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# Quantifier and implicature processing in contexts with full and partial information.

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**Abstract**

When evaluating the truth of a sentence, we do not always have full information available. While there exists psycholinguistic research on how an uncertain speaker influences a listener's quantifier processing and interpretation, it remains difficult to disentangle a listener's preferred utterances from ones they merely tolerate as acceptable if uttered by someone else. In the presented research, we investigate how readers process assertable and non-assertable quantified statements in epistemically uncertain situations. We focus on the weak and strong scalar implicatures for the quantifier "some", which arise in such contexts. We show differential ERP effects depending on whether participants adopt the weak or strong pragmatic interpretation. We also show that partial-information contexts are associated with a late and sustained negativity effect, likely signaling epistemic context monitoring.

**Keywords: quantifiers, scalar implicature, sustained negativity, N400, partial information**

## Introduction

Quantifiers, such as "all", "some, "no", etc., are used to express quantity and to specify reference in context. Evaluating the truth-value of a quantified sentence requires knowledge of its domain. For example, to determine whether "All apples are ripe" is true, one has to establish the quantification domain (the relevant set of apples) and then check each element (apple) of this set with respect to the property of being ripe.

For the existentially quantified statement "Some apples are ripe", it may suffice to check the domain until one element satisfying the property (a ripe apple) is found. However, this procedure does not suffice if we consider the "not all" implicature: Semantically, "Some apples are ripe" means that at least one apple is ripe; however, it also allows the inference that the stronger alternative, "All apples are ripe," is false–a scalar implicature. In the Gricean framework, this inference relies on the Conversational Maxim of Quantity, which assumes that speakers aim to be as informative as required, and thus would use the strongest available alternative (Grice, 1975; Horn, 1984). In order for a (cooperative) speaker to use "some", an alternative with "all" must be unavailable, either because it is outright false or because its truth is unknown to the speaker.

Thus, within this framework, deriving implicatures inherently involves considering the speaker's knowledge. The addressee may infer the "not all" implicature only by assuming that the speaker is informed, or at least has a belief, about the truth of the stronger alternative (*competence assumption*) (Geurts, 2010; Sauerland, 2004). Without this assumption, the speaker's use of the weaker alternative merely suggests epistemic ignorance, implying that they do not believe that "all" is true (*weak* or *primary implicature*). By contrast, in alternative frameworks, such as the grammatical account (Chierchia et al., 2012), scalar implicatures can arise through local strengthening of weak scalar terms without considering the speaker's knowledge (*strong* or *secondary implicature*).

It has been repeatedly shown that in contexts where full information is available, people show mixed truth-value intuitions when evaluating underinformative statements (i.e., violating the Maxim of Quantity). For instance, if it is known that all apples are ripe, the quantifier "all" is preferred, and statements with "some" receive divergent judgments: some individuals accept them as true, reflecting the literal interpretation (*logical responders*), while others reject them as false, indicating that they derive the implicature (*pragmatic responders*) (Bott & Noveck, 2004; Spychalska et al., 2016).

However, when the speaker's knowledge status is uncertain, an utterance using "some" gives rise to the weak implicature that the speaker lacks sufficient evidence to assert "all". If the speaker is genuinely ignorant about the status of the stronger alternative, the weak implicature is trivially satisfied. Consequently, accepting "some" in such contexts is compatible with both the literal, semantic interpretation and the weak implicature. Although empirical research has shown that weak implicature readings are dominant, listeners and readers occasionally reject "some" even in contexts where the status of "all" is unknown, thus exhibiting the strong implicature interpretation (Dieuleveut et al., 2019; Spychalska et al., 2021).

