Priming Pragmatic Ambiguities: Context Adaptation and Inverse Preference Effects in Plural Interpretations and Scalar Implicatures

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I, Yihang Shen, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the work.

Abstract

This thesis investigates the cognitive mechanisms underlying the interpretation of pragmatic ambiguities, focusing on plural ambiguities and scalar implicatures. While previous studies have suggested that priming effects in these domains support structural explanations—such as the existence of a silent distributivity operator in plural interpretations and the Salience Hypothesis in scalar implicature generation—this research explores whether adaptive processes like context adaptation and inverse preference effects offer a better account.

In the first study, we replicated Maldonado, Chemla, and Spector's (2017) experiment on plural ambiguities using a two-block design to control for spillover effects and establish a neutral baseline. Our findings revealed that the disfavored cumulative reading exerted a stronger priming effect, decreasing the likelihood of the preferred distributive reading. This inverse preference effect challenges the notion that priming supports the existence of a silent distributivity operator, suggesting instead that participants adapt their interpretations based on recent linguistic input and probabilistic expectations.

The second study reanalyzed reaction time data from Marty et al.'s (2022) experiment on scalar implicature priming. The analysis showed that reaction times varied depending on the alignment of primes with participants' prior preferences. Unexpected or less preferred primes often led to increased reaction times or stronger influences on participants' processing. These results support the Context Adaptation Hypothesis over the Salience Hypothesis, indicating that participants adjust their expectations and interpretations in response to recent experiences.

Overall, the findings across both studies suggest that adaptive mechanisms, rather than structural priming or increased salience, better explain priming effects in pragmatic ambiguities. Participants actively modify their interpretative strategies based on context and prior preferences, highlighting the dynamic interplay between

linguistic input and cognitive processing. This research contributes to a more nuanced understanding of language comprehension and has implications for theories of pragmatics, psycholinguistics, and language education.

Impact Statement

This research explores the cognitive processes that underlie linguistic communication, offering valuable insights into both typical and atypical communicative development. By investigating the computational mechanisms of plural ambiguities and scalar implicatures, the findings can inform a range of disciplines, including linguistics, psychology, and cognitive science. The implications extend to practical applications in education, particularly for individuals with language processing difficulties. Understanding how individuals interpret and generate implicatures can enhance teaching methodologies and interventions aimed at improving communicative competence.

Furthermore, this work has significance for the development of computational models of language use. By investigating the cognitive strategies involved in ambiguities and implicature processing, the research contributes to the design of more sophisticated natural language processing systems. These systems have the potential to improve human-computer interaction, benefiting industries reliant on AI and machine learning technologies. Enhanced models can lead to better understanding of user intent and more effective communication between humans and machines.

The findings also hold implications for public policy and communication strategies, particularly in contexts where clear and effective communication is essential. For instance, understanding how individuals derive meaning from language can inform guidelines for public health messaging, ensuring that crucial information is conveyed in a manner that is easily understood by diverse audiences. This is especially pertinent in times of crisis, where effective communication can have direct implications for public safety and well-being.

The impact of this research can be seen both locally and globally. By engaging with educational institutions, clinicians, and policymakers, the insights generated can foster improved practices in language education and communication strategies across various sectors. Moreover, disseminating these findings through scholarly publications and public engagement initiatives will contribute to a broader understanding of the complexities of linguistic communication.

In summary, this thesis not only advances theoretical knowledge in the field of linguistics but also offers practical applications that can benefit individuals, communities, and organizations. By bridging the gap between cognitive research and real-world applications, the findings promise to enhance our understanding of language use and its implications for society, thereby contributing to the ongoing discourse surrounding language, cognition, and communication.

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Chapter 1 Introduction

1.1 Introduction to Priming in Linguistics

Priming is a psychological phenomenon in which exposure to one stimulus influences the response to a subsequent stimulus. It is widely used across various domains of cognitive science to study processes such as memory, perception, and decision-making (Neely, 1977). In language studies, priming serves as a powerful tool to investigate the mental representations of linguistic structures. Priming effects can reveal underlying cognitive mechanisms that influence language use and processing. One classic example is semantic priming, where exposure to a word (e.g., "doctor") facilitates faster recognition of a related word (e.g., "nurse") compared to an unrelated word (Meyer & Schvaneveldt, 1971). This effect suggests that related concepts are connected in the mental lexicon, and exposure to one concept activates related ones, making them more accessible.

In linguistics, priming has become an important experimental method for studying how people process language. Syntactic priming is one of the most well-researched areas. Bock (1986) was one of the first to demonstrate how syntactic structures tend to be reused when they have been recently encountered, a phenomenon often called structural priming. For example, if participants hear a sentence with a passive structure, they are more likely to produce a passive sentence in subsequent utterances, even when not explicitly required to do so. This syntactic persistence reveals that syntactic structures are mentally represented and can be primed, providing evidence for abstract representations of grammar in the mind (Pickering & Branigan, 1998).

Further studies on syntactic priming have shown that this effect can occur across modalities (e.g., from comprehension to production) and even across languages in bilingual speakers (Hartsuiker et al., 2004). These findings suggest that mental representations of syntax are robust and flexible, supporting the notion that priming plays a key role in understanding how linguistic structures are stored and accessed.

An important phenomenon observed in priming studies is the inverse preference effect, where the less preferred reading in the baseline condition drives the priming effects rather than the preferred reading boosting them (Bock & Loebell, 1990; Ferreira & Bock, 2006; Hartsuiker & Kolk, 1998). Some studies suggest that the emergence of inverse preference effects stems from people's coping strategies for unexpected information (Jaeger & Snider, 2013). When an unexpected linguistic structure appears, this new information may influence individuals' expectations in that context. As a coping strategy, people may increase their predicted probability of encountering this unexpected structure and adjust their behavior accordingly. This adjustment leads to greater influence of the less preferred interpretation on subsequent processing and behavior.

Understanding inverse preference effects is crucial for interpreting priming results, as it highlights how exposure to less frequent or unexpected linguistic structures can lead to adjustments in cognitive processing. This phenomenon underscores the dynamic nature of language comprehension and production, where individuals continually adapt to new information and update their linguistic expectations.

Priming not only sheds light on structural aspects of language but also on pragmatic aspects, such as how listeners derive meaning from context and implicit information. Studies on pragmatic priming explore how exposure to certain pragmatic interpretations influences subsequent language processing, revealing the interplay between linguistic form, context, and meaning.

1.2 Priming in plural ambiguities and scalar implicatures

In the field of semantics and pragmatics, priming has been instrumental in exploring how individuals resolve linguistic ambiguities. Two key phenomena—plural ambiguities and scalar implicatures—illustrate how priming helps uncover the cognitive strategies employed during interpretation.

1.2.1 Plural ambiguities and priming

Plural expressions may cause multiple interpretations, especially when sentences contain more than one plural noun phrase. In studies of plural interpretation, priming is used to investigate how speakers resolve ambiguities between cumulative and distributive readings of sentences like "Two boys have three balls" (Maldonado, Chemla, & Spector, 2017). A cumulative reading suggests that there are two boys who share three balls, whereas a distributive reading implies that each of two boys has three balls. The distributive reading is often analyzed as involving a silent distributivity operator (Δ), which distributes the predicate over the members of the plural subject (Link, 1998; Champollion, 2016). The logical form can be represented as "[Two boys] [Δ [have [three balls]]]". In contrast, the cumulative reading does not involve such an operator and is considered the default or primitive interpretation (Roberts, 1987; Beck & Sauerland, 2000).

By repeatedly exposing participants to one interpretation (priming), Maldonado, Chemla, and Spector (2017) found that participants were more likely to adopt the distributive reading after distributive primes, suggesting that this reading could be primed, potentially due to the activation of the silent distributivity operator.

However, their study raised methodological concerns regarding the adequacy of their baseline conditions due to potential spillover effects. Because neutral primes were intermixed with cumulative and distributive primes within a single block, it was possible that priming effects from adjacent trials could spill over into the neutral condition, contaminating the baseline and making it difficult to interpret the results conclusively (Marty et al., 2024; Waldon & Degen, 2020).

1.2.2 Scalar implicatures and priming

In the context of scalar implicatures, priming has also been used to examine how repeated exposure to specific readings can influence implicature generation. Scalar implicatures (SIs) are pragmatic inferences where the use of a less informative term implies the negation of a more informative alternative (Horn, 1972; Grice, 1989). For example, the word "some" can lead to an implicature. Take example of "Some of the apples were eaten." A literal meaning (Weak Reading) suggests “At least one apple was eaten, possibly all”, whereas a pragmatic meaning (Strong Reading) suggests “Not all apples were eaten”.

The generation of SIs involves considering alternative expressions (e.g., "all") and inferring that the speaker chose "some" to indicate that "all" does not hold. The cognitive mechanisms underlying SI generation have been debated, with some proposing a default inference and others suggesting a context-dependent process (Chierchia, Fox, & Spector, 2012; Geurts, 2010).

Bott and Chemla (2016) conducted a series of experiments where participants were repeatedly exposed to sentences containing scalar terms like "some" in contexts that either encouraged the strong implicature reading ("some, but not all") or the weak literal reading ("some, possibly all"). Their study found that participants exposed to the implicature reading became more likely to generate implicatures in subsequent trials, compared to when exposed to the weak reading. This evidence is interpreted to suggest that priming can increase the salience of certain pragmatic inferences.

1.2.3 Inverse preference and spillover effects in implicature priming

Recent studies on scalar implicatures have provided deeper insights into the mechanisms underlying priming effects in pragmatic interpretation. Building upon the work of Bott and Chemla (2016) and Rees and Bott (2018), Marty et al. (2024) conducted experiments to investigate whether priming effects in scalar implicature generation are due to structural factors or adaptive processes like context adaptation. Importantly, they addressed methodological concerns by introducing a more reliable neutral baseline through an initial block of trials before any priming occurred. This design allowed for a clear measurement of participants' default scalar implicature (SI) preferences without contamination from priming effects.

Marty et al. found that participants exhibited stronger SI preferences after strong primes compared to weak primes, replicating the general pattern observed by Bott and Chemla (2016). However, the inclusion of a clear baseline revealed that this pattern was actually the result of an inverse preference effect modulated by spillover effects. Specifically, in cases where the baseline rate for SI was very low—as with ad hoc implicatures—the default preference was for the literal interpretation without implicature. When participants encountered strong primes that forced SI generation, they adjusted their assumptions, leading to an increase in SI responses. This resulted in the pattern where SI preference was higher after strong primes than at baseline, with weak primes showing similar rates to the baseline (Strong > Baseline ≈ Weak). Here, the prime trials that forced the dispreferred SI reading caused participants to adapt, resulting in increased SI responses.

In contrast, for numerals, the baseline preference for SI was very high, indicating that participants typically interpreted numerals with an upper-bounded meaning (e.g., interpreting "two" as "exactly two" rather than "at least two"). Strong primes had little effect on increasing SI preferences because participants were already favoring the SI interpretation. However, weak primes introduced unexpected readings that contradicted participants' default expectations, leading to a significant decrease in SI responses after weak primes. Interestingly, in this condition, SI preference after strong primes was slightly below the baseline (Baseline > Strong > Weak). Marty et al. interpreted the lower-than-baseline SI rates after strong primes as a result of spillover effects from previous weak prime trials. This spillover effect suggests that the influence of unexpected weak primes persisted, affecting participants' interpretations even after the priming condition had changed back to strong primes.

These findings highlight the importance of considering inverse preference and spillover effects in implicature priming. The adjustments participants made in response to dispreferred or unexpected stimuli led to adaptations in their expectations and processing strategies. Such adaptations influenced not only the immediate responses but also subsequent trials, demonstrating how prior experiences shape interpretative processes in real time.

1.2.4 Theories of Priming and Spillover Effects

The observations made by Marty et al. (2024) have significant implications for theories of priming and spillover effects in pragmatic interpretation. Two main hypotheses have been proposed to explain the observed priming effects: the Salience Hypothesis and the Context Adaptation Hypothesis.

The Salience Hypothesis, as posited by Bott and Chemla (2016), suggests that priming increases the salience of alternative expressions, thereby facilitating implicature generation. According to this view, strong primes should enhance the prominence of the SI interpretation, making it more accessible in subsequent trials. Weak primes, conversely, should decrease the salience of the SI, leading to fewer implicature responses.

However, Marty et al.'s findings challenge the explanatory power of the Salience Hypothesis. In their experiments, SI rates after strong primes were below the baseline in conditions like numerals and for participants who typically generated pragmatic interpretations of "some." This contradicts the prediction that increased salience from strong primes should enhance SI generation. The significant decrease in SI preferences after weak primes and the lower-than-baseline SI rates after strong primes suggest that salience alone cannot account for the observed patterns.

Alternatively, the Context Adaptation Hypothesis offers a more comprehensive explanation. Marty et al. proposed that priming effects arise from participants adapting to the statistical properties of the experimental context, particularly when encountering unexpected or less frequent interpretations. Scalar expressions can have different readings depending on the context or the Questions Under Discussion (QUDs) that participants project based on their long-term linguistic experience. When participants encounter stimuli that force the dispreferred reading—such as weak primes in the numerals condition—they adjust their prior beliefs about the kinds of contexts associated with the scalar expression. This context adaptation leads to a stronger influence of the less preferred interpretation, resulting in the inverse preference effect.

