Predictive pre-updating: Evidence from event-related potentials

Tal Ness1 and Aya Meltzer-Asscher1,2

1 Sagol School of Neuroscience 2 Linguistics Department, Tel Aviv University

Introduction

During sentence processing, comprehenders form expectations regarding upcoming material, and may even predict a specific word. Lau, Holcomb, & Kuperberg (2013) suggested a distinction between two prediction mechanisms:

- pre-activation of representations in long term memory (i.e. the knowledge of a concept independently from the context).
- pre-updating of the context’s representation in working memory to include the predicted word.

We would expect pre-updating to only take place in cases where a strong prediction is made.

Previous ERP studies have suggested that the P600 component is a correlate of integration processes (Brouwer, Fitz, & Hoeks, 2012; Gouvea, Phillips, Kazanina, & Poeppel, 2010).

Methods

- 84 sentences, visually presented word-by-word, 500ms SOA.
- Half defined as high-constraint – average 89.5%, all above 80%.
- Half defined as low-constraint – average 68%, all below 80%.
- Following the verb, the sentences continued with either the predicted word, a congruent but unpredicted word, or an anomaly.
- The verbs in the high-constraint and low-constraint sentence conditions were matched for length, frequency and position in the sentence (measured in number of words).
- Participants: 24 students, average age 25.7 (19-37).

This research was supported by Marie Curie Career Integration Grant #631512 (Aya Meltzer-Asscher)

Hypothesis

We sought evidence for integration processes prior to the onset of a highly predictable word in a sentence.

We examined ERPs on verbs with a highly predictable complement (i.e. in high-constraint sentences), relative to those with no highly predictable complement (i.e. in low-constraint sentences).

We predicted an increased P600 in the high-constraint condition, reflecting pre-updating.

Results

For mother’s day, Rafi baked (a cake / bread / a chair) ...

When Yotam cooked, he accidentally broke (a plate / a mug / a question) ...

A main effect of constraint (p = .017)

500-800ms central, centro-parietal and parietal electrodes.

Discussion

Results show an increased P600 amplitude on verbs when their anticipated argument is highly predictable. These results support the notion of pre-updating, by suggesting that an argument can be integrated prior to its anticipated realization in the input, if a specific prediction is highly encouraged by a constraining context.

A more controlled experiment is currently ongoing, to test this further.

Example materials

High constraint

1. lijvod yom ha-em, rafi ata (uga / lexem / kise) ve-katav braxa muška’at. For mother’s day, Rafi baked (a cake / bread / a chair) and wrote a nice card.
2. oren tamid ayef, az hu ohev látot (kafe / te / kof) lifnei še-hu holex la-avoda. Oren is always tired, so he likes to drink (coffee / tea / a monkey) before he goes to work.
3. kša-ha-xaverim nifgešu irir ot misxak, hem hizminu (pica / oxel / kir) ki kulam haju re’evim. When the guys gathered to watch the game, they ordered (pizza / food / a wall) because everybody was hungry.

Low constraint

1. kša-yotam bisel, hu be-ta’ut šavar (calaxat / sefel / še’ela) ve-hakol misaviv hitlaxle. When Yotam cooked, he accidentally broke (a plate / a mug / a question) and everything got messy.
2. likrat ha-xoref, dina hextila likro (eveder / garbaim / mazleg) la-nexadot šela. For the winter, Dina decided to knit (a sweater / socks / a fork) for her granddaughter.
3. leaxar ha-imun avner raca le’xol pn, az hu kilet (banana / tapuax / kiner) ve-axal ota bederex habaita. After practice Avner wanted to eat a fruit, so he peeled (a banana / an apple / a violin) and ate it on his way home.

References