

ABSTRACT
**of the dissertation by Zhaksylykkyzy Karlygash entitled “Neurolinguistics
of trilingualism: markers of lexico-semantic processing in
cross-language interaction” submitted for the degree of Doctor of
Philosophy (PhD) in the educational program “8D02303 – Linguistics”**

The relevance of the research is determined by the particular significance of multilingualism in Kazakhstan, where languages function within a complex system of cross-language interaction. In the current language situation, Kazakh functions as the state language and a state-building component, Russian plays an important role in interethnic communication, and English serves as one of the key means of international political, economic, academic, and professional integration. In this regard, the study of cross-language processing mechanisms is of not only linguistic but also strategic importance. The relevance of the study is also determined by the specific features of the current language situation and language policy in education, in which English is usually acquired against the background of already established Kazakh–Russian or Russian–Kazakh natural bilingualism. Although there are studies devoted to bilingualism and multilingualism, the neurolinguistic aspect involving electroencephalography (EEG) and event-related potentials (ERP) data remains at an initial stage of development in Kazakhstani science. The relevance of the study is further strengthened by the growing interest in integrative linguistics and by the need to apply modern scientific and methodological approaches to the study of multilingualism in Kazakhstan.

The object of the research is the lexico-semantic processing of language units in cross-language interaction in the context of trilingualism.

The subject of the research comprises neurolinguistic markers of lexico-semantic word processing that reflect the specific involvement of the first, second, and third languages.

The purpose of the research is to conduct an integrative neurolinguistic analysis of the markers and neurocognitive mechanisms of lexico-semantic word processing in cross-language interaction in the context of trilingualism.

The following **research objectives** were formulated to achieve this purpose:

- to construct the metalanguage of the study within an integrative approach and to substantiate the conceptual prerequisites for the development of neurolinguistic research in Kazakhstan, taking into account the language situation of the republic and the role of Kazakh, Russian, and English in multilingual education;
- to analyse theoretical approaches to the study of bilingualism and trilingualism, with reference to the mechanisms of language information processing in the mental lexicon of speakers of heterogeneous and typologically distinct languages;
- to justify the choice of English irregular verbs as stimulus material and to substantiate the use of the translation recognition paradigm as a method for assessing cross-language activation across Kazakh, Russian, and English;

- to analyse and integrate behavioural and EEG/ERP indicators of word recognition as a function of the participants' first and second languages;
- to propose an integrative design for the neurolinguistic analysis of lexico-semantic processing markers in cross-language interaction.

Materials and sources of the study. The research material consisted of 105 English irregular verbs, 210 Kazakh verbs, and 210 Russian verbs selected and verified using the following sources: Cambridge Dictionary, Oxford Learner's Dictionaries, the British National Corpus (BNC), the Corpus of Contemporary American English (COCA), the National Corpus of the Kazakh Language (NCKL), and the Russian National Corpus (RNC).

Experimental setting and participants. The study involved 38 right-handed students of the Faculty of Philology at Al-Farabi Kazakh National University (Almaty, Kazakhstan), who formed two mirror-image groups of sequential trilinguals with the same language repertoire (Kazakh, Russian, and English) but differing in their first language: L1 Kazakh ($n = 22$) and L1 Russian ($n = 16$).

Research methods. The study was conducted in three stages: preparatory, experimental, and analytical. At the preparatory stage, purposive selection of word stimuli, analysis of translation equivalence, expert evaluation of the stimulus material, and participant questionnaires were administered. At the experimental stage, the translation recognition paradigm was applied with EEG recording. At the analytical stage, behavioural data processing, ERP analysis, and statistical modelling were performed. The experiment was implemented in E-Prime; EEG/ERP data were processed using BrainVision, and statistical analysis was carried out in R/RStudio.

The theoretical and methodological basis of the research. The theoretical and methodological basis of the study draws on the concepts and ideas of international and Kazakhstani scholars in the fields of neurolinguistics, psycholinguistics, bilingualism and multilingualism studies, cognitive neuroscience, and language processing (W. Kroll, E. Stewart, A. de Groot, T. Dijkstra, W. Van Heuven, D. Green, J. Abutalebi, C. Bardel, Y. Falk, J. Rothman, M. Westergaard, B. Hammarberg, J. Cenoz, G. De Angelis, H. Ringbom, S. Flynn, M. Paradis, G. Hickok, D. Poeppel, M. Kutas, S. Hillyard, K. D. Federmeier, I. V. Brak, E. D. Suleimenova, Sh. K. Zharkynbekova, A. D. Zhakupova, Zh. K. Ibrayeva, A. M. Kustubayeva, A. K. Shayakhmet).

The theoretical and practical significance of the research. The study contributes to the development of Kazakhstani neurolinguistics, psycholinguistics, and cognitive neuroscience by expanding the analysis of lexico-semantic processing of language units, cross-language interaction, and the application of EEG, ERP methodology and N400 component analysis to studies of bilingualism and trilingualism in the Kazakhstani scientific context. This work proposes a reproducible experimental framework for studying trilingual lexico-semantic processing using the translation recognition paradigm and ERP methodology. The principles for constructing the stimulus material may be applied in subsequent psycholinguistic and neurolinguistic experiments involving Kazakh, Russian, English, and other typologically and genetically different

languages. The results and conclusions may also be useful for contrastive linguistics and language pedagogy.

