

How do in/congruent Prompts interfere with the translation Process of a bilingual Brain?:
A fixation-related EEG analysis

*Verena Braunstein¹, Alexander Gerganov², Vera Kaiser³, Ivo Popivanov², Clemens Brunner³,
Maxim Stamenov² and Christa Neuper^{1,3}*

¹University of Graz

²New Bulgarian University, Sofia

³University of Technology, Graz

In this study a written word translation task (L2 into L1) was performed by 13 proficient Austrian bilinguals. The stimulus material consisted of 120 trials of false and true cognates. 250ms after the L2 (English) word appeared, a L1 (German) prompt was presented above the target word at a distance of 6 degrees of visual angle. This time line should provide a natural reading process. The prompt was either a correct translation of the target word or a semantically incongruent one. The aim was to look at the effects of meaning competition in this translation task. Therefore three data streams (EEG, eye tracking and key logging) were synchronized and recorded.

As the gaze data shows, the participants fixated on the L1 word longer than expected (>300ms) so the automatic reading pattern was suppressed. This offers the possibility to investigate the nature of the relationship between single words and their translations within the bilingual lexicon as such. Additionally viewing time for the prompt region is longer in trials with incongruent prompts, which signals difficulties in achieving the word translation task. The prompt is viewed longer relative to the target word when the prompt is congruent than when the prompt is incongruent. This is probably due to top-down strategic processing.

Significant differences are found for the behavioural data: Participants were faster when translating words with a congruent prompt and made more errors in trials where an incongruent prompt was provided.

Several analyses were performed with the EEG data. As a general marker the first fixation on the prompt was taken. Eye-fixation-related potentials (EFRP) show differences resulting in a larger negative amplitude for incongruent prompts than for congruent ones in a time window from 100 to 200 ms after the fixation on the prompt. Analyses of regions of interest reveal the largest negative amplitude at parietal site and in the right hemisphere. EFRP results indicate that the congruent prompt facilitates the lexical access for the L1 prompt word so it's considered a priming-like paradigm. According to the event-related de/synchronisation analysis (ERD/S) two significant effects are found: First in the theta band (4-7 Hz) in right frontal areas a faster and stronger ERS is seen after incongruent prompts as compared to congruent prompts. Second in the upper alpha band (10-13 Hz) in right central areas a longer and stronger ERD occurs after incongruent prompts. These effects point to a higher cognitive load for processing incongruent prompts.

The integrated technologies of the Eye Tracker and the EEG have offered opportunities which cannot be achieved by each of them individually in investigating the nature of the lexical access to the bilingual brain. The combined measures of the gaze data and the EEG give precise information on how fast the brain reacts with well defined signatures to semantic incongruence as early as 100-200 ms after the prompt. Additionally the gaze data shows how the participants responded to the L1-L2-words.

Acknowledgement: This research was supported by the EU project "EYE-to-IT" (Project No. 517590) within the 6th Framework Programme.