COGNITIVE PROCESSING OF LINGUISTIC RESOURCES IN TRANSLAGUAGING: A PSYCHOLINGUISTIC EXPLORATION IN PAKISTANI CONTEXT

BY

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Candidate of **Doctor of Philosophy** at the National University of Modern Languages do hereby declare that the thesis **Cognitive Processing of Linguistic Resources in Translanguaging: A Psycholinguistic Exploration in Pakistani Context** submitted by me in partial fulfillment of PhD degree, is my original work, and has not been submitted or published earlier. I also solemnly declare that it shall not, in future, be submitted by me for obtaining any other degree from this or any other university or institution.

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ABSTRACT

Title: Cognitive Processing of Linguistic Resources in Translanguaging: A Psycholinguistic Exploration in Pakistani Context

The use of translanguaging practices is a natural consequence of multilingualism. When individuals are proficient in multiple languages, they tend to draw on all of their linguistic resources to communicate their thoughts and ideas effectively. This study examines how Punjabi-Urdu-English trilingual speakers in Pakistan cognitively process multiple languages during comprehension and production. Informed by the theoretical lens of translanguaging and the Multilink model, this study examines the structural composition and cognitive mechanisms underlying the trilingual mental lexicon. The study sample consisted of 105 undergraduate students who were proficient in Punjabi, Urdu, and English. The participants were recruited through a stratified sampling technique. The study employs a mixed-methods design integrating psycholinguistic experiments (the picture-naming task, the Stroop task, and the translation-elicitation task) with qualitative insights from a language background questionnaire, interpretation of experimental tasks, and analysis of errors. The results reveal a unitary linguistic repertoire, with simultaneous activation of multiple language systems resulting in both facilitation and interference effects. The study's findings also highlight the interconnectedness of languages in the minds of trilingual speakers, as activation of one language influences the processing of another either as facilitation or interference. These results highlight the dynamic interconnectedness of linguistic resources in trilinguals, offering implications for language teaching and cognitive linguistics. The study recommends recognising translanguaging as a legitimate practice in Pakistan's language-in-education policies and integrating indigenous languages alongside Urdu and English. By focusing on cross-script language processing in a previously under-researched context, this study contributes original insights to psycholinguistics and multilingual education.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANOVA:	Analysis of variance
BIA:	Bilingual Interactive Activation Model
BIA+:	Bilingual Interactive Activation Model Plus
BIA-d:	Developmental Bilingual Interactive Activation Model
BIMOLA:	Bilingual Interactive Model of Lexical Access
DCFM:	Distributed Conceptual Feature Model
DMM:	Dynamic Model of Multilingualism
EFL:	English as a Foreign Language
ERPs:	Event-related potentials
fMRI:	Functional Magnetic Resonance Imaging
IC Model:	Inhibitory Control Model
L1:	native language/first language/mother tongue
L2:	Second language
L3:	Third language
LDL:	Less dominant language
LexTALE:	Lexical Test for Advanced Learners of English
MANOVA:	Multivariate analysis of variance
MDL:	More dominant language
MHM:	Modified Hierarchical Model
MIA Model:	Multilingual Interactive Activation Model
MPM:	Multilingual Processing Model
RHM:	Revised Hierarchical Model

R-RHM: Re-Revised Hierarchical Model

RSVP: Rapid serial visual presentation

SAM: Shared (distributed) Asymmetrical Model

SOPHIA: Semantic, Orthographic, Phonological, and Interactive Activation Model

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DEDICATION

To

My Parents,

whose prayers guided and encouraged me;

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whose unwavering support made it possible;

and

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who patiently waited for long hours and accompanied me while I worked on this project.

CHAPTER 1

INTRODUCTION

Meaning-making process lies at the heart of communication practices. All communication practices, whether verbal or nonverbal, linguistic or non-linguistic, convey a message using available resources. Meaning-making refers to the process through which interlocutors make sense of situations, interpret meaning, and extract messages. It encompasses all possible linguistic and non-linguistic resources for effective communication. Linguistic resources refer to the use of all possible languages of interlocutors that they can employ to communicate. In contrast, non-linguistic resources include paralinguistic features, pictures, models, charts, or other means or objects in the environment that can add or convey meaning to speakers.

Translanguaging, a common feature of multilingual communication, involves drawing on an integrated linguistic repertoire to co-construct meaning across languages. Translanguaging is central to bilingual, trilingual, or multilingual societies as it is the natural outcome of multiple linguistic systems (Garcia, 2019). The general perception of translanguaging is that multilingual or bilingual speakers switch between languages. As a theory, translanguaging operates beyond the level of languages, which can help the interlocutors understand and convey the desired message, also known as the creation of a third space. Translanguaging regards languages as part of a more extensive repertoire that can be used for meaning-making. It does not consider a language a discrete or separate entity; instead, the knowledge of all languages is viewed as an integrated system generated from the competence of various languages, all of which can be negotiated during communication for meaning-making.

In recent years, translanguaging has gained attention as a way to understand and support multilingualism in education. Translanguaging refers to the dynamic language practices in which tri-/multilingual individuals use their linguistic resources to communicate and make meaning. The Multilink model, developed by Dijkstra et al. (2018), is a theoretical framework that builds on the concept of translanguaging (Wei, 2018) and emphasizes the importance of understanding language as a complex system of links between different linguistic resources. This thesis aims to assess the potential of the multilink model as a framework for supporting translanguaging practices in trilingual settings, focusing on how speakers organise and use their languages effectively in the Pakistani context.

Translanguaging focuses on the repertoire building of learners (Canagarajah, 2011) regardless of the number of languages that the learners speak. Pakistan is linguistically a diverse state (Rahman, 2006). A child is exposed to multiple languages at a very young age, including indigenous language(s), Urdu, and English. Code mixing is the natural consequence of multilingualism. Multilingualism considers learning additional languages an impediment and hindrance to learners, whereas translanguaging considers it an asset for learners. Additionally, translanguaging is not limited to switching between languages. Instead, it transforms the perception of discourse patterns, focusing on drawing on multiple resources for meaning-making (Wei & Lin, 2019).

Translanguaging from the perspective of bilingual, trilingual, and multilingual participants has been widely examined in the past two decades to highlight the pedagogical and ideological perspective of Language Planning and Policy (Hornberger, & Link, 2012; Jonsson, 2012; García, et al., 2011; Creese & Blackledge, 2015; Gynne, 2016; Lewis et al., 2012; De Los Reyes, 2018; Yuvayapan, 2019; Prada, 2019; Velasco & Garcia, 2014; Torpsten, 2018; Escobar, 2019). In translanguaging, individuals hold a central position in contrast to bilingualism or multilingualism, where languages are of vital significance (Lin, 2019). So, the focus shifts from the number of languages to how individuals process and interpret various resources (Conteh, 2018). The current study aims to empirically assess the fundamental principle of translanguaging: the existence of a unitary linguistic repertoire and the (non)selectivity of cognitive processing of linguistic resources, employing and evaluating psycholinguistic tests. A unitary linguistic repertoire is a single mental lexicon storing all linguistic information regarding all speakers' languages. In addition, these linguistic resources are activated in parallel, a psycholinguistic phenomenon known as non-selectivity. Non-selectivity refers to the activation of various languages of bi-/tri-/multilinguals that compete to be selected according to the decision task of the speaker.

In order to analyse the nature of the lexical organisation, access, and processing, two types of variables play a fundamental role: first, the language speakers and the features of the language itself. The first variable pertains to the language speakers, including features such as level of language proficiency in the non-native language, experience, context of use, extent of use, and learning environment of the foreign language. The second category of variables is related to language, such as types of words, cognates, homophones, interlingual homographs, dominant and non-dominant languages, similarity among the languages at the phonological, orthographic, and semantic level, frequency of words, concreteness, and the like.

Psycholinguistic studies have attempted to provide evidence for (non)selectivity, mostly in bilingual speakers, and a few studies have examined trilingual speakers. These languages tended to be orthographically similar, such as English-French, Dutch-English, English-Spanish, and English-German, except for Chinese-English and Hindi-English. In contrast, the current research focuses on one of the indigenous languages of Pakistan, along with English and Urdu, which do not share orthographic similarities.

1.1 Background of the Study

Multilingualism is a widespread phenomenon worldwide (Wei, 2013), yet traditional language education models often rely on monolingual assumptions that overlook the complex realities of bi-, tri-, and multilingual individuals. In response, translanguaging has emerged as a framework that acknowledges the fluid and dynamic use of multiple languages. Rather than viewing languages as separate systems, translanguaging recognises the multilingual individual's ability to draw on an integrated repertoire to communicate and construct meaning across contexts.

Complementing this sociolinguistic perspective, the Multilink Model (Dijkstra et al., 2018) provides a psycholinguistic framework for understanding how multiple languages are stored and accessed in the mind. It suggests that different languages are linked through shared conceptual and lexical networks, and that activation in one language can influence processing in another. This model challenges the notion of isolated language systems, often referred to as dual correspondence theory, by proposing a dynamic, interconnected structure that aligns with translanguaging principles.

Several psycholinguistic studies have attempted to examine bilingual and trilingual lexical organisation, focusing on language pairs with shared orthographic systems such as French-English (Jared & Kroll, 2010), English-Spanish (Sunderman & Kroll, 2006), Dutch-English (Van Assche et al., 2013), German-Dutch-English (Poarch & Van Hell, 2014), German-English-French (Tytus, 2018), and Portuguese-German-English (Toassi, 2016). Others have examined cross-script combinations, such as Chinese-English (Hu & Zhang, 2023), Hindi-English (Mishra & Singh, 2013), and Urdu-English (Khan, 2012). While these studies provide valuable insights into cognitive processing across languages, they largely neglect indigenous language constellations, particularly within the Pakistani context.

Only a few studies, such as Khan (2012) on Urdu-English bilinguals and Gill (2013) on lexical organisation through a phenomenological lens, have focused on participants using languages spoken in Pakistan. However, comprehensive psycholinguistic studies on trilingual speakers using local language combinations such as Punjabi, Urdu, and English remain scarce.

This research addresses that gap by examining lexical access and organisation in Pakistani trilingual speakers through the integrated lenses of translanguaging and the Multilink model. By exploring how these speakers navigate, retrieve, and utilize linguistic resources in comprehension and production tasks, the study aims to contribute to a deeper understanding of the cognitive and linguistic processes underlying multilingual language use.

Combining both frameworks allows the study to examine how conceptual and lexical networks function across languages and how this interaction influences lexical processing, retrieval, and comprehension. Understanding these processes is essential not only for expanding theoretical knowledge in bilingualism and multilingualism but also for informing pedagogical strategies in multilingual classrooms. Ultimately, the study aims to deepen the examination of language processing in trilingual contexts that involve indigenous languages, promote translanguaging practices, and examine models, such as the Multilink, to reflect the complexities of global and local multilingualism.

1.2 Statement of the Problem

Multilingualism, more specifically trilingualism, has become increasingly prevalent in many societies as the world becomes increasingly interconnected. However, traditional approaches to language education have often been based on monolingual teaching methodologies that do not accurately reflect the complex linguistic practices of tri- or multilingual individuals. Multilingual speakers' use of available linguistic resources at their will and ease requires the activation, access, and retrieval of multiple cognitive mechanisms for effective communication. It is amenable to several intricate cognitive processes that stipulate how varied linguistic resources interact**,** thus permitting individuals to utilise their linguistic resources at their will without interference. Translanguaging has emerged in recent years as a way to understand and support multilingualism in education. It involves multilingual individuals utilizing all their available linguistic resources to communicate and construct meaning. This research analyses how linguistic resources are organised and accessed in the mental lexicon of trilingual speakers. It aims to examine whether trilinguals have a common repertoire or separate stores for each language and if they display (non)selectivity and cross-language competition when selecting linguistic resources. It analyses the relationship between linguistic variables and participant features. These factors guide this study in understanding the nature of lexical organisation and access in trilingual speakers. This study utilises translanguaging and the multilink model as a framework for exploring language processing in trilinguals, focusing on how trilingual Pakistani speakers with a Punjabi-Urdu-English language combination organise, access, and retrieve their linguistic resources. The study employs three psycholinguistic tasks, namely, the picture-naming task, the Stroop task, and the translation-elicitation task, to address this issue.

1.3 Research Objectives

The primary objective of the present research is:

1. to examine the organisation of mental lexicon in Pakistani trilingual speakers (Punjabi-Urdu-English)

The secondary objectives of this research are:

1. to ascertain the (non)selectivity of language processing and interference for trilingual mental lexicon.
2. to analyse the mediating role of interference between (non)selectivity of language processing and mental lexicon.

1.4 Research Hypotheses

1.4.1 Primary Hypothesis

1. There is a unitary linguistic repertoire, which includes the linguistic resources from the three languages of the trilinguals.

1.4.2 Secondary Hypotheses

1. In the trilingual mental lexicon, there is simultaneous activation of linguistic systems, creating a repertoire in the mental lexicon of speakers.
2. There is competition amongst various linguistic resources for selection, and speakers select a language according to the task.
3. There is facilitation/interference among various linguistic resources in the mental lexicon.

1.5 Theoretical Framework

The theoretical orientation for this study draws on translanguaging (Wei, 2018) and the Multilink Model (Dijkstra et al., 2018). The fundamental assumption of translanguaging is the existence of a unitary linguistic repertoire in which all speakers' languages are simultaneously activated. This approach involves using one's unique way of speaking, or idiolect, without being constrained by social or personal factors such as social class, geography, gender, or age. The term "linguistic repertoire" refers to all the verbal and cognitive tools available to individuals to create and understand meaning and is seen as a process rather than a static entity. Translanguaging is a dynamic process that integrates the use of different languages, dialects, and other knowledge systems to generate meaning and is not limited to simply switching between languages or using a language that learners can understand. It involves the entire linguistic repertoire of speakers to transform the communication process.

Translanguaging as a theoretical framework emphasises the dynamic and fluid nature of language use. It acknowledges that individuals draw on their linguistic repertoire to communicate and make meaning rather than treating their languages as separate and discrete entities. Translanguaging recognises that languages are not fixed or static systems but dynamic processes shaped by social, cultural, and historical contexts. This means that individuals can use multiple languages simultaneously or switch between languages depending on the context and purpose of communication.

As a theoretical framework, the Multilink model posits five fundamental assumptions as compared to earlier models of language organisation and processing, which include an integrated lexicon, non-selective lexical access, translation is done through semantic mediation instead of word association, a stronger connection between second language lexical items and their meanings, holistic semantic features, and a lack of a bottom-up approach. It supports that different languages are interconnected and influence each other in various ways during language processing. It proposes that the different languages a multilingual speaker knows are linked in their mind and that activating one language can also activate other languages. The multilink model posits that the connections between languages are not fixed or static, but rather dynamic and flexible, depending on the context and the speaker's language use.

The Multilink model consists of language networks, where each network is composed of nodes representing words or concepts in that language, and the connections between nodes represent the strength of the associations between them. When a bilingual, trilingual, or multilingual speaker encounters a stimulus, either a word or a sentence, all language networks become activated simultaneously. The activation spreads through each network, and the magnitude of activation is contingent on the strength of the connections between nodes. In addition, connections between the two networks represent the degree of similarity between the two or more languages of speakers. One essential feature of Multilink is that it incorporates language proficiency into the model. Specifically, the strength of connections within and between the two networks depends on an individual's proficiency in each language. This means that individuals with higher proficiency in a given language will have stronger connections within that language network and weaker connections between the two networks. Multilink has been used to explain various phenomena related to bilingual language processing, such as code-switching, lexical access, and semantic processing. The model has also been used to analyse the impact of language proficiency, age of acquiring a language, experience of language use, and other factors on bilingual language processing. The Multilink model provides a valuable framework for understanding how bilingual or multilingual individuals process language and how various factors influence this process.

Both translanguaging and the multilink model recognise tri-/multilingual language use and processing complexity. They acknowledge that multilingual speakers do not simply switch between languages but instead employ their linguistic repertoire to communicate and make meaning. They also recognise that multilingual language processing is not a linear or sequential process but a dynamic and interactive process involving constant negotiation and adaptation. These frameworks offer a more nuanced understanding of trilingual language use and processing. They highlight the importance of recognising language use's dynamic and fluid nature and the interconnectedness of different languages in the trilingual mind.

1.6 Research Methodology

The research design of the current research is a mixed-method research design. The data is collected through a language background questionnaire and three psycholinguistic experiments: the picture-naming task, the Stroop task, and the translation-elicitation task. The language background questionnaire collects information about participants' languages, their subjective language proficiency, experience with each language, and patterns of language use. The objective language proficiency is determined through LexTALE (Lemhofer & Broersma, 2012). It is an online test designed to assess the objective language proficiency of participants in English, Dutch, and German in second-language contexts, suitable for use in psycholinguistic tasks.

The psycholinguistic tasks have been selected to examine various aspects of trilingual language processing and to provide insights into the cognitive mechanisms underlying language use in trilingual individuals. The stimuli for experiments consisted of images, linguistic items in isolation, and linguistic items in a sentential context. The images consist of triple cognates, double cognates, and unrelated words. The linguistic and visual stimuli were presented through DMDX (Forster & Forster, 2003). DMDX is open-source software that presents linguistic and visual stimuli. The response times of participants were recorded. The analysis of responses provides information about error rates and types of errors. The qualitative analysis of the language background questionnaire and participants' responses and the quantitative analysis of response times are combined to assess the effect of English language proficiency, status of lexical items whether cognates or non-cognates, lexical frequency for instance high or low frequency lexical item on the lexical processing in particular the response time, error rate and types of errors to validate the study hypotheses.

1.7 Data Analysis

The data from the language background questionnaire and psycholinguistic tasks are analysed to examine trilingual language processing comprehensively. The data is analysed quantitatively using descriptive and inferential statistics, such as correlation analysis, regression analysis, ANOVA, *t*-test, and MANOVA, and qualitatively by assessing the accuracy of responses to examine the study hypotheses.

1.8 Delimitation of the Study

Considering the time constraints and the scope of this research, the study is delimited to a selected sample of 105 undergraduate students from three departments of the National University of Modern Languages. 35 BS students are selected from each of the following departments: 35 BS English students from the Faculty of Arts and Humanities, 35 BBA students from the Faculty of Management Sciences, and 35 students from the Faculty of Engineering and Computing. The selected sample consisted of trilingual speakers who spoke Punjabi-Urdu-English to ensure primary stimuli selection and data collection.