Numerous psycholinguistic studies using response times, eye-tracking, or EEG have shown that scalar implicatures incur a processing cost (Bott & Noveck, 2004; Degen & Tanenhaus, 2015; Grodner et al., 2010; Huang & Snedeker, 2009; Tomlinson et al., 2013). EEG research, in particular, has demonstrated that outright implicature violations elicit an enhanced N400 component (see Politzer-Ahles (2020) for a review)–a centro-parietal negativity peaking around 400 ms after stimulus onset, typically linked to semantic expectancy and meaning-related predictability (Kutas & Federmeier, 2011; Rabovsky, 2020). Notably, the magnitude and presence of the N400 effect for implicature violations have been found to depend on contextual factors (Augurzky et al., 2019; Hartshorne et al., 2015; Spychalska et al., 2021), individual personality traits (Nieuwland et al., 2010), and participants' truth-value



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evaluations of implicature-violating statements (Hunt et al., 2013; Politzer-Ahles, 2020; Spychalska et al., 2019; Spychalska et al., 2016). In line with accounts linking the N400 to meaning-based predictability (Rabovsky et al., 2018, see also Lau et al., 2013; Spychalska et al., 2025), these findings suggest that implicatures can influence predictive processing when they are sufficiently supported by the context.

Using a sentence–picture verification paradigm in full-information contexts, Spychalska et al. (2016) showed that implicature processing correlates with participants' truth-value judgments. Participants evaluated sentences such as "Some/All cards contain As" against visual displays consisting of five cards and containing two object categories: one present on all cards and one on a subset. In sentences using "all", critical nouns referring to the subset category (rendering the sentence false) elicited a larger N400 than those referring to the category present on all cards (true). This effect was followed by a P600—a late positivity observed for syntactic and certain semantic violations (Swaab et al., 2012), especially involving a conflict between the comprehender's contextual model and the linguistic input (Brothers et al., 2020; Kuperberg et al., 2020). By contrast, "some"-statements were underinformative when the critical noun referred to the category appearing on all cards, leading to divergent truth-value judgments. Pragmatic responders showed an N400-P600 pattern for underinformative versus true, informative sentences, whereas for semantic responders, there were no effects.

Psycholinguistic research directly addressing the role of speaker knowledge for implicature processing remains limited (Katsos, 2021). Available studies (Bergen & Grodner, 2012; Breheny et al., 2013; Dieuleveut et al., 2019; Goodman & Stuhlmüller, 2013; Spychalska et al., 2021) suggest that readers/listeners consider the speaker's epistemic perspective when deriving quantity implicatures. Using eye-tracking, Breheny et al. (2013) found that listeners fixated more on pictures matching the ad-hoc implicature interpretation when the speaker was knowledgeable (shared their perspective) and less so, when the speaker was ignorant. Other authors argue that inferential processes concerning the speaker's epistemic state are only necessary for deriving implicatures during comprehension but not during production (Mognon et al., 2021): While the comprehension of "some" requires the listener to consider the speaker's perspective, its production does not require the speaker to consider the listener's perspective.

Spychalska et al. (2021) investigated whether listeners are sensitive to the speaker's epistemic state while processing underinformative statements with "some". The experiment used a card game paradigm in which four cards were dealt face up on a table and two additional cards were placed face down outside the table; their content was unknown to both the speaker and listener. The speaker, represented by a 2D static avatar, described game situations by referring either to "cards in the game" (partial-information context), i.e., all displayed cards, or to the "cards on the table" (full-information context). The participants had to judge whether the speaker's descriptions were appropriate given the information context.

In line with prior studies on scalar implicatures, in full information contexts, participants had divergent intuitions about underinformative statements. When the speaker said "some cards on the table contain cats" but all cards on the table showed the mentioned object, they fell into two groups: those who judged such statements as acceptable (logical responders), and those who judged them as not acceptable (pragmatic responders). However, when all table cards showed cats and the speaker said "some cards in the game contain cats", almost all participants judged the statement as appropriate. While such a response is unremarkable under the literal interpretation, for pragmatic responders, it indicates that they derived only the weak implicature. For this group, a late sustained negativity effect emerged in the context where the speaker was ignorant about the stronger alternative relative to the context where the speaker was knowledgeable. This effect was argued to reflect listeners' sensitivity to the speaker's epistemic state in their processing of scalar implicatures.

