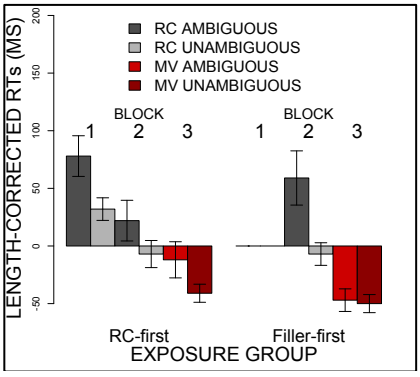
Syntactic adaptation: converging on the statistics of the linguistic environment

Language is variable in that language is *used differently* in different situations (e.g., by different speakers). This has been observed at multiple levels of linguistic representation, including syntax [1-2]. In light of evidence suggesting that language comprehension is sensitive to the statistics of previous linguistic experience [3], and the claim that experience-based processing leads to efficient processing [4], such variability raises a fundamental question for models of parsing: how do we reap the benefits of experience-based processing when the statistics of individual situations vary? We propose that comprehenders adapt to novel linguistic environments such that their expectations *converge on the statistics of the environment*. This proposal extends and offers a broad conceptualization of work on syntactic priming [5-7]. We test our proposal with three self-paced reading experiments. The experiments manipulated the relative proportion of temporarily ambiguous relative clauses (RCs) and matrix verb sentences (MVs; cf. (1)-(4); mixed with fillers). In all experiments, the "ambiguity effect"—the difference in reading times at the underlined regions in ambiguous vs. unambiguous RCs—diminished as a function of the relative probability of RCs *in the experiment* compared to *everyday language use*. Crucially, the ambiguity effect for MVs (the a priori more frequent structure) either remained unchanged (when their relative probability in the experiment was comparable to real life experience) or *in*creased (if their relative probability in the experiment was smaller than in real life). The latter is illustrated for Exp. 3, which manipulated the amount of RC exposure in a blocked, between-subjects design (see table). As RCs are assigned *higher* subjective probabilities, MVs should be assigned *lower* subjective probabilities, and the ambiguity effect for MVs (RTs in 3 vs. 4) should *increase* as more RCs are observed and as the ambiguity effect for RCs *decreases*. The figure plots the ambiguity effect across blocks for both groups. The ambiguity effect for RCs is diminished in block 2 for the RC-first group, but not for the filler-first group. Crucially, the ambiguity effect for MVs in block 3 is greater for the RC-first group than for the filler-first group: the more RCs subjects have seen, the *more* they expect RCs, and the *less* they expect MVs. In short, we find that the *local* environment-specific statistics of syntactic structures can both speed up and slow down processing. Our findings are *in*compatible with transient activation [7] and episodic memory [8] accounts of syntactic priming, which are insensitive to local environment-specific statistics. Instead, our findings are interpretable as cumulative syntactic priming only if (a) the magnitude of syntactic priming is sensitive to the prediction error experienced while processing the prime [9] and (b) syntactic predictions are continuously adapted to match the statistics of the current environment. Our work thus links syntactic adaptation, implicit statistical learning, and syntactic priming in one coherent framework.

Subject Group	Block 1 (Exposure)	Block 2 (RC-test)	Block 3 (MV-test)
RC-first (n=23)	16 RCs (8 ambiguous)	10 RCs (5 ambiguous) + 20 fillers	10 MVs (5 ambiguous) + 15 fillers
Filler-first (n=24)	16 fillers	10 RCs (5 ambiguous) + 20 fillers	10 MVs (5 ambiguous) + 15 fillers



1. **Ambiguous RC:** The soldiers warned about the dangers conducted the midnight raid.
2. **Unambiguous RC:** The soldiers who were warned about the dangers conducted the midnight raid.
3. **Ambiguous MV:** The soldiers warned about the dangers before the midnight raid.
4. **Unambiguous MV:** The soldiers spoke about the dangers before the midnight raid.

References: **1.** LibermanEtAl67 **2.** Tagliamonte05 **3.** MacDonaldEtAl94 **4.** SmithLevy08 **5.** AraiEtAl07 **6.** ThoathathiriSnedeker08 **7** PickeringGarrod04 **8.** KaschakGlenberg04 **9.** ChangEtAl06