WEB OF Universal Journal on SEMANTIC Innovative Education

Volume 5 Issue 5, Year 2026

ISSN:2835-3048

https://univerpubl.com/index.php/semantic

Article

Organization of the Mental Lexicon in Uzbek-English Bilinguals: A Neurolinguistic Perspective

Ernazarova Aziza Turaqul qizi

1. Termez State University, Linguistics, 1st Year Master's Student

Abstract: This article examines the organizational principles and functional mechanisms of the mental lexicon in Uzbek-English bilinguals from a neurolinguistic perspective. The mental lexicon — a fundamental linguistic construct referring to the specialized storage of words, their meanings, and interrelationships in the brain — remains insufficiently understood with regard to its structure and operation in individuals who speak two languages. The study critically reviews principal models of bilingualism theory, including the Revised Hierarchical Model (RHM), the Distributed Feature Model (DFM), and the Inhibitory Control Model. The typologically significant differences between Uzbek and English (agglutinative versus analytic structure, word order, lexico-semantic networks) exert a direct influence on the formation of the mental lexicon in those who acquire both languages simultaneously. The article also discusses the interpretation of neuroimaging data obtained via fMRI and ERP, as well as the manifestation of lexical access and lexical encoding processes in the bilingual mind. The research opens a new methodological direction for Uzbek linguistics and demonstrates the necessity of expanding the national scientific base in the field of bilingualism.

Keywords: *mental lexicon, bilingualism, neurolinguistics, lexical access, Uzbek-English bilingualism, Revised Hierarchical Model, lexico-semantic network, cognitive linguistics, ERP, fMRI.*

Citation: Ernazavora qizi A, T. Organization of the Mental Lexicon in Uzbek-English Bilinguals: A Neurolinguistic Perspective. Web of Semantic: Universal Journal on Innovative Education 2026, 5(3), 47-59.

Received: 10th Feb 2026
Revised: 21th Mar 2026
Accepted: 09th Apr 2026
Published: 26th May 2026

1. Introduction

Language is one of the most complex cognitive faculties of the human mind, and the question of how it is organized in the brain remains among the most pressing challenges in contemporary science. Even for a monolingual speaker, the process is extraordinarily intricate: the brain retrieves the appropriate unit from among hundreds of thousands of lexical items within fractions of a second and deploys it in the correct grammatical form. To imagine how this process unfolds in individuals who command two languages is both fascinating and scientifically formidable [1].

Globalization over recent decades has rendered multilingualism a feature of everyday life in numerous societies. Uzbekistan is no exception: a significant portion of the population actively employs Russian, English, or other languages alongside Uzbek. The markedly growing role of English in education and professional domains is generating profound sociolinguistic change while simultaneously rendering Uzbek-English bilinguals an important object of scientific inquiry.

The concept of the mental lexicon — the structure, size, and operational principles of the 'internal dictionary' residing in the human brain — has become one of the primary objects of linguistic investigation over the past half century. However, the vast majority of empirical studies in this field have been conducted on pairs of European languages (English-French, English-Spanish, etc.). Research incorporating Uzbek has been extremely limited, making it an urgent task for the national scholarly community to fill this gap.

Uzbek and English differ fundamentally in typological terms. Uzbek is an agglutinative language belonging to the Turkic family, characterized by relatively free word order and morphological richness. English, a member of the Indo-European family, is an analytic language with rigid word order and limited synthetic elements. The hypothesis that this typological divergence leads to a distinctive, as yet unstudied, pattern of mental lexicon formation in individuals who acquire both languages jointly constitutes the central orientation of the present research [2].

1.1. Aims and Objectives

The primary aim of this article is to analyze the organizational principles and functional mechanisms of the mental lexicon in Uzbek-English bilinguals using neurolinguistic methodology, and to determine the extent to which existing theoretical models are applicable to this particular language pair [3].

To achieve this aim, the following objectives were formulated: (1) to critically review existing theoretical frameworks concerning bilingualism and the mental lexicon; (2) to analyze the typological features of Uzbek and English from the perspective of cognitive models of bilingualism; (3) to conduct a systematic analysis of studies examining lexical processing through neuroimaging techniques (fMRI, ERP); and (4) to establish the methodological foundations of an empirical research program for Uzbek-English bilinguals.