1.9 Significance and Rationale of the Study

This study holds significant value for both theoretical and empirical advancements in the fields of psycholinguistics, multilingualism, and translanguaging, particularly within the under-researched Pakistani trilingual context, which involves Punjabi (L1), Urdu (L2), and English (L3). While much of the existing psycholinguistic research on bilingual and multilingual lexical processing has predominantly focused on Western language pairings and contexts, the current study addresses the need for contextually grounded psycholinguistic research in South Asian multilingual settings. It provides empirical evidence from a unique linguistic configuration, thus extending the generalisability of established psycholinguistic models, such as the Multilink Model (Dijkstra et al., 2019), to non-Western, typologically distinct language combinations.

The study's significance lies in its focus on the cognitive mechanisms underlying translanguaging practices in trilingual speakers. This area remains underexplored in psycholinguistics despite its growing relevance in sociolinguistic and educational contexts. By employing three established psycholinguistic tasks (the picture-naming task, the Stroop task, and the translation-elicitation task), the study offers a nuanced examination of lexical access, cross-linguistic activation, competition, facilitation, and interference within a trilingual mental lexicon. These findings contribute to a more comprehensive understanding of how multilingual speakers cognitively manage their linguistic resources during language processing, supporting the view of an integrated, dynamic, and fluid mental lexicon as proposed by contemporary models of bilingual and multilingual processing.

Furthermore, this research addresses a critical gap in the literature regarding the cognitive dimensions of translanguaging, a phenomenon that is often examined primarily through qualitative or pedagogical lenses. By bringing experimental evidence to bear on cognitive processes in translanguaging, the study bridges the gap between psycholinguistics and applied linguistics, offering insights that are both theoretically meaningful and practically relevant. The findings have implications for language policy, pedagogy, and assessment in multilingual societies, such as Pakistan, where speakers routinely draw on complex linguistic repertoires in both formal and informal contexts. Overall, this research makes a significant contribution to a more nuanced understanding of multilingualism and language processing, which has important implications for individuals, communities, and society.

1.9.1 Social Relevance of the Study

The current research aims to empirically investigate the existence of a unitary mental lexicon through psycholinguistic tests, specifically examining the formation of a single linguistic resource that facilitates meaning-making for individuals. Earlier researchers have focused on language pairs that share similar orthography and phonology; thus, cognates were used as an essential identification or interference device, except for a few studies that involved orthographically dissimilar language sets, such as English-Hindi, Arabic-English-Hebrew, and Chinese-English. Regarding linguistic diversity, as observed in Pakistan, speakers acquire one or two indigenous languages and Urdu almost simultaneously. Afterwards, they learn English for academic purposes. These languages have varied phonological and orthographic patterns. Due to distinctive writing scripts, English, Urdu, and major indigenous languages such as Punjabi, Sindhi, Pashto, and Balochi do not share orthographical cognates. Thus, it presents an optimal opportunity to examine the (non-)selectivity of language processing and interference in the translingual mental lexicon among university students in Pakistan.

1.9.2 Prospects of the Study for Community Development

The present study intends to sensitise translingual speakers to the strengths of their languages. Whereas multilingualism considers the existence and use of multiple language systems a hindrance or impediment in acquiring a proficient second language, translingualism regards the use of all the linguistic resources of speakers as a strength. The indigenous languages of Pakistan hold equal significance. This study aims to contribute to reducing linguistic ethnocentrism among students from diverse linguistic backgrounds. Language is an expression of thought, not a barrier, and no language is superior to another. Every language has its significance. Speakers' ability to use their linguistic resources is a cognitively demanding task. A speaker's ability to use multiple linguistic resources for meaning-making should be considered a unique talent. This study also hopes to acknowledge and appreciate the richness of linguistic diversity available in Pakistan.

1.9.3 Prospective Marketability of this Study

This research is of immense significance to universities and institutes offering language courses, including NUML. It intends to make people realise the importance of their linguistic repertoire. The study also highlights that each language in a person's repertoire holds equal significance in that person's linguistic performance. In this way, the study aims to bring marginalised languages to linguistic research.

1.10 Major Concepts Involved in the Study

1.10.1 Linguistic Repertoire

In the context of multilingual language processing, linguistic resources are operationally defined as the dynamic repertoire of lexical, morphological, syntactic, semantic, pragmatic, and phonological/orthographic elements that speakers flexibly draw upon across their languages. Within a translanguaging perspective, these resources are not confined to discrete linguistic systems but are mobilized holistically as an integrated repertoire (Wei, 2018; Vogel & García, 2017). They manifest in measurable forms such as vocabulary breadth, morphological variation, syntactic fluidity, semantic equivalence, pragmatic markers, and orthographic or phonological transfer. Operationally, they can be captured through indices such as type–token ratios, code-switching or code-mixing frequencies, syntactic and discourse complexity, and accuracy in cross-linguistic comprehension or production tasks.

From a processing standpoint, translanguaging highlights the observable strategies through which multilinguals access, coordinate, and integrate these resources in real-time. Experimental measures such as reaction times, error rates, eye-tracking, and electrophysiological responses provide quantifiable evidence of how linguistic resources are simultaneously activated across languages during comprehension and production. Likewise, discourse-analytic approaches highlight how pragmatic and semantic resources are strategically deployed in interaction to achieve communicative goals. Thus, when examined through translanguaging, linguistic resources are operationalized not as isolated competencies within separate linguistic codes but as measurable variables reflecting the fluid and adaptive mobilization of an integrated multilingual repertoire (García & Li, 2014).

1.10.2 Mental Lexicon

The mental lexicon may be defined as the representation of lexical items and their meanings in the minds of speakers. It is a crucial component of language processing and is constantly being updated and expanded throughout one's lifetime. The mental lexicon is organised hierarchically, with more frequently used words being stored at a higher activation level than less frequently used words. Research has shown that various factors, including age, language proficiency, and cultural background, influence the mental lexicon. The mental lexicon stores information related to all linguistic aspects, including phonology, morphology, syntax, and semantics. Words that share similar meanings or sounds are thought to be stored in proximity to one another, allowing for efficient retrieval and processing.

The mental lexicon is a cognitive construct representing an individual's internalised knowledge and understanding of words and their meanings. The mental lexicon is defined as the human word-store (Aitchison, 2012). It is considered a mental dictionary or database that stores information about words in a person's mind (Levelt, 1989). The mental lexicon performs a critical role in language processing and communication processes and is an active research area in linguistics. The mental lexicon is not just a static storage of information; it is also dynamic and interconnected, in which words are constantly added (Aitchison, 2012). It enables the retrieval and processing of words in real-time during language comprehension and production. When speakers encounter a word, the mental lexicon is activated, and speakers retrieve relevant information to understand its meaning and use it appropriately in context. The mental lexicon continuously expands and evolves as we acquire new words. Moreover, the lexical items that are not used gradually become inaccessible. Various factors influence it, including language exposure, vocabulary development, and individual experiences.

1.10.3 Unitary Repertoire

The concept of unitary repertoire has been widely used in the language teaching domain and psycholinguistic studies. In the last two decades, language teaching scholarships have placed immense significance on the repertoire building of pupils in language learning situations, owing to the invaluable importance attached to the unitary repertoire, which includes cognitive benefits (Garcia, 2019). The unitary repertoire is a single store where all speakers' languages are stored (Szubko-Sitarek, 2015). The concept of a unitary repertoire has been debated and investigated in psycholinguistics. Some studies have supported the idea of a single linguistic store, whereas others suggested separate stores corresponding to each language of speakers.

One line of research (Dijkstra et al., 1999; Chambers & Cook, 2009) has examined the processing of homophones, focusing on how bilingual and trilingual/multilingual speakers process lexical items that have similar pronunciations but different spellings and meanings. Studies have found that context and individual differences influence the processing of homophones, suggesting that there may be multiple representations of these words in the mental lexicon. Another domain of analysis for investigating the nature of lexical processing is the use of cognates and unrelated words (Dijkstra et al., 2010). Since cognates share similar phonetic, semantic, and orthographic representations, the analysis of lexical similarity, such as cognates and unrelated words across various languages, may provide insights into the nature of lexical organisation. Other studies have investigated the processing of irregular verbs, which do not follow regular patterns of inflexion. Some researchers have argued that irregular verbs are stored as whole units in the mental lexicon, while others have suggested that they are generated through rule-based processes. A unitary repertoire has essential implications for understanding language processing and acquisition. While some evidence supports the idea of a single representation for linguistic items, it is clear that there is also variability and flexibility in how we access and use language.

1.10.4 Multilingualism

In psycholinguistic studies, multilingualism generally refers to speakers who can use three or more languages (De Angelis, 2007; Cenoz, 2008). This distinction is essential as it distinguishes multilinguals from monolinguals and bilinguals. Multilingual speakers differ from bilingual speakers concerning the organisation of languages stored in the mental dictionary, as the interconnection of linguistic levels makes it more complex for three or more languages than for only one or two languages. In addition, L2 and L3 are not merely numbers of languages attributed to languages in the order of acquisition, but rather the number corresponds to the level of proficiency, thus adhering to the formula, the lower the number, the higher the proficiency of speakers (Szubko-Sitarek, 2015).

Multilingualism refers to the aptitude of speakers who are capable of speaking and understanding multiple languages. It is a general linguistic practice in many parts of the world where individuals are exposed to many languages. Multilingual individuals can have varying degrees of proficiency in each language. There are numerous benefits to being multilingual. It can enhance cognitive abilities, such as problem-solving skills and creativity. It also provides individuals with broader cultural and social perspectives, as they can communicate with people from different linguistic backgrounds. Additionally, being multilingual can open up more opportunities for education, work, and travel.

Multilingualism can be acquired through various means, including formal education, immersion programs, community language exposure, and personal motivation to learn new languages. It is worth noting that multilingualism is a dynamic process, and language proficiency can evolve in response to factors such as language use and exposure. Overall, being multilingual is a valuable asset that enables individuals to engage with diverse cultures and communities in a globalized world.

1.10.5 Selectivity/Non-selectivity

In language processing, selectivity refers to attending to relevant information while ignoring irrelevant information. This means that when processing language, speakers can focus on the most critical aspects of the input while filtering out distractions or noise. Conversely, non-selectivity is the opposite scenario, where all information is processed equally without filtering or prioritisation. The concepts of selectivity or non-selectivity pertain to the activation of linguistic resources. Selectivity refers to the activation of language demanded by the task, which means bilingual or tri-/multilingual speakers can access the desired language selectively. On the other hand, non-selectivity refers to the activation of all linguistic resources regardless of the task requirement (Szubko-Sitarek,2015; Toassi, 2016). All linguistic resources get simultaneously activated, and speakers choose according to the task's requirements.

1.10.6 Cognates / Non-cognates

In psycholinguistic studies, the term cognate is loosely applied to lexical items with similar forms and meanings across various languages (Dijkstra et al., 2010). In other words, cognates and non-cognates are terms used in linguistics to describe words that share similarities or differences across different languages. Cognates are words that may have a common origin or have been made through language contact and have similar meanings in different languages. In orthographically dissimilar languages, cognates often share similar semantic and phonological representations, which have become a part of the language through language contact situations, such as borrowing due to cultural contact and technological development (Kim & Davies, 2003). Conversely, non-cognates are lexical items that do not share a common origin and have different meanings in different languages. They may have different spellings or pronunciations. Cognates may prove facilitative for language learners because these lexical items provide a connection between languages and make it convenient for learners to recognise and comprehend new words. Non-cognates may require more effort to learn and remember since they lack apparent similarities. It is essential to point out that not all words in different languages are cognates or non-cognates. Language evolution and borrowing can lead to changes in word forms and meanings over time, making it necessary to study the historical relationships between languages to determine cognate relationships accurately.

In the scenario of language processing in trilingual participants, triple cognates and double cognates are employed to explore the nature of the lexical organisation, access, and retrieval. Triple cognates refer to lexical items that share identical meaning and form across three languages of speakers, and double cognates refer to lexical items that intersect in meaning as well as form across two languages of speakers (Tytus, 2018). In contrast to triple cognates and double cognates, control words are used. Control words refer to lexical items that have dissimilar corresponding lexical items.

1.10.7 Congruent / Incongruent Trials

Congruent and incongruent trials in the Stroop task refer to different types of stimuli used to test cognitive processing and inhibition. The ink colour corresponds to the name of the word being presented in congruent trials. For instance, if the lexical item "red" is presented in red ink, it is an instance of a congruent trial. In incongruent trials, the ink colour does not correspond to the name of the word being presented (Marian et al., 2013). For example, if the word "blue" is presented in red ink, this is an example of an incongruent trial. The Stroop task is typically used to measure cognitive control and inhibition, as participants need to respond to the ink's colour while ignoring the word's meaning. Other variants of congruent and incongruent trials include the picture-word interference paradigm. In the current study, the colour-word interference paradigm is used. Researchers can gain insight into individuals' cognitive processing and inhibition abilities by comparing accuracy and response times on both congruent and incongruent trials.

1.10.8 Cognate Facilitation Effect

The cognate facilitation effect means there is a facilitatory effect when cognate words are processed. As stated earlier, cognates share similar forms and meanings across various languages and are processed more rapidly and precisely than non-cognate lexical items in bilingual, trilingual, or multilingual individuals. It is observed in word recognition, lexical decision, and language production tasks. When bilingual speakers encounter a cognate word, the shared form and meaning activate both the target and non-target languages. This activation creates a processing advantage, as the bilingual's knowledge of both languages aids in recognising and accessing the word's meaning more efficiently (Dijkstra et al., 2010). This facilitation effect is ascribed to the mutual connection between the corresponding lexical items of the two languages. The cognate facilitation effect is evidence of the interconnected nature of multiple languages. The influence of cross-linguistic interactions is displayed during processing in the form of facilitation. It highlights the advantages bilingual or tri-/multilingual individuals have in accessing and processing words that share similarities across their languages.

1.10.9 Cross-Linguistic Interference

Cross-linguistic interference, also known as linguistic interference or language interference, refers to the effect of one language on the comprehension or production of another language in bilingual or tri-/multilingual individuals (Szubko-Sitarek, 2015). It occurs when elements from one language unintentionally affect the use or understanding of another language. Linguistic interference can manifest in various ways. For example, interference can occur at the phonological level, where the phonetic patterns in one language influence the phonetic patterns of another language. It can also occur at the grammatical level, where one language's sentence structure or word order is applied to another. Vocabulary interference is another common form of linguistic interference. Bilingual individuals may unintentionally use words from one language while speaking or writing in another. This can result in code-switching, where individuals alternate between languages within a conversation. Linguistic interference is often more prevalent when bilingual individuals are less proficient in one of their languages or in a context where one language dominates. It is often influenced by language similarity, frequency of language use, and language proficiency. While linguistic interference can sometimes lead to communication challenges or errors, it is a natural and common occurrence in bilingual and tri-/multilingual individuals. With increased language proficiency and exposure, individuals can develop strategies to minimise interference and enhance their ability to separate and control the use of different languages.

1.10.10 Simultaneous Activation

Simultaneous activation refers to the process by which bilingual individuals simultaneously activate and process multiple languages in the brain. When a bilingual person encounters a lexical item or sentence in a specific language, both languages are activated and compete for processing resources (Tytus, 2018). Simultaneous activation occurs because a bilingual speaker's two languages are activated simultaneously and share common neural pathways in the brain. When one language is used, this activation spreads to related words and concepts in the other language, even if the individual is not consciously aware of it. This process can facilitate or interfere, contingent on the context and the individual's language proficiency. For example, if a bilingual person is more proficient in one language than the other, they may experience interference when processing the less proficient language. However, if both languages are equally proficient, simultaneous activation can lead to facilitation effects, where using one language can enhance processing in the other language. Simultaneous activation of various languages is central to bilingual and tri-/multilingual language processing as it highlights the dynamic and intricate nature of language use and processing in tri-/multilingual contexts.

1.11 Organization of the Study

This section outlines a preliminary design of significant parts to facilitate a systematic progression of the study. The current study is structured into six major sections, each corresponding to a chapter. Chapter 1 provides a brief introduction to the study, the background of the study (1.1), statement of the problem (1.2), research objectives of the study (1.3), research hypotheses (1.4), theoretical framework (1.5), research methodology (1.6), data analysis (1.7), delimitation of the study (1.8), rationale and significance of the study (1.9), and chapter breakdown (1.10)

Chapter 2 presents relevant literature for the current study. This chapter covers the following major topics: translanguaging (2.1); translanguaging vs. bi/multilingualism (2.2); 2.3 translanguaging and mental lexicon: repertoire building (2.3); background of models of lexical representation and processing (2.4); hierarchical models of bilingual representation and processing (2.4.1), computational models of bilingual language representation and processing (2.4.2); distributed models (2.4.2.1); localist models (2.4.2.2); models of multilingual lexical representation and processing (2.4.3); multilingual interactive activation model (2.4.3.1); multilingual processing model (2.4.3.2); Dynamic model of multilingualism (2.4.3.3); the Multilink model (2.4.3.4); evidence for selectivity of language processing (2.5); evidence for non-selectivity of language processing (2.6); evidence for non-selectivity in bilingual studies (2.6.1); studies supporting BIA and BIA+ (2.6.1.1); studies supporting Multilink (2.6.1.2); evidence for non-selectivity in multilingual studies (2.6.2); lexical processing and access in sentential context (2.7); factors influencing lexical processing and access (2.8); lexical processing and access in Pakistani context (2.9); research gap (2.10); and section summary (2.11).

Chapter 3 presents and discusses the research methodology employed for the current study. The sub-section in chapter 3 is structured as follows: theoretical frameworks (3.1); research design (3.2); preparation and presentation of linguistic and visual stimuli, psycholinguistic software, approaches for establishing cognate status (3.3); research participants (3.4); sampling of participants (3.5); ethical considerations (3.6); data collection tools (3.7); qualitative data collection tool (3.7.1); participant language background questionnaire (3.7.1.1); analysis of errors (3.7.1.2); quantitative data collection tools (3.7.2); language proficiency test (3.7.2.1); psycholinguistic experiments (3.7.2.2); Experiments (3.8); experiment 1-the picture-naming task (3.8.1); experiment 2-the Stroop task (3.8.2); experiment 3-the translation-elicitation task in sentential context (3.8.3); procedure (3.9); section summary (3.10).