Moreover, this adjustment to prior expectations can influence trials that immediately follow, causing spillover effects. In the case of numerals, after exposure to unexpected weak primes, participants' adjusted expectations remained below their initial baseline preference for SI. Even when strong primes were reintroduced, the influence of the prior weak primes persisted, leading to SI rates after strong primes that were still below baseline. This demonstrates how context adaptation accounts for both the inverse preference and spillover effects observed in implicature priming.

Marty et al.'s findings underscore the importance of considering adaptive responses to unexpected input in models of language processing. The Context Adaptation Hypothesis explains how participants dynamically adjust their interpretative strategies based on recent experiences, leading to adjustments in cognitive processing that are not predicted by the Salience Hypothesis. This adaptive mechanism aligns with broader theories in psycholinguistics that emphasize the role of expectation and prediction in language comprehension (Jaeger & Snider, 2013; Fine et al., 2013).

In conclusion, the debate between the Salience Hypothesis and the Context Adaptation Hypothesis highlights the need for further empirical studies that can distinguish between structural mechanisms and adaptive processes in priming effects. Marty et al.'s work provides compelling evidence in favor of context adaptation, suggesting that participants' adjustments to unexpected stimuli play a crucial role in shaping pragmatic interpretation. Understanding these mechanisms has significant implications for theories of language processing and the interplay between semantics, pragmatics, and context in comprehension.

1.3 Current studies

The current study aims to address these gaps by investigating priming effects in plural ambiguities and scalar implicatures with improved experimental designs that control for potential confounds. Specifically, there are two main research questions to be answered: (i) Do priming effects in plural ambiguities support the existence of a silent distributivity operator, or are they better explained by inverse preference and context adaptation? (ii) Does reaction time data provide evidence for the Salience Hypothesis or the Context Adaptation Hypothesis in implicature priming?

In chapter 2, plural priming is revisited to determine whether the priming effects observed in plural ambiguities are due to structural priming of a silent distributivity operator or can be better explained by inverse preference and spillover effects. I present a study which replicates Maldonado et al.'s (2017) Experiment 1 using a two-block design to separate baseline measurements from priming conditions, thereby minimizing spillover effects. In chapter 3, a new analysis of reaction time is conducted to implicature priming, which aims to investigate whether reaction time data supports the Salience Hypothesis or the Context Adaptation Hypothesis in implicature priming. In chapter 4, I synthesise the findings from both studies and explores theoretical implications for linguistic theory and cognitive models of language processing. Some insights about future research are also discussed in this section.

By addressing methodological limitations and incorporating reaction time analyses, this thesis seeks to provide a more nuanced understanding of the cognitive mechanisms involved in resolving pragmatic ambiguities. The findings have implications for theories of language processing, particularly regarding how context and prior experiences influence interpretation.

Understanding whether priming effects are due to structural factors or adaptive processes contributes to the broader debate on the nature of linguistic representations and the interplay between semantics, syntax, and pragmatics in language comprehension.

Chapter 2 Plural priming revisited: inverse preference and spillover effects

2.1 Introduction

Multiple interpretations of sentences may occur when more than one plural expression is involved in sentences. For example, in a sentence like "Two boys have three balls", there can be at least two different readings, as exemplified by the fact that (1) can be judged true in either scenario (a) or (b) below.

(1) Two boys have three balls.

a. **Cumulative scenario:** Two boys have three balls in total.

b. **Distributive scenario:** Two boys each have three balls.

The derivation of a distributive reading glossed in (1b) is standardly assumed to involve a silent *distributivity operator* ("Δ"). In this way, the logical form for the distributive reading is presented as "[Two boys] [Δ [have [three balls]]]". For cumulative reading, on the other hand, different compositional semantic theories have been put forward (e.g., Beck & Sauerland, 2000; Landman, 2000: Schmitt, 2019). One theory suggests that the cumulative reading of plural ambiguity sentences is the primitive reading, presented as "[Two boys] [have [three balls]]" in logical form. In this sense, the derivation of distributive reading is based on cumulative reading (Champollion, 2016; Link, 1998; Roberts, 1987). When modifying this *distributivity operator* (Δ) to VP "have three balls", the ownership of three balls applies to every member belonging to the set of the plural subject, "two boys"; therefore, each boy is holding three balls, which means that there are six balls in total among these two boys. Maldonado, Chemla and Spector (2017) investigated this cumulative-distributive contrast in ambiguous sentences consisting of plural expressions such as "Two boys have three balls" using a structural priming paradigm.

With the structural priming paradigm, Maldonado, Chemla and Spector (2017) compared “distributive primes”, which are priming trials forcing the distributive reading, “cumulative primes”, which are priming trials forcing the cumulative reading, and “neutral primes”, which do not force either reading. These comparisons aim to examine whether a specific reading for one ambiguous sentence will have a priming effect on the following similar sentence, which can be demonstrated by the increased ratio of the second sentence being interpreted on the specific reading. Furthermore, if this kind of contrast does give rise to a priming effect, comparing the impact of cumulative priming and distributive priming can also provide answers to the existence of *distributivity operator*. Specifically, based on the different logical forms for cumulative and distributive readings, if a priming effect can be found in distributive priming and is stronger than that found in cumulative priming, it may suggest that distributivity operator does contribute to the priming effects in some way.

Maldonado, Chemla and Spector’s hypothesis is based on the salience effect, which suggest the more salient reading among readings may have stronger boosting effect than the other. It means if taking the “neutral primes” (baseline) as a reference, a different intensity of boosting priming effect can be found when comparing the boosting priming effect of the cumulative and distributive primes.

However, in addition to primes’ boosting effects, the *inverse preference effect* is also a possible explanation when interpreting the results of the priming experiment. Inverse preference effects refer to the phenomenon that the less preferred reading in the baseline condition drives the priming effects rather than the preferred reading in the baseline condition boosts the priming effects on structural priming (Bock & Loebell, 1990; Ferreira & Bock, 2006; Hartsuiker & Kolk, 1998, etc.). Some studies suggest that the rise of inverse preference effects comes from people’s coping strategies for unexpected information (Jaeger& Snider, 2013). When an unexpected linguistic structure appears, this new information may influence people's expectations in this context. People may increase their prediction probability of encountering this unexpected linguistic structure as a coping strategy and adjust their behaviour accordingly.

In Maldonado, Chemla and Spector (2017)'s study, results show that (i) sentences that are ambiguous between a distributive and a cumulative reading were more likely to be interpreted on the distributive reading after distributive primes than after neutral primes (68.33% vs. 61.15%) and (ii) there was no reliable difference in the rate at which the distributive reading was observed after cumulative primes and neutral primes (58.17% vs. 61.15%). Based on these results, the authors make two claims: first, the observed priming effects cannot be characterized as inverse preference effects since the distributive reading was relatively preferred after the neutral primes but still gave rise to priming effects; second, the observed priming effects are to be explained in terms of structural priming of the silent distributivity operator, and as such constitute evidence for its existence.

Maldonado & Chemla & Spector's (2017) experimental design, however, has one potential issue. While the neutral primes were meant to reveal the baseline rate of distributive readings, these primes were interspersed among distributive and cumulative primes and, as previously pointed out for implicature priming (Marty et al. 2024; Waldon & Degen 2020), the presentation of non-neutral primes may trigger strong and long-lasting priming effects which, in turn, may affect the responses in the purportedly neutral priming conditions. If such 'spillover priming effects' were present, then Maldonado & Chemla & Spector's reasoning about the direction of priming could have been misguided.

In this study, we planned to replicate Maldonado et al. (2017)'s Experiment 1 but with a more neutral baseline. Specifically, following Marty et al. (2024), we adopted a block design where baseline trials involving no priming at all were conducted in the first block of the experiment and where priming trials were only introduced in the second block.

2.2 Plural Priming

Since our experiments are designed based on the priming experiments conducted by Maldonado, Chemla and Spector (2017), we will review their study in detail first. Maldonado, Chemla and Spector (2017) employed a sentence-picture matching task involving priming trials. In their experiment 1, each participant was shown one sentence and two pictures each time. The sentence indicates a relation between shapes. All sentences are either unambiguous or ambiguous:

(2) a. "A [shape 1] is connected to two/three [shape 2]". (Unambiguous)

b. "Two [shape 1] are connected to two/three [shape 2]". (Ambiguous)

For the ambiguous sentence, there may be two different readings:

(3) a. "Two [shape 1] are connected to two/three [shape 2] in total" (cumulative reading).

b. "Two [shape 1] are each connected to two/three [shape 2]" (distributive reading).

For each sentence, two pictures were displayed below to illustrate what the sentence described, typically showing a certain number of shapes linked to another set of shapes. Participants had to select the picture they believed best matched the sentence they read.

Participants encountered three different experimental trials: prime, baseline, and target, as depicted in Fig. 1. In prime trials, all sentences were ambiguous. One of the two pictures in these trials corresponded to a specific reading. In these trials, one picture was consistent with one of the two readings of interest – either the cumulative reading in the cumulative primes or the distributive reading in the distributive primes – while the other picture rendered the sentence false for both readings. Consequently, participants were compelled to choose the "correct" picture with either cumulative or distributive readings to align with the sentence. Depending on the prime trial condition they were in, they might be nudged to interpret sentences in a particular manner.

In baseline trials, all sentences were unambiguous, as illustrated in Fig. 1. One of the two pictures precisely represented what the sentence described, marking it as the correct option. Conversely, the other picture did not align with the sentence. While baseline trials required participants to select a specific picture, unlike prime trials, they weren't steered to think in a predetermined manner. They simply had to make the correct choice. Hence, no anticipated priming effects targeted them.

In target trials, sentences remained ambiguous between the cumulative and distributive readings (e.g., "Two circles are connected to two hearts."). However, the pictures in target trials differed from those in prime trials. There were no incorrect pictures in these target trials. Participants had the freedom to choose a picture based on their preferred interpretation of the sentence.

Experimental trials followed a triplet design. After two cumulative prime trials, two distributive prime trials, or two baseline trials, a target trial ensued. Two primes were used to enhance the priming effect and to increase the interval time from the previous prime trials in the last triplet, as suggested by Raffray & Pickering (2010). Sentences varied across the three trials in a triplet. Every two prime/baseline trials in a triplet shared the same numerals but differed in shapes, colors, and the position of the correct picture.

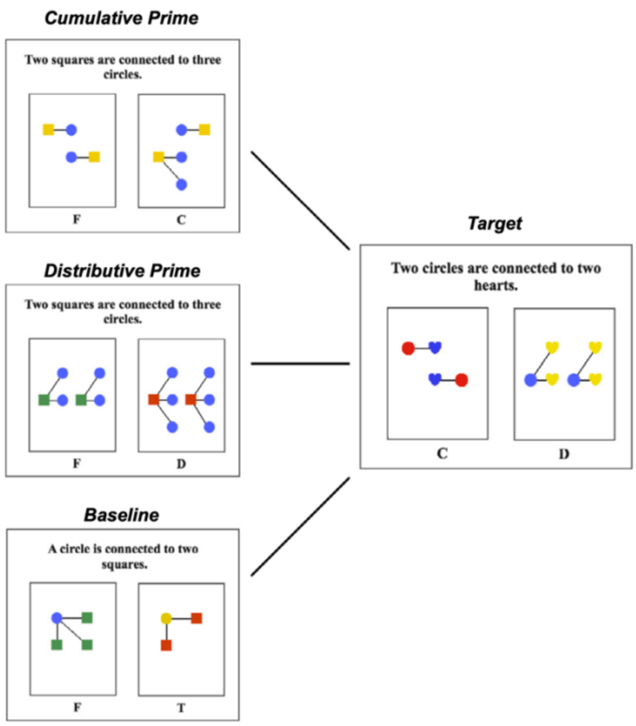

Fig. 1. Schematic representation of Maldonado, Chemla and Spector's (2017) Experiment 1

In their Experiment 1, The proportion of distributive responses in target trials after distributive primes was significantly higher than that following baseline trials. This was interpreted to indicate the presence of a structural priming effect driven by distributive readings. However, the proportion of distributive responses in target trials after cumulative primes was lower than that after baseline trials, though not significantly so. This suggests that cumulative readings cannot be primed. Maldonado, Chemla, and Spector (2017) argue that the difference in priming results between the two readings provides evidence for the existence of a distributivity operator. In other words, the structural priming effect of the distributive reading arises from the distributivity operator. The absence of this operator in the cumulative reading explains why cumulative reading cannot be primed.

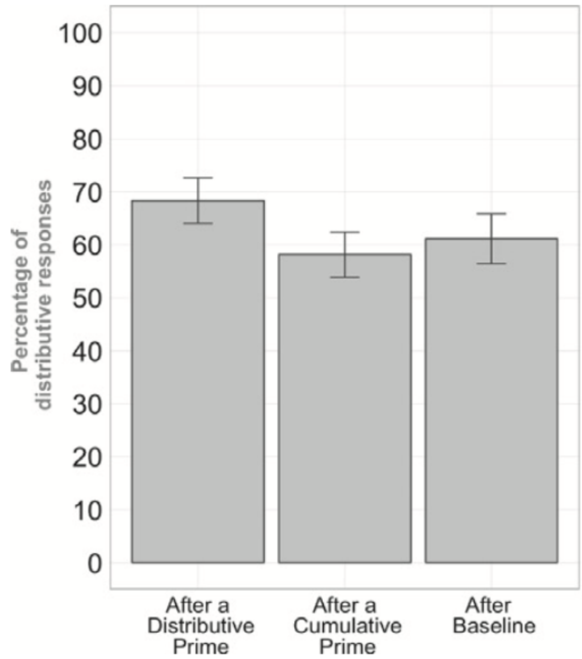

Fig. 2. Mean percentage of distributive responses to targets in Maldonado, Chemla and Spector's (2017) Experiment 1

Maldonado, Chemla, and Spector (2017) conducted two additional experiments to reinforce their findings. The primary objective of these experiments was to eliminate the potential influence of visual priming effects, rather than structural priming effects, as an explanation for the results of Experiment 1. Visual priming effects refer to the influence exerted by visual stimuli, such as pictures (Tulving & Schacter, 1990). Compared to other types of stimuli, visual stimuli are often considered easier to process.