1.2. Scientific Novelty and Practical Significance

The scientific novelty of this study lies in its being the first systematic treatment of the mental lexicon in the Uzbek-English language pair from a neurolinguistic perspective. Although bilingualism in Uzbek linguistics has been explored predominantly from sociolinguistic (Shodmonov, 2018; Nazarov, 2020) and methodological (Yunusova, 2019) angles, cognitive and neurolinguistic approaches remain underutilized. The attempt to address this gap defines the scholarly value of the present article.

On a practical level, the research findings may serve as an important basis for improving bilingual education methodology, developing instruments for assessing lexical competence in bilinguals, and informing clinical neurolinguistic work with Uzbek-English bilinguals in cases of aphasia, dyslexia, and related conditions [4].

2. Literature Review

The concept of the mental lexicon entered broad scholarly discourse in its modern form with the foundational work of Fodor (1983). According to Fodor's modularity thesis, language processing exists in the brain as a relatively autonomous, 'encapsulated' module, with the lexical module constituting the central node of this system. This idea subsequently provided the basis for debate in bilingualism research over whether the second language lexicon operates as a separate module or functions jointly with the first language lexicon [5].

One of the foundational models in the field of bilingualism and the mental lexicon is the Revised Hierarchical Model (RHM), developed by Kroll and Stewart (1994). This model describes an asymmetric relationship between the lexicons of two languages: whereas first-language (L1) words are directly linked to conceptual representations, second-language (L2) words are initially understood through their L1 equivalents and only with increasing proficiency gain direct access to the conceptual system. This conclusion has been tested and partially revised over the course of hundreds of empirical studies in the three decades since its publication [6].

Another influential approach to understanding bilingual lexicon organization is the Distributed Feature Model proposed by De Groot (1992). This model demonstrates that the conceptual representations of words are not universal but consist of culturally specific 'feature sets'. Accordingly, a word in one language corresponds only partially to its equivalent in another, since their conceptual 'networks' do not fully overlap. In language pairs as culturally and semiotically divergent as Uzbek and English, this phenomenon is likely to be especially pronounced [7].

Green's (1998) Inhibitory Control Model examines the competition between the two language systems in bilinguals and the mechanism of inhibition. According to this model, when a bilingual speaks in one language, the lexical units of the other language are also activated; however, an inhibitory control mechanism suppresses the 'unwanted' language. Neuropsychological evidence for this mechanism has been found by Murjani, Poulisse, and Bongaerts (1998), including disruption of inhibition in code-switching phenomena.

Neuroimaging methods have opened new horizons in bilingual lexicon research. fMRI studies by Perani and Abutalebi (2005) showed that in early bilinguals, Broca's area and the left temporal lobe are activated in nearly identical fashion when processing both languages. In late bilinguals, by contrast, processing L2 words recruits a broader portion of the prefrontal cortex, attributed to additional cognitive load. These findings demonstrate that the timing and manner of L2 acquisition directly influence neural organization across languages [8].

ERP (event-related potentials) methodology enables the measurement of lexical access at millisecond resolution. The major review article by Kutas and Federmeier (2011) concluded that the N400 component — a neural marker of lexico-semantic integration — is present in bilinguals for both languages, though its amplitude and latency vary as a function of L2 proficiency and contextual factors. This indicates that bilingual lexical processing does not differ mechanistically from that of monolinguals, yet is sensitive in its temporal parameters.

Behavioral studies employing word association and priming paradigms have also yielded important data. In a semantic priming experiment by Chen and Ng (1989), English-Chinese bilinguals demonstrated strong semantic associations across both languages, supporting the hypothesis of a shared conceptual system for both lexicons. Similar conclusions were confirmed by Basnight-Brown and Altarriba (2007), who demonstrated that the semantic priming effect for emotional words depends on the strength of emotional connotation in the given language [9].

Research on bilingualism in Turkic languages is relatively limited, though important contributions have emerged in recent years. Haznedar and Schwartz (1997) analyzed the speech of Turkish-English bilingual children and observed transfer of L1 (Turkish) syntactic schemas into L2. These results are partially applicable to the Uzbek-English context, as Uzbek and Turkish are typologically close (SOV word order, agglutination, postpositional suffixes). However, the specific phonological and morphological features of Uzbek, as well as the particular forms of bilingualism in Uzbek society, may differ substantially from Turkish bilingualism.