In chapter 4, the data collected from undergraduate participants through qualitative analysis of language background questionnaire and participants' responses (4.1); information regarding acquiring/learning of Punjab I, Urdu and English (4.1.1); self-estimated proficiency of English Urdu and Punjabi (4.1.2); frequency of use of English, Urdu and Punjabi (4.1.3); ways of contact with English, Urdu and Punjabi (4.1.4); qualitative analysis of responses (4.1.5); language proficiency test (4.2); descriptive statistics and psychometric properties (4.3); descriptive statistics and psychometric properties of the picture-naming task (4.3.1); descriptive statistics and psychometric properties of the Stroop task (4.3.2); descriptive statistics and psychometric properties of the translation-elicitation task (4.3.3); relationship between study variables (4.4); statistical analysis of interaction of language background questionnaire and experimental data (4.6); regression analysis (4.6.1); predictors of triple cognates in the picture-naming task (4.6.1.1); predictors of double cognates in the picture-naming task (4.6.1.2); predictors of unrelated words in the picture-naming task (4.6.1.3); predictors of congruent trials in the Stroop task in English (4.6.1.4); predictors of incongruent trials in the Stroop task in English (4.6.1.5); predictors of control trials in the Stroop task in English (4.6.1.6); predictors of congruent trials in the Stroop task in Urdu (4.6.1.7); predictors of incongruent trials in the Stroop task in Urdu (4.6.1.8); predictors of control trials in the Stroop task in Urdu (4.6.1.9); predictors of congruent trials in the Stroop task in Punjabi (4.6.1.10); predictors of incongruent trials in the Stroop task in Punjabi (4.6.1.11); predictors of control trials in the Stroop task in Punjabi (4.6.1.12); predictors of blocked English and Urdu trials in the translation-elicitation task (4.6.1.13); predictors of mixed English and Urdu trials in the translation-elicitation task (4.6.1.14); predictors of triple cognates in blocked English and Urdu trials in the translation-elicitation task (4.6.1.15); predictors of double cognates in blocked English and Urdu trials in the translation-elicitation task (4.6.1.16); predictors of unrelated words in blocked English and Urdu trials in the translation-elicitation task (4.6.1.17); predictors of triple cognates in mixed English and Urdu trials in the translation-elicitation task (4.6.1.18); predictors of double cognates in mixed English and Urdu trials in the translation-elicitation task (4.6.1.19); predictors of unrelated words in mixed English and Urdu trials in the translation-elicitation task (4.6.1.20); moderation analysis (4.6.2); moderation of frequency of using English (4.6.2.1);

moderation of frequency of using Urdu (4.6.2.2); moderation of frequency of using Punjabi (4.6.2.3); interaction of frequency of using English, Urdu and Punjabi (4.6.3); interaction of frequency of using English, across all language conditions (4.6.3.1); interaction of frequency of using Punjabi, across all language conditions (4.6.3.2); interaction of frequency of using Urdu, across all language conditions (4.6.3.3); interaction of English language proficiency with experimental conditions (4.7); analysis of within groups interaction (4.8); qualitative interpretations (4.9); integration of quantitative findings with qualitative interpretation (4.9.1); qualitative analysis of errors (4.9.2); chapter summary (4.10).

Chapter 5 presents the results and discussion of experiments to answer the research hypotheses presented in 1.4. It attempts to analyse and evaluate the organisation of the mental lexicon in multilingual speakers. The discussion of each experiment is presented first individually and later collectively: findings from experiment 1-the picture-naming task (5.1); findings from experiment 2-the Stroop task (5.2); findings from experiment 3- the translation-elicitation task (5.3); discussion (5.4); discussion of findings from experiment 1-the picture-naming task (5.4.1); discussion of findings from experiment 2-the Stroop task (5.4.2); discussion of findings from experiment 3-the translation-elicitation task (5.4.3); general discussion (5.4.4); hypothesis driven discussion (5.4.5) and chapter summary (5.5). Finally, in chapter 6, the conclusion is drawn based on results presented in chapter 4 and the findings and discussion presented in chapter 5, in addition to implications of the study (6.1); pedagogical implications (6.1.1); linguistic implications (6.1.2); limitations of the study (6.2), and future recommendations (6.3).

CHAPTER 2

LITERATURE REVIEW

The present study aims to empirically investigate the fundamental principles of translanguaging, particularly how they enable trilingual speakers to access and utilise their full linguistic repertoire for effective communication. Translanguaging theory posits that multilingual individuals draw on an integrated linguistic system rather than compartmentalised language stores. A core tenet of this perspective is the concept of a unitary mental lexicon—a shared cognitive space encompassing all known languages (Aitchison, 2012). In this framework, repertoire building and simultaneous activation of all languages are considered essential mechanisms of multilingual language use.

To explore this, the current study employs three psycholinguistic experimental tasks designed to examine the organisation and access of linguistic resources in trilingual speakers. These include the picture-naming task**,** the Stroop task, and the translation-elicitation task, which have been widely used in psycholinguistic research to probe lexical access, cognitive control, and cross-linguistic interaction. With this aim, the literature review critically examines key areas, including the theoretical underpinnings of translanguaging and multilingualism, major models of bilingual and multilingual lexical organisation and access, empirical findings on selective versus non-selective language processing, studies involving lexical processing in sentential contexts, and existing psycholinguistic research conducted within the Pakistani linguistic landscape.

Much of the existing psycholinguistic research has predominantly focused on bilingual lexical organisation, yielding various theoretical models that account for bilingual processing (discussed later in section 2.4). In contrast, studies addressing tri-/multilingual language organisation remain limited (discussed in section 2.6.2), and those that examine language configurations involving Pakistan's indigenous languages are even scarcer (discussed in section 2.9). This highlights a notable research gap, particularly concerning the integration of regional languages, such as Punjabi, alongside Urdu and English, within multilingual lexical processing paradigms.

The latter part of this chapter is devoted to reviewing empirical studies and theoretical models that attempt to explain trilingual lexical organisation and access. Special attention is given to the Multilink model**,** which provides a comprehensive framework for understanding multilingual lexical interaction. Together with the translanguaging framework, which emphasises fluid, context-driven language practices, the Multilink model (as discussed in chapter 1, section 1.5)—focusing on interconnected lexical representations across languages—offers a robust theoretical foundation for this study. These models collectively guide the interpretation of experimental findings and inform the analysis of how trilingual speakers in the Pakistani context organise and access their mental lexicon.

2.1 Translanguaging

In multilingual communities, speakers draw on a wide range of linguistic resources to co-construct meaning—a phenomenon commonly referred to as translanguaging (García, 2019). More than mere language switching, translanguaging is central to bi-, tri-, or multilingual societies, as it reflects the natural integration of multiple linguistic systems (García, 2019). While traditionally perceived as the alternation between named languages, translanguaging theory reconceptualizes this practice as the flexible and dynamic deployment of all semiotic, cognitive, and linguistic resources available to a speaker. It rejects the notion of discrete language systems, advocating instead for a unitary, integrated mental repertoire (Otheguy et al., 2015). This perspective emphasizes repertoire building, where language knowledge is viewed as a holistic system developed through interaction with various languages and signs, all of which can be accessed fluidly in communication (Canagarajah, 2011; Wei & Lin, 2019).

The term translanguaging was first introduced by Cen Williams in 1994 to describe bilingual pedagogical practices in Welsh classrooms—such as reading in one language and writing in another (Vogel & García, 2017). It was later translated into English by Baker (2011), who described it as a process of meaning-making that involves drawing from the whole linguistic repertoire of speakers. Since then, the concept has been developed and expanded by various scholars in applied linguistics and education (García, 2009; Wei, 2011; Canagarajah, 2011; Vogel & García, 2017; Wei, 2018; Wei & Lin, 2019). While their definitions vary slightly, they share the view that translanguaging shifts the focus from languages as separate entities to speakers as active agents who construct meaning through integrated linguistic practices. It redefines multilingualism not as a challenge to language learning, but as a rich resource for communication and identity formation (García & Wei, 2014).

Translanguaging also challenges conventional linguistic boundaries by offering a social semiotic perspective in which linguistic and non-linguistic signs together contribute to the speaker's communicative repertoire (Kress, 2015). Vogel and García (2017) outline three foundational principles of translanguaging theory: (1) the existence of a dynamic and integrated linguistic repertoire; (2) a view of multilingualism that privileges linguistic fluidity over separation; and (3) the acknowledgment of the sociopolitical implications of named languages, particularly for minoritized language communities.

This theoretical orientation contrasts with traditional views of bilingualism and multilingualism, which often prioritize the number of languages spoken over how speakers use them in context. Translanguaging, by contrast, focuses on how linguistic resources are mobilised to make meaning (Conteh, 2018). According to Wei (2018), while traditional multilingual theories are language-centric, translanguaging theory is speaker-centric, emphasizing the cognitive, discursive, and social practices of meaning-making.

Over the past two decades, translanguaging has become a significant framework for investigating multilingualism in education and language policy (Hornberger & Link, 2012; García et al., 2011; Creese & Blackledge, 2015; Jonsson, 2012; Gynne, 2016; Velasco & García, 2014; Prada, 2019; Yuvayapan, 2019; Torpsten, 2018; Escobar, 2019; De Los Reyes, 2018). Within Pakistan, several recent studies have explored translanguaging practices in educational contexts, reflecting the multilingual reality of its classrooms and communities (Shah et al., 2019; Batool et al., 2022; Hussain & Khan, 2021; Alam, 2020; Mushtaq, 2023; Saleem et al., 2023; Panezai et al., 2023; Atta, 2024; Mahmood et al., 2024).

The growing interest in multilingualism has also shaped psycholinguistic research, which seeks to understand how bilinguals and multilinguals process language. Psycholinguistic studies focus on the interactive patterns and cognitive mechanisms through which speakers access and manage multiple languages. These studies investigate whether and how the languages of an individual influence one another during comprehension and production. Although bilingual processing has received substantial attention, research specifically addressing trilingual or multilingual lexical processing remains comparatively limited, marking a significant gap in the literature.

2.2 Translanguaging vs. Bi/multilingualism

Bi/multilingualism is primarily a sociocultural phenomenon that involves speakers' knowledge and use of multiple language systems. Two major theoretical orientations have emerged in its study: the bi/multilingual perspective and the translingual perspective. The former, grounded in dual correspondence theory (MacSwan, 2017), maintains that speakers possess separate cognitive systems for each language and activate only the relevant one during communication, functioning in what Grosjean (1998) termed a 'monolingual mode'. In contrast, the translingual perspective views language knowledge as an integrated and dynamic entity. According to Otheguy et al. (2015), speakers draw from a unified linguistic repertoire without compartmentalising features by socially named languages.

Translanguaging challenges traditional models of bilingualism by reconceptualising the communicative process itself (García & Lin, 2016). It critiques monolingual pedagogies and advocates the mobilisation of multilingual learners' full linguistic resources. As a classroom practice, translanguaging empowers both teachers and students, fosters collaborative knowledge construction, and supports identity development (García & Lin, 2016; Wei, 2018). It is not mere code-switching, but a strategic deployment of a speaker's complete linguistic repertoire for meaning-making (Canagarajah, 2011; García, 2009).

A growing body of research has demonstrated the pedagogical and ideological potential of translanguaging across diverse educational settings (e.g., De Los Reyes, 2018; Prada, 2019; Escobar, 2019; García et al., 2011; Hornberger & Link, 2012; Creese & Blackledge, 2015). For instance, Escobar (2019) demonstrated how EFL learners in a Costa Rican university drew spontaneously on their full linguistic repertoires to interpret English-language graffiti, thereby challenging monolingual ideologies. Prada (2019) found that translanguaging reshaped students' language attitudes and disrupted hierarchical language norms. Similarly, De Los Reyes (2018), in a study of multilingual classrooms in the Philippines, observed that translanguaging led to more effective instruction and increased student engagement.

In Pakistan, several recent studies have explored translanguaging in educational contexts, reflecting the country's linguistically diverse classrooms (Shah et al., 2019; Batool et al., 2022; Hussain & Khan, 2021; Alam, 2020; Mushtaq, 2023; Saleem et al., 2023; Panezai et al., 2023; Atta, 2024; Mahmood et al., 2024). These studies contribute valuable insights into the socio-educational dimensions of translanguaging, documenting how students and teachers navigate multiple languages for classroom interaction and learning. For instance, Shah et al. (2019) and Alam (2020) observed fluid language use among students and teachers, while Batool et al. (2022) and Panezai et al. (2023) highlighted translanguaging as a culturally responsive pedagogy that supports learner participation. These studies affirm the pedagogical value of translanguaging in multilingual education.

However, they tend to adopt qualitative or ethnographic approaches, focusing primarily on discourse practices, teacher beliefs, and language policy. While they establish the practical and ideological relevance of translanguaging, they rarely address the cognitive mechanisms that underlie multilingual processing. Constructs such as lexical integration, cross-linguistic interference, and parallel activation remain largely unexplored.

This gap partly reflects the persistence of monolingual ideologies in formal education systems. Despite multilingual realities, state-mandated policies in countries like Pakistan often promote a dominant, non-native language, marginalising indigenous languages (García, 2009). This reinforces the ideology of "one language at a time," which constrains learners' access to their complete linguistic resources and limits the adoption of translanguaging pedagogies.

At the same time, various frameworks have been proposed to conceptualise multilingual practices, including language crossing (Rampton, 1995), polyglot repertoire (Blommaert, 2008), plurilingualism (García & Otheguy, 2020), polylingual languaging (Jørgensen, 2008), translanguaging space (Wei, 2011), and metrolingualism (Otsuji &

Pennycook, 2010). While these differ in focus, they share an emphasis on the fluid, non-compartmentalised nature of multilingual language use. Positioned within this theoretical landscape, the current study adopts a psycholinguistic lens to investigate how multilingual individuals access and manage their lexical resources in real time.

Although recent Pakistani studies such as Mushtaq (2023), Atta (2024), and Mahmood et al. (2024) have addressed translanguaging in literacy and policy domains, they do not utilise experimental methods capable of probing language activation patterns, interference, or cognitive control mechanisms. In contrast, the present study employs three experimental tasks, namely, the picture-naming task, the Stroop task, and the translation-elicitation task, to examine how trilingual speakers in Pakistan cognitively process language in real-time, multilingual contexts.

Furthermore, while most existing studies rely on translanguaging theory as a socio-pedagogical framework, they do not incorporate cognitive models such as the Multilink model (Dijkstra et al., 2018), which offers a detailed account of how multilingual lexical networks are structured and activated. By integrating translanguaging theory with the Multilink model, this study offers a more comprehensive understanding of multilingual language processing that considers both social practice and cognitive architecture.

Overall, while the reviewed studies highlight how translanguaging is practiced in multilingual classrooms, the current thesis extends this work by investigating how it is processed cognitively. By bridging the sociolinguistic and psycholinguistic dimensions through experimental methodology, this research offers a novel and empirically grounded contribution to the understanding of trilingual language use in Pakistan.

2.3 Translanguaging and Mental Lexicon: Repertoire Building

Translanguaging is grounded in the principle of repertoire building, a concept that has gained renewed relevance in contemporary linguistic theory. While the concept of a linguistic repertoire is not new, translanguaging reframes it through both cognitive and sociolinguistic lenses. Traditionally, bi/multilingualism has been approached as a sociopolitical and ideological phenomenon; however, growing psycholinguistic evidence challenges the assumption of discrete language systems in the mind. Instead, multilingual speakers appear to access linguistic features from a shared, integrated cognitive space—a perspective known as the unitary view (Otheguy et al., 2015). This framework posits that language users draw fluidly from a unified mental lexicon, rather than from compartmentalised, socially named languages.

The notion of a verbal repertoire was first articulated by Gumperz (1964), who defined it as "the totality of linguistic forms" routinely employed in a speech community to accomplish socially meaningful interaction (pp. 137–138). Rather than viewing language as a fixed system tied to static identities, Gumperz highlighted the context-sensitive selection of diverse linguistic forms, including dialects, registers, and styles, that speakers use to navigate complex social landscapes. Although rooted in sociolinguistics, Gumperz's model remains widely influential and has been reinterpreted in response to evolving social, digital, and multilingual realities (e.g., Busch, 2012).

Subsequent developments in the concept of repertoire have emerged under various labels such as 'language crossing' (Rampton, 1995), 'translanguaging space' (Wei, 2011), and 'translanguaging' itself (García & Wei, 2014; Otheguy et al., 2015). Blommaert (2008) reconceptualized repertoire as reflective of a speaker's lifelong sociocultural trajectory, encompassing political, historical, and personal dimensions. Rymes (2014) similarly advanced a repertoire-based framework that transcends traditional language boundaries by incorporating multimodal discursive practices. Pennycook and Otsuji (2014) further extended the idea with their notion of 'spatial repertoire', highlighting the fluid mobilization of linguistic resources in urban, multilingual settings through 'metrolingual multitasking'. While these interpretations have primarily focused on interactional dimensions and observable communicative behaviors in sociolinguistic contexts, they have not extensively examined the cognitive organization of repertoires.

In contrast, psycholinguistic research has increasingly turned to the mental lexicon to explore how multilingual speakers access and manage their linguistic resources. Studies provide mixed evidence regarding the nature of lexical access in bi-/tri-/multilinguals, whether it is language-selective or non-selective, thereby enriching the conceptual scope of repertoire to include cognitive as well as social dimensions. The integration of these perspectives is essential for understanding the dynamic interplay between multilingual language use and mental representation.

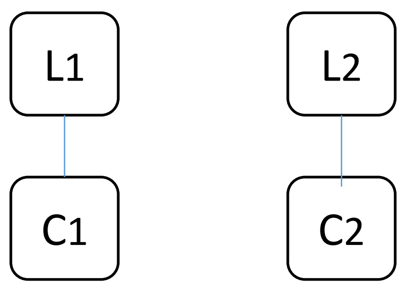
2.4 Background of Models of Lexical Representation and Processing

With the increase in the bi/multilingual population, psycholinguists have turned to explore the nature, processing, and interrelationship of the different languages spoken by speakers. Several models have been proposed to understand the processing and representation of bi- and multilingual mental lexicons, which were initially developed for bilingual speakers and later extended to accommodate multilingual speakers. The first notable study to expound the processing and interrelationship of two languages of bilingual speakers was put forward by Weinreich in 1953.

