

Event-related potentials in pragmatic priming

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In this study we use electrophysiology to investigate the neural correlates of pragmatic priming for two enrichment categories: quantifiers and disjunctions. We test whether priming effects are due to meaning related expectations or priming of structural representations.

Utterances often communicate more than is encoded in their explicit content. For example, “Mary passed some of her exams” implies that Mary passed *some but not all* of the exams. Similarly, the utterance “You can have potatoes or rice with your chicken” could be interpreted as *you cannot have both potatoes and rice*. These are examples of scalar implicatures, which are believed to arise because of linguistic scales that are ordered based on their informational strength (e.g. Horn, 1972).

Recent work in pragmatics has found that it is possible to prime quantity implicatures (Bott & Chemla, 2016; Rees & Bott, 2017; 2018). These studies used a sentence-to-picture priming paradigm where participants matched a sentence to one of two pictures. The configuration of images was such that in some prime trials, participants were obliged to derive an enriched interpretation of the sentence in order to match the correct image to the sentence. Target trials offered the choice to derive an enriched interpretation or not. In target trials, participants were more likely to derive an enrichment if the prime trial had required an enrichment. Pragmatic priming has also been found in sentence production (Rees & Bott, 2017). The nature of pragmatic priming is unclear, however. Bott and Chemla (2016) suggest the effect may arise through processes tied to the lexicon (similar to polysemy), or through structural representations, independent from the lexicon (similar to syntactic frames, e.g. Branigan & Pickering, 1997).

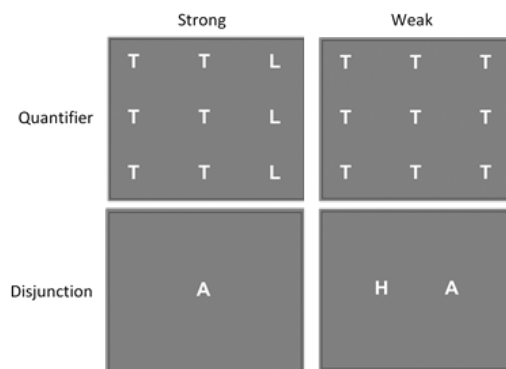
There are no ERP studies on pragmatic priming but neural correlates for structural priming have been found. Reductions in the N400 amplitude are typically associated with processes arising from meaning related expectations such as lexical repetition (e.g. Kutas & Federmeier, 2000; 2011). Ledoux et al. (2007) found reductions in N400 when a word was repeated in a structural priming task. Structural ambiguities and reanalysis elicit a P600 (Osterhout & Holcomb, 1992; 1995). Reductions in P600 amplitude have been found in priming studies (Ledoux et al., 2007; Tooley et al., 2009).

Overview. Participants completed a task similar to Bott & Chemla (2016). They were presented with a sentence followed by a picture and had to decide if the picture matched the sentence. There were prime trials and target trials. The prime trials were either strong or weak depending on the picture configuration. In strong trials the picture supported an enriched interpretation of the sentence (e.g., *some but not all*) whereas in weak trials the picture was consistent with an unenriched interpretation (e.g., *some and possibly all*). Target trials followed prime trials and were always strong trials. We tested two scalar expressions, quantifiers and disjunctions.

We expected facilitation on the (strong) target trials when they were preceded by a strong prime. If priming of enrichment is linked to meaning related expectations, we should observe a lower N400 amplitude following the strong prime relative to the weak prime. If priming of enrichment is related to structural representations, we should observe a reduced P600 in the strong prime condition.

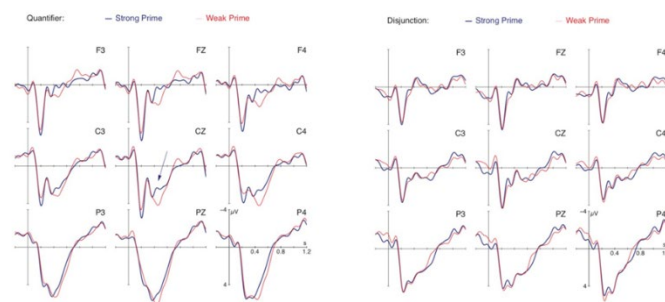
Method. Each trial involved a sentence followed by a verification picture. Two categories of expression were used: quantifiers and disjunctions. Fig.1 shows examples of the pictures used. For quantifier trials the sentence frame was “Some of the letters are [letter]” (e.g., “Einige der Buchstaben sind Ts.” In German). The pictures contained 9 letters. In strong prime trials the nine letters consisted of six letters that matched the predicate (i.e., “T”) and

three that did not (see Fig.1, top left). In weak prime trials all nine letters matched the predicate (see Fig.1, top right). For disjunction trials, the sentence frame was “There is a [letter] or a [letter]” (e.g., “Es gibt ein A oder ein H.”). In strong prime trials the picture contained one letter that had been mentioned in the predicate (Fig.1, bottom left). In weak prime trials the picture contained two letters that matched the predicate (Fig.1, bottom right). Target trials always represented strong trials.



Participants (N=25) were asked to indicate whether each picture matched the previous sentence and they were told to hold their response until a question mark appeared on the screen.

Results. Behavioural responses to target trials indicate that participants responded overwhelmingly with “match” (99.7% responses), suggesting an implicature interpretation regardless of the prime. For the online data, we examined the grand average ERPs to target trials in the windows 400-



600ms and 600-700ms for the quantifier contrast. Fig.2 (left side) indicates facilitation through priming for quantifiers: after strong prime trials there is a reduced positivity in the 400-600ms window, which extends to the 600-700ms over right posterior electrodes. No other differences between the quantifier conditions emerge. In quantifiers between 400-600ms we observed an interaction of prime and ROI [$F(3,72)=6.07, p<.003$] and a main effect of prime [$F(1,24)=30.70, p<.001$]. The effect of prime was significant for all ROIs [F 's(1,24)>6.21, p 's <.02]. The analysis between 600-700ms registered an interaction of prime and ROI [$F(3,72)=5.87, p<.002$]. Resolution of this interaction by ROI showed an effect of prime over right posterior sites [$F(1,24)=10.34, p<.004$]. No effect of prime type is observable for disjunction (Fig.2, right side).

Discussion. This experiment investigated the neural response to priming scalar implicatures. We tested quantifiers and disjunctions and only found priming effects for quantifiers, where we observed a facilitatory effect on a positive deflection, which was reduced following priming. This is in line with previous work showing reduced P600s in targets when preceded by the same type of prime trial. The absence of negativity effects and the presence of positivity effects suggest an abstract process that derives implicature derivation.

The data further revealed no effect of priming for disjunction (and Bayes factors using the JZS prior (<.022) indicates that the absence of an effect was not due to general insensitivity of the experiment). This may suggest that the exclusive disjunction interpretation is not derived via a scalar implicature from the inclusive interpretation (cf. Geurts 2006, Zondervan 2010).

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