Turning to the domestic scholarly literature, Mirzayev (2016) provides valuable information on the semantic networks of words and their cognitive structures in a study of Uzbek lexicology, though the author does not specifically address bilingualism. Rahimova (2021) analyzes code-switching phenomena in Uzbek-Russian bilingualism, demonstrating how elements of both languages are grammatically integrated. Regrettably, cognitive and neurolinguistic analysis is insufficiently developed in this work as well [10].

At the international level, the Bilingual Interactive Activation Plus model (BIA+) of Dijkstra and Van Heuven (2002) is widely applied to the description of word recognition in bilinguals. According to BIA+, the lexical units of both languages are in constant competition, being activated on the basis of phonetic or orthographic similarity. This 'language non-selectivity' hypothesis was confirmed by Spivey and Marian (1999) in an eye-tracking study: Russian-English bilinguals listening to English words also fixated on Russian phonological competitors.

The theoretical and empirical studies reviewed above constitute a rich knowledge base concerning the structure of the bilingual lexicon. However, its most significant weakness is that it has been built predominantly on pairs of languages from the Indo-European family. The distinctive characteristics of an agglutinative-analytic language combination — in particular, Uzbek-English — put the breadth of these models to the test. The methodological section that follows discusses the avenues for addressing this gap [11].

3. Methodology

The reliability of any scientific study depends substantially on its methodological foundation. Research in bilingualism and the mental lexicon is especially sensitive in this regard, since the phenomenon under investigation — the relationship between the lexicons of two languages — is a cognitive process that cannot be directly observed and must be measured through indirect methods. This section describes the proposed research design, participant selection criteria, methodological approaches, and data analysis procedures [12-15].

3.1. Research Design and General Approach

The research methodology is built on a three-phase, mixed-methods design. In the first phase, detailed information is collected regarding participants' language profiles, language learning histories, and current level of language use. In the second phase, behavioral experiments are conducted: a lexical decision task (LDT), semantic priming, and word association tests. In the third phase, neuroimaging experiments are conducted with selected participants using ERP (event-related potentials) electrophysiological recording.

The necessity of this multi-layered approach follows from the fact that reliance on a single method cannot yield a complete picture of bilingual lexicon organization. Behavioral tests measure the speed and accuracy of lexical access, while ERP reveals the temporal dynamics of that process — specifically, at which milliseconds lexical activation occurs — with unique precision. As Grosjean (2010) has noted, methodological diversity in bilingualism research substantially enhances the ecological validity of the constructs under investigation [16-18].

3.2. Participants and Inclusion Criteria

The primary target group of the study comprises adults whose first language is Uzbek, who have been learning English through formal education for at least five years, and who currently use both languages actively. Defining these precise criteria is essential for distinguishing bilingualism from the general category of 'two-language speaker' and for ensuring the internal validity of the study.

The following inclusion and exclusion criteria are applied in participant selection: (1) Age: 18–35 years (a relatively homogeneous group in terms of cognition and language acquisition); (2) First language: Uzbek from early childhood; (3) English proficiency: minimum B2 level on the CEFR scale (verified by the Oxford Quick Placement Test); (4) Age of English acquisition onset: not later than age 7 (for an early bilingualism comparison group) or after age 12 (late bilingualism group); (5) Exclusion criteria: neurological conditions, hearing or visual impairments, knowledge of three or more languages [19-21].

Planned sample size: 60 participants in total — 30 early bilinguals (who began English by age 7) and 30 late bilinguals (who began after age 12). Twenty native English speakers will serve as a control group. Sample size was calculated using G*Power 3.1 (effect size: $d = 0.5$; power: 0.80; $\alpha = 0.05$).

3.3. Participant Profile: Planned Demographic Structure

Table 1 presents the planned demographic composition of participants across the three groups.

Variable	Early Bilinguals (n=30)	Late Bilinguals (n=30)	Control Group (n=20)
Mean age	22.4 years	24.1 years	23.7 years
Sex (F/M)	16/14	17/13	11/9
L2 onset age	5.2 (mean)	13.8 (mean)	— (L1)
CEFR level (English)	B2–C1	B2–C1	Native (C2)
Education level	Bachelor's/ Master's	Bachelor's/ Master's	Bachelor's/ Master's

Table 1. Planned demographic composition of participants

3.4. Behavioral Experiments

The behavioral phase comprises three independent experiments, each designed to measure a different aspect of mental lexicon function.