To address this, Maldonado, Chemla, and Spector modified the ambiguous sentences in the cumulative prime trials and distributive prime trials to be unambiguous. These were labeled as pseudo cumulative primes (e.g., "There are four/six [shape 2]") and pseudo distributive primes (e.g., "There are two/three [shape2]"). Based on the results of Experiment 2, no priming effects were observed across all conditions when ambiguous sentences were controlled (with the percentages of distributive responses hovering slightly above 70% for all conditions). This indicated that the visual stimuli in Experiment 1 did not contribute to the observed priming effects.

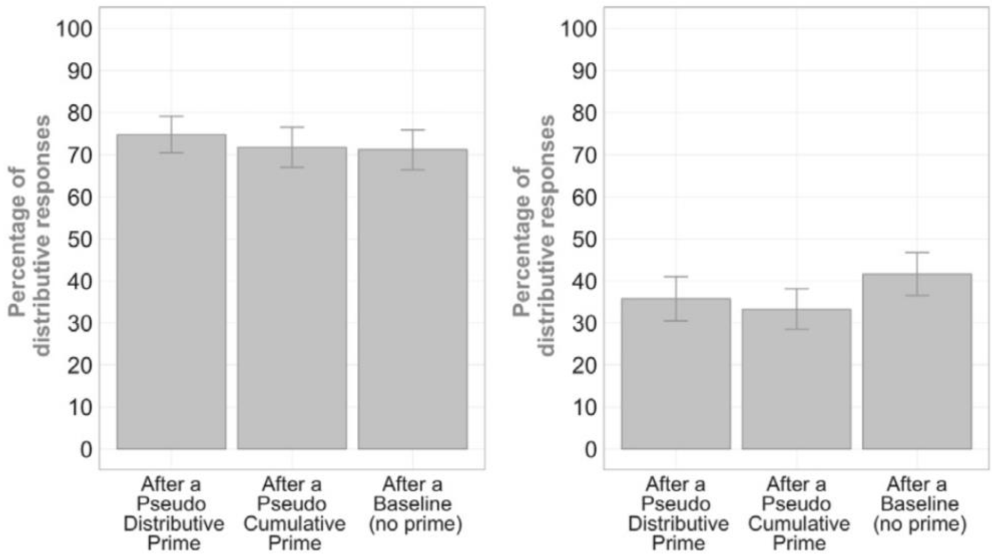

Fig. 3. Mean percentage of distributive responses to targets in Maldonado, Chemla and Spector's (2017) Experiment 2 (Left) & 3 (Right)

However, the results from Maldonado et al. (2017) cannot conclusively rule out the possibility of a spillover effect. Given that all triplets, irrespective of prime or baseline condition, were presented randomly within a single block, it's plausible that the priming effects from prime trials situated close to target trials in the baseline condition might persist. Consequently, a baseline derived from this design cannot be considered a truly neutral baseline for comparison.

Evidence supporting spillover effects is evident in the outcomes of the three experiments. Notably, the baseline percentage preference for distributive readings was distinctly lower in Experiment 1 than in Experiment 2. Such a discrepancy shouldn't occur in the absence of interference. Moreover, this couldn't be attributed to the priming effect of the distributive reading, as the baseline in Experiment 1 didn't show an increase compared to Experiment 2. The most plausible explanation is that the cumulative prime trials in Experiment 1 influenced the baseline condition, causing the baseline in Experiment 1 to be lower than expected. Results from Experiment 3 exhibited a similar trend. Given that all priming effects originated from the cumulative reading in that experiment, the so-called baseline plummeted to the lowest level across all experiments. This suggests that the distributive reading priming effect identified in Experiment 1 is not robust since it's based on a compromised baseline. It's conceivable that the design of Maldonado et al.'s experiments doesn't provide a definitive answer to the cumulative-distributive contrast in plural ambiguities. Furthermore, an inverse preference effect driven by the cumulative reading might be discerned with a more neutral baseline.

Experiment 2's results from Maldonado, Chemla, and Spector (2017) bolster the inverse preference effect as a viable explanation. The outcomes of Experiment 2 can serve as a more neutral baseline since it excludes priming. As demonstrated in Experiment 2, the distributive reading consistently emerged as the preferred interpretation (as in Experiment 1) in this series of experiments, rendering the cumulative reading undeniably the less favored interpretation. According to Experiment 2, the proportion of distributive responses following pseudo cumulative primes exceeded 70%. However, this proportion dipped to below 60% following "real" cumulative primes in Experiment 1. If we consider the data from Experiment 2 as the "true" baseline, rather than that from Experiment 1, a more pronounced effect from the cumulative reading might be evident.

Experiment 3's results from Maldonado, Chemla, and Spector (2017) further substantiate the inverse preference effects. In Experiment 3, all distributive prime trials from Experiment 1 were converted to cumulative prime trials. Consequently, both pseudo distributive primes and pseudo cumulative primes compelled participants to adopt a cumulative reading. As depicted in Fig. 3, the proportion of distributive responses markedly decreased after both pseudo distributive and pseudo cumulative prime trials. This underscores the potency of the effect induced by the cumulative reading, even if it wasn't the preferred interpretation in preceding experiments.

The aim of the current study is to discern the direction of priming effects using a more neutral baseline than that employed by Maldonado et al. (2017). To this end, we embraced a two-block design akin to Marty et al. (2024). In the experiment's first block, devoid of priming, participants were free to express their preference for plural ambiguities. Subsequently, in the second block, we replicated Experiment 1 from Maldonado, Chemla, and Spector (2017). This approach, in contrast to the one-block design, allowed us to derive a purer baseline from the initial block. We could then juxtapose the priming effects observed in the second block against this more pristine baseline.

2.3 Experiment

2.3.1 Materials

Each trial consisted of one sentence and two pictures appearing below. All sentences in the experiment trials were generated based on one of the two frames shown as example (2) and example (3) (in common with Experiment 1 in Maldonado, Chemla and Spector (2017)). The [shape 1] and [shape 2] denoted the shape type from the following list: triangle, square, circle and heart.

(2) Ambiguous sentences in primes and targets:

a. Two [shape 1] are connected to two [shape 2].

b. Two [shape 1] are connected to three [shape 2].

(3) Unambiguous sentences in baseline trials:

a. A [shape 1] is connected to two [shape 2].

b. A [shape 1] is connected to three [shape 2].

Fig. 4 below presents examples of sentence-picture combinations that might appear in block 2. As shown, all sentences were exactly like what Maldonado, Chemla and Spector used in their Experiment 1. Sentences used the same predicate "be connected to", and the two shapes in one sentence were not the same. Pictures were made up of four shapes (triangle, square, circle and heart) and presented as a certain number of one shape linked by lines to a certain number of another shape.

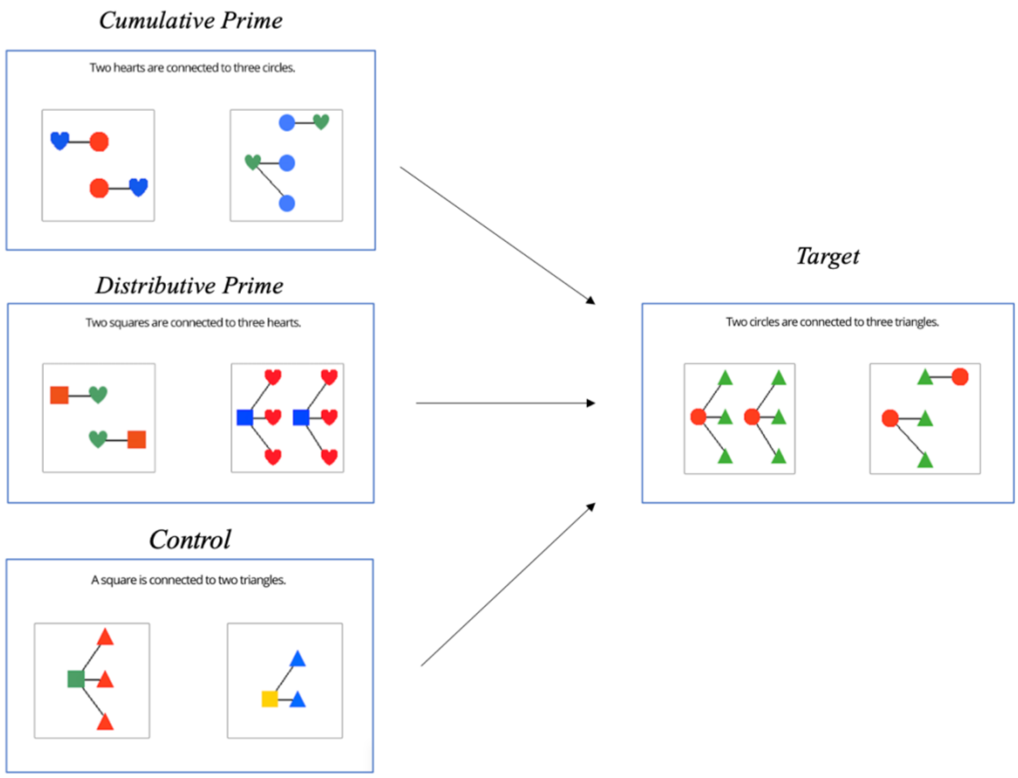

Fig. 4. Schematic presentation of different sentence-picture combinations in block 2.

Prime trials in block 2 consisted of an ambiguous sentence and two pictures: one was consistent with one of the two readings (cumulative or distributive), and another was false because of the wrong number of shapes regarding of sentence. While control trials (previously called baseline trials in Maldonado, Chemla and Spector (2017)) consisted of an unambiguous sentence together with two pictures: one was true as it was consistent with the sentence in both shape and number, and another was false as the number of one shape was not correct. As for target trials, sentences were all ambiguous. In the meantime, the two pictures were both "true" as they each corresponded to one of the readings of this sentence. Filler trials were similar to prime trials, except the false picture employed a different visual display.

Trials in block 1 were extracted from trials in block 2. Fig. 5 below shows an example of a target trail and filler in this block. Target trials in this block were the same as target trials in block 2, which consisted of one ambiguous sentence and two pictures (one was consistent with cumulative reading, and another was consistent with distributive reading). At the same time, filler trials were the same as control trials of block 2.

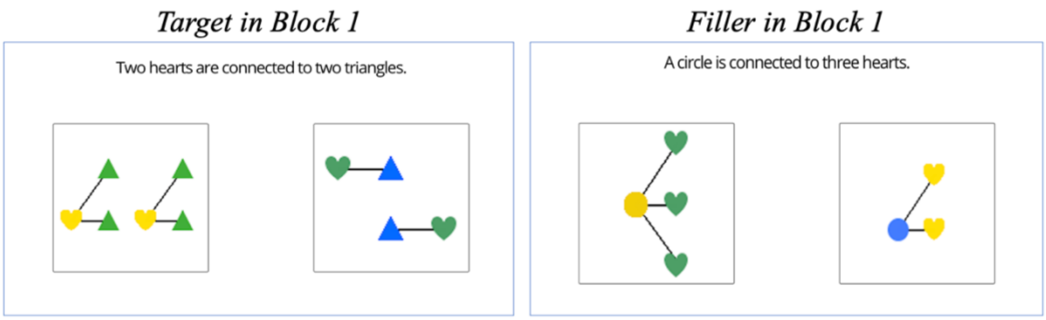

Fig. 5. Schematic presentation of different sentence-picture combinations in block 1.

2.3.2 Design

There were two blocks in the experiment. In block 1, all trials were not primed. While in block 2, trials were organised in a triplet pattern where target trials are preceded by two priming trials or two control trials.

Block 1 included 16 target trials, and 16 filler trials were inserted randomly. In this block, we intended to establish a neutral baseline without any possible priming effects. Participants could choose the picture according to their interpretations of sentences. In this block, different participants might exhibit different preferences between the cumulative reading and distributive reading. Whether they were pro-cumulative or pro-distributive people, their statistics would serve as a better baseline for assessing priming effects' direction.

Block 2 intended to replicate the original experiment by Maldonado, Chemla and Spector (2017). Trials in this block followed a triplet pattern, meaning there were always two cumulative primes, two distributive primes, or two control primes before each target trail. There were 48 triplets, meaning 144 experimental trials in total. Another 48 filler trials were added, which made the total number of trials in this block achieve 192.

2.3.3 Procedure.

The study was run as an online survey using the Gorilla Experiment Builder (https: //www.gorilla.sc; see Anwyl-Irvine et al. (2019) for an overview). In the instructions, participants were told that they would be presented with English sentences, each of which would be accompanied by two pictures. They were told that each sentence is meant to describe one and only one of the two pictures and that their task was to decide which picture they think the sentence is describing. They were instructed to provide their responses by clicking on the picture they consider a better match for the sentence.