The scientific novelty of the research. This work represents the first instance of neurolinguistic research in the Kazakhstani scientific context that examines trilingual lexico-semantic processing using EEG/ERP methodology at the Department of Turkology and Language Theory and the Brain Institute of Al-Farabi Kazakh National University.

1. For the first time in the Kazakhstani context, ERP analysis of lexico-semantic processing in trilinguals has been conducted, and an integrative design has been developed for the neurolinguistic analysis of lexico-semantic processing markers in cross-language interaction.

2. For the first time, the metalinguistic and terminological basis of neurolinguistics in the Kazakh language has been systematised. This contribution is reflected in the published *Psycholinguistics and Neurolinguistics Russian-English-Kazakh learner's dictionary of terms* (Almaty: Qazaq Universiteti, 2023 (authors: Zh. K. Ibrayeva, G. S. Nabiyeva, K. Zhaksylykkyzy, A. M. Kustubayeva)), which represents one of the first attempts to create a specialised trilingual dictionary.

3. For the first time, a neurolinguistic analysis has been carried out to determine how functional experience, language dominance, and the sequence of acquisition of Kazakh and Russian modulate lexico-semantic access in cross-language processing.

4. This study developed and implemented a translation recognition paradigm with EEG recording, in which English irregular verbs served as semantic primes, while stimuli in Kazakh and Russian were presented as congruent translation equivalents or incongruent stimuli.

5. For the first time, behavioural and ERP data have been obtained indicating the asymmetric nature of cross-language activation during the processing of English as a third language. This study established that the sequence of acquisition of the first and second languages plays a significant role in cross-language access initiated by the third language and contributes to the formation of two different functional routes of lexico-semantic processing.

The main provisions submitted for defence are as follows:

1. Neurolinguistics in Kazakhstan is an emerging integrative field that requires its own methodological and metalinguistic substantiation. An analytical review of psycholinguistic and cognitive studies confirms that the study of language and the brain requires an interdisciplinary approach capable of linking linguistic phenomena with cognitive processes. At the same time, under the conditions of the dominance of English as the language of science, the metalinguistic basis of Kazakhstani neurolinguistics remains insufficiently systematised, and many established English-language terms still do not have stable Kazakh equivalents. This underscores the need to develop and standardise a specialised terminological base for neurolinguistic research in Kazakhstan.

2. The language situation and the language policy implemented in the field of education in the Republic of Kazakhstan have formed a specific group of sequential trilinguals for whom English functions as a third language on the basis of already established naturally acquired Kazakh–Russian or Russian–Kazakh bilingualism. Differences among Kazakh, Russian, and English in order of acquisition, degree of dominance, functional experience, typological structure, and sociolinguistic status make it possible to consider the mirror comparison of language configurations as a theoretically grounded model for investigating cross-language activation and lexico-semantic processing.

3. Trilingual word recognition in the translation recognition paradigm is based on semantic verification and reveals systematic effects of match-mismatch. Under conditions in which an English prime is presented and stimuli in Kazakh and Russian are subsequently verified, the processing outcome is determined by whether the given language unit is a congruent translation equivalent or an incongruent stimulus. Incongruent stimuli elicit greater processing difficulty, expressed simultaneously in slower reaction times and lower response accuracy, thereby excluding an explanation of the results as a simple speed–accuracy trade-off.

4. Electrophysiological data indicate that semantic mismatch is detected at the stage of lexico-semantic processing. Incongruent stimuli in Kazakh and Russian elicit a more pronounced negativity in the 400–600 ms time window corresponding to the N400 component. Stimulus differentiation occurs at the level of semantic evaluation and is not limited to later decision-making processes. Thus, ERP data complement behavioural indicators by revealing the temporal dynamics of detecting semantic mismatch in the trilingual mental lexicon.

5. The N400 mismatch effect is modulated by stimulus language and participants' language profile, indicating an integrated but functionally asymmetrical pattern of cross-language semantic activation in trilinguals. Uneven activation of Kazakh and Russian during translation recognition initiated by English as a third language demonstrates that lexico-semantic access is shaped by the combined influence of typological distance, acquisition sequence, language dominance, and language experience. The observed effects provide grounds for distinguishing two routes of cross-language access initiated by the third language: the forked route, which assumes relatively direct and parallel activation of both background languages, and the roundabout route, characterised by weakened access to the less dominant language. The findings make it possible to consider the trilingual lexico-semantic system as a dynamic neurocognitive network with functionally asymmetric cross-language connections.

Approbation of the dissertation. The main theoretical and empirical results of the study were discussed and approved at scientific seminars of the Department of Turkology and Language Theory and the Brain Institute of Al-Farabi Kazakh National University. The dissertation research was carried out within the framework of the Program-Targeted Funding project No. BR27198099, “Development of Integrative Scientific Research in Neuroscience”, funded by the Science Committee of the Ministry

of Science and Higher Education of the Republic of Kazakhstan. Based on the dissertation materials, nine scientific publications have been published, including one article in a journal indexed in Scopus (Q1), five articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Republic of Kazakhstan, three publications in proceedings of international conferences, and one trilingual learner's dictionary.

The structure of the dissertation. The dissertation consists of an introduction, three chapters, a conclusion, a list of references, and appendices.