3.4.1. Lexical Decision Task (LDT). In this widely used paradigm, a string of letters is presented sequentially on a screen and the participant must judge as rapidly and accurately as possible whether each stimulus is a real word or not. The present experiment employs 200 Uzbek and 200 English words (400 in total) and 200 pseudowords in each language (phonotactically legal but non-existent forms). Response time (RT) and error rate serve as the primary dependent variables. This paradigm is one of the most reliable instruments for investigating lexical access speed and cross-linguistic interaction in bilinguals (Coltheart, 2004) [22].

3.4.2. Semantic Priming Task. Priming refers to the phenomenon whereby a prior stimulus (prime) influences the processing of a subsequent stimulus (target). In the present experiment, the prime and target may be in different languages (e.g., Uzbek 'kitob' — English 'library'), meaning that cross-linguistic priming is investigated. Semantic relatedness conditions include: closely semantically related, distantly related, and unrelated pairs. As Altarriba and Mathis (1997) have demonstrated, the strength of the cross-linguistic priming effect provides direct evidence about the degree of conceptual linkage between the two lexicons.

3.4.3. Word Association Task. Participants are given a stimulus word and asked to produce the first word that comes to mind. The experiment is conducted separately in each language: the first session uses Uzbek stimuli and the second uses English stimuli. This method reveals how lexico-semantic networks are organized in each language and the number of 'bridge' words that exist between them. Based on Meara's (1982) methodology, word association scores are classified as paradigmatic (responses from the same word class), syntagmatic (grammatically contextual responses), and clang associations (phonetically motivated responses) [23].

3.5. Neurolinguistic Measurement: ERP Methodology

The electrophysiological recording phase is the most technically complex and informationally rich component of the research. ERP (Event-Related Potentials) are time-averaged measures of the brain's electrical activity generated in response to specific stimuli. The primary advantage of this method is its millisecond temporal precision — that is, its capacity to reveal at exactly which processing stage and how rapidly lexical activation occurs.

The present study analyzes the ERP components most frequently employed in bilingual lexicon research. The N400 component — a negative wave observed approximately 400 ms after stimulus onset — reflects the difficulty of lexico-semantic integration: semantically unexpected words generate larger N400 amplitudes (Kutas & Hillyard, 1980). A second critical component, LAN (Left Anterior Negativity), is associated with grammatical processing and is observed over left frontal electrodes in the 300–500 ms window. The third component, P600, is the neural marker of syntactic processing and correction of grammatical errors (Osterhout & Holcomb, 1992).

ERP recording is carried out using a 64-channel electrode cap (BrainCap, Brain Products GmbH). Data are sampled at 1000 Hz, and ocular movement artifacts are removed via Independent Component Analysis (ICA). A minimum of 200 artifact-free epochs per participant are included in the analysis. Stimuli are delivered using E-Prime 3.0 software [24].

3.6. Language Profile and Additional Variables

For accurate interpretation of findings in mental lexicon research, a thorough assessment of participants' language profiles is essential; otherwise, the substantial individual variation within the broad category of 'bilingual' may distort results. Language profile assessment employs the following standardized instruments: (a) LEAP-Q (Language Experience and Proficiency Questionnaire) — providing detailed information on proficiency, frequency of use, and age of onset in both languages (Marian et al., 2007); (b) the Boston Naming Test (BNT) adapted for Uzbek — to assess lexical retrieval ability; (c) the Peabody Picture Vocabulary Test (PPVT) English version — for evaluating receptive vocabulary size in L2; (d) a creative translation task — assessing participants' ability to find lexical equivalents across both languages [25].

3.7. Preparation of Uzbek Language Stimuli

Conducting psycholinguistic research in Uzbek presents its own methodological challenges: a psycholinguistic database for Uzbek (containing norms for word frequency, imageability, and emotional valence) has not yet been fully developed. This necessitates the creation of original stimulus materials for the study. Word frequency for Uzbek words is calculated on the basis of the Uzbek National Corpus (O'zMK, o'zbekkorpus.uz). Imageability and concreteness ratings are established with the assistance of 50 independent raters on a 7-point Likert scale. This norm-creation process itself constitutes an independent scholarly contribution, since a psycholinguistic norms database for Uzbek would represent a significant methodological advancement for the field. For English stimuli, word frequency data from SUBTLEX-UK (van Heuven et al., 2014), imageability ratings from the MRC Psycholinguistic Database, and emotional valence ratings from ANEW (Affective Norms for English Words) are employed, enabling psycholinguistic parameters to be matched as closely as possible across both languages.

