Literal and Figurative Language Processing:
an Event-Related Potential (ERP) Study

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Abstract

There are three primary models to deal with literal/non-literal language processing. The first is the indirect access model proposed by Grice (1975) and Searle (1979). As indicated by this model, sentences are first processed literally when the literal meaning was not the adequate interpretation; at that point the look for the metaphorical interpretation begins. The second is the direct access model proposed by Glucksberg et al. (1982). As indicated by this model, metaphors are processed as easily as literal sentences. Their findings demonstrated that there is no contrast between the processing of literal sentences and metaphor. The third is a continual processing model, for example, "The contemporary theory of metaphor", Lakoff (1993); "the Gradient Salience Model", Giora (1997, 2003) and "the Career of Metaphor Model", Bowdel and Gentner (2005). In these models, literal sentences and conventional metaphors are processed in the same way. Lakoff (1993) believes that the meaning of literal sentences and conventional metaphors are accessed at the same time since they both are retrieved from memory. But Giora (1997, 2003) believes that the reason for this simultaneous processing is that conventional metaphors are as salient as literal sentences. Novel metaphors are processed more slowly than literal sentences and conventional metaphors. Their processing includes more cognitive efforts. Lakoff (1993) asserts that this slower processing of novel metaphors is due to the comparison and the conceptual mapping of the source domain on the target domain (online processing compared with retrieving from memory). Bowdel and Gentner (2005) believe that novel metaphors are processed as "analogy", but conventional metaphors are processed as "categorization". However, Giora (1997, 2003) considers the non-saliency as the main cause of this slower processing.

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Behavioral researches have mainly focused on the reaction time of subjects during the processing of metaphors. The improvement of brain imaging technologies in recent decades has motivated researchers to use techniques such as ERP, PET, and fMRI, to study the processing of non-literal language including metaphors. Kutas, Federmeyer, Coulson, King, and Munte (2000) state that techniques with high temporal resolution, for example, ERPs and eye tracking, can help revealing how language processing unfolds over time. They can be used to track the availability of different sorts of linguistic information and the temporal course of their interactions. Since 1980, many researches, including Pynte, Besson, Robichon and Poli (1996), Tarrter, Gomes, Dubrovsky, Molholm, and Stewart (2002), Coulson, and van Petten (2002), Iakimova, Passerieux, Laurent and Hardy-Bayle (2005), Arzoan, Goldstein, and Faust (2007), Lai, Menn, and Curran (2009), Lai and Curran (2013) have used ERP and N400 to study metaphor processing.

This research, using Event-Related Potential technique, studies the processing of literal and metaphorical sentences in Farsi and the role of conceptual mapping in this process. We anticipate literal sentences and conventional metaphors to be processed at a similar speed, but conventional metaphors are processed quicker than novel metaphors. In other words, more cognitive effort happen during the processing of novel metaphors. We also expect that conceptual mapping to occur during the conventional and novel metaphors in different ways. Four hundred sentences (literal, conventional metaphor, novel metaphor and anomalous) were made, then these sentences were designed by Psycopy software to be displayed on the computer screen. The brain electrical signals of 22 participants, were recorded during the reading task by a 64 channels EEG set made by Ant company and ASA lab software. The sample rate was 512 Hz, and the electrodes were arranged based on the 10-20 system. The signals were recorded from 32 electrodes. Using EEGLAB and ERPLAB, the mean amplitude of N400 in 7 areas including midline channels (Fpz, Fz, Cz, Pz, Oz), left medial channels (FC1, CP1, C3), right medial channels (CP2, C4, FC2), left lateral channels (CP5, F3, P3, FC5), right lateral channels (CP6, P4, F4, FC6), left peripheral channels (Fp1, F7, T7, O1) and right peripheral channels (Fp2, F8, T8, O2) were extracted. The data were analyzed by repeated measure (ANOVA) and pair-wise comparison (SPSS).

The repeated measure analysis (ANOVA) showed that mean amplitude of four conditions: literal, conventional metaphors, novel metaphors and anomalous sentences in the midline, left and right medial and right peripheral were significantly different. Pair-wise comparison of the amplitude of 400 in 7 areas did not show any significant differences between literal sentences and conventional metaphors, but the pair-wise comparison of the mean amplitude of N400 in left medial channels showed a significant difference between conventional metaphors and novel metaphors processing. The Findings of this research showed that the processing of literal language and conventional metaphors take the same speed and cognitive effort. However, the processing of novel metaphors need more cognitive efforts, which can be considered as an evidence of conceptual mapping. Our findings are consistent with this premise that conceptual mapping in novel metaphors occurs through analogy and in conventional metaphors it happens through categorization.