Principles and Mechanisms Underlying Syntactic Adaptation

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Comprehenders seem to exploit probabilistic information in order to efficiently process incremental, noisy input [1-4]. This raises the question of whether this information is acquired once during infancy or is *continuously adapted* throughout adulthood. While there is some evidence compatible with the hypothesis that recent exposure can cause short- and longer-term changes in sentence-processing behavior in adults [5-7], it is unknown whether these changes reflect the rational integration of recent evidence and what mechanisms mediate these changes. We present a series of comprehension experiments addressing this question at multiple timescales.

Short-term Adaptation: Recent evidence suggests that comprehenders update their expectations based on very recently processed stimuli, a phenomenon known as 'syntactic priming in comprehension' [6,8]. In SPR Experiment 1—a modified version of [13]—we find further evidence for this effect from the processing of temporarily ambiguous complement clauses (CCs; e.g. Ex1), where ambiguity effects are reduced after recent exposure to a CC. The effect is localized to the disambiguating region and cannot be attributed to generally decreasing RTs throughout the experiment (task adaptation, independently observed).

Experiment 2 asked what mechanism could underlie rapid adaptation. Specifically, we tested whether *error-driven learning* can account for the priming effects observed in [6] (following [9,10]). Supporting this proposal, we find that the effect of a prime is significantly larger when the error-signal associated with that prime is larger (operationalized as the *surprisal* of the prime, assessed using norms).

Intermediate-term adaptation: Recently, Wells and colleagues provided evidence that exposure to rare types of constructions over several days reduces the comprehension difficulty associated with these structures [7]. Experiment 3 takes their seminal efforts one step further. In a multi-day study (pre-test session, three exposure sessions over 6 days, post-test session 2 days after last exposure session), we investigate whether comprehenders update their estimates of *subcategorization* probabilities. In a between-subjects design, the All-CC group received evidence that CC-taking verbs *always* take CCs. The 50%-CC group was exposed to a 50/50 mix of CC (Ex1) and direct object (Ex2) continuations. If comprehenders update their subcategorization expecations based on exposure, the All-CC group should show drastically reduced ambiguity effects for CCs in the post- compared to pre-test session. The 50%-CC group should (a) show less of a reduction and (b) even a relative *increase* in the ambiguity effect for verbs with *a priori* CC-biases. This is indeed what we observed: comprehension of a structure is not only affected by how *often* it was observed over recent days, but also by how often competing structures have been observed.

In conclusion, we find rapid- and intermediate-term adaptation of syntactic expectations based on recent exposure in adults, and that error-driven learning might underlie these adaptations. We discuss broad consequences for language processing and link our results to recent related findings from perceptual adaptation in phonological processing [11-12].

References

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Examples

Ex. 1 The judge believed (that) the lawyer was lying.

Ex. 2 The judge believed the lawyer with the red sweater.