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

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It is considered underinformative to say *Some cards contain cats* if all cards contain cats, even though semantically it is true. This phenomenon is described in Gricean pragmatics [4, 5] in terms of scalar implicature: if the speaker uses a semantically weak quantifier *some*, the listener may infer that the she is not in a position to use the stronger alternative *all*. Assuming that the speaker is informed (*competence assumption*), the listener may infer that the stronger alternative is believed by the speaker to be false. From the psycholinguistic perspective the main question has been whether this implicature is processed incrementally – as a fast, automatic inference upon encountering the quantifier *some*, or whether it is only inferred at the later stage during sentence processing [1, 7, 6, 8]. Most experiments investigating this issue have involved paradigms where full information relevant for the sentence evaluation is available to all parties involved. In such contexts, underinformative sentences tend to trigger divergent truth-value judgments. Using ERPs, [9] showed that this intuitive truth-value evaluation determines the way the implicature is processed: underinformative sentences were associated with larger N400 ERPs relative to informative sentences only for subjects who evaluated them as false (*pragmatic responders*), whereas no such effect was observed for those participants who evaluated underinformative sentences as true.

Up to date, there is relatively little evidence regarding the role of the speaker's competence assumption for the implicature processing (related work [2, 3]). In our 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 where 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) 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 all cards including the face-down cards (*Some cards **in the game** contain As*), or to the cards on the table only (*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 [9], 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*).

	Some cards (in the game/on the table) contain...		
place	Noun		
	cats	*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.

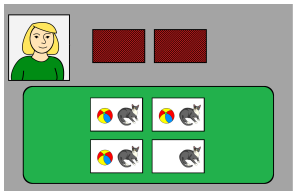

Figure 1: Schematic illustration of a target visual scenario: In the experiment sentences are presented as auditory stimuli during the presentation of the visual scenario. **Note:** Filler trials are used to balance the materials (i) with a different number of object categories presented, (ii) with other 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 trails allowed also to control that the subject understood the task and was able to make a distinction between **table** and **game** sentences.

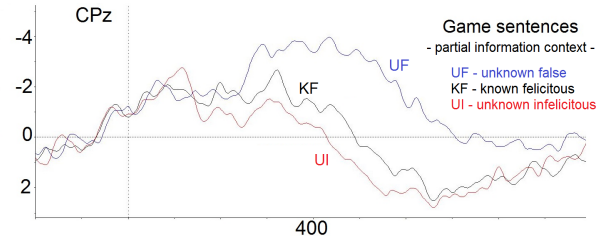

Figure 2: Grand averages (N=23) for the **Game**-sentences (partial information). Cluster-based permutation statistics: Significant negativity for *unknown false* (**Game-False**) relative to *known felicitous* (**Game-Informative**) as well as *unknown infelicitous* (**Game-Underinformative**) conditions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

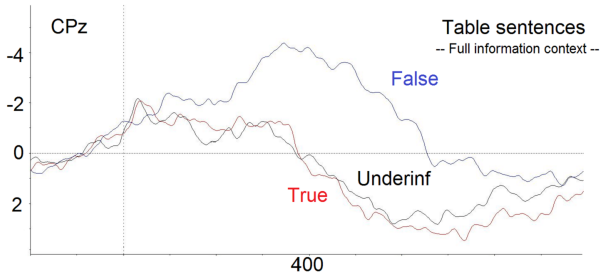

Figure 3: Grand averages (N=23) for the **Table**-sentences (full information context) at the critical sentence-final noun. Cluster-based permutation statistics: Significant negativity for the *false* relative to *true* ($p < .0001$) and *underinformative* ($p < .0001$) conditions. No significant differences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

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