded speech with a puppet character instead of an adult confederate or an avatar producing referring expressions. We track children's eye-movements in response to requests, such as "Pick up the small horse", to find out whether and at what point during sentence processing children take CG information into account. To gain insights into the developmental relationship between pragmatic skills, Theory of Mind, and further cognitive skills, false-belief and working memory tests are also conducted.

References

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