However, introducing an avatar to represent a speaker revealed several issues, such as participants struggling with understanding the epistemic context of the speaker, rendering the observed effects difficult to interpret. Furthermore, the design differed from Spychalska et al. (2016) not only by including an avatar-represented speaker, but also by using auditory sentence presentation, two types of contexts, and by having higher proportion of trials with "some" ($\sim$ 66%) compared to filler quantifiers ("all", "no", numerals). Consequently, the observed effects are hardly comparable across the two studies.

For instance, the proportion of spontaneous pragmatic responders in Spychalska et al. (2021) was relatively low (25%) compared to Spychalska et al. (2016) and earlier studies, which typically report a roughly 50/50 split between logical and pragmatic interpretations when full information is available and no speaker is involved (Bott & Noveck, 2004). This difference may be due to a low prominence of the stronger alternative "all" in Spychalska et al. (2021) or due to a suspension of the Maxim of Quality ("Be truthful. Do not say things for which you lack evidence."). Because the speaker frequently produced both false and inappropriate statements and was explicitly described as potentially unreliable (making wrong statements deliberately or by mistake), some participants may have treated her as untrustworthy and uncooperative. This, in turn, may have led to weakening of the Maxim of Quantity, suppressing the implicatures.

The goal of the current study was to directly test the role of information access in the processing of quantifiers and scalar implicatures, by addressing these shortcomings. To this aim, we designed a study which was more closely comparable to the prior experiment by Spychalska et al. (2016). The design used a similar proportion of trials with "all" and "some", did not include any avatar of a virtual speaker, and the linguistic stimuli were presented in a visual manner. We also used the same paradigm where the sentence presentation is interrupted by the presentation of the picture, which appears just before the critical noun. The only new feature was to include two types of contexts: with full and partial access to the domain.

Can we see the cost of epistemic uncertainty in sentence processing when a statement needs to be evaluated for its assertability in a given epistemic context? If evaluating a sentence requires assessing information access, we expect to see a mark of this epistemic process in the ERPs. Furthermore, can we dissociate the processing patterns for primary and secondary implicatures? Under the Gricean approach we would expect participants to derive only primary implicatures, possibly at the late stage of processing, leading to the epistemic aspect showing as a late effect rather than modulating early ERP responses (N400). By contrast, if secondary implicatures are derived, they are expected to be lexically embedded, yielding processing patterns comparable to those observed for semantically unambiguous quantifiers.

## Experiment 1

The experiment tested the role of epistemic access for the acceptability of quantified sentences with "some" (German 'einige') and "all" ('alle'). Participants were asked whether they would state sentences such as "Some/All cards contain Xs" in situations in which they had full or partial knowledge of the domain: **Full-access** (all cards face-up) vs. **Partial-access** (some of the cards face-down) (see Figure 1). In the **Fullset** condition, the noun referred to the object category contained by every face-up card, whereas in the **Subset** condition, it referred to the object category contained by a subset of face-up cards. The task was to evaluate whether a given sentence "can be said" about the given set of cards. It was explained that only sentences known to be true "can be said". If a sentence was false, or its truth-value unknown, it "cannot be said".

Sentences with "some" were semantically true in all cases; however, in the Fullset Full-access scenario, the scalar implicature was visibly violated and divergent judgments were expected, with acceptance indicating the literal interpretation and rejection indicating the pragmatic interpretation. Partial-access scenarios allowed to further differentiate between the strong and weak pragmatic reading: Whereas in the Subset condition, the implicature was known to be true, its status was unknown in the Fullset condition. Consequently, accepting "some" in both Full-set conditions (Full and Partial-access), would indicate the logical interpretation, whereas rejecting "some" in the Fullset Full-access condition but accepting it in Fullset Partial-access would suggest a weak implicature, aligning with the Gricean view. Finally, rejecting "some" in both of these conditions would indicate a strong implicature, meaning that "some" was not accepted because the truth of the implicature remained uncertain. Sentences with "all" were known to be true in the Fullset Full-access condition, they were known to be false in both Subset conditions, and had unknown truth-value in the Fullset Partial-access condition.

