

Exploring Association-Masked N400 Expectancy Effects in Role-Reversal Constructions

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The absence of N400 expectancy effects in contexts where a reversal of role-assignments results in a plausible meaning, has led some researchers to claim that comprehenders generate (sometimes inaccurate) expectations that are insensitive to argument roles [1, 2] – and thus similar predictions for contexts differing only in their role assignments (e.g., expect *gespitzt* ‘sharpen’ in both (1a) and (2a)) – resulting in the absence of the N400 effect. An alternative explanation is that the underlying generators of the N400 do in principle reflect true expectancy, but the strong association between the context and the target words maximally attenuates the N400 such that the underlying expectancy effect is not observed. Such “floor” effects of the N400 are in fact observed in cases of repetition [3,4] and event-based association [5] outside of the reversal phenomena. Crucially, this explanation predicts that the expectancy effect on the N400 should be more visible in reversal structures where association is weaker.

To evaluate this prediction, we crossed expectancy based on canonical and reversed role assignments with high/low association (Table 1). In line with previous studies, we predicted that the high-association conditions would overall elicit a smaller N400 than the low-association conditions. Additionally, if the lack of the N400 effects for role reversals is due to role-insensitive expectations, then there would be no effect of role-assignment regardless of the association. Alternatively, if the strong association can hide the expectancy effect by reaching the floor of the N400 amplitudes, we would predict an effect of role-assignment in the low association conditions but not in the high-association conditions.

Association was established in an online pretest (N=24) that presented two nouns (e.g., *Bleistift* ‘pencil’, *Schüler* ‘student’) to participants and asked them to generate up to three verbs describing likely situations involving these nouns (e.g., *schreiben* ‘write’, *spitzen* ‘sharpen’). Different participants (N=25) performed a cloze task for the active sentences. The target verbs in the high association condition were produced by 45.3% of participants on average in the association task and had 36.8% cloze probability. The target verbs in the low-association condition were not produced by any participant in the association task but were all attested in the cloze task (4.6%), to ensure they are nonetheless expected.

In an EEG study, native German speakers (N=32) read 88 experimental items and 112 fillers in RSVP, completing a comprehension question for every trial. LME analyses of N400 amplitude confirmed a main effect of association ($p = .02$; Figure 1). The predicted interaction of role-assignment and association is visually present but was not significant. Pairwise comparison in the mid-centro-posterior electrodes (Figure 2), however, did reveal a significant effect of role-assignment in the low-association conditions ($p = .04$), but not in the high-association conditions ($p = .74$). Analyses in the P600 time window for the same region revealed an interaction ($p = .03$) such that a P600 effect emerged for the high-association conditions (replicating e.g., [1, 5]) but not for the low-association conditions, potentially due to component overlap [6]. Overall, our results suggest that the lack of N400 effects in argument role reversals may not be due to inaccurate expectations that are insensitive to argument roles. Rather, they are more consistent with the view that comprehenders generate accurate expectations but the expectancy effect is simply masked for contexts with strong association, similar to other cases of misalignment between expectancy and N400 effects [3, 4, 5].

						Role-assignment	Association	
(1) a.	Morgens	hat	der Schüler	den Bleistift	gespitzt	während...	Canonical	High
	<i>In the mornings</i>	<i>has</i>	<i>the student</i>	<i>the pencil</i>	<i>sharpened</i>	<i>while...</i>		
b.					angeknabbert		Canonical	Low
					<i>nibbled</i>			
(2) a.	Morgens	wurde	der Schüler	vom Bleistift	gespitzt	während...	Reversed	High
	<i>In the mornings</i>	<i>was</i>	<i>the student</i>	<i>by the pencil</i>	<i>sharpened</i>	<i>while...</i>		
b.					angeknabbert		Reversed	Low
					<i>nibbled</i>			

Table 1: The experimental items with crossed Role-assignment (Canonical/Reversed) and Association (High/Low) for the target verbs. The words between vertical lines were presented together in the RSVP.