The instructions were followed by a short practise phase to help the participants get familiar with the visual display and response procedure. During this phase, participants were presented with two practice trials, each of which consisted of an unambiguous sentence and two pictures. They received feedback on their responses and, in case they did not select the right picture, they were asked to redo the trial. Participants could not enter the test phase until they gave correct responses on both practice trials.

The test phase started with the trials from Block 1 (BASELINE conditions) and then continued with the trials from Block 2 (CONTROL, CUMULATIVE and DISTRIBUTIVE priming conditions), with a short self-timed break in-between. Individual and triplet trials were presented in random order in each block. On each trial, a fixation cross appeared and remained on the screen for 500 ms before the items were displayed. For each item, participants provided their response by clicking with the mouse on the picture of their choosing. Items remained on the screen until participants gave their response.

2.3.4 Participants

75 self-reported native speakers of English (36 females, 38 males, 1 other; average age 40.3 years old) participated in this experiment. Participants were recruited online through Prolific.ac (https://www.prolific.co; see Palan & Schitter (2018) for an overview) using the following pre-screening criteria: English as a first language, UK/US IP ad- dresses, minimum 90% prior approval rating. The survey took around 14 minutes to complete, and participants were paid £2.4 for their time. All participants gave written informed consent to the processing of their information for the purposes of this study, which was approved by the Research Ethics Committee at UCL. Three participants were excluded prior to data treatment: two for taking the survey on mobile phones rather than computers and one for suspiciously short mean response times (lower than 1s per trial).

2.3.5 Data Treatment

Data treatment and analyses only included responses to experimental trials. Responses from 2 participants were excluded because they used mobile/tablets to participate in the experiment. As the display of experiments might be different on mobile/tablets screen, the possible zoom-in or zoom-out actions from these users might have an unknown influence on the results. Responses from the other 1 participant were removed because their performance in filler and prime trials did not reach the 80% accuracy standard pre-established by Marty et al. (2024). Another 1 participant's responses were removed because the average reaction time was lower than 1 second.

2.3.6 Data Analyses

First, we carried out a global analysis of participants' responses in the target trials to test (a) for pairwise contrasts among the CUMULATIVE, DISTRIBUTIVE and CONTROL conditions from Block 2 and (b) for unimodality of the distribution of the by-participant mean rates in the BASELINE conditions from Block 1. Participants' baseline rates were found to be distributed bimodally indicating that some participants consistently interpreted the target sentences on their distributive reading while others consistently interpreted these sentences on their cumulative reading. Thus, we carried out a second analysis considering participant's baseline preferences: participants were classified as Distributive or Cumulative responders based on their baseline rates, and responses to the target trials were sorted out according to these two responder profiles. Responses from both groups of responders were then analysed using the data analysis pipelines from the first analysis.

Data analyses were conducted using the lme4 (Bates et al. 2015), car (Fox & Weis- berg 2019) and diptest (Maechler 2021) libraries for the R statistics program (R Core Team 2021). Participants' responses were analysed through model comparison of binomial linear mixed-effects models (Jaeger 2008). The models included random intercepts for Subjects, random slopes for Condition grouped by Subjects and random intercepts for Items (in some cases, only random intercepts for Subjects and Items), as the maximal random effect structure supported by the data. p-values were adjusted using the Bonferroni correction method for multiple testing.

2.3.7 Results

2.3.7.1 Global Analysis

Figure 6 shows the mean proportion of distributive choices on target trials by experimental condition. Overall, the rates of distributive responses in the priming conditions were similar to those reported in Maldonado, Chemla & Spector (2017), suggesting that participants' performance in the priming trials from Block 2 was largely unaffected by the baseline trials from Block 1. As in Maldonado et al., participants gave significantly more distributive responses in the DISTRIBUTIVE than in the CUMULATIVE condition (62% vs. 54.8%; $\chi2(1) = 8.32$, adjusted-p = .012) and no significant difference was found between the CUMULATIVE and CONTROL conditions (54.8% vs. 59.1%; $\chi2(1) = 4.11$, adjusted- p = .128). While the difference between the DISTRIBUTIVE and CONTROL conditions did not reach significance ($\chi2(1) = 2.53$, adjusted-p = .336), unlike in Maldonado et al., a trend in the same direction was present, and we consider this small discrepancy between the two studies to be non-essential.

Zooming in on the BASELINE conditions, we found that participants' baseline rates were not distributed unimodally ($D = 0.088$, $p < .001$) and that two modes were present in the data: the mode with the highest estimated density value peaked at 98.4% and the second at 4.1%. The estimated location and density values of these modes show that (i) a vast majority of the participants had a strong preference for one of the two readings and (ii) some of them consistently favored the distributive reading while others consistently favored the cumulative reading. In the following, we present a more-fine grained analysis of the data informed by participants' baseline preferences.

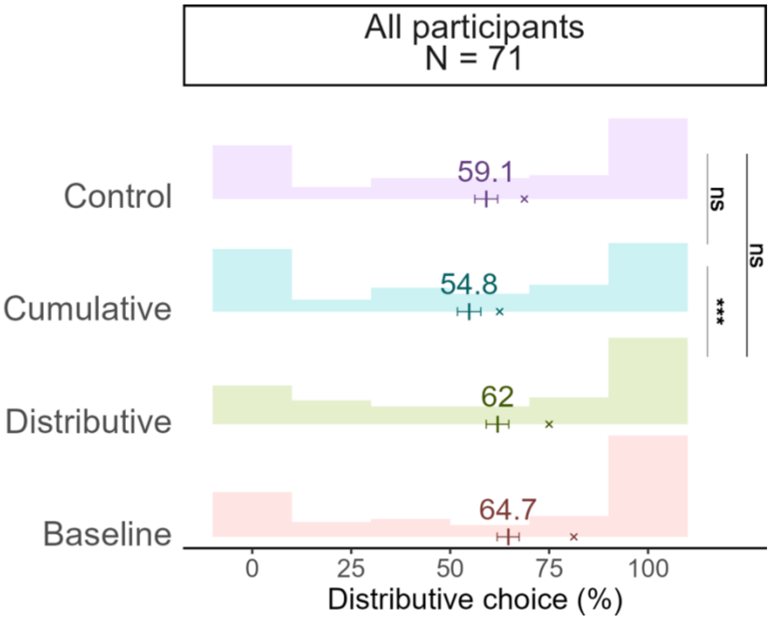

Fig. 6. Proportion of distributive choices on target trials by experimental condition. For each condition, the distribution of by-participant mean proportions is visualised by a histogram, the grand mean by a thick bar with its value on top and the 95% CI around it, and the median by a cross. The significance levels are based on the adjusted p-values for all comparisons tested.

2.3.7.2 Analysis informed by participants' baseline preferences

In order to see how participants with opposite baseline preferences were affected by the priming conditions, responses to the target trials were sorted according to two responder types: participants were classified as CUMULATIVE responders if their baseline rate was below 50% and as DISTRIBUTIVE responders if their baseline rate was above 50%. There were 22 CUMULATIVE responders and 45 DISTRIBUTIVE responders, representing 30% and63%of the subjects in our sample, respectively. Figure 7 shows the mean proportion of distributive choices on target trials by responder type and experimental condition.

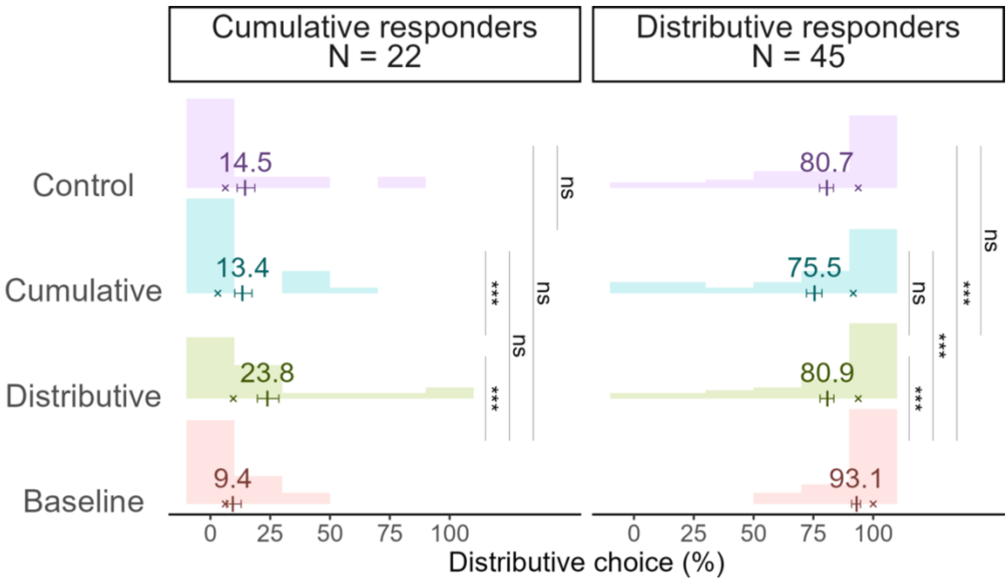

Fig. 7. Proportion of distributive choices on target trials by experimental condition. This graph reads in an analogous way to the previous one (see Fig.6 for details).

Pairwise comparisons were conducted between all conditions for each responder type. For the CUMULATIVE responders, the results showed a classical priming effect driven by the DISTRIBUTIVE primes. CUMULATIVE responders gave significantly more distributive responses in the DISTRIBUTIVE conditions (23.8%, 95%CI=[19.6, 28.6]) than in the CUMULATIVE conditions (13.4%, 95%CI=[10.2, 17.4]; $\chi2(1) = 6.45$, adjusted-p = ...)]. For the DISTRIBUTIVE responders, results showed spillover priming effects from the CUMULATIVE primes onto the other priming conditions. DISTRIBUTIVE responders gave significantly fewer distributive responses in the CUMULATIVE (75.5%, 95%CI=[72.1, 78.5]), CONTROL (80.7%, 95%CI=[77.6, 83.4]) and DISTRIBUTIVE (80.9%, 95%CI=[77.8, 83.6]) conditions than in the BASELINE conditions (93.1%, 95%CI=[91.0, 94.7; all χs> ..., adjusted-ps< ...).

2.4 Discussion and Conclusion

2.4.1 Discussion

Our results replicate the findings from Maldonado & Chemla & Spector (2017) in showing that, overall, participants generally provided more distributive responses in the DISTRIBUTIVE than in the CUMULATIVE conditions. But our novel BASELINE conditions also show that there is more to these original results than meets the eye. Participants in Maldonado et al. (2017)'s experiments preferred to interpret plural ambiguities with the distributive reading, whereas the data in our "Distributive responder" group are also pro-distributive. Among pro-distributive responses to experimental target trials, the comparison between the baseline and control conditions aims to check whether there is a difference between the neutral baseline produced by an independent block without any possible priming and a possibly contaminated baseline generated by the all-in-one block 2. It turns out the difference is significant, which means other prime trials influenced the responses to target trials in the controls condition in the same block. As our control condition is actually the baseline condition in Maldonado et al. (2017), the original baseline used in analyses by Maldonado et al. (2017) was not neutral, and the conclusions, therefore, might not be accurate.

According to the results, it seems that it is the cumulative primes which drive the effects in our experiment. Results suggest that the cumulative primes caused a significant decrease in distributive responses in target trials compared with the neutral baseline. In this way, it seems that the cumulative reading, as the disfavoured reading caused a very strong priming effect, the so-called inverse preference effect, on target trials.

Furthermore, the comparison between the distributive condition and the new baseline condition also suggests an opposite result to the priming boost effect found by Maldonado et al.. Instead of boosting distributive responses after distributive primes, the proportion of distributive responses to target trials in the distributive condition is significantly lower than in the baseline condition. As the distributive reading is the preferred reading in this group, it is not possible that the distributive primes caused this decrease, which leads the attention to the cumulative primes in the same block again. The disfavoured cumulative primes seem so strong and even cause a spillover effect which influences the target trials in distributive conditions.

A similar trend can also be found in the “Cumulative responder” group. Note that the disfavoured reading in this group is the distributive reading; therefore, if there is an inverse preference effect, it should be driven by distributive primes.

According to the results, the proportion of distributive responses to target trials increased significantly after the distributive primes compared with baseline, which suggests an inverse preference effect driven by the disfavoured reading. Furthermore, since the proportion of distributive responses to target trials in cumulative conditions is higher than in the baseline condition, it seems that the spillover effect happens again: the strong distributive primes spill their impact out of the triplets and influence the target trials in cumulative conditions.

2.4.1 Conclusion

In our study, we adopted a two-block design of priming experiments on plural ambiguities. It turns out that it is the disfavoured reading which drives an inverse preference effect for the priming study of cumulative-distributive contrast. In this way, if the cumulative reading is the disfavoured reading among people, it will drive the priming experiment and decrease the possibility of another reading being employed. Therefore, when applying a neutral baseline, the priming boost effects found in

Maldonado et al. (2017) are actually the opposite: it is not the distributive reading (the preferred reading in their study) that causes a structural priming effect, whereas the cumulative reading does not; in contrast, it is the disfavoured reading display an inverse preference effect.