Weinreich (1953) proposed three mental configurations for the organisation and operation of a bilingual mental lexicon: coordinate, compound, and subordinate. A bilingual speaker would have two different lexical stores corresponding to two conceptual representations in a coordinated bilingual framework.

Figure 1

The Coordinate Model

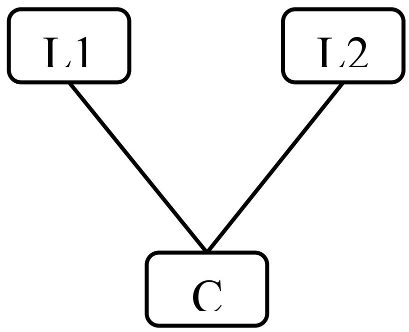


Note. Adapted from Weinreich, 1953

The Coordinate model proposed an independent language system for each language that reflected no connection between the two language systems. In contrast to the coordinate model, the Compound and Subordinate Models both preferred a shared meaning form, but the fundamental difference in the two models rested in the way the second language was learnt; when the speakers learnt two languages simultaneously, it led to the formation of the common conceptual store for equivalent lexical items in both of the languages, whereas, the second language was learnt through the native language of speakers using translation equivalents. The Compound Model assumed direct access from the lexical stores of both language systems to a single common conceptual store. In contrast, the Subordinate Model proposed that the meaning of lexical items in a second or foreign language could be accessed just via the mediation of the mother tongue, that is, by using translation counterparts in the native language. From the standpoint of the Compound Model, the meanings of words can be accessed directly from a common conceptual store, whereas according to the Subordinate Model, the meanings of lexical items are accessed through the mediation of their translation counterparts in the native language.

Figure 2

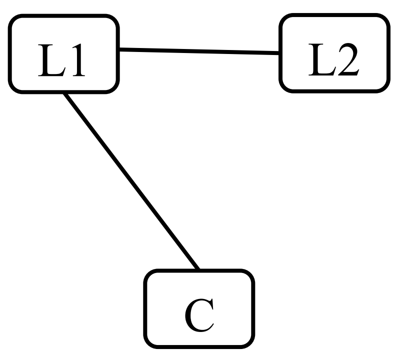
The Compound Model



Note. Adapted from Weinreich, 1953

Figure 3

The Subordinate Model



Note. Adapted from Weinreich, 1953

From the analysis of coordinate, compound, and subordinate frameworks proposed by Weinreich (1953), it is evident that bilingual lexical processing and memory comprise two distinct levels: conceptual and lexical. These bilingual lexical access frameworks laid the foundation for the long-standing controversy between concepts and lexis and pioneered systematically organised cognitive research on language processing in bilingual speakers. These frameworks of bilingualism were further developed and explained in detail by Ervin and Osgood (1954), but from a behavioristic perspective, due to their background.

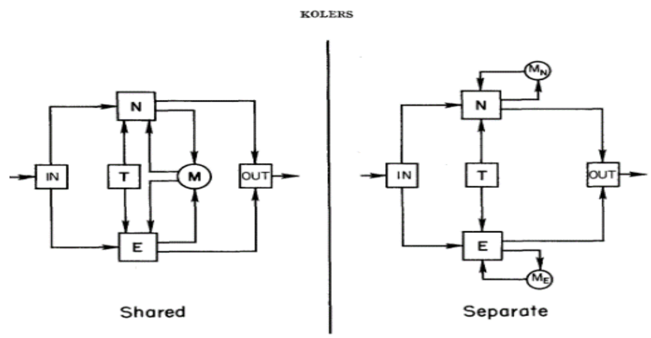
Ervin and Osgood (1954) elaborated two models of Weinreich, that is, “Compound and Coordinate Language Systems” (p.139), with a particular focus on context and how the two languages were acquired by speakers, whether directly or through mediation of their native language, instead of the interrelationship and organisation of two languages in the memory. Ervin and Osgood suggested that in a compound language system, linguistic signs in the two languages become linked to the same set of meanings or the same representational processes. (p.139–140). They likened the compound language system to typically learning a second language in school, where vocabulary lists fostered the learning process. In addition, the two languages were reserved for different contexts, having distinctive signs for each set corresponding to different meanings through the same set of meditational processes. An actual instance of a compound language system would be a bilingual speaker who acquired two languages simultaneously in the same context and used both languages interchangeably with the same speakers. A shared representational process can be developed in such circumstances, but no language can claim dominance. On the other hand, a coordinate language system refers to “the set of linguistic signs and responses” that come to be attached to two “different sets of representational processes” for both languages (Ervin & Osgood, 1954, p.140). Bilingual speakers employ the first language at home with intimate family members, while the second language is used at school. For Ervin & Osgood, a coordinate bilingual is a ‘true’ bilingual who has learnt to use two languages in two distinctive contexts. Ervin and Osgood’s compound and coordinate language systems (1954) have become part of history as compound bilingualism and coordinate bilingualism.

Although the distinction between compound and coordinate bilingualism survived till today, Kolers (1963) criticised the dichotomy. They questioned the distinction's usefulness in describing the underlying psychological functions because it merely identified how the second language was learnt either through their native language mediation or independently without it. He argued that bilinguals learning the second language through these two methods tended to converge to exhibit similar linguistic performance. On the other hand, after learning the same technique, two bilinguals tended to reflect highly different results. Kolers (1963) redirected the memory storage issue and the interrelationship of two languages of bilinguals and proposed the Independence/Interdependence Hypothesis. In addition, he brought into focus the issue of how bilingual speakers organise their two languages, whether in a common memory store or two different memory stores, one for each language. Regardless of the findings of Kolers's experiments, he established the foundation of bilingual memory store, a focal point of current research.

Kolers (1963) conducted four sets of word-association experiments with three groups of thirty-four bilingual participants to examine the validity of a shared/separate hypothesis for the memory store. The experiments consisted of four test conditions: two interlingual paradigms, that is, a stimulus word in English responded to in their mother tongue, a stimulus in their mother tongue translated into their second language, that is, English, and two intralingual paradigms, that is, an English word stimulus answered in English and a native language stimulus answered in the mother tongue. The mother tongue of bilingual participants was Spanish, Thai, or German, and English was their second language. The stimuli for the experiments consisted of five semantic categories of fifty-five lexical items. The results revealed that only one-third of the responses were translated into the other language, and the frequency of scores was similar between language and across language conditions; of this proportion, only two-thirds were translations or lexically similar words in interlingual tests. The frequency of similar associations differed sharply with the semantic category of lexical items. In addition, bilinguals attached different associations to lexical items in their mother tongue than their equivalent translation in the second language. The data also interpreted that memories experienced in two languages were stored separately and not in a common store in some "supralinguistic" form (Koler, 1963, p.291). The experiment's findings supported the independent hypothesis, the separate store hypothesis, which posits that a different memory store exists to save memories experienced in each of the speakers' languages. He further claimed that describing events experienced in one language had to be translated into another. Contrary to the independent store hypothesis, he also claimed that similar experiences produced similar results; concrete nouns had nearly identical associations for both languages of bilingual speakers compared to abstract nouns, which are more conceptual and differed for both languages.

Figure 4

Representation of Shared and Separate Hypotheses



Note. Adapted from Kolers, 1963

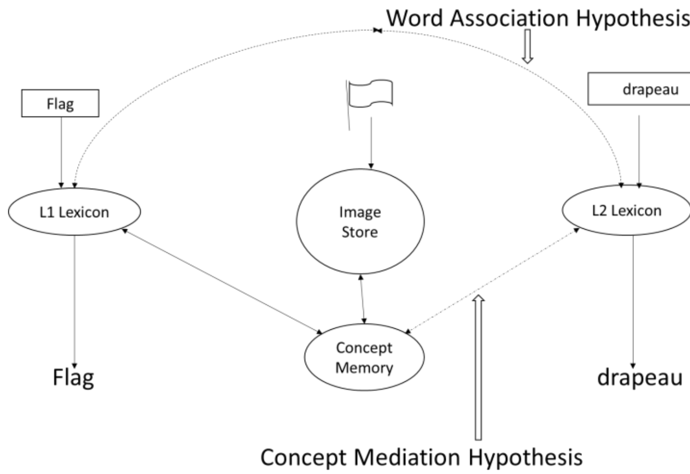
Kolers's independent or separate store hypothesis for both languages of bilingual speakers was further tested in two different studies by Scarborough et al. (1984) and Potter et al. (1984), which investigated how information gathered through experiences in one language was exclusively transmitted to conditions, which involved the use of a second language. They conducted two-word recognition experiments with Spanish-English bilingual participants to examine how information in one language was transferred to another. In experiment 1, fluent bilingual participants needed to respond positively to a series of lexical decision trials in only one language, followed by another series of lexical items in the second language that consisted of some translation equivalents of already seen, along with some new words and non-words. The participants were unaware of the second part of the experiment that involved translation equivalents of already seen words. Thus, there was little reason to translate in part 1. The scores of experiment 1 revealed no evidence of transmission from English to Spanish or from Spanish to English. In experiment 2, the participants were supposed to reply positively if the stimulus presented was an actual word in the target language. This experiment also consisted of two parts that differed essentially in the stimuli type: pure language condition and mixed language condition. Two other variables included using 50% high-frequency words and repeating 50% of the stimuli. The scores suggested that bilinguals performed as if they were monolinguals in the setting of this experiment. The findings of both investigations advocated that participants could access memory in a language-selective manner. They further explained the results by stating that the lexicon of bilingual speakers was separated by language, and lexical access was language-selective.

It is to be noted that the participants inducted in the research by Scarborough et al. (1984) were required to recognise whether words belonged to a target language. The word recognition task merely required the participants to differentiate between words and non-words, which was a superficial activity and did not require stimulation of underlying processes, that is, the conceptual level activation. The study's technique has questioned reliability if it provided an appropriate layout to investigate the common representations of translation equivalents.

The compound and subordinate frameworks proposed by Weinreich (1953) and Kolers's separate and shared hypothesis were employed by Potter et al. (1984) in developing the Word Association and the Concept Mediation frameworks. They explained the connection between the lexical items of the two languages of a bilingual speaker. According to Potter et al., the word association hypothesis represented a direct relationship between new second and first-language words. This association was helpful until the L2 was a less dominant language than the L1. On the contrary, the concept mediation hypothesis states that lexical items from the second language of speakers are not directly linked to the first-language lexical items but are associated with concepts common to both languages. They claimed the presence of a shared conceptual store for both languages and separate lexical stores corresponding to the lexical items of each language of bilingual speakers. They also favoured the presence of a shared image store that stored word representations. Both of these hypotheses suggested differences in the lexical and conceptual representation of lexical items.

Figure 5

Word Association & Concept Mediation Hypothesis through Example



Note. Adapted from Potter et al. (1984)

Potter et al.'s (1984) word association model hypothesised that the meanings of lexical items from the second language could only be accessed through native-language translation equivalents. On the contrary, the concept mediation model proposed unmediated access to second-language and first-language meanings. Potter et al., (1984) experimented to examine the performance of fluent Chinese-English bilingual speakers in contrast to the performance of less proficient English-French bilingual speakers using a picture-naming task and a translation production task with the assumption that is in line with the word association hypothesis, the picture-naming task should consume more time while according to the concept mediation hypothesis, both of the studies would take equal time. The findings of the two tasks revealed no variation in the naming latency of both groups of bilingual participants, which proved that both tasks required comparable component procedures, that is, conceptual access before access to second-language words. Participants' relative proficiency level did not affect their scores in experimental conditions. The concept mediation model was adopted as an approximation to bilingual lexical representation. In addition, another substantial contribution was the insignificance of participants' relative proficiency levels, as fluent bilinguals and less fluent bilinguals yielded similar performances.

It is important to note that both Scarborough et al. (1984) and Potter et al. (1984) brought forth contrasting outcomes, thus stimulating a debate in psycholinguistic experimental research where some studies supported Independent/separate conceptual stores while others advocated dependent/shared conceptual stores. Studies have demonstrated results favouring both hypotheses, though the evidence for a shared conceptual store outnumbered the evidence for a separate conceptual store. Potter et al. (1984) advocated for a shared conceptual store. Their basic assumption that concepts universally mediate between the two languages of bilinguals was challenged and further tested by various researchers, including studies conducted by Kroll and Curly (1988) and Kroll and Stewart (1990), which led to the formulation of the Hierarchical Model of Bilingual Memory Representation.

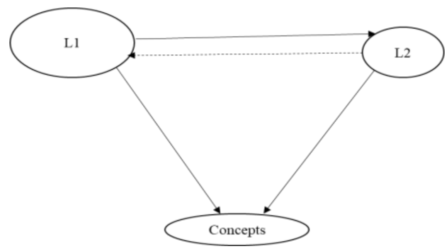
2.4.1. Hierarchical Models of Bilingual Representation and Processing

Research on bilingual lexical access has undergone significant evolution since the early models that sought to explain translation mechanisms in bilinguals. Kroll and Curly (1988) expanded on Potter et al.'s (1984) foundational study by testing the developmental trajectory of L2 acquisition. Their findings supported the developmental hypothesis, suggesting a shift from lexical-level word associations in early bilinguals to conceptual-level mediation in more proficient speakers by taking a wide range of bilingual participants, as they speculated that the participants of Potter et al.'s study may have reached the critical period of learning the foreign language. To test the hypothesis, they included two groups of bilingual participants, one who had studied the second language for less than two years and the other who had studied for more than two years, to analyse the performance of the two groups. The results of the study supported the developmental hypothesis. The scores of participants who had studied the second language for less than two years were consistent with the word association hypothesis; the participants translated faster into a second language than they did in picture naming in a second language. On the contrary, the scores of participants who had studied the second language for more than two years were consistent with the scores produced by Potter et al.'s study, pointing to the conceptual mediation of the second language. Thus, the findings reflected a developmental shift in bilinguals' second language learning from word association to concept mediation. The study supported the hierarchical organisation of the two models; less fluent bilingual speakers lexically mediated the two languages, whereas fluent bilingual speakers conceptually mediated the two languages. In addition to this experiment, Kroll and Curly (1988) performed another experiment on the concept mediation hypothesis. The bilinguals translated words, named pictures, and named words in their native and second languages under two situations. The stimuli were semantically categorised in category one, whereas the lists were mixed words from various semantic categories. They expected the fluent bilingual participants who were conceptually mediating their two languages to take advantage of the semantic categorisation of lists. However, the findings of the experiment were counterintuitive. The semantic organisation of lists influenced the performance of fluent bilingual participants, but it was interference rather than facilitation. The participants took more time to translate semantically organised lists than mixed lists. Similarly, all participants took a longer time in the picture-naming task in their native language. The pattern of findings suggested a developmental shift from word association to concept mediation, as only proficient bilingual participants exhibited interference rather than facilitation. However, it was confusing that instead of category facilitation, category interference was observed.

Kroll and Stewart (1990) proposed a revised variant of the hierarchical model of bilingual lexical organisation to address the issue of translation asymmetry. From the point of view of the revised model, both conceptual and lexical links are active during bilingual language processing. However, their function is dependent upon the level of a bilingual speaker’s proficiency in the foreign language and the relative dominance of the mother tongue and the foreign language. Kroll and Stewart (1994) revised the hierarchical model again to replicate the category interference effect in two tasks: the translation task and the picture-naming task. This revision aimed to examine the structure of bilingual memory and processing. To account for the conflicting findings of the word association model and the concept mediation model, particularly for the developmental shift, the Revised Hierarchical Model (RHM) integrated features of both the word association hypothesis and the concept mediation hypothesis. The framework of RHM assumed the presence of two separate lexical stores for each of the two languages of bilingual speakers and one shared conceptual store. It proposed a larger lexical store for L1 than L2, as L1 is expected to comprise more information than L2.

Figure 6

Revised Hierarchical Model



Note: Adapted from Kroll and Stewart, 1994

From the perspective of the asymmetric RHM model, when a bilingual speaker acquires a second language after early childhood, it results in the formation of a robust connection in the L1 and the conceptual store. During the early levels of second language learning, the words of the second language are linked to the already established system through lexical links with the native language. When the bilinguals attain higher second language proficiency, direct conceptual links get established. Though direct conceptual links are established, the word links at the lexical level continue to exist. The RHM was more elaborate compared to the earlier models, particularly in terms of the number and strength of two-way mutual links between the two stores. The model proposed that the connection between the second language and the native language is more vital than in the opposite direction. It also supported a more vital link of shared concepts with the native language than the second language. The asymmetric connection strength was reinforced by the fact that bilinguals usually acquired native language words first and relied on translation to learn lexical items in the second language. Similarly, the link from the first language to the conceptual store was assumed to be stronger than the connection from the second language lexical items to the conceptual store. This implies that the model claimed two translation routes: translation from L2 to L1 would be lexically mediated, whereas translation in the opposite direction from L1 to L2 would be conceptually mediated. In other words, the model predicted category interference for fluent bilinguals while translating from L1 to L2.

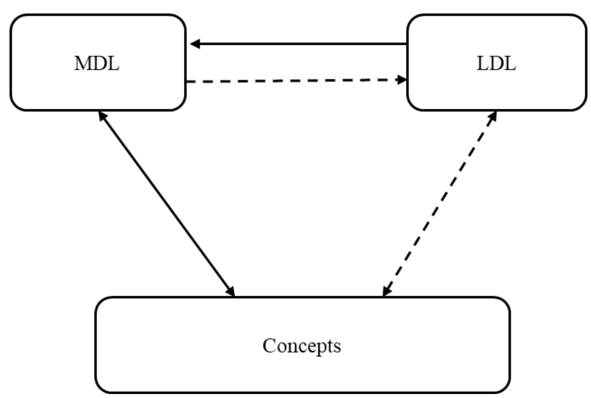
The hypotheses of RHM were tested by Kroll and Stewart (1994) with Dutch-English bilingual participants in three experiments. The picture-naming task and the translation production task were presented in semantically categorised lists, such as all animals, all fruits, etc., and mixed lists, such as words from different categories. The analysis revealed that translation from L1 to L2 was slower and less accurate than translation from L2 to L1. In addition, translation from the native language to the second language was affected by semantic categorisation, while translation from L2 to L1 remained uninfluenced. The central feature of RHM included a manifestation between lexical and conceptual representations, the presence of separate lexicons corresponding to each language, and the asymmetry between L1 and L2. Finally, it supported the developmental shift in bilingual speakers.

