

Scalar implicatures in the context of full and partial information. Evidence from ERPs.

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In Gricean pragmatics, reasoning about the speaker's intentions and epistemic state plays an important role in inferring the implicature. Yet, most of the experimental work on implicatures focuses on scenarios where both the speaker and the listener are fully informed and thus the role of the epistemic reasoning cannot be directly investigated. (However, see [1, 2]). In my talk/poster I would like to present results of an ERP experiment addressing this question (part of the short-term collaboration project with Petra Schumacher and Markus Werning). I also discuss planned follow-up studies that focus on the role of both the speaker's and listener's perspectives in the processing of generalized implicatures.

In the ERP experiment we investigated the processing of the scalar implicature in the context of partial information, i.e. when the assumption of the speaker's competence is violated. The experiment uses a paradigm in which participants evaluate appropriateness of the speaker's utterances about a card game situation. The target scenarios consist of (i) the speaker's avatar; (ii) four open cards placed on the table; and (iii) two cards face down (whose content cannot be seen) that are placed on the side of the speaker (Tab 1, Fig 2). The subject is informed that the speaker doesn't know what is on the face-down cards. The speaker's utterances are presented auditorily and either refer to the cards in the game, i.e. all cards including the face-down cards (**game-sentences**: *Some cards in the game contain As*), or to the cards on the table only (**table-sentences**: *Some cards on the table contain As*). By manipulating whether the critical noun A refers to (i) the object category contained by every visible card; (ii) the object category contained by a subset of visible cards; (iii) another object category not presented at the screen, we compare cases where the sentence's truth-value and pragmatic felicity is either known or unknown to the speaker.

The results indicate an N400 effect for false relative to informative and underinformative sentences, both for the **table** and **game** context. Unlike in [3], in the context of full information, no effect is found for the implicature violation (**Table-Underinformative** vs. **-True**) for pragmatic responders, i.e. those who reject **Table-Underinformative** sentences as not appropriate utterances. We argue that the context of our experiment does not endorse the scalar implicature due to the presence of additional partial information scenarios. Among the available alternatives, *some* can be considered the most optimal quantifier to express uncertainty, which endorses its logical (*some and possibly all*) interpretation. Consequently, even for the pragmatic responders (31%) the implicature is not incrementally processed. For the partial information context, we observe that sentences that are *known* to be informative (**Game-True**) form a significant negativity relative to *potentially* underinformative sentences (**Game-Underinformative**) ($p < .014$), as well as relative to **Table-Underinformative** sentences ($p < .004$). This effect supports the hypothesis that *some* is interpreted as means of expressing uncertainty: it indicates that *some cards in the game* is more optimally used to describe the quantity of those objects that occur in all visible cards (and thus may also be present on the face-down cards), whereas for objects that occur only in a subset of visible cards more appropriate quantifying expressions are available (e.g. *some cards on the table*).

Follow-up experiments are planned to directly investigate the role of perspective taking in the scalar implicature processing. I present a design of a study where the speaker has only a partial access to the context model, whereas the listener has a privileged, full access to the model. I briefly discuss further studies planned in my project for the second phase of the XPRAG.de

place	Some cards (in the game/on the table) contain...		
	cats	Noun balls	dogs
in the game	Game-Underinformative Unknown infelicitous Yes/No	Game-Informative Known felicitous Yes	Game-False Unknown false No
on the table	Table-Underinformative Known infelicitous Yes/No	Table-informative Known felicitous Yes	Table-False Known false No

Table 1: For each critical word the table provides: the condition's label (first line), semantic/pragmatic value of the sentence in that condition (second line), expected resp. possible response (third line). **Note:** A "no" response in **Table-Underinformative** condition indicates a pragmatic interpretation. Participants were highly **consistent** in their choice of the logical (ca. 70%) or pragmatic (ca. 30%) interpretation. A "no" response in **Game-Underinformative** condition is considered a *strong pragmatic interpretation* and was chosen by only one participant in the whole tested group.

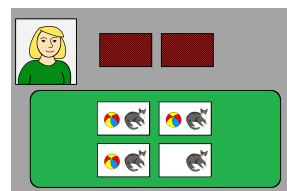


Figure 1: Schematic illustration of a target visual scenario: In the experiment sentences are presented as auditory stimuli during the presentation of the visual scenario. **Note:** Filler trials are used to balance the materials (i) with a different number of object categories presented, (ii) with other quantifiers (*all, no, more than three/two, fewer than four/three, three/four*), (iii) with additional cards outside the table being face-up (both the speaker and the listener can see what these cards present), or with no additional cards outside the table dealt (in this way we highlight the relevance of the face-down cards in the target trials). Filler trials allowed also to control that the subject understood the task and was able to make a distinction between **table** and **game** sentences.

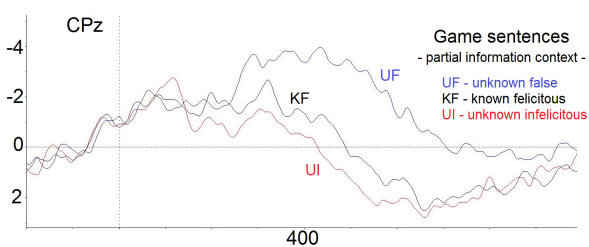


Figure 2: Grand averages (N=23) for the **Game**-sentences (partial information). Cluster-based permutation statistics: Significant negativity for *unknown false (Game-False)* relative to *known felicitous (Game-Informative)* as well as *unknown infelicitous (Game-Underinformative)* conditions (effects with $p < .0001$). Significant negativity for the *known felicitous* relative to the *unknown felicitous* condition ($p < 0.014$).

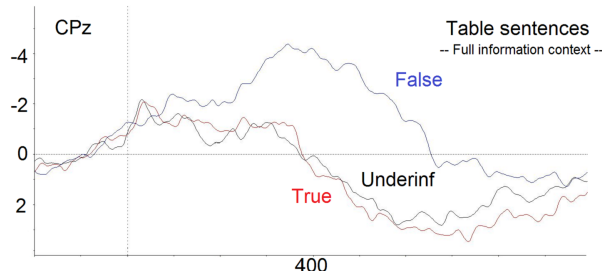


Figure 3: Grand averages (N=23) for the **Table**-sentences (full information context) at the critical sentence-final noun. Cluster-based permutation statistics: Significant negativity for the *false* relative to *true* ($p < .0001$) and *underinformative* ($p < .0001$) conditions. No significant differences between *true* and *underinformative* conditions; no effect due to divergent evaluation of *underinformative* sentences.

- [1] Richard Breheny, Heather J. Ferguson, and Napoleon Katsos. Taking the epistemic step: toward a model of on-line access to conversational implicatures. *Cognition*, 126(3):423–40, 2013. Doi:10.1016/j.cognition.2012.11.012.
- [2] Noah D. Goodman and Andreas Stuhlmüller. Knowledge and implicature: Modeling language understanding as social cognition. *Topics in Cognitive Science*, 5:173–184, 2013. Doi:10.1111/tops.12007.
- [3] Maria Spychalska, Jarmo Kontinen, and Markus Werning. Investigating scalar implicatures in a truth-value judgment task: Evidence from event-related brain potentials. *Language, Cognition and Neuroscience*, 31(6):817–840, 2016. Doi:10.1080/23273798.2016.1161806.