**Materials** For target trials, we used 160 words and their corresponding images, organized in two lists of unique word pairs. The first word of a pair determined one shown object and the target word, while the second word determined the competing object. Each word was used as a target twice (once for "some" and once for "all") and was shown as an object four times (twice per quantifier), resulting in 320 word pairs that were pseudo-randomly assigned to the target trials. In addition, we constructed 200 filler trials using 90 additional words, that were organized into unique pairs and triplets and combined with the quantifiers "some" (60 trials), "all" (40)[1], "no" (40), "most" (20), and numerals (40, "two" to "five").

**Participants** 51 participants (33 women and 18 men, aged 18 to 34, mean age 24.25, SD 3.93), German native speakers were tested. Seven participants displayed unexpected response patterns in the unambiguous cases, suggesting misinterpretation of the task, and had to be excluded; one participant was excluded due to a high level of artifacts. The final analyzed group consisted of 43 participants (29 women and 14 men, age range 18 to 34, mean 24.14, SD 3.99).

**Procedures** Upon arrival, participants received information and signed written consent concerning their participation, anonymous data handling, and their right to withdraw from the experiment at any time. All procedures followed the Declaration of Helsinki and an ethics-approved protocol.

Participants had to judge whether or not they can assert ("say") the displayed sentence with certainty about a given scenario. They were instructed to reject a sentence "All cards contain Xs" if X referred to an object category presented in all open cards while two cards were only visible with their backside, since they could not know whether both of the flipped cards also showed Xs.

Before the experiment, four practice trials, each followed by feedback, were presented. The aim of the practice trials was to familiarize participants with the distinction between full and partial information, as well as to ensure that they understood that sentences with uncertain truth-values should be rejected.

Trials started with a presentation of the first part of the sentence for 1800 ms, followed by the scenario for 2500 ms. After a blank screen of 300 ms, the **critical, sentence-final noun** was presented for 1000 ms, followed by another blank screen of 300 ms. Afterwards, the response screen was shown until a response was given, timing out at 4000 ms. An 1000 ms inter-trial interval of a blank screen was added. The experiment was divided into eight blocks of 60 trials and a final ninth block of 40 trials. Including breaks, the whole session lasted ca. 1.5 h. Participants received financial compensation.

**EEG recording and data analyses** The EEG was recorded using a 64-channel ActiCAP snap system (Brain Products), with 60 active Ag/AgCl electrodes placed according to the 10-20 system. Electrode AFz served as ground and FCz as the online reference. Four additional electrodes were used to record eye movements: two placed above and below the right eye to monitor vertical eye movements, and two placed at the outer canthi of both eyes to monitor horizontal eye

[1] Fillers with "some" and "all" were used with context scenarios that had no contrast between the competing objects (both objects in fullset or subset), or with single objects, or with critical words referring to something that was not shown.

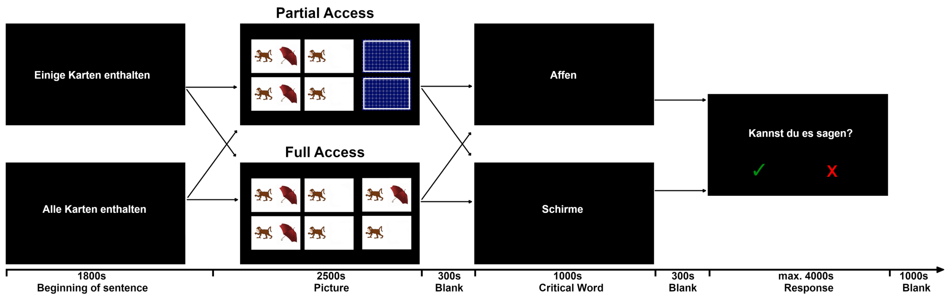


Table 1: Experimental conditions

| Context | Quantifier | Fullset (monkeys) | Subset (umbrellas) |
|---|---|---|---|
| Full access | *All* | True | False |
| | *Some* | True (Infelicitous) | True (Felicitous) |
| Partial access | *All* | Unknown | False |
| | *Some* | True (Unknown) | True (Felicitous) |