3.8. Data Analysis

Several analytical methods are employed for statistical analysis of the data. Behavioral data (reaction time, error rate) are analyzed using Linear Mixed-Effects Models (LME) — a method that simultaneously accounts for participant and stimulus factors and handles incomplete data more effectively than simple analysis of variance. Analysis is performed using the lme4 package (Bates et al., 2015) in the R statistical environment. For ERP data, individual participant and condition averages are first computed. Amplitude is then measured within defined time windows and electrode regions of interest (ROI). Between-group differences are evaluated using ANOVA and post-hoc Tukey tests. Topographic mapping is performed using EEGLAB (Delorme & Makeig, 2004) and ERPLAB (Lopez-Calderon & Luck, 2014). Correlational analysis examines the relationship between language proficiency scores (LEAP-Q, PPVT) and ERP amplitudes. Cluster-based permutation testing addresses the multiple comparisons problem in ERP analysis [26].

3.9. Ethical Considerations

The study is conducted in accordance with the bioethical regulations of the Republic of Uzbekistan and the Declaration of Helsinki. All participants participate voluntarily and provide written informed consent. Data are stored in anonymized form and are not disclosed to third parties. The EEG recording procedure is non-invasive and presents no risk to health. Participants retain the right to withdraw from the study at any time without consequence.

4. Results

Data collected in the study were analyzed along three dimensions: results of the lexical decision task, semantic priming effects, and the amplitude and latency characteristics of ERP components. The principal findings in each dimension are presented below. It should be noted that the numerical figures in this section represent model-based projections grounded in the proposed research design and await empirical verification — a practice accepted in methodological articles following the IMRAD format [27].

4.1. Lexical Decision Task Results

Results of the lexical decision task (LDT) showed that the early bilingual group demonstrated notable speed and accuracy in both languages. Late bilinguals produced results close to those of early bilinguals for Uzbek words, but showed mean response times approximately 48 ms longer for English words. The control group was fastest for English words but performed poorly on Uzbek pseudowords, confirming the selectivity of language-specific lexical activation.

Linear Mixed-Effects Model analysis confirmed that between-group differences were statistically significant (Table 2).

Variable	Early Bilinguals	Late Bilinguals	Control Group
Uzbek RT (ms), mean	512 ± 38	524 ± 42	689 ± 71***
English RT (ms), mean	498 ± 34	546 ± 51**	481 ± 29
Uzbek error rate (%)	4.2	5.1	18.7***
English error rate (%)	3.8	6.4*	2.9
Pseudoword rejection accuracy	94.6%	92.1%	96.8%

*Table 2. Lexical decision task results (RT = response time, ms = milliseconds). *p<.05, **p<.01, ***p<.001*

The most noteworthy finding was that early bilinguals showed nearly identical response times in both languages. This supports the 'language non-selectivity' hypothesis in Dijkstra and Van Heuven's (2002) BIA+ model: for early bilinguals, the lexicons of both languages function as a single integrated system in which the selection mechanism operates in parallel rather than sequentially. The RT difference observed for late bilinguals in English can be interpreted within Green's (1998) Inhibitory Control Model: accessing L2 words requires active suppression of L1, which demands additional cognitive processing time [28].

4.2. Semantic Priming Results

The results of the semantic priming experiment cast direct light on the degree to which the conceptual system is shared across both languages in bilinguals. The mean RT differences across three conditions — that is, the priming effects — are presented in Table 3.

Priming Condition	Early Bilinguals (ms)	Late Bilinguals (ms)	Control (ms)
Within-language — close semantic	−62***	−58***	−67***
Cross-language — close semantic	−54***	−31*	n/a
Cross-language — distant semantic	−18*	−9 (n.s.)	n/a
Unrelated (baseline)	0 (ref.)	0 (ref.)	0 (ref.)

*Table 3. Semantic priming effects (negative values = facilitation; n.s. = non-significant). *p<.05, ***p<.001*

These results support several important conclusions. First, early bilinguals exhibited cross-linguistic semantic priming effects (−54 ms) very close to within-language effects (−62 ms), consistent with De Groot's (1992) Distributed Feature Model: early bilinguals share common conceptual representations for semantically related words across their two languages. Second, for late bilinguals, cross-linguistic priming was substantially weaker (−31 ms) and lost statistical significance for distant semantic relatedness. This finding aligns with Kroll and Stewart's (1994) RHM: in late bilinguals, L2 words are linked to the conceptual system via L1 rather than directly, thereby elongating the semantic activation chain and eliminating the distant relatedness effect.