We argue that the present findings undermine Maldonado, Chemla & Spector (2017)'s claim that their results provide evidence for the silent distributivity operator. First of all, since the results exhibit an inverse preference pattern, we have to conclude that both distributive and cumulative primes have priming effects. If this observation were to be interpreted in terms of structural priming, we would conclude that both readings are to be accounted for by a silent operator, or at least by some distinguished structural property such as silent movement. This is certainly a possibility, but the inverse preference pattern is amenable to an alternative explanation that makes no recourse to structural priming at all. For instance, it can be accounted for in terms of online adaptation of probabilistic expectations about the distributions of the two readings, as proposed for other kinds of syntactic or semantic priming effects (Fine et al. 2010; Marty et al. 2024). Given this alternative explanation, we conclude that, although compatible with the existence of a silent distributivity operator, the results do not provide support for such an operator.

In addition, our study also sheds light on the results of another study, Maldonado & Chemla & Spector (2019), in which the authors used the priming paradigm to investigate the distributive vs. collective interpretations of adjectives in sentences like The bags are heavy. The results indicate priming effects from both distributive and collective interpretations, which is, as the authors discuss, unexpected from the view they expounded in Maldonado & Chemla & Spector (2017). However, in this study too, the authors argue that the observed priming effects are unlikely to be inverse preference effects, because the 'baseline' conditions in Experiment 2 indicate an overall preference for the collective interpretation, from which one would expect a larger effect of distributive priming. However, we would like to point out that, as in Maldonado & Chemla & Spector (2017), the baseline conditions used in Maldonado, Chemla & Spector (2019) were interspersed with other priming trials, which could have had spillover priming effects on the baseline trials. Thus, the preference for the collective interpretation could be a byproduct of a relatively stronger priming effect of the collective primes. In addition, they do not report individual variation that might be present in their results, making it difficult to see if there were inverse preference effects in different directions that partially cancelled each other out in the aggregated results. Given these considerations, it is possible that the results they report can be characterised in terms of inverse preference effects, and that any discrepancy between Maldonado & Chemla & Spector (2017) and Maldonado & Chemla & Spector (2019) is attributable to different baseline preferences for the different linguistic stimuli used in these studies. To ascertain whether this is the case, one would have to rerun Maldonado & Chemla & Spector's (2019) experiments with more neutral baseline trials to probe subject's interpretive preferences prior to the priming phase.

In sum, our study replicates the results reported in Maldonado, Chemla & Spector (2017). In addition, our novel baseline conditions uncovered inter-participant variation in the default interpretation, which in turn revealed the inverse preference pattern in the priming results. This means that both distributive and cumulative interpretations can be primed when they are the dispreferred reading. We pointed out that, as inverse preference effects, the observed priming effects can be explained without referring to structural priming, and therefore do not provide support for the presence of silent operators at LF. The study also provides further support for the context adaptation hypothesis of Marty et al. (2024).

Chapter 3 A reaction time study of implicature priming: salience or context adaption

3.1 Introduction

Scalar implicatures (SIs) have emerged as a focal point in Experimental

Pragmatics over the past two decades. A typical example of SI is derived from the word "some" in English. Consider the sentence, "Some of the symbols are circles." It can be interpreted in two distinct ways: a strong reading suggests that while some symbols are circles, not all are; a weak reading merely confirms the presence of circles without specifying whether or not all symbols are circles (Bott & Noveck, 2004; Katsos & Cummins, 2010; Chemla & Singh, 2014; Noveck, 2018).

Building on Grice's foundational work (1989), the weak reading is typically viewed as the literal interpretation of the sentence. In contrast, the strong reading necessitates an additional inference—the SI—which negates the version of the sentence where "some" is substituted with "all". Broadly speaking, SIs can be described as negations of such alternatives: related sentences whose negations align with the literal meaning of the original assertion. The precise inferential process behind these negations remains a contentious topic in theoretical literature (Sauerland, 2004; Chierchia, Fox & Spector, 2012; Geurts, 2010; Bergen, Levy & Goodman, 2016).

The priming paradigm has gained attention as an experimental technique to probe various facets of SI (Bott & Chemla, 2016; Rees & Bott, 2018; Waldon & Degen, 2020; Meyer & Feiman, 2021). Common observations from these studies indicate that SIs are more prevalent following strong primes—priming trials that necessitate the strong reading and thus the computation of an SI—than after weak primes, which promote the weak reading and exclude SI. Bott & Chemla (2016) posited an explanation for this trend, attributing it to the priming of the computational mechanism responsible for generating SIs. They argue that this pattern can be rationalized through the Salience Hypothesis: elevating the salience level of an alternative expression amplifies the priming effect, leading to more frequent SIs in subsequent target trials.

However, Marty et al. (2024) challenge this Salience Hypothesis, introducing an alternative theory grounded in the Context Adaption Hypothesis. In their research, Marty et al. incorporate an independent baseline block to gauge participants' inherent preferences. Using this unbiased baseline, they identify the so-called inverse preference effect, suggesting that less preferred interpretations exert a stronger priming influence than their favored counterparts. For instance, with the scalar item “some”, if participants predominantly interpret “some” as the SI “some but not all” in the baseline block, it's not the strong primes that enhance the computation of SI, but rather the weak primes that suppress it. Conversely, for participants inclined towards a literal interpretation of “some” as “some and possibly all” in the baseline block, the dynamics are reversed. By adding a neutral baseline against a potentially skewed one, Marty et al. discovered that the proportion of choices reflecting SI computation didn't markedly increase post-strong primes for pragmatic responders. Instead, this proportion notably diminished post-weak primes. As discussed in the introduction, Marty et al. (2024) attribute this inverse preference effect to implicit online learning and adaptation, grounded in probabilistic context expectations. As participants navigate a context, they may cultivate a holistic understanding of the conversational context they inhabit, informed by both prior knowledge and ongoing experiences.

While previous studies primarily rely on choice proportions in target trials, reaction time (RT) might offer additional insights which bear on the debate between the salience and context adaptation hypotheses in implicature priming research. In our current investigation, we re-examine the RT data collected by Marty et al. (2024), anticipating that it might either corroborate or refute the context adaptation hypothesis in implicature priming studies. Although reaction times have not been often used in structural priming research previously, Bott & Frisson (2022) conducted a RT study involving sentence verification trials involving ‘some’ which were primed either with Alternatives or control sentences containing non-alternative quantifiers, ‘some’ and ‘no’, and also ‘all’. As in the priming paradigm discussed below, target stimuli involved a sentence with ‘some’ (‘Some lions are mammals’) which was true if understood literally, but false if the reading was strengthened to include the implicature. Bott & Frisson only report RTs for ‘False’ judgements (i.e. for those participants who accessed the strengthened reading) and found a facilitation effect after true prime sentences with ‘all’ compared to false prime sentences with ‘all’, and also compared to false prime sentences with 'some' and false prime sentences with 'no'. They argue that this is evidence that alternative salience facilitates SI derivation based on lower reaction times compared to conditions in which the alternative is less salient. However, this conclusion seems not very well supported since one of the control conditions contains the same alternative expression, 'all'. Bott and Frisson argue that the difference between experimental and control conditions with 'all' lies in the truth value of the prime. They argue that evaluating primes as true attracts more attention to the meaning of 'all' than false, but that seems a very dubious assumption.

In the investigation reported below, we test Bott & Frisson's linking assumption, based on the Salience Hypothesis, that the greater salience of an alternative leads to a reduced RT for SI generation post-strong primes, relative to baseline RT. For this purpose, I use the Reaction Time data that was collected in the experiments by Marty and colleagues but has yet to be analysed. I turn now to a more detailed presentation of priming research on scalars, and the results which led to the Salience Hypothesis and the alternative Context Adaptation Hypothesis

3.2 Implicature priming: salience and context adaption

3.2.1 Previous research

This section begins by reviewing Bott and Chemla's (2016) study, as our current research is primarily based on their experimental design. They utilized a sentence-picture selection task in which each sentence could optionally be understood with a Scalar Implicature or not. In Target trials, one picture is an open card, compatible only with the literal reading of the sentence, while the other is obscured with a label reading "Better Picture" (see Fig. 8 below). Under this design, participants would choose the open card if they found the weaker literal reading of the sentence acceptable. Selecting the covered card indicates that they deemed the weak reading unacceptable. Bott and Chemla (2016) interpreted the act of choosing the covered card as an indirect measure for the strong reading being the one that is assigned to the stimulus sentence.

Following Raffray & Pickering (2010), Bott and Chemla's (2016) priming experiments adopted a triplet structure: each target trial was preceded by two prime trials of the same type. Each prime trial also featured one sentence and two pictures, but both pictures were open cards. There are two types of priming trials: weak primes and strong primes (see Fig. 8 below). In a weak prime, only one picture validates the sentence under its literal reading. For instance, with the sentence "Some of the symbols are circles," one picture displays all symbols as circles (true under the weak reading), while the other shows no circles, clearly making it a false choice. This design ensures that participants, when faced with a weak prime, must choose the first picture, thereby accessing the weak reading. In a strong prime, using the same example, one picture remains consistent with the first picture in the weak prime, while the other displays some, but not all, symbols as circles. Since participants are informed that only one picture validates the sentence, they are compelled to access the strong reading and select the second picture, which aligns with the strong reading.

Bott and Chemla (2016) tested three types of scalar items: Ad hoc, Some, and Number[1]:

(2) a. There is a cross. (Ad hoc)

b. Some of the symbols are crosses. (Some)

c. There are four crosses. (Number)

The corresponding scalar implicatures are:

(3) a. There is only a cross. (Ad hoc)

b. Some but not all symbols are crosses. (Some)

[1] Bott & Chemla (2016) involved both priming within scales and between scales. In within-scale priming, target trials were preceded by primes involving the same scalar expression (some-prime trials preceded some-target trials, and so forth). In between-scale priming, prime trials involved a different scalar expression to the target (e.g. some-prime trials preceded number-target trials, and so forth). Here I focus on the results and discussion of the within-scale priming, as this was the focus of much subsequent priming work, including in Marty et al. (forthcoming) – which is discussed below.

c. There are exactly four crosses. (Number)

Their results indicated that the frequency of choosing the covered card in target trials after strong primes exceeded that after weak primes for all three scalar expressions. Bott and Chemla interpreted these consistent trends across different scalar items as evidence of a shared mechanism underlying the generation of SI inferences. Generally, two steps are involved in SI computation: (i) referencing an alternative and (ii) negating it. When encountering a strong prime, participants are compelled to reference an alternative and compute an SI. Referencing the alternative in prime trials heightens its salience, making it more likely to be employed in subsequent target trials with the same scalar item. If this salience hypothesis holds, the RT data should reveal a general trend: strong primes accelerate RTs for SI generation, while weak primes decelerate them.

3.2.2 Context Adaption Hypothesis

We turn to a study reported in Marty et al. (2024) in detail, as our data originates from their research. In response to the salience hypothesis proposed by Bott and Chemla (2016), Marty et al. (2024) raised an important question: due to the absence of a neutral baseline, it remains unclear whether strong primes boost SI generation, weak primes suppress it, or both. Waldon and Degen (2020) first identified this issue and introduced a Baseline condition to their experiment. In this condition, each target trial was preceded by a simple math task, devoid of any implicature priming, such as “2+3=?”. Their findings indicated that the rate of selecting the strong reading option was lower than after strong primes but higher than after weak primes, supporting Bott and Chemla’s hypothesis. However, since the baseline condition in Waldon and Degen’s experiment was grouped with the priming trial, potential contamination from the priming trials to the baseline condition couldn't be entirely dismissed. Although priming effects are generally believed to diminish over time, closely positioned priming trials could still influence the baseline, rendering it non-neutral. This potentially skewed baseline might not be suitable for comparison in the implicature priming study.

To establish a neutral baseline, Marty et al. (2024) employed a two-block design. Block 1 was devoid of any priming, ensuring a neutral baseline free from priming effects. Block 2 partially replicated Bott and Chemla (2016)'s experiment, involving only within-scale priming (see footnote 1). Similar to Bott and Chemla, each trial comprised one sentence and two pictures. Three different sentence types were included, as shown in (4). The [symbol] represents eight different symbol types: arrow, cross, diamond, heart, square, star, and triangle.

(4) a. There is a [symbol]. (Ad hoc)

b. Some of the symbols are [symbol]. (Some)

c. There are four [symbol]. (Number)

Two picture types were presented: an open card composed of symbols and a covered card labeled "Better Picture". Open cards could be strong (supporting the strong reading), weak (supporting the weak reading), or false. Strong priming trials consisted of a weak card and a strong card, guiding participants towards the strong reading. Weak priming trials included a false card and a weak card, directing participants towards the weak reading. Each Target and Control trial involved one symbol card and one covered card.