Figure 1: The structure of the design and the time-course of a trial.

movements. Impedance was kept below 5 kΩ. Recording was done using Brain Vision Recorder, with a sampling rate of 1000 Hz, a resolution of 0.1 µV, a low cut-off time constant of 10$s$ (≈ 0.016 Hz), and a high cut-off filter of 250 Hz.

The EEG-data was preprocessed using the BrainVision Analyzer 2.2. The data was down-sampled to 500 Hz. An offline band-pass zero-phase (forward–backward) 4th-order Butterworth filter of 0.1- 30 Hz was applied. The raw data was manually inspected: break intervals and large physical artifacts were excluded. Afterwards, automatic artifact rejection removed all periods with (i) signal changes exceeding 150 µV within 150 ms, (ii) signal changes smaller than 0.5 µV within 100 ms, and (iii) voltage steps larger than 50 µV/ms. Electrodes recording eye activity and anterior channels were excluded from this procedure to avoid classifying blinks as artifacts. Eye-blinks were then corrected using independent component analysis (ICA) with a biased Infomax algorithm, on the continuous data. Components capturing eye movements and blinks in the data were removed. The data were re-referenced to the average of the mastoid electrodes (TP9, TP10). Baseline-correction was calculated using the 200ms pre-stimulus interval. Segments with any remaining artifacts (activity lower than -90µV or higher than 90µV) were removed and the remaining segments were averaged for each condition.

For the statistical analysis, a cluster-based permutation test was performed (Maris & Oostenveld, 2007; Oostenveld et al., 2011). For each subject, the ERPs were averaged across trials in the compared conditions, in 1000 ms long epochs and for all channels. The data-points (Time x Channel) between the sets (conditions) were compared by a two-tailed dependent t-test. Significantly different ($\alpha = .025$) data-points were then clustered according to the time-spatial adjacency. Cluster-level statistics were calculated by taking the sum over the t-values for each cluster. Cluster level p-values were evaluated with a Monte Carlo simulation: For each subject, the ERP averages were randomly swapped between the two conditions. The cluster-level statistics were computed again and the maximum of the cluster-level statistics was taken as the test statistics for this permutation. This procedure was repeated 10,000 times and the p-values of the observed cluster-level statistics were estimated as the proportion of permutations that resulted in a higher test statistic than the observed one. We compared pairwise Set conditions for the same Context and Context conditions for the same Set, separately for each quantifier. For "all", the analysis was run over the whole group; for "some", for each interpretation group separately.

**Behavioral results** In the ambiguous conditions with "some", participants were consistent in their choice of either the logical, weak or strong pragmatic interpretation. To categorize the participants, we first used their acceptance rates in condition Full-access Fullset. Using a 0.3/0.7 threshold led to a binary divide: participants with acceptance rate at most 0.3 were counted as pragmatist (10 participants, mean acceptance 0.135, SD 0.079, range 0 and 0.3), while those with acceptance rate higher than 0.7 were logicians (33 participants, mean 0.983, SD 0.0189, range 0.925 to 1).

To split the pragmatic responders into weak and strong pragmatists, we looked at their answer strategies in the condition Partial-access Fullset: weak pragmatists (N=6) had to score higher than 0.7 (measured range 0.875 to 1, mean 0.933, SD 0.0449) and strong pragmatists' (N=4) upper threshold was 0.3 (range 0.1 to 0.2, mean 0.169, SD 0.0410).

**ERP results** For semantically unambiguous sentences with "all", the cluster-based permutation analysis showed a negative cluster around the N400 time-window for condition Subset vs. Fullset in the Full-access context (cluster extension: 246-494 ms, $p < .0005$), followed by a positive cluster around the P600 time-window (576-840 ms, $p = .025$).