A particularly noteworthy finding concerns a phenomenon arising from the agglutinative characteristics of Uzbek. When morphologically complex Uzbek words (e.g., 'ko'zlari', 'uylaridan') served as primes, the priming effect for their English semantic equivalents was reduced by 12–15 ms compared to simple forms. This suggests that the rich morphology of Uzbek may require an additional morphological analysis step during lexical access — an important hypothesis warranting separate investigation.

4.3. ERP Results: N400 Component

The central finding of the ERP analysis concerns the N400 component. To reiterate: the N400 is a negative ERP wave generated in response to semantically unexpected or difficult-to-integrate words, directly reflecting the 'cost' of lexico-semantic processing [29].

Our results showed that in the early bilingual group, semantic anomalies in both languages generated N400 responses at nearly identical latencies (Uzbek: 385–420 ms; English: 390–415 ms) and with similar amplitudes. This indicates that semantic integration in both languages relies on the same neural mechanisms. In the late bilingual group, English anomalies elicited N400 responses with a mean latency approximately 35 ms longer and smaller amplitude (−2.8 μV vs. −4.1 μV) compared to Uzbek.

ERP Measure	Early Bil. (Uzbek)	Early Bil. (Eng)	Late Bil. (Uzbek)	Late Bil. (Eng)
N400 latency (ms)	398 ± 22	405 ± 19	402 ± 25	437 ± 31**
N400 amplitude (μV)	−4.2 ± 0.8	−4.0 ± 0.9	−4.1 ± 0.7	−2.8 ± 1.1**
N400 topography	Centro-parietal	Centro-parietal	Centro-parietal	Extended frontal
P600 latency (ms)	592 ± 44	601 ± 39	608 ± 51	648 ± 58*

*Table 4. ERP component measures for semantic anomaly condition. *p<.05, **p<.01*

The topographic difference in N400 — specifically, the stronger response over frontal electrodes for English anomalies in late bilinguals — is consistent with Perani and Abutalebi's (2005) fMRI data: late L2 processing recruits prefrontal regions more extensively. This additional frontal activation represents the neural signature of the 'extra cognitive effort' involved in lower-proficiency L2 processing.

4.4. Word Association Results

In the word association task, responses produced by participants were classified as paradigmatic, syntagmatic, or clang associations. This classification reveals how lexico-semantic networks are structured across both languages in bilinguals.

In response to Uzbek stimulus words, both bilingual groups showed a high proportion of paradigmatic associations (early: 61%; late: 57%), reflecting the maturity of their Uzbek lexicon. In response to English stimuli, late bilinguals showed a relatively higher proportion of syntagmatic associations (early: 28% vs. late: 41%). This phenomenon — the 'syntagmatic-to-paradigmatic shift' in linguistics — indicates that the L2 lexicon is not yet fully formed, with words stored on the basis of usage context rather than conceptual networks [30].

A particularly interesting finding was the 'cultural lacuna' phenomenon. For concepts that exist in Uzbek but lack lexicalization in English (such as 'gap' — a social gathering for conversation, or 'mahalla' — a neighborhood community), participants showed an absence of or very slow and hesitant English associations. This corroborates De Groot's (1992) conceptual 'feature set' theory: the conceptual representations of culturally specific concepts are not fully replicated in their translation equivalents.

5. Discussion

The results presented above are intimately interrelated and provide grounds for several important theoretical conclusions about the organization of the mental lexicon in Uzbek-English bilinguals. In this section, the findings are interpreted within the framework of existing theoretical models, the influence of Uzbek's typological distinctiveness on lexicon organization is discussed, and the limitations and future directions of the research are identified.

5.1. Interpretation within Theoretical Models

The first and most fundamental question is: which model — the Revised Hierarchical Model (RHM) or the Distributed Feature Model (DFM) — has greater explanatory power for Uzbek-English bilinguals? Rather than yielding a unitary answer, our results demonstrate that the two models are differentially activated depending on the degree of bilingualism. Kroll and Stewart's (1994) RHM offers a more accurate depiction for late bilinguals: L2 words are linked to the conceptual system via L1, resulting in weaker cross-linguistic priming effects and delayed N400 responses. De Groot's (1992) DFM is more applicable to early bilinguals: the semantic networks of both languages are linked at the conceptual level in a direct and symmetric fashion [31].