RHM has inspired numerous research studies on bilingual memory representation and processing. Subsequently, some studies introduced revisions in the original architecture of RHM. Heredia (1996) made one such modification and proposed a re-revised Hierarchical Model. Heredia (1995) reported experiments with Spanish-English bilingual participants in an earlier study. The study manipulated word frequency and concreteness variables, and the subjects performed a translation recognition and a translation task. The tasks focused on both directions of translation from L1 to L2 and from L2 to L1, with the perspective that the word concreteness effect facilitated the task. On the other hand, in the abstract word condition, translation from L2 to L1 exhibited higher latency scores than the translation recognition task and translation task in the opposite direction, that is, from L1 to L2. The findings of the experiment did not conform to RHM for two reasons: there was no language asymmetry as translation in both directions was dependent on conceptual factors, and translation from L2 to L1 in the abstract condition took more time, in contrast to translation in the opposite direction, exhibiting sensitivity to conceptual factors, which was contrary to the features of RHM.

To account for the discrepancy between his findings and RHM, Heredia (1996) explained that the subjects of his previous study (1995) were highly proficient bilingual speakers in both languages. English was their second language, but it was more dominant as they received their formal education predominantly in it, and it was a comparatively more active language for daily tasks. Heredia claimed that RHM took into consideration the level of participants' language proficiency and did not consider language dominance. He claimed that RHM could provide an explanation of bilingual memory concerning early bilinguals and was unable to account for highly advanced bilingual speakers. Thus, he modified RHM by asserting that R-2 HM (the Re-Revised Hierarchical Model) focused on the relative dominance of two languages, that is, MDL (More Dominant Language) and LDL (Less Dominant Language), instead of the order in which the languages are learnt. The revised model did not distinguish first and second languages, thus allowing the second language to dominate. In addition, neither of the two lexicons was presumed to be larger, but the LDL lexicon was not readily available due to its lesser use. Nonetheless, the nature of links between two lexicons and their relationship with the conceptual store remained the same as in the original RHM.

Figure 7

Re-Revised Hierarchical Model



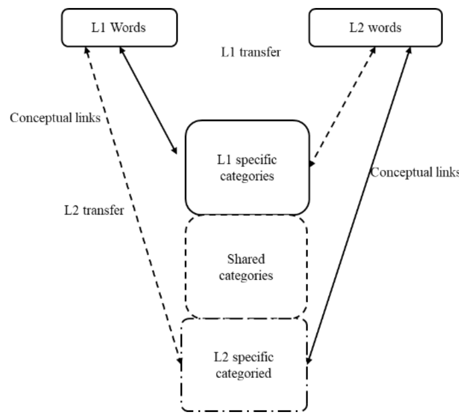
Note. Adapted from Heredia (1996)

Another revision of the RHM of bilingual memory and representation was proposed by Pavlenko (2009) as the Modified Hierarchical Model (MHM). It retained the merits of three other bilingual memory representation models: The Distributed Feature Model (De Groot, 1992), the RHM (Kroll & Stewart, 1994), and the Shared Asymmetrical Model

(Dong et al., 2005). Pavlenko evaluated the basic tenets of these three models, but the proposed model retained the basic structure of RHM, so it was named MHM. Nevertheless, MHM differed from the models it drew from in three significant ways: (i) the organisation of the conceptual store, (ii) the recognition of the phenomenon of conceptual transfer, and (iii) the performance of second language learners.

Figure 8

Modified Revised Hierarchical Model



Note. Adapted from Pavlenko, 2009

The MHM proposed a distributed representation that could be entirely or partly shared or specific to one language instead of a unified conceptual store, enabling it to account for lexical borrowing, code-switching, and context-dependent bilingual competence. Moreover, it differentiated between semantic representation and conceptual representation. The modified version of the model suggested two conceptual transfer conditions: using second-language words in agreement with first-language linguistic categories would result in the first-language conceptual transfer, and vice versa.

Many research studies have been inspired by RHM since 1994 to test some features, and most of these studies considered only one feature to be validated or proven otherwise. RHM has systematised research on bilingualism. It has a profound influence on subsequent research on bilingualism. A study measuring the impact and testing the features of RHM was conducted by Brysbaert et al. (2010) from 1993 to 2009. They critically analysed 166 experimental studies examining some aspects of RHM. Out of these studies, 64 studies had been conducted to testify asymmetry between the first and second language processing, 30 had examined developmental changes in bilingual speakers, 13 studies had examined the existence of a shared conceptual store for the two languages of bilingual participants, and six had suggested the presence of two separate lexicons and a language-selective view of language processing. The critical analysis of these studies reflected that the presence of a shared conceptual store and language (non)selective access remained the least studied aspect.

However, the basic tenets of the RHM have been challenged, and Brysbaert and Duyck (2010) have raised the question of its effectiveness. The features that have been challenged include: first, for lack of evidence for separate lexical stores; second, for lack of validation for language selective access; third, excitatory connections would impede lexical recognition; fourth, the presence of more robust links between L2 words and their meanings as opposed to RHM; and finally, the presence of differentiation between language-independent and language-dependent semantic features. The study proposed the need to adapt a computational model to account for language processing in bilingual and multilingual speakers.

In addition to the revision of Hierarchical Models, various computational models operating on the principles of the connectionist tradition have been proposed at different times to account for representation and processing in bilinguals, including distributed and localist models.

2.4.2. Computational Models of Bilingual Representation and Processing

Most computational models of bilingual word representation and processing have been developed within the connectionist framework, which is inspired by the principles of neurocomputation (MacWhinney et al., 2005). These models function on the principles of neural processing. Researchers have focused on two types of connectionist models to account for the nature of bilingual language representation, comprehension, and production: distributed and localist models. Both models were founded on the neural principle that all computations would be accomplished through simple processing units connected to networks. In computational models, units possessed a level of activation, and each unit influenced other units' activity levels. These models differed in terms of varying the strength of connections as a function of experience and assignment or absence of prior identities to individual units in the network.

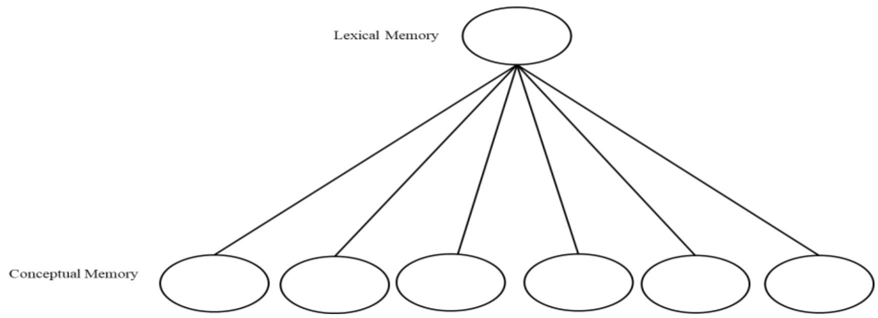
2.4.2.1 Distributed Models

The distributed models presented lexical items as activity patterns stretched across groups of items. In computational models, the entity rendered by a network would not be realised through an item but rather as a code extending over multiple items. In addition, these models emphasised experience-driven modification, particularly delineating between codes for various kinds of material, such as words in different languages and their meanings. The connection strengths would be random at initial stages but modified over time; the system would learn to connect each word to its meaning. Moreover, these networks contained many "hidden" processing components that would develop internal representations during learning, mediating the intricate connection between input and output. Since distributed models incorporate experience-driven changes, these can be applied to problems concerning language acquisition, second language learning, and shifts in language dominance over time.

Research on bilingual memory and representation has identified two levels of memory representation: the lexical level and the conceptual level, as delineated by Scarborough et al. (1984) and Potter et al. (1984). According to earlier studies, a word was represented by a single node at the lexical level, and a single node at the conceptual level represented its meaning. De Groot (1992) suggested that a lexical node can correspond to many concept nodes covering varied aspects of meaning instead of a single concept node. De Groot (1992) proposed one of the earliest connectionist models, the Distributed Conceptual Feature Model (DCFM), to account for bilingual memory representation and processing, drawing on statistics from earlier studies on bilingual memory representation and suggesting alternative explanations rather than presenting new data. The Distributed Feature Model proposed that instead of just one link between a lexical node corresponding to its conceptual node, it has links or connections to each of the meaning elements of the conceptual representation (De Groot, 1992). Upon presentation of a lexical item, all the relevant elements get activated through its connection with the lexical node.

Figure 9

A Distributed Conceptual Representation in Memory

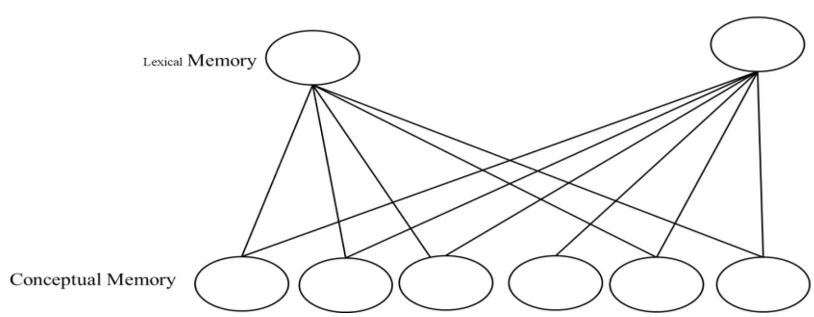


Note. Adapted from De Groot (1992)

The various conceptual representations corresponding to a single lexical node are considered 'distributed'. In other words, the concept node 'can be seen as built up from several meaning elements' (De Groot, 1992, p. 390). The meanings of lexical items do not fully correspond to those of other languages of bilingual speakers, particularly in the case of abstract words. However, it may overlap to a greater degree in concrete words. The varied conceptual nodes could better explain the degree of dissimilarity in translation equivalents. In other words, memory with distributed conceptual representations could deal with variation in translation performance; some words may fully correspond to conceptual representations, while others may not correspond to some features.

Figure 10

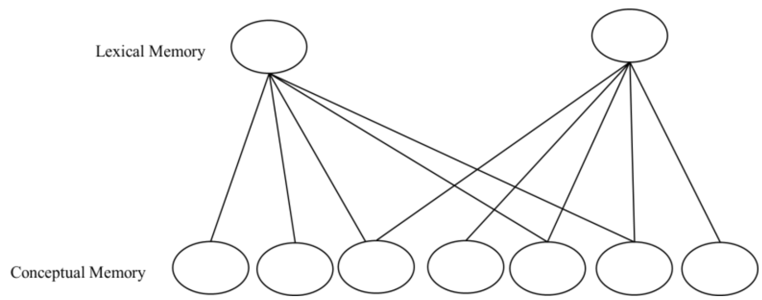
A Distributed Conceptual Representation in Memory (overlapping translations)



Note. Adapted from De Groot, 1992

Figure 11

A Distributed Conceptual Representation (partially overlapping translations)



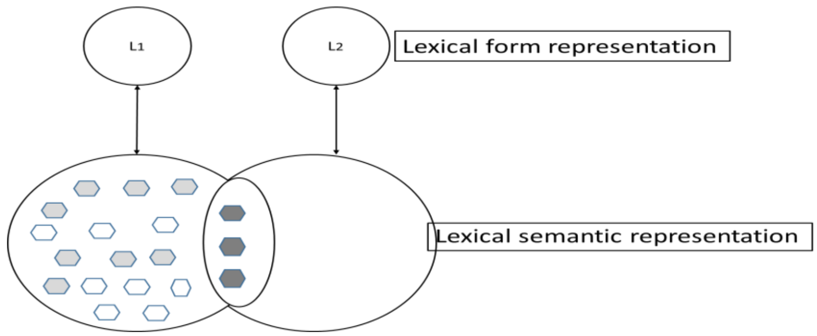
Note. Adapted from De Groot, 1992

The Figures reflected the mapping of words across two languages of bilingual speakers for similar translation equivalents and partially equivalent translation pairs. The words in two languages may not fully correspond to all the features of words in the other language. In Figure 10, two approximately overlapping translation equivalents are presented, whereas in Figure 11, two partially overlapping lexical items are presented. The figures represented features of similarity as well as features of dissimilarity.

Finkbeiner et al. (2004) critically evaluated DCFM and suggested that languages varied in terms of the range of senses words could have, as it would be a language-specific feature. They proposed another distributed model, the Sense Model, to consider bilingual asymmetry in translation equivalents. The sense model stressed the degree to which lexical representation would be activated compared to the standard features between translation equivalents. In other words, several of the word's senses would be language-specific except for the semantic sense, resulting in translation equivalence. This model differed from former bilingual representation and processing models concerning its explanation of translation asymmetry, which is not restricted to the bilingual lexicon. Instead, it would explain the priming effect within language priming. According to the projection of the sense model, the lexical pairs that effectively manifest the assumed representational asymmetry would produce the same priming asymmetry in lexical decision.

Figure 12

The Sense Model (Representation of Two Translation Equivalents)

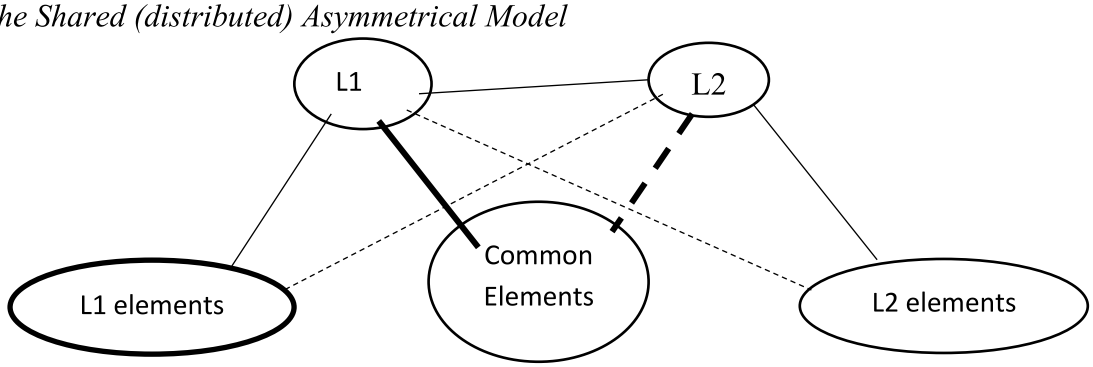


Note. Adapted from Finkbeiner et al., 2004

Another distributed model, the Shared, Distributed, Asymmetrical Feature (SAM) model for bilingual representation and processing, was proposed by Dong et al. (2005) to examine the sharing of conceptual relations across translation equivalent pairs and language or culture-specific components. It offered a dynamic view that accounted for both shared and language or culture-specific elements for both native and second languages. The model comprised a large store of shared features and two comparatively smaller stores reserved for language or culture-specific units, one for each language. The shared (distributed) asymmetrical (SAM) model assumed a higher proportion of common conceptual elements than language or culture-related distinctive components. In addition, the connections between lexical and conceptual stores were complex and varied in strength. It demonstrated the development of conceptual convergence, that is, the development of an intermediate level of representation owing to the interaction between the two languages.

Figure 13

The Shared (distributed) Asymmetrical Model



Note: Adapted from Dong et al. (2005)

The shared (distributed) asymmetrical model proposed three separate independent conceptual stores without any immediate connections among the conceptual stores. Nevertheless, SAM was criticised for needing more clarity (Pavlenko, 2009) regarding the nature and organisation of conceptual representations.

2.4.2.2. Localist Models

Unlike the distributed models, localist models tend to ascribe discrete properties to single units, for example, by dividing networks into layers of units consistent with letters, words, and language features. Further, these models did not consider changes in the model through learning. Alternatively, connection strengths were established in advance to implement the theory directly. The localist models are descendants of word detector models proposed in the 1970s. The main emphasis of localist models in bilingual research was to analyse the static architecture of lexical recognition and processing systems in bilingual speakers. The main advantage of localist models was that all network conditions were comprehensible, as activation at every unit had a straightforward interpretation. Although these models appeared simple at the surface level, their function could be intricate through the interaction between teams within and between layers. The interaction model for a single language was extended to account for language representation and processing in bilinguals.

Building upon the Interactive Activation model of monolinguals (McClelland & Rumelhart, 1981) of lexical recognition and processing, an interactive connectionist model, the Bilingual Interactive Activation Model, was proposed by Grainger and Dijkstra (1992). They tested two distinct hypotheses, the language tag and language network, through two distinctive models' frameworks of word recognition: the interactive activation model and the serial search model. It attempted to resolve the issue of how bilingual speakers recognised that a word belonged to a particular language; an exceptionally connected issue would be how language material interferes with ordinary language comprehension processes—one of the primary concerns pertained to the relation of external information to stored knowledge. The data analysed from two experimental tasks, the language decision task and the lexical decision task, as well as the language context effect on word recognition, provided evidence for bilingual interactive activation.

Figure 14

Bilingual Interactive Activation (for the word 'lire')

Language nodes activated	ENGLISH	FRENCH.
Word nodes activated	fire line	lire pire
	hire	cire
Letter nodes	L I R E	

Stimulus . 'lire'

Note: Adapted from Grainger and Dijkstra (1992)

Figure 14 displayed the activation of nodes for the word 'lire'. As the figure reflects, the Bilingual Interactive Activation framework comprises three interconnected representational levels: letter, word, and language. All nodes are connected between adjacent levels; for instance, all words belonging to one language are linked to that particular language node. The language tag hypothesis of language representation was applied in a non-interactive form of the model in which the connections between word components and language nodes were unidirectional. To put it another way, the information followed the forward direction from letter to word nodes and word nodes to language units, thus prohibiting any back-feed. Hence, language node activation would not influence word-level processing in such a model. On the other hand, in a different version of the bilingual interactive activation model, which employed the language network hypothesis, the connections between lexical units and language units were considered bidirectional. So, differences in language node activation would simultaneously influence the activation of word units.