The comparison between the two contexts resulted in sustained centro-parietal negativity for the Partial-access relative to Full-access context: in both the Subset (408-1000 ms, $p < .0001$), and the Fullset condition (two clusters: 194-606 ms, $p = .0012$ and 656-1000 ms, $p = .0039$). In the Subset condition, there was also a frontal positivity for Partial-access around the N400 time-window (300-442 ms, $p = .021$).

For the quantifier "some", the effects were dependent on the quantifier interpretation. For the pragmatic responders (grouped together: weak and strong), a non-significant trend of an N400-like effect was observed for the condition inconsistent with implicature (Fullset Full-access) relative to the condition consistent with the implicature (Subset Full-access), followed by a non-significant trend of a frontally sustained negativity (556-670 ms, $p = .0565$). For logical responders, an effect around 200 ms post onset was observed for the Partial-access Subset relative to Full-access Subset condition

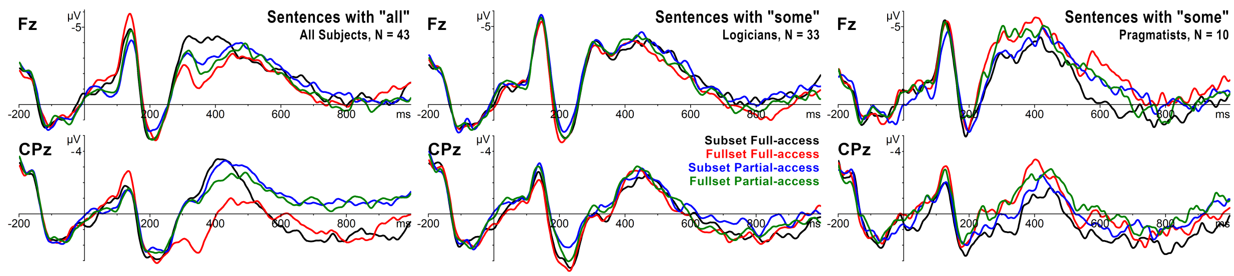


Figure 2: Experiment 1: Grand averages for sentences with "all" (all analyzed participants) and "some" (two groups).

(supported by a cluster 144-272 ms, $p = 0.019$) and relative to Full-access Fullset condition (158-260 ms, $p = .031$).

**Discussion** The biphasic effect observed for the unambiguous quantifier "all", where sentences known to be false (Subset Full-access) elicited an N400 effect relative to sentences known to be true (Fullset Full-access), followed by a P600 effect, replicates a similar result from Spychalska et al. (2016).

As a key result, we observe that Partial-access context led to a late, sustained posterior negativity effect in the case of sentences with the unambiguous quantifier "all": In the Subset condition, where both contrasted "all" conditions were known to be false, the effect starts around 400 ms post onset and is proceeded by a slightly more frontal positivity for partial-access around the N400 time-window. By contrast, in the Fullset condition, sentences with "all" had unknown truth-value in the Partial-access context, and were true in the Full-access context. In this case we observed a negativity already in the N400 time-window, possibly triggered by a difference in the acceptability judgment, which was followed by a sustained effect similar to that observed in the Subset condition. In several prior studies, sustained negativity effects have been argued to reflect various types of inferential processing (Baggio et al., 2008, 2010; Pijnacker et al., 2010; Politzer-Ahles et al., 2012; Van Berkum et al., 2003, 2007). In memory research (Mecklinger et al., 2016), they were linked to context monitoring and reevaluation. In our study, the effect appears to reflect inferential processes related to the evaluation of epistemic access in contexts with partial information.

For the quantifier "some", differential effects dependent on the quantifier interpretation are in line with the results from Spychalska et al. (2016). The early effect for logical responders, where condition Partial-access Subset showed a less positive peak around 200 ms post-onset, is consistent with the modulation of the N1-P2 complex, which are early components influenced by selective attention, with stimuli requiring increased attentiveness showing more negative N1 and less positive P2 peaks (Vogel & Luck, 2000).

