

Listeners rapidly update their predictions in response to unexpected information

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Comprehenders can use rich contextual information to predict upcoming language in real time [1-3], and recent studies have shown that they can also use unexpected information to update their predictions very quickly [4, 5]. A recent study examined listeners' sensitivity to cues that are inconsistent with their predictions and found that Mandarin Chinese listeners were able to rapidly redirect their eye gaze towards a previously unexpected object upon hearing a prediction-inconsistent classifier [5]. In the present study, we extended these findings to English using measure words (MW; e.g., "pile" in "a pile of books"). Unlike classifiers in Mandarin Chinese, MWs are not obligatory for nouns in English, and therefore, allow us to test whether comprehenders can quickly revise their predictions even when the relevant cue is not routinely present in the language. Our results extend earlier findings [5] and suggest that English listeners can rapidly use an unexpected MW to revise their noun predictions.

Method: Adopting the same experimental design as [5], we fully crossed the predictability of noun (expected vs. unexpected; measured by cloze probability) and measure word type (specific vs. general) in 24 items. Specific MWs delimit objects with certain features (e.g., *a cup of, a herd of*), whereas general MWs are compatible with a much wider range of objects (e.g., *a bunch of, a number of*) [6]. Participants ($n=29$) were presented with pictures of four objects on the screen in each trial (expected and unexpected objects along with two distractors, as shown in Fig.1), and we tracked their eye movements as they listened to sentences like (1).

(1) In the barn at the back of the field, the shepherd was keeping a

- (a) herd/roomful of recently stolen sheep. (*Expected noun – Specific/General MW*)
- (b) pile/roomful of recently stolen hay. (*Unexpected noun – Specific/General MW*)

Results: Following [5] we conducted two analyses: (1) Mix-effects logistic regressions showed that, in the MW window, participants were more likely to look at the expected object than the unexpected object ($\beta = 1.75$, $p = 0.002$). In the adjective window following the MW, an additional significant main effect of MW type indicated that listeners were more likely to look towards the target after hearing a specific (than a general) MW regardless of whether the target was initially expected or not (predictability: $\beta = 0.97$, $p = 0.010$; MW type: $\beta = 0.80$, $p = 0.016$). (2) Cluster-based permutation tests comparing listeners' eye movements in the unexpected noun conditions identified a significant cluster from 640 to 1740 ms, where listeners were more likely to look away from the expected object and towards the unexpected target upon hearing a specific, relative to a general MW. Given that noun onset was at least 658 ms after that of the MW (average = 1199 ms), these results showed that listeners were able to revise their predictions upon encountering a prediction-inconsistent MW before they heard the noun.

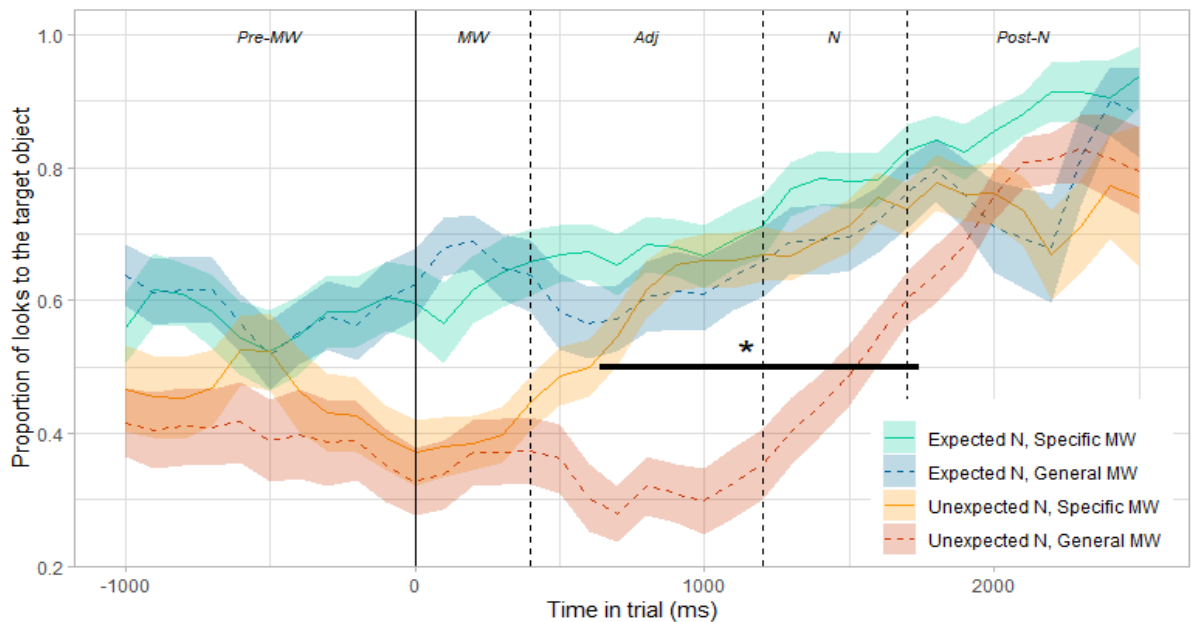
Outlook: We aim to test an additional 31 participants (total $n = 60$) to increase statistical power. Results so far are consistent with the effect first reported in Mandarin Chinese [5], providing further evidence that comprehenders can rapidly update their predictions in response to unexpected incoming information.

Figure 1. Sample visual display



- (1) In the barn at the back of the field, the shepherd was keeping a
- (a) herd/roomful of recently stolen sheep. (Expected noun – Specific/General MW)
- (b) pile/roomful of recently stolen hay. (Unexpected noun – Specific/General MW)

Figure 2. Average proportion of looks to the target (time-locked to MW onset)



Note: The target is the object ultimately named in the sentence (the expected object in expected noun conditions and the unexpected object in unexpected noun conditions). Standard errors are shown with transparent shading. The Significant cluster (from 640 to 1740 ms) identified by cluster-based permutation analyses is marked with an asterisk. Proportion of looks in the figure is only for illustration purpose.

Reference. [1] Kamide, 2008. *Language and Linguistics Compass*. [2] Kutas et al., 2011. *Predictions in the brain: Using our past to generate a future* [3] Pickering & Gambi, 2018. *Psychological Bulletin*. [4] Szewczyk & Wodniecka, 2020. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. [5] Chow & Chen, 2020. *Language, Cognition and Neuroscience*. [6] Klein et al., 2012. *Oxford Studies in Theoretical Linguistics*.