However, existing models show some inadequacy in accounting for phenomena arising from Uzbek's agglutinative morphology. The reduction in priming effect for morphologically complex Uzbek words — even among early bilinguals — has not been specifically addressed by any existing model. This finding suggests that Uzbek words may be stored in the mental lexicon in a structurally distinct 'stem + morpheme' format, unlike English words. Schreuder and Baayen's (1995) morphological decomposition theory provides a useful framework for explaining this.

5.2. Typological Features of Uzbek and Lexicon Organization

The most original contribution of this study is its demonstration of how the agglutinative structure of Uzbek leaves its mark on the bilingual lexicon. In English, most words exist in the lexicon in relatively isolated form with minimal morphological variation. In Uzbek, a single lexical root may generate hundreds of forms: 'uy', 'uyda', 'uydan', 'uychada', 'uylashtirmoq', 'uylashtirmasdan', and so on. This necessitates a reconsideration of the very concept of the lexical unit in Uzbek.

Our findings demonstrate that Uzbek-English bilinguals exhibit the ability to process Uzbek words by extracting the stem — that is, through morphological decomposition — even among relatively less proficient bilinguals. This is consistent with Taft and Forster's (1975) morphological decomposition hypothesis: morphologically complex words are stored in the lexicon via a list of their component roots, and during access the root is first extracted before lexical access is completed. Uzbek provides far richer material for this type of processing than English.

Furthermore, the difference in word order between Uzbek (SOV: Subject-Object-Verb) and English (SVO: Subject-Verb-Object) generates important differences in syntactic processing. The longer latency of the P600 component for English grammatical anomalies in late bilinguals provides evidence of this: L1 syntactic schemas are being automatically transferred to L2, and resolving this conflict requires additional neural resources.

5.3. Inhibitory Control and Language Switching

Green's (1998) Inhibitory Control Model depicts the mechanism by which the other language is 'switched off' in bilinguals. An interesting phenomenon observed in our word association task — some participants responding in English to an Uzbek stimulus word and immediately noticing and correcting the error — represents the mechanism in action. Such apparent inhibition failures were 2.3 times more frequent in late bilinguals than in early bilinguals ($p < .01$), demonstrating the close relationship between inhibitory control and proficiency.

Particularly noteworthy is the observation that 'gaps' in lexical coverage between Uzbek and English may complicate inhibitory control. Where Uzbek offers precise and nuanced vocabulary for a given concept — for example, 'do'stlash-', 'ulfatlash-', 'ahboblash-', all covered by the single English word 'befriend' — the manner in which bilinguals bridge these gaps remains an important direction for future investigation.

5.4. Neural Organization: Early vs. Late Bilingualism

The topographic difference in N400 — specifically, the more pronounced involvement of frontal regions for L2 in late bilinguals — corroborates at the ERP level Perani and Abutalebi's (2005) conclusion that delayed L2 acquisition demands additional frontal resources. The pedagogical implications of this finding are substantial: it provides neural-level evidence that teaching English to Uzbek children at primary school age is more cognitively efficient.

However, an important nuance must be noted: the stronger frontal activation observed in late bilinguals should not always be interpreted as 'difficulty'. Some researchers (Buchweitz & Prat, 2013) associate this phenomenon with the neural trace of additional metacognitive monitoring and conscious analytical strategy — late bilinguals process L2 with greater 'conscious deliberation', which may be advantageous in complex discursive contexts. In the Uzbek-English context, this hypothesis seems particularly relevant for university students acquiring academic English.

5.5. Limitations

Like any research, this study has a number of methodological limitations. First, as the sample is drawn from institutions of higher education in and around Tashkent, the generalizability of findings to all regions and social strata of Uzbekistan requires caution. The character of second-language bilingualism may differ substantially between rural and urban settings. Second, while ERP offers high temporal precision, its spatial resolution is lower than that of fMRI. Determining with greater precision in which brain regions lexical activation occurs will require supplementary fMRI investigation in future work. Third, participants' vocabulary size and level of general education — as individual difference variables — were not fully controlled in the word association task. These factors should be more rigorously managed as covariates in future studies.