Due to a low proportion of pragmatic responses, the statistical power was not sufficient to compare the two pragmatic interpretations: weak and strong. However, it is likely that these two interpretations lead to distinct processing patterns. To further dissociate between the processing patterns associated with the two readings, we ran Experiment 2.

## Experiment 2

Since, in Experiment 1, participants predominantly adopted the logical interpretation, while weak and strong pragmatic interpretations were chosen too rarely to allow for a reliable statistical comparison, we ran Experiment 2. The experimental instructions were changed to prime the pragmatic interpretation in the Full-access context. Specifically, participants were explicitly told that the statement "Some cards contain Xs" cannot be "said" in the Fullset Full-access condition, because in this situation it is clearly visible that not only some, but all cards contain Xs. All other instructions as well as the exercises remained the same.

**Participants** We tested 46 participants (31 women, 13 men, 2 did not specify, age 18 to 37, mean 24.14, SD 4.31). We excluded 12 participants: One due to excessive artifacts, five because they did not adhere to the instructions and responded logically, and six since they misunderstood the task leading to high error rates in unambiguous conditions. The analyzed group consisted of 34 participants (23 women, 10 men, 1 n/a, aged 18 to 37 years, mean 23.52, SD 4.16).

**Behavioral results** Out of 34 participants, who rejected sentences in the condition Full-access Fullset (mean acceptance 0.0574, SD 0.0589, range 0 to 0.225), based on the 0.3/0.7 acceptance threshold in condition Partial-access Fullset, 16 showed a preference for the weak (range 0.775 to 1, mean 0.964, SD 0.0545) and 18 for the strong interpretation (range 0 to 0.3, mean 0.0653, SD 0.0826).

**ERP Results** For the quantifier "all", the results of Experiment 1 were replicated: sentences known to be false (Subset Full-access) elicited an N400 effect relative to sentences known to be true (Fullset Full-access) (242-474 ms, $p < .0001$) followed by a P600 effect (550-846 ms, $p = .0029$). In addition, a late and sustained posterior negativity effect was observed for Partial-access contexts: In the Fullset condition, sentences of unknown truth-value (Partial-access) formed a sustained N400-like effect (208-644 ms, $p < .0001$) relative to sentences known to be true (Full-access). In the Subset condition, sentences known to be false in the Partial-access context formed a late sustained negativity relative to sentences known to be false in the Full-access context (430-1000 ms, $p < .0001$), despite the same sentence evaluation.

In the case of ambiguous sentences with "some", where participants could decide between the weak and strong read-

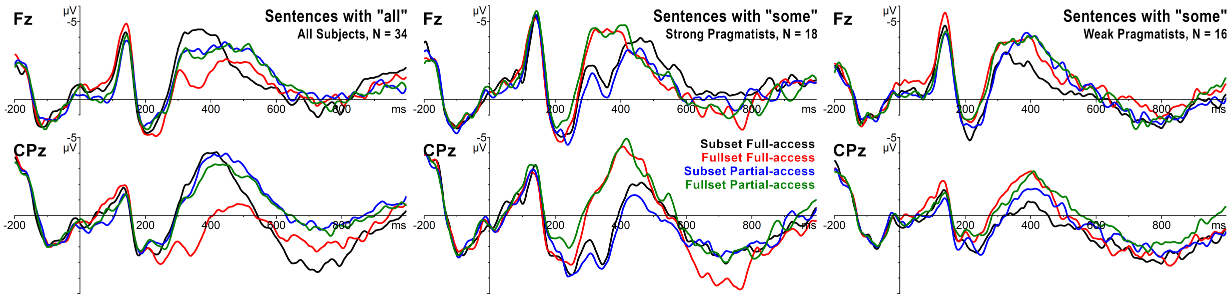


Figure 3: Experiment 2: Grand averages for sentences with "all" (all analyzed participants) and "some" (two groups).

