INTEGRATIVE BRAIN ACTIVITY IN PROCESS OF VISUAL AND AUDIAL RECOGNITION OF IMITATIVE WORDS ON DIFFERENT DE-ICONIZATION STAGES

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1. Iconicity and de-iconization as a process of language evolution

Iconicity is a relationship of resemblance (Peirce, 1940). In the lexicon it manifests itself in a form of imitative (onomatopoeic, sound-symbolic) words and ideophones (Hinton et al, 1994; Voelz et al, 2001). It is believed to be a design feature of the language (Voronin, 2005) that has played an important role in the proto-language (Moreno-Cabrera, 2012; Voronin, 2005). Indeed, in the absence of an established system of signs, it is likely that the first-ever elements of 'language' could have been based on the 'natural' form-meaning similarity. There is no possibility to study the proto-language *in vivo* to establish the role of lexical iconicity in the language origin and evolution. However, there is a possibility to conduct research on the imitative words existing in modern languages and to study *their* evolution. Flaksman (2017) established that imitative words undergo four de-iconization stages (SDs) and transform from 'vivid' iconic interjections on SD-1 (*ha-ha*!, *zzz*!) to words on SD-4 which have completely lost the original form-meaning correlation under the influence of

phonetic and changes (*cliché*, once a sound of molten metal). Thus, de-iconization in a way can be considered as a model for evolution of a part of the language's lexicon. The study aims to study this process by means of EEG.

2. EEG markers of words recognition

There are several EEG markers connected with semantic processing, among them early event-related potential (ERP) components in the range 100–200 ms which are known to be sensitive to lexical frequency (Carreiras et al, 2005); N250, which is sensitive to orthographic similarity (Carreiras et al, 2009a) and the phonological status of the letters (Carreiras et al, 2009b); P300 component reflects the processes of distribution of arbitrary attention and stimulus categorization (Didoné et al., 2016); N400 component is associated with lexical–semantic access (Laszlo, & Armstrong, 2013).

3. Research aims, material, and methods

The *aim* of this research was to conduct an experimental EEG study on Russian words on different de-iconization stages and to establish whether there are differences in the brain activity while processing visual and audial stimuli of different nature.

3.1. Stimuli selection for the experiment

The material for the research were 15 sound imitative (SI) words equally distributed into 3 groups according to the criterion of iconicity. The stimuli were preselected by means of a lexical decision task. To investigate the degrees of iconicity in word recognition the experiment by Sidhu et al. (2020) was partly replicated. The results revealed typical representatives of each group: explicit SI words – xlop (clap), čmok (smack), voj (howl), pisk (squeak), čix (sneeze); implicit SI words - žuk (bug, beetle), zud (itch), pux (fluff), xrjak (boar), gus′ (goose); and arbitrary, non-SI, words - vosk (wax), svod (vault), syp′ (rash), taz (basin, bowl), trost′ (cane).

3.2. Methods and procedure

110 Russian adult participants took part in this experiment after signing up informed consent officially approved by ethical committee of S-Petersburg State University. The basic experiment was preceded by a preparatory step, which included the selection and validation of visual stimulus material for each lexical stimulus. Each participant was randomly presented with 60 words, 30 visually and 30 audibly. The task of the subjects was to identify the word and choose the

appropriate picture from the two proposed. EEG was recorded using Mitsar electroencephalograph (bandwidth, 0.5–70 Hz) with a 250Hz sampling rate for each channel. 19 monopolar leads were arranged symmetrically according to the International 10–20 System (Fp1, Fp2, Fp3, Fp4, F7, F8, C3, C4, Fz, Cz, Pz, T3, T4, T5, T6, P3, P4, O1, and O2), EOG was recorded. Visual and auditory ERP were calculated using Repeated Measures Analysis of Variance.

4. Results and discussion

It was found that there was no statistically significant difference between *visually* presented explicit-, implicit-SI words and non-SI words. However, statistically significant differences were obtained for *audibly* presented explicit SI words in contrast to implicit SI words at N400 ERP ($p=0.014050$) and implicit SI words in contrast to non-SI words at P300 endogenous evoked potential ($p=0.043261$). The first result corresponds to the fact that the N400 is larger for figurative language (Kutas, & Federmeier, 2011). The second one lets us speculate that explicit SI words demand more cognitive resources in process of audial recognition than non-SI words.

5. Conclusions

We assume that the results obtained indicate a specific brain response associated with directed attention in the process of cognitive decision-making task regarding explicit and implicit SI words presented audibly, which may reflect a higher level of cognitive complexity of identifying this type of stimuli. Explicit SI words, thus, are not only defined as extra-systemic and 'archaic' by means of linguistics, but also stand out according to our findings in EEG experiments.

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