The Bilingual Interactive Activation framework advocated the existence of an integrated lexicon in addition to non-selective lexical access through a top-down inhibiting approach. It has successfully extended the monolingual connectionist language processing mechanism to bilingual speakers. Grainger and Dijkstra (1992) conducted three experiments with French-English bilingual participants: language decision and lexical decision, Language context effect during word recognition, and neighbourhood effects across languages.

In the language decision, the participants were supposed to determine whether a string of letters constituted a lexical item or not, independent of language. In contrast, in language decision, they were required to determine whether the word belonged to one language or the other. The scores of language and lexical decisions were compared to examine whether language decisions took longer than lexical decisions. In the second trial, the bilingual participants were asked to respond to mixed language conditions to study the intralingual and interlingual semantic priming effect. The findings supported that primes from the same language gave way to faster lexical decision latencies. These lexical priming effects could be taken to keep the bilingual interactive activation model framework. The final experiment measured the neighbourhood effect both within and across languages.

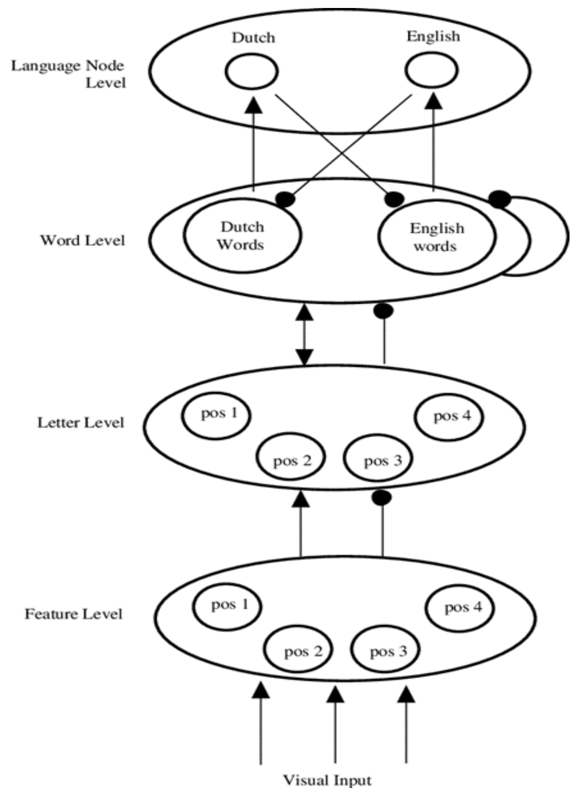
The participants were presented with three types of stimuli specifically constructed to study the neighbourhood effect. The experiment's findings supported language-independent lexical access in bilingual participants, as claimed in a revised BIA model, which posits that the bilingual mental lexicon is integrated across languages and that lexical access is language non-selective. In other words, the framework of Bilingual Interactive Activation maintained simultaneous activation of all lexical representations from both languages, which share letters with the stimulus corresponding to a given letter string.

After the initial BIA (1992), Lewy and Grosjean (1997) proposed another localist-connectionist model, the Bilingual Interactive Model of Lexical Access (BIMOLA). BIMOLA was an interactive model but differed from other interactive models, particularly the BIA model, concerning the orientation of memory stores; that is, it advocated separate memory stores for the two languages of bilingual speakers. BIMOLA shared certain standard features with other models, such as the levels of features, phonemes, lexemes, and language nodes. However, in BIMOLA, the feature level was shared across languages. However, phonemes and word levels were organized concerning languages, differentiating it from the BIA model, in which languages needed to be distinguished at the level of phonemes and words.

The initial BIA model (1992) was primarily concerned with orthographic representations and ignored phonological and semantic components. Dijkstra and Van Heuven (1998) revised the initial BIA and explained the model structure in detail. It consisted of four levels of nodes. It maintained the integrated mental lexicon structure, which would simultaneously activate all words. Nonetheless, lateral connections would allow them to compete and inhibit each other.

Figure 15

Bilingual Interactive Activation Model



Note: Adapted from Dijkstra and Van Heuven, 1998

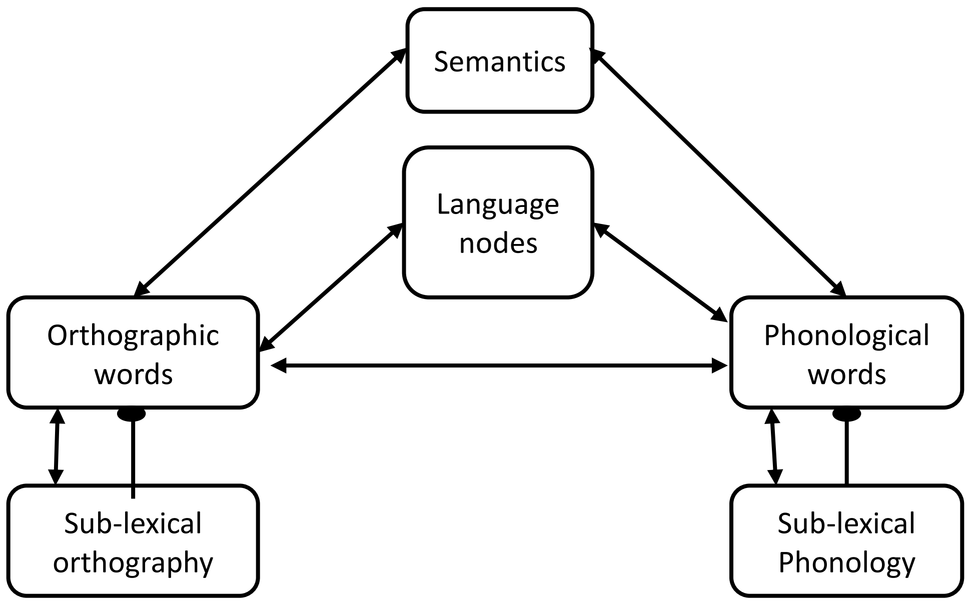
In other words, the model would enable top-down inhibition. In addition, the additional limitations included word and language representation, representation of cognates and interlingual homographs, stimulus-response association in lexical decision and language switching, under-specification of context effects, and implementation of task structure.

Another connectionist model reflecting how bilingual speakers control their two languages, the Inhibitory Control (IC) Model, was put forward by Green (1998) as a means to provide solutions to selection and competition problems confronted by earlier studies, in particular by Kroll and Stewart (1994) and Dijkstra and Van Heuven (1998). Green grounded the IC model's assumptions on examining the findings of various earlier studies instead of collecting data from bilingual participants. It shared various features with other studies but differed from those concerning inhibition control mechanisms—the former studies examining bilingual representation and processing employed either a top-down or bottom-up approach to inhibition. However, the IC model suggests multiple levels of control: external control, which is exogenous or bottom-up control, and internal control, also known as endogenous control or top-down control. A critical feature of the model was that the dominant language would play a vital role in defining reaction time, and the state of activation of competitors would determine the selection of appropriate responses. The control would be exerted through task schemas. The model suggested that language switching would incur a time cost, as it necessitated a change in language lemma for a particular task; switching languages would require overcoming the inhibition of previous language tags.

To account for semantic and phonological aspects, Van Heuven and Dijkstra (2001) proposed an extended model that involved additional nodes to represent phonology and semantics in addition to orthography and language nodes. This model was named the Semantic, Orthographic, Phonological Interactive Activation (SOPHIA) Model (2001) to account for all the features of the model, including phonological, orthographic, lexical, and language levels. This model differed from BIA in its treatment of connections among nodes. BIA contained both excitatory and inhibitory connections. However, the latter links were removed from SOPHIA. However, removing these inhibitory connections required alternative solutions for various effects, such as the language-switching effect simulated with BIA. Such shortcomings were handled in a subsequent modification of BIA.

Figure 16

Semantic, Orthographic, and Phonological Interactive Activation Model



Note. Adapted from Van Heuven and Dijkstra (2001)

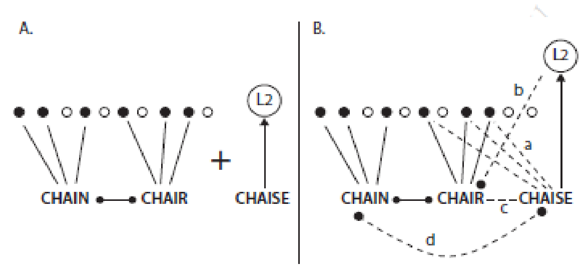
To overcome the limitations of the BIA model, Dijkstra and Van Heuven (2002) proposed yet another modification of BIA+ and retained the basic structure of the earlier model. BIA+ clearly distinguished between the lexical identification and task systems, which could account for a more extensive and diverse set of experimental findings. The extended model consisted of an identification system, which provided evidence for stimulated representations from two languages to a response selection and decision system functioning as part of the schema. Compared to the BIA and IC models, BIA+ was comparatively more overt regarding the time duration of the lexical identification process in bilinguals, the interactions between various intralingual representations, interlingual representations, and language tags. In addition, the model also distinguished between the impact of linguistic and nonlinguistic contexts on performance. According to the BIA+ model, the linguistic context directly influenced the performance of the word identification system, whereas the nonlinguistic context influenced the decision system.

Grainger, Midgley, and Holcomb (2010) proposed another revision of the BIA model as Developmental Bilingual Interactive Activation (BIA-d). The model took into consideration the evolution of proficiency in bilingual speakers. It emphasised that a sequence of changes in the connectivity of two languages of late bilingual speakers would allow a revised Hierarchical model to convert into a bilingual interactive activation model. The initial step would involve exposing adult speakers to a second language. So, the model would apply to late learners of a second language. Preliminary acquaintance with a non-native language would generate connections between translation equivalents, strengthening as exposure to a second language increased, on the principles of Hebbian learning. When links between translation counterparts were being reinforced, simultaneously, direct links were established between second-language lexical units and already prevailing semantic representations. The developmental pattern up to this point corresponded to the one delineated in the RHM (Kroll & Stewart, 1994).

As the direct connections between second-language lexical units and semantic representations gained more strength, the links between translation counterparts got revised as second-language lexical representations became integrated into a common lateral inhibitory framework for lexical units from both languages of bilingual speakers, as in the BIA model (Dijkstra et al., 1998). The direct correspondence of lexical units to semantic representations was a "magic moment" for bilingual speakers since it made their second language experience less effortful. The qualitative shift in the association between lexical units and semantic representations of translation counterparts in two languages was linked to improved control over second-language activation, a crucial stage as second-language vocabulary expanded. This enhanced control would correspond to the improvement of the capability to globally inhibit first-language words when processing second-language lexical items and vice versa. The task was executed by language nodes in the BIA model. This sort of regulatory mechanism was not possible with excitatory links between translation counterparts of two languages. BIA-d employed elementary learning mechanisms that would explain these developmental shifts. In doing so, BIA-d moved a step forward from the inert modeling technique of the RHM and BIA to robust and dynamic models that employed elementary learning precepts in numerous domains of cognitive development (For instance, Li et al. 2007; Dufau et al., 2010; Dandurand et al, 2010).

Figure 17

The BIA-d Model



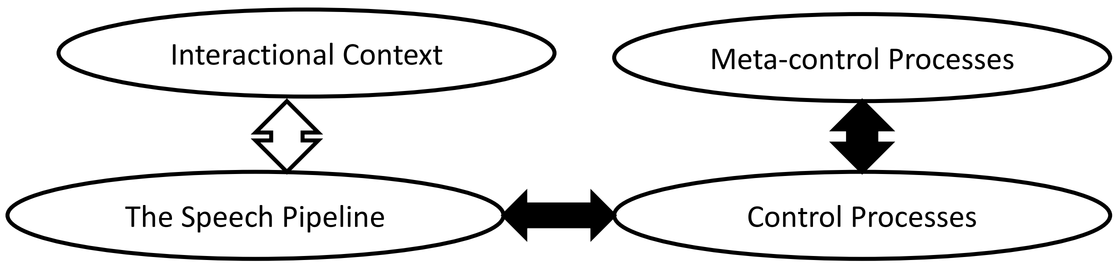
Note. Adapted from Grainger and Midgley (2010)

The BIA-d model was simplified to represent orthographic/visual word-only forms, but was also expected to apply to spoken/auditory forms. The model was considered applicable to language pairs with similar orthography, as involved in Grainger and Midgley's (2010) study, which involved French-English bilingual participants. BIA-d proposed two largely overlapping stages of vocabulary learning: an initial phase characterised by supervised learning in a classroom setting that is replaced by unsupervised learning. It would lead to the co-activation of second-language lexical representations, first-language lexical forms, and their corresponding semantic representations, in addition to the information describing that the new lexical item was a word in the L2 language node. Hence, the model suggested four types of developmental changes to take place as a result of exposure to L2 lexical forms: (i) excitatory link strength from second language lexical form to meaning would gradually rise; (ii) the inhibitory connections establish second language node to first language lexical items would also steadily rise; (iii) the excitatory connections between second language lexical items and the lexical items of their first language equivalents would gradually also rise and then would reduce as the inhibitory stimuli from second language node increase and the first language fastening procedure would be abandoned; (iv) inhibitory connections would progress from second language lexical form to orthographically similar words in both languages. Thus, according to BIA-d, lexical items would rapidly get integrated into a unitary lexicon, evolving inhibitory connections with both languages, which are formally parallel and semantically discordant. Studies furnishing evidence for (non-)selective access to an integrated lexicon will be discussed in detail in forthcoming sections.

Green and Abutalebi (2013) put forward an adaptive control hypothesis to account for control mechanisms in bi/multilingual lexical representation and processing. The adaptive control framework consists of triad interactional contexts: a single-language context, a dual-language context, and a dense code-switching context, which are regulated by a set of (eight) control mechanisms applicable to these contexts. The basic assumption of the framework rests on the varied patterns of adaptive response required in three types of interactional contexts.

Figure 18

The Adaptive Control Hypothesis



Note. Adapted from Green and Abutalebi (2013)

This section has presented a detailed account of various lexical representation and processing models. Some of these models were adapted and modified to account for the nature of heteroglossia and multilingual practices among the emerging multilingual population. In the subsequent section, a detailed account of models of multilingual lexical representation and processing has been discussed.

2.4.3 Models of Multilingual Lexical Representation and Processing

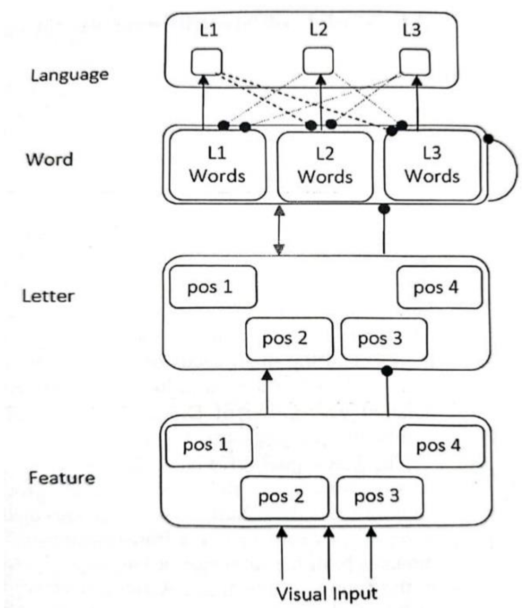
With an increase in multilingual speakers, psycholinguistic studies have taken to examine the nature of multilingual speakers. Some existing models of bilingual lexical organisation, representation, and access were adapted to account for the nature of the multilingual lexical organisation, representation, and processing, as discussed below.

2.4.3.1 Multilingual Interactive Activation Model

The architectural structure of BIA+ was modified to accommodate an additional language, thereby developing one of the initial models of multilingual language processing, known as the Multilingual Interactive Activation model. Dijkstra (2003) proposed the MIA model based on three fundamental assumptions. The basic principle of this model was the existence of an integrated lexicon for French, English, and Dutch; the speakers could access a particular language according to the task and switch among their languages. In addition, words from various languages were simultaneously activated, which thus competed for being selected, but the speakers could also inhibit the activation of some languages if they wished. Finally, the features of words from various languages assisted speakers in selecting lexical items in multilingual speakers. In contrast to BIA+, the MIA model gave rise to a more extensive lexicon or a denser network of words. Dijkstra (2003) proposed that the greater cross-lingual competition would result in slower lexical access compared to bilingual lexical access, thus resulting in greater naming latencies—adding language in the mental lexicon results in 30 ms delayed responses.

Figure 19

Trilingual Interactive Activation Model



Note. Adapted from Dijkstra (2003)

Figure 19, representing the architecture of the Multilingual Interactive Activation Model, demonstrated that the mental lexicon of multilingual speakers consisted of words from three languages: Dutch, French, and English. In contrast to the Bilingual Interactive Activation Model, it consisted of more words, leading to a greater density of words in the mental lexicon. This greater density would make the lexical access slower, resulting from the stronger competition of words from all languages. The following subsection discusses the Multilingual Processing Model, modeled after BIA+.