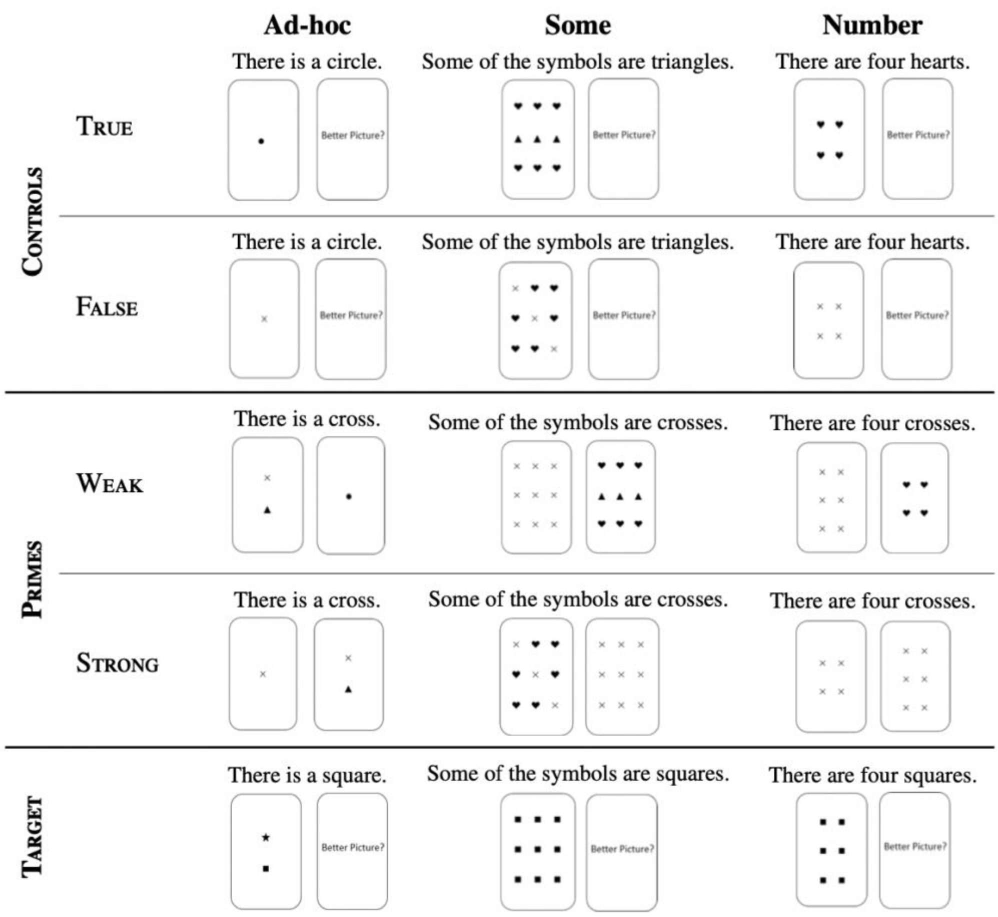

Fig. 8 Example control, priming and target trials for each expression type.

Specifically, in the Ad hoc condition, each weak prime compelled participants to choose the weak card (displaying only one of the two symbols matching the [symbol] denoted in the sentence) by presenting a false card alongside a weak card. Conversely, each strong prime encouraged participants to access the strong reading and select the strong card (displaying one symbol matching [symbol] in the sentence) by presenting both a strong and a weak card. The Some and Number conditions followed similar logic.

A preliminary test for unimodality of participants' response distributions was conducted by Marty et al. (2024). Results indicated that the baseline rates of participants in the Ad hoc and Number groups were distributed unimodally, but not for the Some group. In the Some group, results revealed two types of pre-existing preferences in the baseline block. Consequently, participants were divided into two sub-groups based on their baseline rate of choosing the covered card. Those with a low baseline rate were classified into the Literal some group, while those with a high rate were categorized into the Pragmatic some group. The trends observed in the Number and Pragmatic some groups were strikingly similar, while the opposite was found in the Ad hoc and Literal some groups. For ad hoc and literal some, results showed low rates of covered card choice in the baseline block. The main change in the second block was that strong primes led to higher-than-baseline preference for covered card. In the numbers and pragmatic-some group, the opposite pattern occurred with the second block, participants overwhelmingly preferred the covered card in the baseline block, and that preference was affected mainly after weak primes, where far more open card choices were made. These findings suggested that (i) a spill-over effect was present in Bott and Chemla's original experiment design, contaminating their baseline, and (ii) the inverse preference effect was the primary driver in the implicature priming experiment.

From Marty et al.'s perspective, Bott and Chemla's activation-based Salience hypothesis was insufficient to explain the inverse preference effect they observed. They introduced an "adaptation hypothesis" used in other syntactic priming studies (Fine et al., 2013; Jaeger and Snider, 2013). Generally, SIs are context-dependent. In real conversations, if participants lack context information, they might rely on prior information to hypothesize about the context and adjust their expectations accordingly. This context adaptation might be what transpires in the implicature priming experiment. If the primes encountered align with participants' prior knowledge, no change in card choice preference are observed. However, if contradictory primes appear, significant changes might occur. Generally, the inverse preference effect arises when unexpected cues lead to rapid, significant context adaptation.

Based on this context adaptation account of participants' preferences in choosing the open or covered card, reaction time might exhibit varying trends influenced by participants' prior expectations, adaptations, spill-over effects, and the inverse preference effect.

Turning now to more detailed predictions, we have to consider what were the choice preferences for each scalar expression in each of the prime conditions. These are shown in Fig. 9 below:

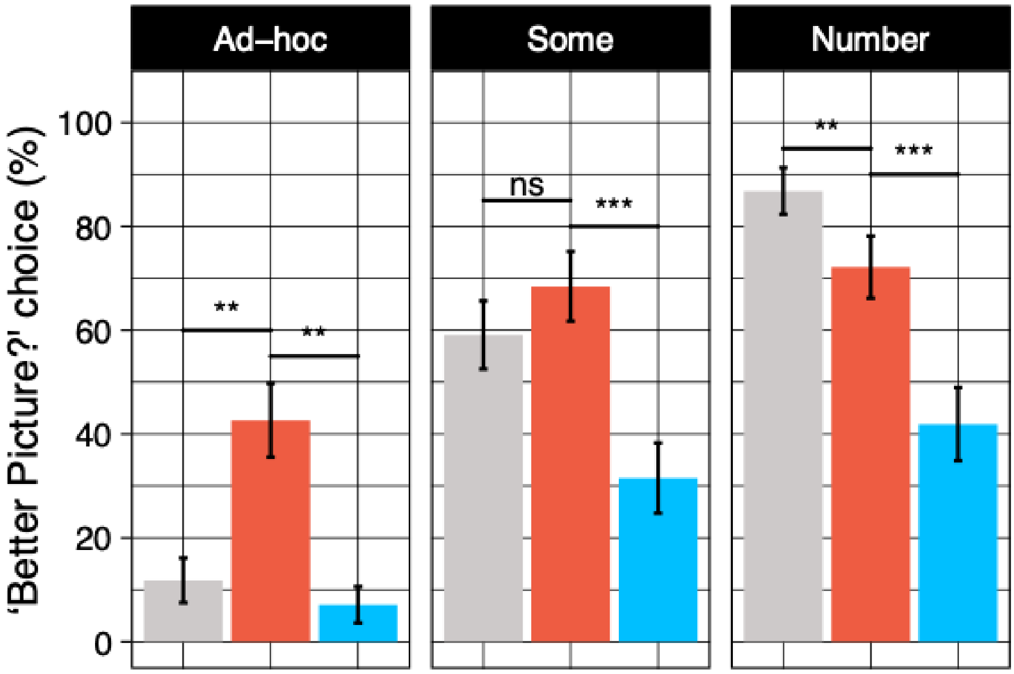

Fig. 9 Choice preferences for each scalar expression in each of the prime conditions (Grey: Baseline, Red: Strong Primes, Blue: Weak Primes)

As discussed above, Baseline preferences varied across scalar expressions. For Ad Hoc expressions, the baseline covered card choice was low, suggesting that the prior expectation for a strong context is low. After Strong primes, we see a marked increase in covered card preference for Ad Hoc trials, while the preference is not significantly different after Weak primes. For the Number condition, we see below baseline rates in the second block of trials both after Weak and Strong primes. Marty et al. interpret these data as resulting from a context adaptation stemming from exposure to equal numbers of Weak and Strong primes. The adaptation is much stronger directly after Weak primes but can even be observed after Strong primes – what Marty et al. call a spillover effect. For Some, the overall results shown in Fig. 9 obscure the fact that the choice preference pattern among participants was bimodal, as discussed below.

From the perspective of the Context Adaptation hypothesis, readings both with and without the SI are possible. We do not at this stage assume that aspects of the mechanism to derive implictures, involving Alternatives and their exclusion, affect Reaction times. Rather, I assume that RTs for responses in these cases can be affected by the time it takes to make a decision and this in turn is affected by a participant's confidence in their decision. I assume that results in the Baseline condition give information about participants prior expectations for stimuli of the kind they receive, with regards to what kind of context and hence what kind of reading is intended. Where there is a low expectation for a Strong context, as seems apparent in the case of Ad Hoc, we can assume that participants are confident in their choice of open card. We can further assume that the presentation of Weak primes would reinforce that expectation, leading to lower RT on open card choice after weak prime, compared to Baseline. However, we should reckon with the fact that, in the second block of trials, participants encounter Ad Hoc trials where they are more or less forced to understand the sentence with the SI, in addition to changing their preference on these trials, we might find a kind of spillover effect on RTs for trials even after Weak primes, reflecting the fact that overall certainty for the non-SI reading is lower in the second block.

Similarly, we can consider the Baseline covered card choice rates for the Number condition to indicate a prior expectation for Strong contexts with numbers. In the second block of trials, we should see greater reduction of RT after Strong primes than Weak. Again, we should also reckon with spillover effects from the presence of Weak primes in the second block, perhaps reducing confidence in choice across the block.

It is to be noted that the current study relies on RT data from an experiment originally designed for analyzing choice distribution rates, and so here other factors might also influence RT. For instance, the absence of a training session in the experiments means participants are directly exposed to the actual experiment after instructions. This might cause an initial delay as participants familiarize themselves with the task. Also, normally in a reaction time study, participants are requested to respond as quickly and accurately as possible. In other words, they are made mindful of a tradeoff between speed and accuracy. In the response-decision focused experiment, no such instruction is given.

Additionally, the design might inherently delay covered choices, as participants are asked to select a card if they can think of a better picture. Since there is no second picture to choose, participants might need more confidence in their decision to commit to this kind of response, and hence more time to consider their choices.

3.3 Experiment

3.3.1 Methods

The reaction time data utilized for the analysis in our current study is sourced from Marty et al. (2024)'s Experiment 2. They recruited 60 participants online through Prolific. Two participants were excluded as they were not native English speakers. In Experiment 2 by Marty et al., the reaction time (RT) data was automatically recorded by the online experiment system. This RT represents the duration from when the participant first viewed each trial until they made a selection by clicking on a card.

The experiment was divided into two parts. In the first part, Block 1, participants were informed that they would see a sentence accompanied by two pictures: one visible to them and the other obscured with the text "Better Picture?" They were instructed to click on the visible picture if they believed it corresponded with the sentence; otherwise, they should click on the covered card. In the second part, Block 2, participants were directed to click on the picture they deemed to be the better match for the sentence. Each block commenced with a few filler trials, allowing participants time to familiarize themselves with the experiment's design and procedure. Subsequent trials were presented in random order.

3.3.2 Data Treatment and analyses

We first assessed participants' overall performance. Their answers to the control trials met the pre-established threshold of 80% accuracy. As a result, data from all participants were included in the analyses. However, some responses were not preceded by two correct prime responses. These responses were subsequently removed, resulting in the exclusion of 149 out of 1392 responses.

As indicated by the unimodality test conducted by Marty et al., the RT data in the Some group was also divided into two sub-groups based on participants' prior preferences. In total, there were 26 Literal Some responders and 30 Pragmatic Some responders. Outliers were excluded from the dataset before statistical analyses, defined as reaction times (RTs) below the 25th percentile and above the 75th percentile within each condition. This criterion was chosen to minimize the influence of extreme values that could distort the results, a method consistent with recommendations for robust data analysis (Wilcox, 2017). Linear mixed-effects models were used to analyse participants' reaction times (RTs) across the Baseline, Strong, and Weak conditions for the Ad hoc, Number, Literal Some, and Pragmatic Some groups. The fixed effect was the condition (Baseline, Strong, Weak), which was coded as a categorical variable to assess its impact on RTs. Random intercepts for subjects were included to account for individual differences in baseline RTs. The RT data were log-transformed to normalize the distribution before analysis. P-values were adjusted using the Bonferroni correction method to control for multiple comparisons. A comprehensive summary of the results from these analyses is provided in the next section.

3.3.3 Results

The figures and tables below display the RTs for responses in target trials by condition for Ad-hoc, Number, Literal Some, and Pragmatic Some groups. A general observation reveals that the RT for selecting the covered card in the baseline is longer than for selecting the uncovered card (see Fig. 10). This observation reaffirms Bott and Noveck's (2004) finding: generating a scalar implicature (SI) typically takes more time than relying on a literal inference. However, a consistent speed-up effect from strong primes across all conditions doesn't seem to be evident. Instead, the distribution of RTs presents a more intricate pattern.