ing, the effects were dependent on the chosen interpretation. Strong Pragmatists (N=18), who rejected "some" in the Partial-access Fullset condition, showed the expected pattern, where the violation of the implicature led to an N400 effect relative to the condition matching the implicature, independent of the knowledge factor: In the Full-access context, the Subset condition showed a smaller N400 relative to the Fullset condition (256-482 ms, $p < .0004$), and a similar effect was observed in the Partial-access context (226-504 ms, $p < .0004$). However, only in the Full-access condition, the N400 was followed by a P600 effect (624-798 ms, $p = .0175$), replicating the biphasic effect from Spychalska et al. (2016).

Weak pragmatists (N=16), who only inferred the primary implicature, showed no effect when comparing Subset and Fullset conditions in the Partial-access context. Thus, for this group, only in the Full-access context, there was an N400 effect for the condition violating the implicature (Fullset) relative to the condition matching the implicature (Subset) (296-482 ms, $p = .0181$). Moreover, the Partial-access context triggered a negativity effect relative to the Full-access context: around the N400 time-window in the Subset condition (372-470 ms, $p = .0241$) as well as a late, sustained effect in the Fullset condition (472-852 ms, $p = .0016$).

## Discussion

To date, there exists only limited research on the role of information access in the processing of quantifiers, and only a few studies have attempted to dissociate weak and strong implicatures. In two experiments, we investigated how epistemic access modulates the processing of quantified statements.

We show that epistemic uncertainty involves processing demands, likely related to inferential context reevaluation and reflected in a sustained negativity for Partial-access context. While statements that are rejected, since they cannot be asserted, show an increase in the N400 component, the context effect is mainly observed in form of a late sustained negativity.

One remarkable result is that global contexts requiring the consideration of information access do not appear to be conducive for implicatures in the first place—an observation similar to that from Spychalska et al. (2021). In Experiment 1, where participants made spontaneous judgments, the proportion of pragmatic responses was low (~ 20%). Even when primed for the pragmatic interpretation in full-access scenarios (Experiment 2), some subjects still applied the logical interpretation despite explicit instructions. While this result may be due to the nature of the task, emphasizing willingness to assert sentences in given contexts rather than the evaluation of truth-value, it aligns with the findings from the prior study, where the task was to evaluate the speaker's appropriateness.

Participants who adopted the pragmatic interpretation in Experiment 2 spontaneously divided into strong and weak pragmatists when faced with partial-access contexts. Crucially, the two pragmatic interpretations were associated with distinct processing patterns. Strong pragmatists showed a pattern suggesting that the implicature was integrated into sentence meaning, as reflected in a larger N400 for the implicature-mismatch condition, independent of epistemic context. Notably, only in the full-access context, the N400 was followed by a P600. This pattern suggests that, in the full-access but not the partial-access context, the implicature-mismatching word was not only less predictable but also in a direct conflict with the comprehender's context model.

By contrast, weak pragmatists showed an N400 effect of the implicature only in the Full-access context. In addition, unlike strong pragmatists, they showed a sustained negativity for Partial-access context, in both Set conditions, which suggests that for this group context monitoring played a more prominent role in incremental processing. Specifically, in the Fullset Partial-access condition, weak pragmatists accepted the statement but might have still considered the uncertainty about the stronger alternative. In sum, the weak implicature appears to be processed by engaging epistemic context processing, consistent with the Gricean account.

To conclude, our results show that information access plays a significant role not only in behavioral judgments about whether a statement can be asserted, but also in processing demands. Even when the available information is sufficient to evaluate a statement, contexts involving partial information access increase processing costs. Furthermore, participants appear to adopt variable processing strategies, with some relying more heavily on contextual information during incremental comprehension. Further analyses—beyond the scope of this paper—should disentangle whether these groups also show variable context effects in the case of unambiguous sentences, which would point to more general individual differences in context sensitivity during language processing.

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