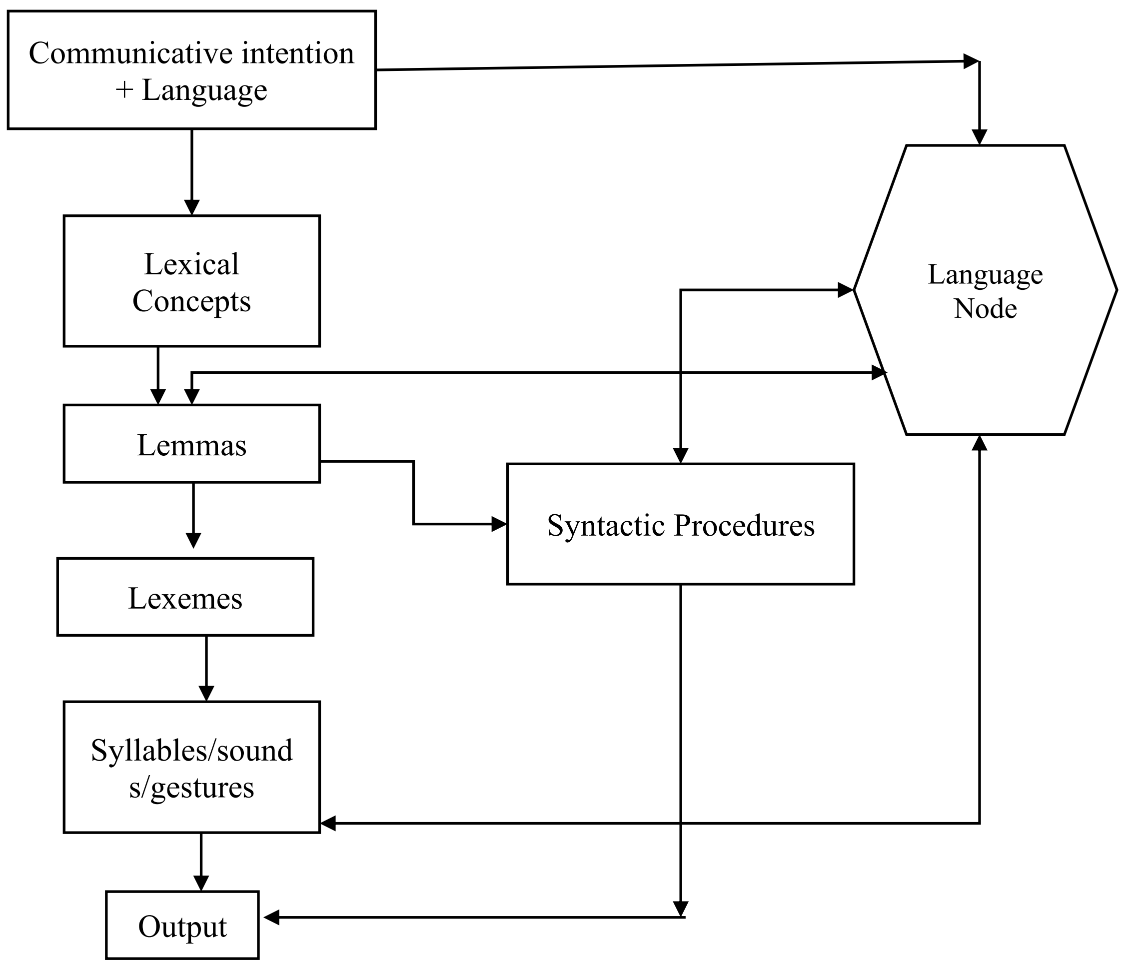
2.4.3.2 Multilingual Processing Model

Another model to account for the organisation and activation of more than two languages of speakers was the Multilingual Processing Model. De Bot (2004) proposed it, focused on language production, and stressed non-selective lexical access for the nature of the lexical organisation and access. The model is generally implemented for both bilinguals and multilinguals, regardless of the number of languages they speak. It advocated three stores, one each for syntactic procedures, conceptual features, and form elements, which were further categorised into language-specific subsets. These language-specific subsets exhibited overlap due to similarities among languages, particularly cognates and interlingual homographs. The language node was responsible for processing components of the intended language. The decision to use a particular language would activate the conceptual level, triggering both the lexical forms and the language node. Previous studies suggested that all language choice information would be incorporated within the lexical concepts. However, certain features, like deliberately adopting a foreign accent, would be challenging to control in this manner. An external language node would govern the language choice. When a specific language was to be used, the language node would notify all pertinent components, which comprise information related to syntactic and form features about the subsets to be activated. The greater stimulation would result in selecting components from the appropriate language. Importantly, information regarding the activation of subsets would be shared among subsets of different languages. Alternatively, the stimulation of syntactic features of language A would transmit this information to other language nodes and subsequently stimulate the subset containing form-related components from language A. Thus, activating part of a language would automatically activate other elements at various levels of that language.

In addition to the sequential activation of various levels of one language node, the overlap among language subsets would simultaneously activate corresponding elements in the other languages. The language node would convey information from the conceptual level to the subsequent stories and among the lower ones. It would gather information regarding the activation status of different languages and function as a monitoring mechanism for comparing the projected language with the language actually used. However, the implementation of the speed of processing could have been more straightforward. There was a possibility of interaction between various levels of activation and speed of processing, as elements activated earlier were more likely to be selected than others that took more time due to the significance of time constraints in language processing. The entire architecture of the multilingual Processing Model has been presented in Figure 20.

Figure 20

Multilingual Processing Model



Note. Adapted from De Bot, 2004

It is evident from Figure 20 that the number of languages was not an issue in this model, as the same principles applied to any number of languages, dialects, registers, etc., which would make subsets in the same manner as were made by languages. The following section presents another multilingual language processing model called the Dynamic Model of Multilingualism.

2.4.3.3 Dynamic Model of Multilingualism

The Dynamic Model of Multilingualism (Herdina & Jessner, 2002) proposed to address the dynamic nature of languages. The DMM model supports the dynamic and adaptive architecture of multilingual systems, which contrasts sharply with the earlier proposed linear models of language processing (Levelt, 1989). It emphasized the development of a complex system due to the additional qualities of the multilingual lexicon resulting from learning a new language. This feature positioned the DMM model in alignment with assumptions proposed by Grosjean (1998) and Cook (2006) that monolinguals and bilinguals differed significantly due to their linguistic competence. In other words, bilinguals possessed multi-competence (Jessner, 2006) due to multiple languages in their mental lexicon. The various languages of multilinguals were considered to be interdependent. Access to a particular language system depends on its frequency, as the lesser use of a language or avoidance strategies would lead to language loss. The DMM was a speaker-oriented model in which significance was attributed to cognitive capacity, language aptitude, self-esteem, language anxiety, and language motivation. It further postulated that language learning requires time, energy resources, and contact with relevant language knowledge, depending on the learner's resources. So, some of the basic features of DMM included nonlinearity, interdependence, reversibility, change of quality, stability, and complexity. DMM draws attention to the nonlinearity of language development, the mutual dependence of language systems, and the variation among learners. Consequently, the model accounts for the changing quality of the language learning course, influenced by the dynamics of the language system (Jessner, 2006). The speakers' proficiency was attributed to several factors, including motivational, perceptual, and anxiety levels, which would influence the development and access of language systems. Compared to other models, DMM has been less examined through experimental linguistics configurations. In the next section, another multilingual model, the Multilink Model, which has drawn significantly from earlier bilingual models, RHM and BIA+, has been discussed in detail.

2.5 Dual Correspondence Theory and the Multilink Model

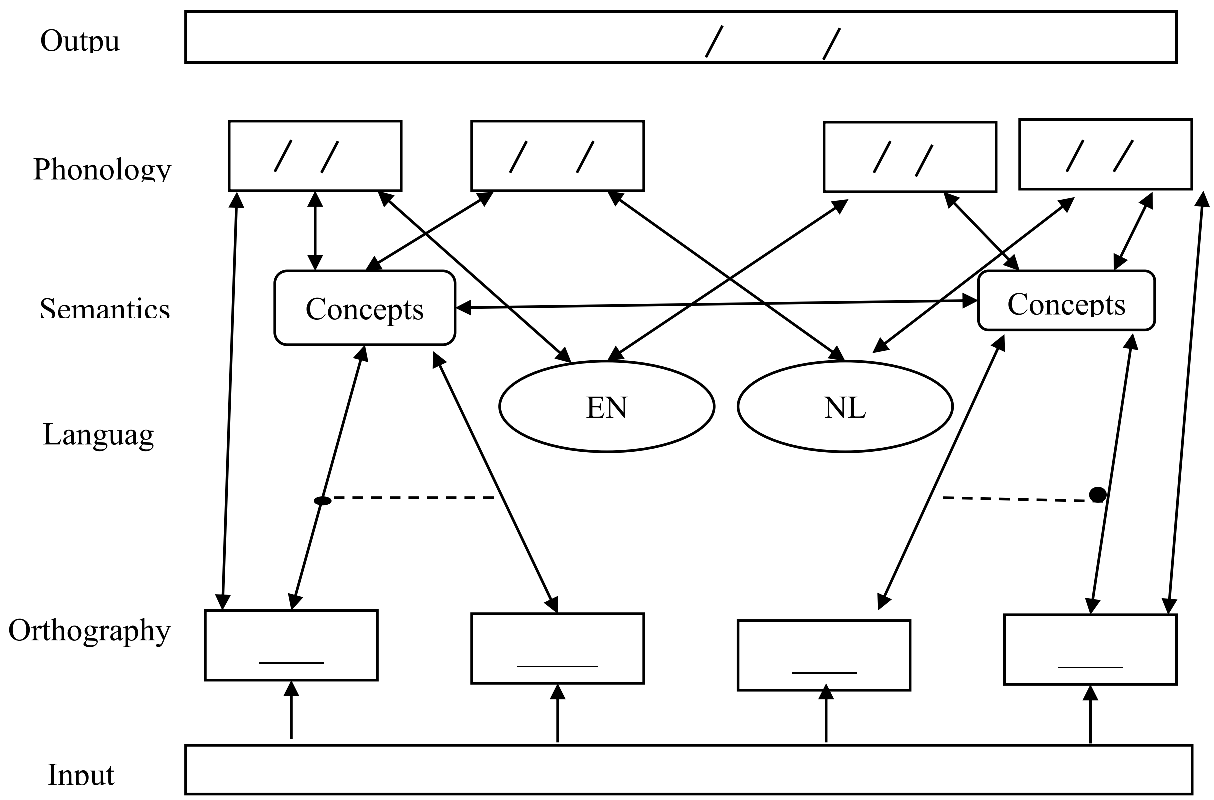
Recent theoretical developments in bilingual and multilingual language processing have expanded upon earlier models, such as RHM and the BIA/BIA+ model, aiming to better capture the dynamic and context-sensitive nature of lexical access. Among these, the Dual Correspondence Theory and the Multilink Model represent two influential but contrasting perspectives on how bilinguals navigate their linguistic systems. The Dual Correspondence Theory posits that bilinguals maintain two distinct yet interconnected lexical stores, both capable of accessing a shared conceptual system. This framework supports language-selective access, suggesting that lexical retrieval can occur independently in each language, especially during intentional language production. Conversely, the Multilink Model, extending the principles of the BIA+ model, proposes a fully integrated mental lexicon where lexical items from both languages are co-activated in a non-selective and interactive manner, particularly during visual word recognition tasks. This model emphasizes automatic cross-linguistic activation and highlights the role of contextual cues in managing language competition. Collectively, these models mark a theoretical shift from static, compartmentalized representations to more dynamic, interactive accounts of bilingual lexical processing, each offering explanatory power contingent on task demands and modes of language use.

2.5.1 The Multilink Model

The Multilink model supported an integrated lexicon for multiple languages, without any inhibitory effects, both within and between languages. In addition to the integrated lexicon, Multilink supported non-selective lexical access, which suggests that the lexical items from various speakers' languages are simultaneously activated. Another assumption of the Multilink model pertained to the phenomenon of word association, which supported that, instead of word association, translation was done through conceptual mediation by connecting forms of lexical items from various languages solely through their semantic forms. Finally, in Multilink, all-inclusive meaning representations were considered, entirely shared or entirely separate across the languages.

Figure 21

The Multilink Model for Bilinguals



Note. Adapted from Dijkstra et al., (2018)

The standard architecture of the Multilink model demonstrates how various processing levels are organised and how the linguistic levels activate during a task. The model proposes that lexical organisation and processing consist of varied levels of representation and processing that are mutually connected through a network of links. These levels of representation corresponded to various linguistic levels, such as the phonological level, the syntactic level, or the semantic level. According to the model, all these linguistic levels of representation are interrelated via a network of connections that permits the activation and integration of information among various linguistic levels. For instance, during the processing of a sentence, the phonological representation of lexical items activates syntactic structure, and the syntactic structure further activates the semantic representation.

The Multilink model has been employed in a range of psycholinguistic studies (Dijkstra et al., 2018; Vanlangendonck et al., 2020; Woumans et al., 2021) to explain multiple facets of lexical organisation and processing, including lexical access, sentence processing, and discourse comprehension. It has also been instrumental in accounting for individual differences in language processing abilities and developing models of bilingual and multilingual language acquisition. Critical commentaries by Van Heuven and Wen (2018) and Mishra (2019) have assessed the model's theoretical advancements and limitations, particularly concerning its universal applicability.

Van Heuven and Wen (2018) highlighted a key distinction of the Multilink model from earlier frameworks—its avoidance of slot-based letter coding systems used in previous computational models (e.g., Grainger & Dijkstra, 1992; Dijkstra & Van Heuven, 2002). Instead, Multilink excludes explicit letter representations, thereby reducing structural complexity while still enabling orthographic similarity calculations via Levenshtein distance. This allows for effective stimulation of orthographically related lexical items. The authors advocated for further empirical testing of the model across various recognition and production paradigms, including a translation-elicitation task, a masked priming task, and an eye-tracking task, using diverse language combinations, especially those involving distinct writing systems. In a subsequent commentary, Van Heuven and Wen (2019) regarded the Multilink model as a milestone in computational modeling of bilingual word recognition and translation. However, they noted the need for future versions to incorporate inhibitory mechanisms and address cross-script bilingualism.

Mishra (2019) similarly acknowledged the model's effort to overcome limitations of prior models, such as the Revised Hierarchical Model (RHM) and Bilingual Interactive Activation (BIA). A significant advancement in Multilink is its proposed control mechanism, which accounts for regulating unintended cross-language activations during bilingual and multilingual language processing. Despite consensus on the existence of an integrated lexicon and non-selective activation across modalities, the mechanisms by which the brain selects target lexical items and inhibits irrelevant ones remain unclear. Mishra emphasized that these points should not be viewed as criticisms, but as necessary considerations for refining comprehensive models of bilingual cognition. Notably, the Multilink model successfully accounts for several psycholinguistic effects that were previously overlooked, providing a valuable framework that integrates lexical activation and control mechanisms.

The following section reviews empirical studies providing evidence for both language-selective and non-selective lexical processing in bilingual and multilingual speakers. While findings vary, the body of evidence in support of non-selectivity significantly outweighs that for selective access, reinforcing the central assumptions of the Multilink model.

2.5. Evidence for Selectivity of Language Processing

Early psycholinguistic research, particularly from the 1960s to the 1980s, largely supported the notion of linguistic selectivity in bilingual language processing. This perspective posits that bilingual speakers possess separate language systems for storage, retrieval, and processing, with only one system activated at a time. Macnamara (1967) introduced the term "linguistic independence," arguing that bilinguals switch between discrete language systems depending on communicative needs, and only one is operational at any given moment.

Supporting this view, Kolers (1963, 1966) conducted a series of experiments exploring whether bilinguals access shared or separate cognitive stores. His findings, drawn from word-association and reading comprehension tasks, suggested that information is stored language-specifically and retrieval requires additional cognitive effort when crossing languages. While these studies were foundational, their experimental designs reflected the methodological limitations of the period, relying heavily on artificial tasks that may not fully capture the complexities of natural bilingual processing.

Further reinforcing the selectivity hypothesis, Tulving and Colotla (1970) found that recall performance deteriorated in bilingual and trilingual participants when processing mixed-language word lists compared to unilingual ones. Such findings were interpreted as evidence for language-specific memory systems, although these early studies often overlooked the role of proficiency, task type, and language dominance in influencing outcomes.

Subsequent research expanded on these early insights through more refined experimental paradigms. Gerard and Scarborough (1989) utilised cognates and homographs in lexical decision tasks with Spanish-English bilinguals, concluding that lexical items are stored separately across languages, with minimal cross-language transfer, despite the facilitative potential of cognates. Similarly, Macnamara and Kushnir (1971) reported longer response times during language switching, reinforcing the view that bilinguals operate within functionally distinct systems. However, their conclusions lacked consideration of bilingual fluency levels or contextual language use.

Altenberg and Cairns (1983) sought to refine these assumptions by distinguishing between independence and interaction hypotheses through lexical decision tasks with English-German bilinguals. Their findings suggested simultaneous activation of phonotactic constraints from both languages, indicating partial interaction rather than complete independence, a nuance overlooked by earlier studies.

The picture-naming paradigm, as employed by Costa et al. (1999), provided further clarity. Their results with Catalan-Spanish bilinguals revealed that facilitation and interference effects occur both within and across languages, yet facilitation was stronger within the same language. These findings complicated the notion of strict selectivity by highlighting dynamic activation patterns influenced by task demands.

Similarly, Bloem and La Heij (2003) demonstrated that contextual pictures facilitated lexical access, whereas contextual words caused interference in bilingual translation tasks. Their findings supported a model of conceptually driven lexical access while cautioning against overgeneralising selectivity claims without considering semantic context.

Studies involving different orthographic scripts also contributed to this debate. Kirsner et al. (1980), using Hindi-English bilinguals in lexical decision tasks, found that facilitation occurred within languages but was significantly reduced across languages, reinforcing the notion of language-specific access. However, the authors did not fully account for potential confounds such as proficiency imbalance or script familiarity.

Later neuroscientific evidence, such as that presented by Rodriguez-Fornells et al. (2002), used brain potentials and fMRI to show that bilinguals suppress non-target language activation at early stages of processing. Their findings provided robust empirical support for language-selective access at the neural level, demonstrating that non-target items are inhibited before semantic integration, aligning with psycholinguistic models advocating selective access.

While these early and mid-period studies were instrumental in shaping foundational theories of bilingual lexical access, their limitations must be acknowledged. These studies employed small samples, examined languages with similar writing systems, and overlooked critical variables such as language proficiency, dominance, and the context of language use. Moreover, the simplistic binary between shared vs. separate storage now appears reductive in light of more recent models, such as the Multilink Model (Dijkstra et al., 2019), which conceptualises lexical access as a dynamic, interactive process rather than strictly selective.

2.6. Evidence for Non-Selectivity of Language Processing

Over the past two decades, psycholinguistic research investigating the nature of language organisation, processing, and access has yielded mixed evidence regarding the structure of the bilingual lexicon and the mechanisms of lexical access. Some studies have supported the notion of a unitary lexicon but did not consistently endorse non-selective access, suggesting that shared storage does not necessarily imply simultaneous activation of multiple languages. In contrast, other studies have demonstrated robust evidence for the co-activation of two or more languages during processing, thereby supporting both a unified lexical store and non-selective access. These findings indicate that lexical items from multiple languages may be activated in parallel and compete for selection. To explore these dynamics, researchers have employed various experimental paradigms, most notably using three types of stimuli: interlingual homographs, interlingual neighbours, and cognate words.

