

Processing quantifiers in partial information contexts

Maria Spychalska & Markus Werning

Semantically weak statements, such as *Some As are B*, allow an inference that sentences of similar content with semantically stronger alternatives (*All As are B*) are false. This phenomenon is known as scalar implicature. Under the neo-Gricean view, this inference is based on a pragmatic mechanism that involves reasoning about the speaker’s communicative goals and epistemic states: If the speaker knew that *All As are B* is true, she would have been required (Maxim of Quantity) to say it directly. Since she said *Some As are B*, the hearer can infer (*primary* or *weak implicature*) that the speaker either believes that the statement with *all* is false, or does not know whether it is true. Since in many communicative contexts one can assume that the speaker is informed regarding the status of the stronger alternative (*competence assumption*), a stronger implicature can be inferred (*secondary* or *strong implicature*), namely, that *All As are B* is false. The reasoning step from the weak to the strong implicature is referred to as the *epistemic step* [cf. 2, 5, 10].

The vast majority of prior research on scalar implicatures has involved experiments where full information about the quantified domain was available. However, if the status of the stronger alternative is given, the distinction between the weak and strong implicature does not arise. Up to date, there exists only ample studies on the role of the speaker’s competence assumption for the implicature processing [cf. 2, 6]. In a prior ERP experiment, [11] showed that sentences with *some* are associated with larger N400 ERPs in contexts where *all* is known to be true relative to contexts where *all* is known to be false, but only if the participant’s truth-value judgment indicates the pragmatic (with the scalar implicature) interpretation of *some* (*pragmatic responders*).

We present a direct follow-up study that investigates the processing of quantified sentences with *some* and *all*, both in contexts with full and with partial information. We test the role of the epistemic access in the processing of pragmatically ambiguous sentences with *some*. By including sentences with *all*, whose truth-conditional evaluation is pragmatically unambiguous, we test whether contexts where the sentence truth-value is unknown involve increased processing costs, that could be linked to epistemic reasoning processes. The experiment uses a sentence-picture judgment paradigm with a 2x2x2 design. Participants are asked to evaluate quantified sentences *Some/All cards contain X/Ys* against visual scenes consisting of 6 cards. In the **partial access** context two of the cards are backside-up so that their content cannot be seen, whereas the four face-up cards present four objects of one category and 2 or 3 objects of another category. In the **full access** context all six cards are placed face-up and they present six objects of one category and 3 or 4 objects of another category. The quantified phrase is presented first, subsequently the cards are displayed and finally the noun is presented. In the **Fullset** condition, the noun refers to the object category contained by every face-up card, whereas in the **Subset** condition, it refers to the object category contained by a subset of face-up cards. The task is to evaluate whether a given sentence “can be said” as true about the given set of cards. The response is given by clicking either a green check mark (“can be said”) or a red cross symbol (“cannot be said”). Sentences that “can be said” are explained to include only those of which one knows that they are true. If a sentence is false, or its truth-value is unknown, it cannot be said as true (Figure 1).

Sentences with *some* are semantically true in all cases; however, in the Fullset Full-access scenario, the scalar implicature is violated, and thus divergent judgments can be expected. Partial-access scenarios allow to differentiate between the strong and weak pragmatic reading: Whereas in the Subset condition the implicature is true, in the Fullset condition its status is unknown. Sentences with *all* are known to be true in the Fullset Full-access condition, they are known to be false in both Subset conditions, and have unknown truth-value in the Fullset Partial-access condition.

In line with the prior results by [11], sentence-final critical nouns in sentences known to be false (Sentences with *all*, Subset Full-access) elicited an N400 effect relative to sentences known to be true (Fullset Full-access) ($p < .0002$) and relative to sentences of unknown truth-value (Fullset

Partial-access) ($p = .013$). Moreover, for sentences with *all*, a sustained negativity effect is observed in Partial-access contexts relative to Full-access contexts, that is evident both for the Fullset ($p < .0001$) and Subset condition ($p < .0001$). Similar sustained negativity effects have been observed in several prior studies [8, 1, 9] as well as in memory research [see 7, for a review]. We argue that the effect reflects processes related to reevaluation of the epistemic access in contexts where only partial information is provided. For sentences with *some*, differential effects are observed depending on the quantifier interpretation. Only around 11 out of 47 tested participants adopted the pragmatic interpretation of *some*, namely, they rejected the target sentences with *some* in the Fullset Full-access condition. This includes 3 subjects who adopted the *strong pragmatic interpretation*, i.e. they rejected *some* also in the Fullset Partial-access condition. For the pragmatic responders, an N400 effect (marginally significant, $p = .056$) is observed for the condition inconsistent with implicature (Fullset Full-access) relative to the condition consistent with the implicature (Subset Full-access). A negativity effect is observed also for the Fullset Partial-access relative to the Subset Full-access condition ($p = .03$). No similar effects are observed for the logical responders. The results are discussed in relation to prior studies and the theoretical debates between the neo-Gricean and grammatical views on scalar implicatures [cf. 4, 3].

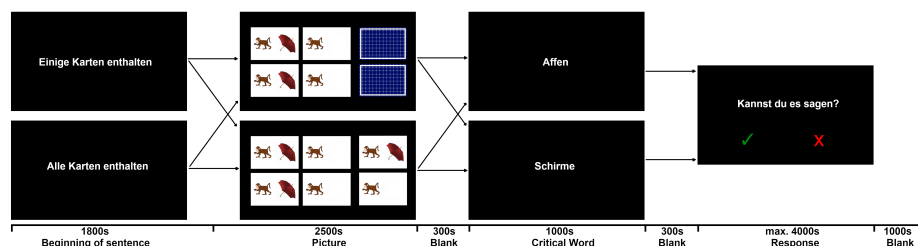
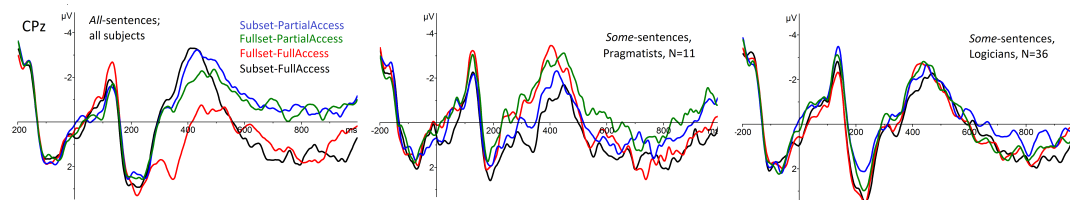


Figure 1: The structure of a trial representing all four conditions (as alternatives). Filler trials with other quantifiers are used as well.

Figure 2: The comparison of grand averages for sentences with *all* (all subjects) and for sentences with *some* for pragmatists and logicians. The statistical results are based on cluster-based permutation analysis.



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