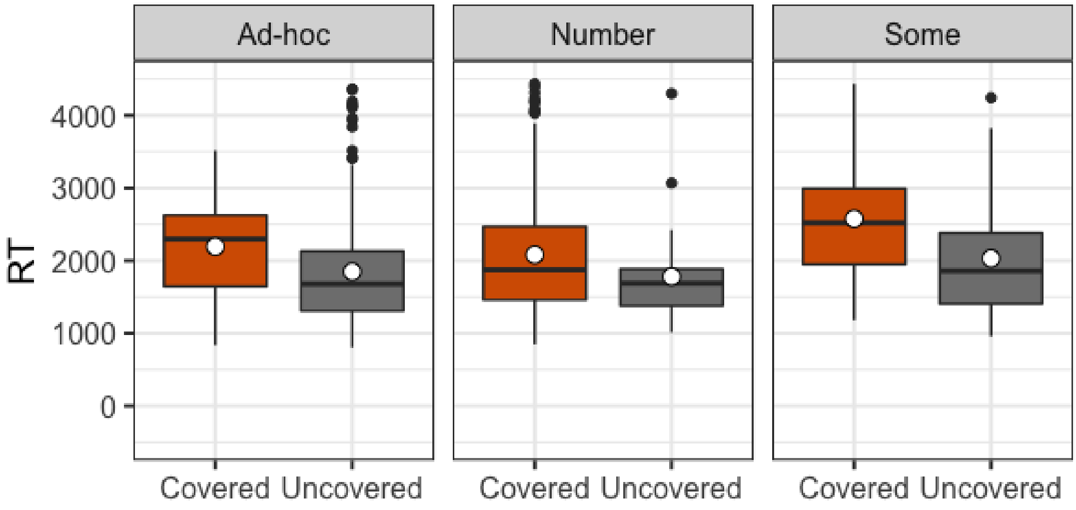

Fig. 10 Comparison of reaction times for covered and uncovered cards across experimental conditions

Specifically, the boxplots in Figure 11 display the distribution of RTs. Table 1, which excludes outliers, presents the mean RTs for selecting the covered card in target trials across the Ad hoc, Number, Literal Some, and Pragmatic Some conditions. Additional results from the data analyses can be found in Table 2.

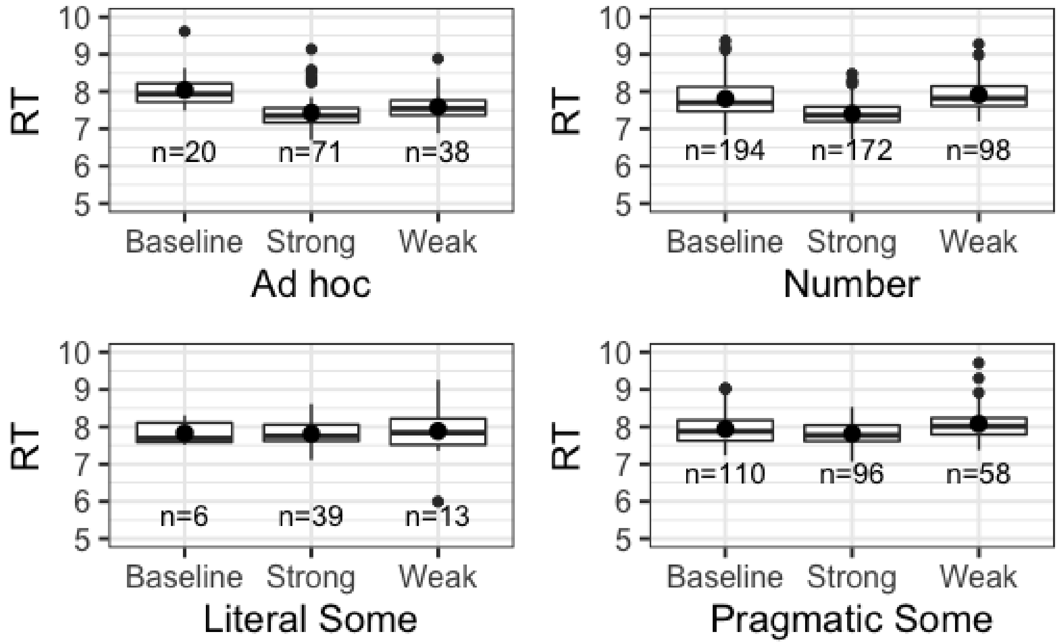

Fig. 11 Reaction times for choosing the covered card (strong reading) across experimental conditions: Ad hoc, Number, Literal Some, and Pragmatic Some groups (n = number of participants per condition)

		RT (ms)			RT (ms)
Ad hoc	Baseline	2609.202	Number	Baseline	2334.464
	Strong	1570.686		Strong	1720.200
	Weak	1889.692		Weak	2464.953
Literal Some	Baseline	2655.493	Pragmatic Some	Baseline	2783.280
	Strong	2654.106		Strong	2596.101
	Weak	2467.959		Weak	3039.126

Table 1: Reaction time of choosing covered card (strong reading).

Remember that selecting the covered card, labeled with the text "Better picture?", is associated with accessing the strong reading of sentences and generating scalar implicatures (SIs). As indicated by the number of responses in the baseline condition:

(i) In the Ad hoc and Literal Some groups, the weak reading of sentences is the predominant preference for most participants.

(ii) In contrast, in the Number and Pragmatic Some groups, the strong reading of sentences is more favored.

For the Number group, the strong prime, which aligns with participants' pre-existing preference, significantly reduced the RTs when choosing the covered card (representing the strong reading) in target trials (adjusted $p < .001$). Conversely, the weak prime, which goes against participants' prior preference, slightly increased the RTs. The Pragmatic Some group exhibited a similar trend, albeit less pronounced. The strong prime reduced the RTs for selecting the covered card, while the weak prime increased them.

In the Ad hoc group, responses for selecting the covered card were comparatively fewer, as generating an SI was less favored. The RTs for choosing the covered card after both strong and weak primes were significantly lower than the baseline (adjusted $p < .001$). The result for the Strong primes is expected. For the Weak prime, this can be attributed to a general spillover effect: a participant choosing a covered card in the second block of trials is more confident in that choice than in the Baseline, due to the higher than baseline presence of SI contexts in their recent experience (Block II).

The Literal Some group had the fewest responses among the four groups. The RTs showed minimal change after strong primes compared to the baseline, but they decreased after weak primes.

		β	S.E.	*t*-value	*p*-value	Adjusted
Ad hoc	Strong vs. Weak	301.99	85.13	3.547	<.001	<.01
	Strong vs. Baseline	973.28	128.00	7.604	<.001	<.001
	Weak vs. Baseline	671.28	137.45	4.884	<.001	<.001
Literal Some	Strong vs. Weak	23.44	346.46	0.068	.946	1.00
	Strong vs. Baseline	377.67	440.23	0.858	.395	1.00
	Weak vs. Baseline	354.23	511.66	0.692	0.492	1.00
Pragmatic Some	Strong vs. Weak	445.68	137.39	3.244	<.01	<.05
	Strong vs. Baseline	242.67	114.40	2.121	<.05	.384
	Weak vs. Baseline	-203.0	138.4	-1.467	.143	1.00
Number	Strong vs. Weak	748.62	86.57	8.647	<.001	<.001
	Strong vs. Baseline	624.50	69.95	8.928	<.001	<.001
	Weak vs. Baseline	-124.13	88.15	-1.408	.16	1.00

Table 2: Outputs of the linear mixed-effects models used to analyze participants' rection time to choose the covered card in target trials. Adjusted p-values are provided in the last column.

Figure 12 displays the RTs for selecting the uncovered card, which represents the weak reading, in target trials. After excluding outliers, Table 3 presents the mean RTs for choosing the uncovered card in target trials across the Ad hoc, Number, Literal Some, and Pragmatic Some conditions. Additional results from the data analyses can be found in Table 4.

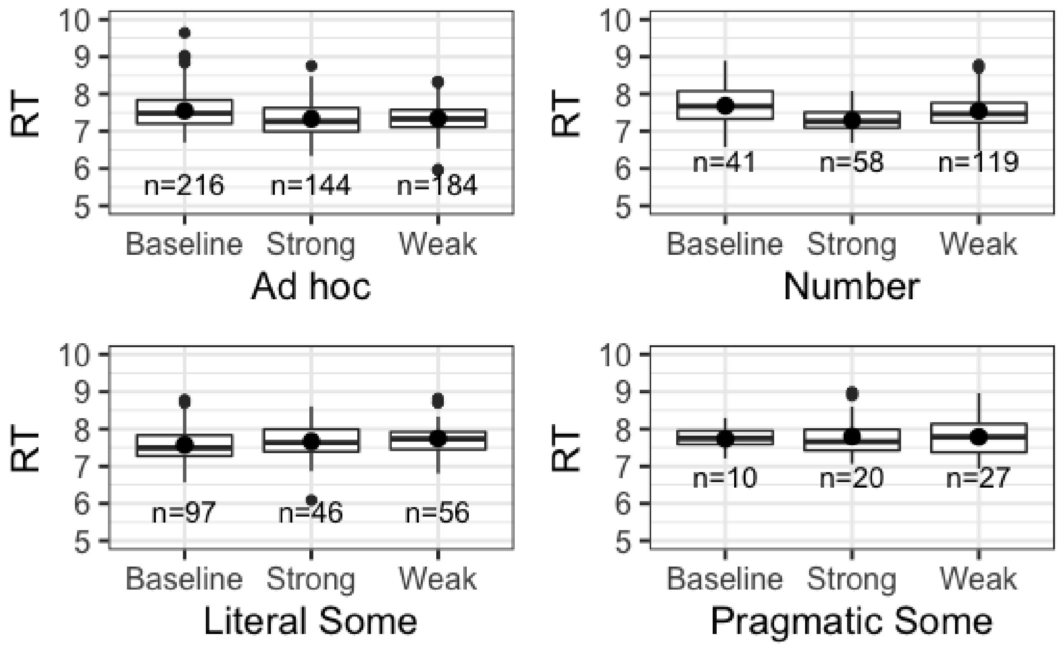

Fig. 12 Reaction time of choosing uncover card (weak reading) across experimental conditions: Ad hoc, Number, Literal Some, and Pragmatic Some groups (n = number of participants per condition)

It's important to note that the weak reading of sentences is the preferred choice in the Ad hoc and Literal Some groups, but not in the Number and Pragmatic Some groups.

In the Ad hoc group, the weak prime, which promotes the weak reading, significantly decreased the RTs for selecting the uncovered card in target trials (adjusted $p < .01$). Surprisingly, the strong primes, which promote the strong reading, also significantly reduced the RTs (adjusted $p < .01$).

In the Literal Some group, the strong primes, which contradict participants' prior preferences, slightly increased the RTs for accessing the weak reading and selecting the uncovered card. Conversely, the weak prime, which promotes the weak reading, did not reduce the RTs for selecting the uncovered card but instead significantly increased them (adjusted $p < .05$). Again, we attribute the latter result to a spillover effect. Since by definition, Literal Some participants have more or less systematically chosen the open card in the baseline, exposure to Strong primes in Block II will have reduced confidence in the literal reading, leading to a longer decision time on what was previously a confident choice of open card.

		RT (ms)			RT (ms)
Ad hoc	Baseline	1845.416	Number	Baseline	1990.195
	Strong	1580.825		Strong	1561.198
	Weak	1625.607		Weak	1874.855
Literal Some	Baseline	2043.304	Pragmatic Some	Baseline	2393.449
	Strong	2138.624		Strong	1997.407
	Weak	2308.125		Weak	2234.322

Table 3: Reaction time of choosing uncover card (weak reading).

In contrast to the Ad hoc and Literal Some groups, the strong reading of sentences is the preferred choice in the Number and Pragmatic Some groups. In the Number group, the RTs for selecting the uncovered card after weak primes are lower than the baseline. The RTs for selecting the uncovered card after strong primes are significantly lower than the baseline (adjusted $p < .01$). The latter result can be attributed to a spillover effect, as explained above.

In the Pragmatic Some group, The RTs for selecting the uncovered card after weak primes are slightly lower than the baseline. The RTs for selecting the uncovered card after strong primes are also lower than the baseline.

		β	S.E.	t-value	p-value	Adjusted
Ad hoc	Strong vs. Weak	15.42	57.02	0.271	.786	1.00
	Strong vs. Baseline	201.62	56.93	3.541	<.001	<.01
	Weak vs. Baseline	186.20	51.80	3.594	<.001	<.01
Literal Some	Strong vs. Weak	185.52	138.87	1.336	.183	1.00
	Strong vs. Baseline	-169.56	125.80	-1.348	.179	1.00
	Weak vs. Baseline	-355.08	116.32	-3.053	<.01	<.05
Pragmatic Some	Strong vs. Weak	59.53	226.30	0.263	.794	1.00
	Strong vs. Baseline	84.54	303.77	0.278	.782	1.00
	Weak vs. Baseline	25.00	287.61	0.087	.931	1.00
Number	Strong vs. Weak	308.32	91.21	3.380	<.001	<.05
	Strong vs. Baseline	497.75	126.72	3.928	<.001	<.01
	Weak vs. Baseline	189.43	115.58	1.639	.102	1.00

Table 4: Outputs of the linear mixed-effects models used to analyze participants' rection time to choose the uncover card in target trials. Adjusted p-values are provided in the last column.

3.4 Discussion and Conclusion

One clear observation from the results is that the reaction time (RT) for choosing the covered card, representing scalar implicature (SI) generation, is reduced after strong primes and increased after weak primes in the Number and Pragmatic Some conditions. Given the baseline, choosing the covered card is the predominant preference for participants in these two groups. Strong primes, which encourage SI generation, might reinforce their prior beliefs, leading to a quicker decision-making process for the covered card, as there are no contradictions in the information process. Conversely, weak primes, which contradict participants' prior beliefs, might cause a delay in decision-making. This phenomenon seems consistent with predictions from the Salience hypothesis. From a Salience-driven perspective, strong primes boost the salience level of the strong reading of sentences, making it easier for participants to continue employing a strong reading, thereby reducing the RT.