5.6. Future Research Directions

This study opens several new questions and directions. The first and most urgent task is the creation of a psycholinguistic norms database for Uzbek: a large-scale collection of word frequency, imageability, concreteness, and emotional valence norms would form the methodological bedrock for bilingualism research across Uzbekistan, and should ideally be accomplished in collaboration with the Uzbek National Corpus (O'zMK).

A second direction concerns bilingualism across different social contexts: examining differences among those who use English primarily for academic purposes, those working in the IT sector, and those who have returned from living abroad. The structure of the mental lexicon in these groups is likely to differ. A third promising direction is the neuropsychological dissociation of two languages in Uzbek-English bilinguals with aphasia or dyslexia — that is, the extent to which one language is preserved when the other is compromised. This clinically significant research direction has not yet been explored in Uzbekistan.

6. Conclusion

This article has examined the organizational principles and functional mechanisms of the mental lexicon in Uzbek-English bilinguals using a neurolinguistic methodology. The results demonstrate that the degree of bilingualism — that is, the timing and manner of English acquisition — remains the decisive factor in the structure of the mental lexicon. Whereas early bilinguals form an integrated conceptual system shared by the lexicons of both languages, late bilinguals retain a degree of hierarchical asymmetry between the two.

Our findings demonstrate that when Uzbek's agglutinative morphology and SOV syntactic structure encounter the analytic structure of English, distinct 'hybrid' processing strategies emerge at the lexical level. This invites new reflection on the extent to which existing bilingual lexicon models — principally RHM and DFM — can be applied to typologically divergent language pairs.

At the neural level, ERP components (most notably N400 and P600) proved to be sensitive indicators of bilingualism proficiency: early bilinguals showed nearly identical neural signatures for both languages, while late bilinguals recruited additional frontal resources for L2. The practical implication of this finding for education is clear and decisive: introducing English to Uzbek children as early as possible, systematically, and within communicative contexts is neurally justified.

Finally, this study is significant in demonstrating the necessity and feasibility of a neurolinguistic approach within Uzbek linguistics. The cognitive and neurolinguistic methodologies widely developed at the international level are now ready to be applied to the study of Uzbek and its interactions with other languages. Building the bridge between foundational scientific knowledge and practical educational methodology is a challenge that the field of Uzbek linguistics is fully equipped to meet.

REFERENCES

[1] V. I. Dal, *Proverbs, Sayings, Jokes of Russian People: Collection*, in 2 vols. St. Petersburg, Russia: 1997, p. 1712.
[2] E. Ajunwa, "Fidelity challenges in translation," *Translation Journal*, vol. 19, no. 1, Jan. 2015.
[3] G‘. Rahimov, *tarjima nazariyasi va amaliyoti*. Toshkent, O‘zbekiston: O‘zbekiston Milliy Ensiklopediyasi, 2016, p. 176.
[4] G'. Salomov, *Tarjima Nazariyasi Asoslari*. Toshkent, O‘zbekiston: O’qituvchi, 2012, p. 215.
[5] "Phraseological units: Contents," *StudFile*.
[6] P. Newmark, *A Textbook of Translation*. London, UK: Prentice Hall, 1988.
[7] M. Baker, *In Other Words: A Coursebook on Translation*. London, UK: Routledge, 1992.
[8] L. S. Barkhudarov, *Yazyk i perevod: Voprosy obshchey i chastnoy teorii perevoda* [Language and Translation: Questions on General and Particular Theory of Translation]. Moscow, Russia: Mezhdunarodnyye otnosheniya, 1975.
[9] V. N. Komissarov, *Teoriya perevoda: Lingvisticheskiye aspekty*. Moscow, Russia: Vysshaya shkola, 1990.
[10] E. A. Nida, *Toward a Science of Translating*. Leiden, Netherlands: Brill, 1964.
[11] S. Bassnett, *Translation Studies*, 4th ed. London, UK: Routledge, 2014.
[12] Sh. Balli, *frantsuzskaya stilistika*. Moscow, Russia: Izdatelstvo inostrannoy literatury, 1961.
[13] V. V. Vinogradov, *Ob osnovnykh tipakh frazeologicheskikh edinits v russkom yazyke*. Moscow, Russia: Nauka, 1977.
[14] A. V. Kunin, *Kurs frazeologii sovremennogo angliyskogo yazyka*. Moscow, Russia: Vysshaya shkola, 1996.
[15] J. Munday, *Introducing Translation Studies: Theories and Applications*, 4th ed. London, UK: Routledge, 2016.