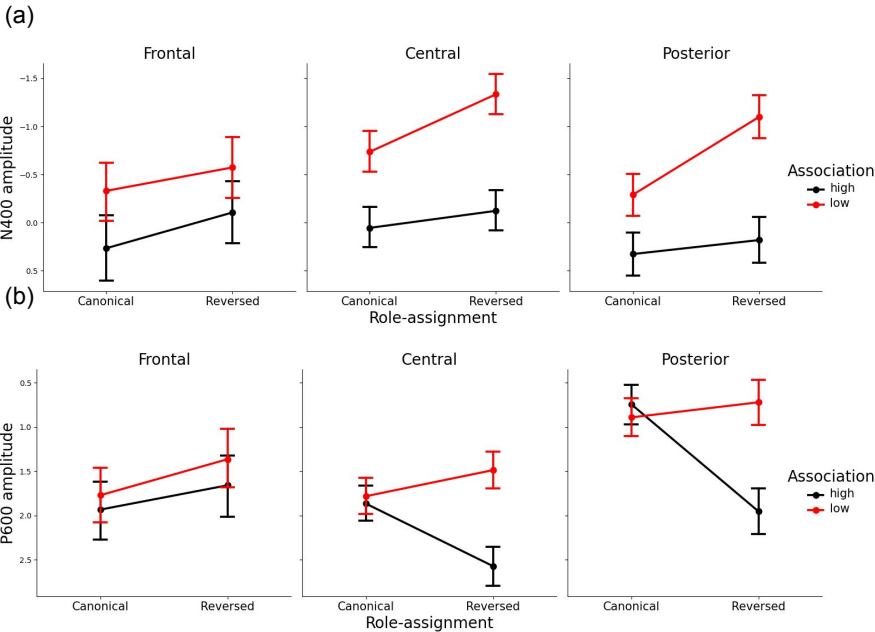


Figure 1: (a) N400 amplitudes (average of 350-450ms post verb onset) and (b) P600 amplitudes (600-800ms) in frontal (F), central (FC, C, CP), and posterior (P, O) electrodes, averaged for each participant and electrode. The error bars show the confidence intervals. The figures and the statistical analyses only include trials where participants accurately responded to the comprehension questions.

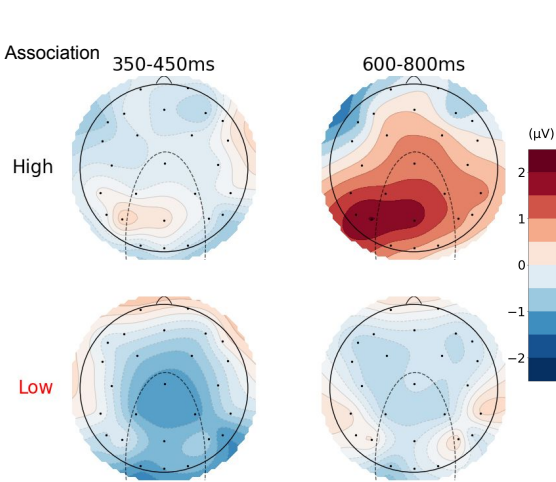


Figure 2: Topography maps showing the subtraction of the Canonical conditions from the Reversed conditions for the N400 and P600 time windows. The top row shows the high-association condition (i.e. (2a) - (1a)) and the bottom row shows the low-association condition (i.e. (2b) - (1b)). The highlighted mid-centro-posterior electrodes (Cz, CP1, CP2, Pz, O1, Oz, O2) are used for the statistical analyses.

Reference

- [1] Chow, Smith, Lau, and Phillips (2016), Language, Cognition, and Neuroscience.
- [2] Kuperberg (2016), Language, Cognition, and Neuroscience.
- [3] Aurnhammer, Delogu, Brouwer, and Crocker (2023), Psychophysiology.
- [4] Nieuwland & van Berkum (2005), Cognitive Brain Research.
- [5] Delogu, Brouwer, and Crocker (2019), Brain and Cognition.
- [6] Delogu, Brouwer, and Crocker (2021), Brain Research.