However, the RT data for choosing the uncovered card in the Number and Pragmatic Some groups challenge the Salience hypothesis. After weak primes, RTs for choosing the uncovered card decreased in these groups. This could be interpreted as weak primes enhancing the recognition of the weak reading of sentences, accelerating the decision-making process for choosing the picture representing the weak reading. Recall that if the general baseline prior is low for the literal reading, particants who choose the open card in the baseline block will do so with more uncertainty than those who choose the open card after Weak primes, where the prior will have been adjusted. As discussed above, the effect of the presence of Weak primes in Block II causes spillover effects and so RTs choosing the uncovered card also decreased after strong primes, relative to Baseline. This result is puzzling in light of the Salience hypothesis, but it is expected if we assume that RTs for this task are more a function of the time to make decisions than the salience of mechanisms of SI. While the RT data for choosing the covered card (strong reading) after strong primes shows that strong primes can indeed facilitate scalar implicature generation, the acceleration in choosing the uncovered card (weak reading) after strong primes suggests a potential effect from the unfavoured weak primes, which may have carried over into the strong prime trials, influencing participants' responses unexpectedly.

Regarding the Ad hoc and Literal Some groups, a similar effect was observed in data from those participants who chose the covered card (strong reading) in block 2: RTs for choosing the covered card after both strong and weak primes were reduced. Recall that the strong reading is not the favored reading in these groups based on the baseline. Reduced RTs for choosing the covered card after strong primes can be explained by participants' expectations for Strong contexts being changed and reinforced by the strong primes, spending less time making their choice in target trials. As discussed, the reduction in RTs for choosing the covered card after weak primes suggests again a spillover effect. Notably, it's always the priming trials consistent with the unfavored reading in each group that make a difference, the so-called inverse preference effect in the Context Adaptation Hypothesis. In the Number and Pragmatic groups, it's the weak primes that cause the choice of the uncovered card after strong primes to drop; in the Literal Some and Ad hoc groups, it's the strong primes that cause the choice of the covered card after weak primes to drop.

As mentioned, RT data for choosing the uncovered card (weak reading) in the Literal Some group can be explained as a result of context adaptation and spillover effects. RTs after both strong and weak primes increased when choosing the uncovered card in the Literal Some group. Given that the weak reading is the favored interpretation of the scalar item "some" in the baseline, slowed RTs for choosing the uncovered card after strong primes may result from the lowering of confidence in the literal reading. As discussed above, the influence of Strong primes on overall expectations in Block II leads to spillover effects, meaning that confidence in the literal reading for ‘some’ may be lower even after Weak primes, compared to the Baseline. It is to be noted that the increase in RTs for choosing the uncovered card after weak primes is puzzling from a salience perspective.

An unexpected observation comes from the data for choosing the uncovered card in the Ad hoc group. After weak primes, RTs for choosing the uncovered card dropped, which may be due to the weak primes encouraging the pre-favored weak reading of the Ad hoc scalar item in this group. However, the RT for choosing the weak reading of sentences also dropped after strong primes. It seems that the strong reading in the Ad hoc group did not enforce any effects, regardless of choosing the covered or uncovered card. One potential explanation relates to the acceptance of readings of sentences.

It's already known that among participants in the Ad hoc group, weak readings of sentences are more likely to be accepted than strong readings. Based on the results of experiment 2 in Marty et al. (2024), participants' weak reading preference is also the hardest to revise. In the Ad hoc group, the covered card choice rate increased by 23% from 8.3% in the baseline to 31.3% after strong primes. In comparison, in the Literal Some group, which had a similar low baseline rate of covered card choice, the rate increased by 36.2% from 5.8% in the baseline to 42% after strong primes. It seems that participants are more easily influenced by strong primes in the Literal Some group than in the Ad hoc group. As the weak reading is more accepted in the Ad hoc group and harder to change, the inverse preference pattern might be harder to detect in the reaction time data, especially when participants consistently choose the uncovered card. It's not to say that the inverse preference effect doesn't exist here; it can still be observed in the data for choosing the covered card in the Ad hoc group. It's just that in the uncovered card group, the responses of lowering RT after strong primes are more powerful than increasing RT. The acceptance hypothesis can also be applied to the Literal Some group. In the Literal Some group, as the weak reading preference is more easily changed, the inverse preference pattern was observed in the reaction time data.

The acceptance hypothesis is more of an add-on sub-hypothesis to the Context Adaptation hypothesis. In Marty et al. (2024), the Context Adaptation hypothesis was suggested to capture the spill-over effect and inverse preference better than the Salience hypothesis. Marty et al. concluded that more surprising new information might give rise to the inverse preference pattern. However, when considering reaction time data, the novelty of the information might still need to compete with people's adherence to their prior preferences. If the new information is more easily accepted, the inverse preference pattern is more likely to be observed in the reaction time.

In conclusion, in the Number and Some groups, including both Pragmatic and Literal Some, the inverse preference pattern and spill-over effects can be observed, and the Context Adaptation hypothesis might be a better explanation for these phenomena. As for the Ad hoc group, the general lower reaction time in the second block may be due to the high insistence on weak reading. However, it should still be considered under the account of the Context Adaptation hypothesis rather than the Salience hypothesis.

In this study, we reanalyzed the experiment data from Marty et al. (2024)'s experiment 2 and aimed to resolve the debate between the Salience hypothesis and the Context Adaptation hypothesis by finding evidence from reaction time data. Because the design of experiment 2 was not specifically for a reaction time study, the further analysis here might be better viewed as a preliminary analysis, providing insights into the study of implicature priming reaction time rather than a definitive explanation. As discussed earlier, some external factors might influence the presentation of RT results. For instance, the general faster RT in the Ad hoc group might also come from the card design, as the uncovered card is open and clear, which might generally take less time than considering the unclear uncovered card as the choice. Also, as there's no training session in advance, participants had to learn how to navigate the experiment gradually on their own. As a result, the initial trials might generally take more response time than later trials. In this sense, those trials presented at the beginning might receive a general delay. Although imperfections exist, an overall trend fitting the Context Adaptation hypothesis can still be observed in some conditions. Therefore, it's possible that, instead of the Salience hypothesis, the Context Adaptation hypothesis can still account for the inverse preference pattern observed by scalar implicature priming with a more neutral design of implicature priming reaction time study.

Chapter 4 General Conclusion

In this study, we investigated the cognitive mechanisms underlying the interpretation of pragmatic ambiguities, focusing on plural ambiguities and scalar implicatures. Our primary aim was to determine whether priming effects in these domains support structural explanations—such as the existence of a silent distributivity operator in plural ambiguities and the Salience Hypothesis in scalar implicatures—or whether they are better explained by adaptive processes like the Context Adaptation Hypothesis and the inverse preference effect.

4.1 Findings and General Conclusions

Our exploration of plural ambiguities involved replicating Maldonado, Chemla, and Spector's (2017) experiment using a two-block design to control for spillover effects and establish a neutral baseline. The results revealed that it is the disfavored reading that drives the inverse preference effect in the cumulative-distributive contrast. Specifically, when the cumulative reading is the less preferred interpretation among participants, it exerts a stronger influence during priming, decreasing the likelihood of the alternative distributive reading being employed. This observation challenges the claim by Maldonado et al. (2017) that their results provide evidence for a silent distributivity operator. Our findings demonstrate that both distributive and cumulative primes have priming effects when they are the dispreferred reading. If interpreted in terms of structural priming, this would suggest that both readings involve a silent operator or distinct structural properties—an unlikely scenario.

We argue that these effects can be accounted for by the online adaptation of probabilistic expectations about the distribution of the two readings, as proposed in other syntactic and semantic priming studies (Fine et al., 2010; Marty et al., 2024). Participants adjust their interpretations based on recent linguistic input, especially when encountering unexpected or less preferred structures. Thus, although our findings are compatible with the existence of a silent distributivity operator, they do not provide direct support for it.

In our investigation of scalar implicatures, we reanalyzed the reaction time data from Marty et al.'s (2024) Experiment 2 to explore the mechanisms behind implicature priming. Our analysis provided insights that challenge the sufficiency of the Salience Hypothesis and support the Context Adaptation Hypothesis. In the Number and Pragmatic Some groups, we observed that reaction times for choosing the covered card (representing scalar implicature generation) decreased after strong primes and increased after weak primes. Given that choosing the covered card was the predominant preference in the baseline for these groups, strong primes likely reinforced participants' prior beliefs, leading to quicker decision-making. Conversely, weak primes contradicted their prior beliefs, causing delays.

However, the reaction time data for choosing the uncovered card (weak reading) in these groups challenged the Salience Hypothesis. After weak primes, reaction times for choosing the uncovered card decreased, suggesting that weak primes enhanced the recognition of the weak reading and accelerated decision-making. Yet, reaction times for choosing the uncovered card also decreased after strong primes, even though these primes promoted the strong reading. This unexpected result indicates that factors such as spillover effects or the influence of prior primes may have played a role, suggesting that the strong primes were less effective than anticipated.

In the Ad hoc and Literal Some groups, where the strong reading was not the favored interpretation, a similar effect was observed. Reaction times for choosing the covered card decreased after both strong and weak primes. Reduced reaction times after strong primes can be explained by participants being influenced by the strong primes to change their preferences more quickly. The reduction in reaction times after weak primes suggests an inverse preference effect, where the unexpected strong primes overshadowed the intended effect of the weak primes.

An interesting observation comes from the reaction time data for choosing the uncovered card in the Ad hoc group. After weak primes, reaction times decreased, likely because the weak primes reinforced the pre-favored weak reading. However, reaction times for choosing the uncovered card also decreased after strong primes, suggesting that the strong reading did not significantly affect participants' choices, possibly due to a strong adherence to their initial preference. This highlights the role of acceptance in processing—participants' willingness to accept new or unexpected interpretations influences reaction time patterns.

Overall, our findings support the Context Adaptation Hypothesis. Participants appear to adapt their expectations based on recent input, with unexpected or less favored interpretations prompting greater cognitive adjustments. The inverse preference effect is evident, as dispreferred primes exert a stronger influence on processing, leading to adjustments in decision-making strategies. These results challenge the Salience Hypothesis, which does not fully account for the complexities observed in the reaction time data, such as the acceleration of weak reading choices after strong primes and the influence of participants' acceptance of new information.

Across both studies, our findings indicate that priming effects in pragmatics are better explained by adaptive processes involving context adaptation and probabilistic expectations rather than by structural priming mechanisms or increased salience alone. Participants actively adjust their interpretations based on recent linguistic input and their prior preferences, especially when encountering unexpected or less favored information. This adaptive mechanism plays a crucial role in language comprehension, highlighting the dynamic interplay between linguistic input, context, and cognitive processing.

4.2 Limitations and Future Studies

While our study provides valuable insights, several limitations should be acknowledged. The reanalysis of reaction time data from Marty et al.'s (2024) Experiment 2 was conducted on data from an experiment not specifically designed for reaction time measurements. External factors such as the lack of training sessions and visual differences in stimuli (e.g., the design of the covered and uncovered cards) may have influenced reaction times. Participants had to learn how to navigate the experiment independently, potentially affecting their response times. Additionally, our sample sizes were relatively small. Larger and more diverse samples would enhance the robustness and generalizability of our findings.

The controlled experimental settings may not fully capture the complexities of language processing in naturalistic contexts. Participants' behavior in the laboratory might differ from everyday language use, necessitating caution when generalizing results. Future studies should consider designing experiments specifically for reaction time analysis, incorporating training sessions to familiarize participants with the tasks and instructions that balance speed and accuracy. Ensuring uniform visual properties of stimuli would prevent unintended influences on reaction times.

Implementing more neutral baseline trials in priming experiments would help accurately assess participants' default interpretations without contamination from priming effects. This approach would clarify whether inverse preference effects are influencing results. Cross-linguistic investigations could examine whether the observed effects occur in other languages, determining the universality of the adaptive mechanisms in language processing.

Exploring individual differences in acceptance levels and prior preferences could provide deeper insights into how these factors influence the inverse preference effect and context adaptation. Understanding how different scalar items or contexts affect the acceptance of new information and the ease of preference change would contribute to a more comprehensive understanding of pragmatic processing. Developing computational models that incorporate probabilistic expectations, context adaptation, and acceptance levels may offer a more precise account of the cognitive processes underlying pragmatic interpretation. Simulating how less preferred interpretations exert stronger priming effects could enhance our understanding of processing dynamics.

In conclusion, this study contributes to a more nuanced understanding of the cognitive mechanisms involved in resolving pragmatic ambiguities. By highlighting the dynamic interplay between prior preferences, contextual adaptation, and cognitive processing, we emphasize the active role of language users in interpreting and adapting to linguistic input. Recognizing that participants adjust their expectations based on recent experiences and prior beliefs—especially when encountering unexpected information—enriches theoretical models and has practical implications for psycholinguistics, cognitive psychology, and language education. Understanding these adaptive mechanisms can inform strategies for effective communication and language instruction.

Continued investigation into these processes will further unravel the complexities of human language comprehension. By addressing the limitations of the current study and exploring new avenues, future research can deepen our understanding of language processing, ultimately enhancing our ability to model linguistic comprehension and inform educational and communicative practices.

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