2.6.1. Evidence for Non-Selectivity in Bilingual Studies

Early psycholinguistic studies provided robust evidence for non-selective lexical access in bilinguals, where lexical representations from both languages are simultaneously activated. Caramazza and Brones (1979) used cognates in lexical decision tasks with Spanish-English bilinguals. They found no significant differences between language-specific and mixed-language conditions, suggesting simultaneous access to both language systems.

Subsequent studies refined this understanding by focusing on orthographic and phonological overlaps across languages. Bijeljac-Babic et al. (1997) and Beauvillain and Grainger (1987) demonstrated through priming experiments that orthographically similar primes influenced lexical recognition regardless of the language context, supporting the view that shared orthography leads to shared activation. Jared and Kroll (2001) further demonstrated that phonological and orthographic features of both languages are co-activated during reading, with language dominance and proficiency serving as moderating factors.

Similarly, Brysbaert et al. (1999) confirmed interlingual phonological priming in French-Dutch bilinguals, even with non-word primes, reinforcing the parallel activation hypothesis. Collectively, these studies rejected models proposing strict language-selective access and instead highlighted the automatic, non-selective nature of lexical activation across orthographically similar languages.

2.6.1.1 Studies supporting BIA and BIA+ Models

Several foundational studies have supported the Bilingual Interactive Activation (BIA/BIA+) model as a robust framework for understanding bilingual lexical processing. These works—including Libben and Titone (2009), Sunderman and Kroll (2006), Perea et al. (2008), Dunabeitia et al. (2010), Van Assche et al. (2013), Kerkhofs et al. (2006), and Titone et al. (2011)—generally endorse a non-selective access view and a shared lexical store, often ignoring the dynamic, socially situated nature of bilingualism that newer frameworks such as translanguaging aim to capture.

Sunderman and Kroll (2006), for example, compared the Revised Hierarchical Model and the BIA model, revealing that lexical neighbours in both L1 and L2 interfere in processing irrespective of proficiency. However, the study still assumes a relatively linear and static view of lexical access, with limited discussion on how such access may change across interactional contexts or tasks involving pragmatic language use.

Similarly, Kroll et al. (2005) highlighted the non-selectivity of lexical access and proposed mechanisms of cognitive control in bilinguals. While the study significantly contributed to understanding language regulation, it foregrounds internal cognitive control without engaging with the sociolinguistic conditions under which such regulation may vary, such as code-switching or translanguaging practices.

Libben and Titone's (2009) study strengthened the case for non-selective access by showing differential eye movement patterns for cognates and interlingual homographs. However, their focus on written stimuli limits the generalisability of the findings to oral or dialogic settings, where bilinguals often shift between languages in real-time.

Perea et al. (2008) and Kerkhofs et al. (2006) provided neurocognitive evidence (e.g., ERPs, semantic priming) to support the idea that bilinguals activate semantic representations across languages. While their methodological rigour is commendable, these studies still implicitly assume a compartmentalised bilingual lexicon and do not fully account for flexible, fluid lexical access seen in multilingual speakers with high interactional competence.

Dunabeitia et al. (2010) and Titone et al. (2011) introduced important variables such as proficiency level and age of acquisition into the discussion. These studies suggest that even low-proficient bilinguals show cross-language activation. Nevertheless, their models fail to sufficiently incorporate how linguistic experiences such as translanguaging in education might restructure access patterns over time.

Van Assche et al. (2013) extended research to verb processing but remained grounded in the non-selective activation paradigm. The delay in cognate facilitation observed during sentence reading (only at later stages) supports the idea that context modulates access; however, the study did not explore how language users might strategically deploy such modulation in real communicative settings.

Shook et al. (2015) explored semantic constraint and lexical access delays in bilinguals versus monolinguals. Though the study highlighted slower access in bilinguals, the absence of eye movement evidence for cross-linguistic competition suggests the need to revise assumptions of automatic activation and investigate more nuanced interactional variables.

Moreover, earlier studies have been criticised for focusing almost exclusively on typologically similar language pairs, often with shared orthographic and phonological features. In contrast, Wu and Thierry (2010) and Mishra and Singh (2013) made significant contributions by testing cross-script language pairs like Chinese-English and Hindi-English. These studies demonstrated that even when orthographic systems diverge, bilinguals show interlingual activation effects, suggesting deeper, more abstract connections across languages. Wu and Thierry's implicit priming approach was particularly valuable in avoiding task-induced biases, though it was limited to monolingual task design. Mishra and Singh (2013) showed bidirectional orthographic activation, reinforcing the notion that bilingual lexical access transcends script boundaries.

In sum, while the BIA/BIA+ model and its supporting studies laid important groundwork in bilingual lexical processing, many of them inadequately reflect the dynamic, context-sensitive, and interactional nature of multilingual language use. These limitations point toward the need for integrating more socially and pragmatically grounded models—such as the Multilink model or translanguaging frameworks—to theorise multilingual mental lexicons more comprehensively.

2.6.1.2 Studies Supporting the Multilink Model

The Multilink Model (Dijkstra et al., 2018) extends BIA+ by integrating word frequency, orthographic similarity, and task demands into a unified framework of lexical processing. Recent studies offer empirical validation for this model. Tomaz et al. (2023) and Hu and Zhang (2023) demonstrated that bilinguals access both L1 and L2 representations during lexical decision and translation tasks, with effects modulated by lexical frequency and proficiency.

Similarly, Vanlangendonck et al. (2020) and McPhedran and Lupker (2020) showed that the degree of cross-linguistic orthographic overlap affects reaction times and accuracy, further supporting Multilink's predictions. These findings highlight the influence of contextual and individual factors, such as task type and proficiency, on shaping non-selective access patterns.

Moreover, Woumans et al. (2021) extended the model to language production, demonstrating cognate facilitation in typing tasks, thus providing converging evidence across modalities (reading, speaking, writing). Geffen (2019) highlighted the importance of lateral inhibition mechanisms within the model, refining its computational fit to experimental data.

While early Multilink simulations (Lormans, 2012; Peacock, 2015) provided foundational support, these studies also acknowledged limitations, such as difficulty capturing word length effects and translation asymmetry. Such critiques highlight the necessity of ongoing model refinement to account for nuanced bilingual processing behaviours.

2.6.2. Evidence for Non-Selectivity in Multilingual Studies

Although bilingual research dominates the field, multilingual studies have increasingly supported non-selective access, demonstrating co-activation across three or more languages. Lemhöfer et al. (2004) and Van Hell and Dijkstra (2002) found that cognate facilitation effects extend to trilinguals, though moderated by L3 proficiency. These findings suggest that higher proficiency enhances cross-language activation, while weaker L3 proficiency limits its impact.

Marian et al. (2013) and Van Heuven et al. (2011) employed the Stroop task to show that language proficiency and script similarity influence cross-language interference. Studies with non-shared scripts, such as Wu and Thierry (2010) and Mishra and Singh (2013), extended these findings to cross-script bilinguals, confirming that phonological activation persists despite orthographic differences.

Further, Poarch and Van Hell (2014) demonstrated that both double and triple cognates facilitate lexical access in trilinguals, regardless of immediate language context, emphasizing the robustness of non-selective access. Tytus (2018) and Toassi (2016) corroborated these results through combining the picture-naming task and the Stroop task, highlighting how language dominance and proficiency shape activation patterns across L1, L2, and L3. Critically, these studies reveal that proficiency, immersion, and script similarity modulate but do not eliminate non-selective access, challenging early views of isolated language systems and aligning with integrated models, such as Multilink.

While early studies established the principle of non-selective lexical access, they often overlooked key factors such as proficiency, immersion, and task type, which later research has shown to be crucial moderators. Moreover, most early work relied on European language pairs with shared scripts, limiting generalisability to cross-script contexts, a gap more recently addressed.

The transition from BIA to BIA+ and ultimately to Multilink reflects a broader theoretical advancement towards models that accommodate task demands, proficiency, and individual differences. However, despite growing empirical support, many studies still predominantly employ lexical decision, raising questions about language use and the extent to which these findings generalize to other understudied linguistic combinations and language use, such as translanguaging in Pakistani trilinguals.

This study responds to these gaps by employing multiple experimental paradigms (the picture-naming task, the Stroop task, the translation-elicitation task) to examine non-selective access in Punjabi-Urdu-English trilinguals, thereby contributing novel insights from a South Asian, non-Western context to current theoretical debates.

2.7 Lexical Processing and Access in Sentential Context

Most earlier studies on lexical organisation and access investigated isolated lexical items using experimental paradigms such as the lexical decision task. While such paradigms have provided foundational insights into bilingual lexical activation, they often neglect the influence of linguistic context, particularly the dynamic role of sentence- and discourse-level cues. To address this gap, several studies have extended inquiry to sentential contexts using eye-tracking, sentence reading, and a translation-elicitation paradigm. These contextually rich paradigms represent a significant theoretical shift from rigid experimental designs to more ecologically valid approaches in bilingual research.

For instance, Schwartz and Kroll (2006) explored the effect of sentential constraint on cross-language activation using eye-tracking. Their two experiments, with high- and intermediate-proficiency Spanish-English bilinguals in bilingual and monolingual settings, respectively, revealed cognate facilitation in low-constraint sentences but diminished effects in high-constraint ones. These findings highlight that while lexical access is non-selective, semantic richness in context can modulate cross-language activation. Notably, even low-proficiency participants employed contextual cues to suppress non-target language interference, which suggests a more dynamic and adaptive mechanism than earlier models like BIA+ could fully explain.

Chambers and Cooke (2009) examined similar dynamics using near-homophones across English and French. Contrary to expectations, L2 proficiency did not significantly reduce interlingual competition, highlighting that proficiency alone may not guarantee selective access. This challenges proficiency-based assumptions within traditional models and supports the need to integrate additional dimensions such as context sensitivity and language mode.

Van Hell and De Groot (2008) added further nuance by manipulating sentence constraint and lexical concreteness. Their results showed that high-constraint contexts neutralised cognate and concreteness effects, whereas low-constraint contexts preserved them. These findings reinforce the importance of semantic predictability in shaping cross-language activation, and they point to the necessity of rethinking static conceptualisations of the bilingual lexicon.

The study by Cop et al. (2017) marked a significant methodological advancement by moving from experimental sentences to naturalistic narrative reading. Through eye-tracking, they found that Dutch-English bilinguals exhibited cognate facilitation even during complex L2 and L1 reading, thus extending non-selective access effects into authentic, extended discourse. The facilitation was stronger in L2, especially for identical cognates, confirming the persistent activation of both lexicons even in fluent, native-language processing. This ecologically valid evidence aligns with translanguaging perspectives, which view the multilingual lexicon as dynamically structured across communicative contexts.

Gullifer et al. (2013) similarly moved beyond isolated word tasks by employing sentence-based translation-elicitation in Spanish-English bilinguals. The study innovatively compared mixed-language and blocked-language sentence presentation. Across both experiments, cognate facilitation persisted regardless of the language context or switching pattern, indicating robust non-selective access. This directly supports the BIA model's assertion that lexical access operates independently of language mode. Interestingly, the study also observed that inter-sentential code-switching incurred no additional processing cost. This finding resonates with translanguaging theory, which views such alternation as a normative and unproblematic cognitive process for multilinguals.

These studies cumulatively demonstrate a theoretical evolution: from rigid, isolated lexical processing models towards more dynamic, interaction-sensitive accounts of the bilingual lexicon. They also highlight the limitations of early models like the RHM, which overemphasised directionality and form-meaning links without adequately considering contextual modulation. Building on these insights, the current study draws particularly from Gullifer et al. (2013), adopting a translation-elicitation paradigm in L2–L3 and L3–L2 directions. It compares blocked and mixed language presentations to assess both cognate facilitation and interference under sentential constraints, thereby contributing to a more nuanced understanding of multilingual lexical access that accommodates both cognitive control mechanisms and contextual dynamics.

2.8 Factors Influencing Lexical Processing and Access

Investigating lexical organisation, access, and processing in bilingual and multilingual psycholinguistic research has highlighted several key factors that influence language processing mechanisms. Szubko-Sitarek (2015) identified three major domains that affect the strength of lexical connections across semantically and orthographically related languages: (1) characteristics of the experimental stimuli, (2) participants' language proficiency, and (3) psychotypological similarity between the languages involved. Among these, linguistic features of the stimuli emerged as particularly influential. These include lexical properties such as cognate status, word length, frequency (high vs. low), concreteness, and contextual constraint (e.g., high- vs. low-constraint contexts).

The second domain relates to speaker-specific variables, such as individual proficiency levels, language exposure, frequency and context of language use, age of acquisition, and learning environment. The third domain, namely, psychotypology, refers to participants' perception of similarity between their languages, which may influence cross-linguistic activation and lexical selection.

In addition to these core factors, previous studies have documented a range of psycholinguistic effects relevant to bilingual lexical processing. These include the word superiority effect (Warren, 2013), word length effect (Lemhöfer et al., 2008), frequency effect (Peeters et al., 2013; Gollan et al., 2008), neighbourhood density effect (Warren, 2013), and cognate facilitation observed in various tasks such as association (Sherkina, 2003), categorisation and translation (Dufour & Kroll, 1995; Kroll & Stewart, 1994), priming (Voga & Grainger, 2007), and lexical decision tasks (Szubko-Sitarek, 2015; Grainger & Dijkstra, 1992).

Building on these insights, the present study examines lexical access in Pakistani trilinguals, with a particular focus on both lexical and speaker-related characteristics. Variables such as cognate status, lexical frequency, congruency of lexical items, and participants' English language proficiency have been selected to explore the architecture of the multilingual mental lexicon and the dynamics of cross-language activation in trilingual contexts.

2.9 Lexical Processing and Access in the Pakistani Context

In psycholinguistics, considerable attention has been given to bilingual and multilingual lexical organisation and access (see Sections 2.5, 2.6, and 2.7). However, there remains a noticeable gap in experimental research on language processing within the Pakistani context. Specifically, few studies have applied psycholinguistic tasks to explore the cognitive mechanisms underlying multilingualism in Pakistan's linguistically diverse population.

Among the limited research conducted, two notable studies—Gill (2013) and Khan (2012)—differ significantly in approach and scope from the present research. Gill (2013) explored the trilingual lexical organisation among Punjabi-Urdu-English speakers using a phenomenological framework and qualitative data collection methods, including essay writing, focus group discussions, and semi-structured interviews. Her study highlighted key aspects including (1) the role of age of acquisition in learning subsequent languages, (2) reliance on Urdu to access English lexicon and asymmetrical translation patterns at lower L3 proficiency, (3) developmental stages of trilingualism, (4) the need for conscious language control to manage interference, and (5) the importance of language proficiency in lexical selection. These findings led to the development of a conceptual model that describes the structure and interaction of trilingual memory systems in the Pakistani context.

In contrast, Khan (2012) adopted a quantitative approach by investigating Urdu-English bilinguals through masked priming in lexical decision tasks. The first experiment tested whether the cognate facilitation effect, observed in other cross-script language pairs, was replicated in Urdu-English processing. Results showed both facilitation and inhibition effects when participants were tested in English, indicating non-selective access to the mental lexicon. However, no significant cognate advantage was observed when the task was conducted in Urdu. The second experiment tested frequency effects across balanced and unbalanced conditions. While frequency-balanced stimuli did not produce significant priming effects, unbalanced conditions revealed facilitation and inhibition for both cognates and non-cognates. These findings challenge the explanatory power of the BIA+ model, which does not fully account for phonological-level inhibition in cross-script processing. However, when the model is adapted to include phonological lateral inhibition, the observed effects become more interpretable. The study also acknowledged the role of individual differences in language proficiency and the use of processing strategies.

Collectively, these studies highlight the need for further psycholinguistic research in multilingual Pakistani settings, employing experimental methodologies grounded in more recent theoretical orientations. Notably, neither study incorporated indigenous languages alongside Urdu and English, nor did they draw on translanguaging theory. This theoretical and empirical gap provides the rationale for the current study, which integrates a psycholinguistic experimental approach with a translanguaging perspective to investigate lexical access and organisation among Pakistani trilinguals.

2.10 Research Gap

Over the past two decades, an increasing number of studies have investigated the multilingual mental lexicon, with particular emphasis on cross-language interaction in tri- and multilingual speakers. These studies have provided evidence for both selective and non-selective lexical access; however, findings predominantly support non-selectivity and shared lexical storage—core principles of translanguaging theory (Otheguy et al., 2015; Vogel & García, 2017). Translanguaging frameworks emphasize the speaker's agency in managing a unified linguistic repertoire, where inhibitory control plays a central role in accessing and regulating multiple languages simultaneously.

Despite this growing body of research, earlier psycholinguistic studies have primarily focused on widely spoken or typologically similar language combinations—such as Romance, East Asian, or South Asian pairs—while overlooking the unique linguistic configuration of Pakistan. In particular, little attention has been given to trilinguals who speak Punjabi as their first language, Urdu as a national and second language, and English as a foreign language. This study addresses that gap by examining lexical organisation and access in Pakistani trilinguals, using a translanguaging perspective to explore how indigenous language combinations function cognitively in multilingual contexts.

The next chapter provides a comprehensive description of the research methodology employed in this study, including the theoretical framework, materials used, participant selection, ethical considerations, psycholinguistic tools, and procedures for the pilot study.

2.11 Chapter Summary

This chapter begins by explicating the concept of translanguaging, its fundamental principles, and its practical efficacy in applied linguistics and psycholinguistics. It highlights the distinction between translanguaging and multilingualism. Translanguaging stresses the significance of repertoire building. All languages of the participants are stored in a unitary mental lexicon. This chapter also provides a detailed discussion of various lexical organisation and access models. Beginning with the earliest attempts to explain the nature of the linguistic organisation in bilinguals, such as Weinreich (1953) and Kolers

(1963). The later models include hierarchical, computational, distributed, and localist bilingual language processing and access models. These models focused on lexical interaction between the two languages of bilingual participants. Besides bilingual language processing models, several models of multilingual language processing have been proposed to account for the nature of the multilingual mental lexicon, including the multilingual processing model, the Dynamic Model of Multilingualism, the Multilingual Interactive Activation Model, and the Multilink Model. Later models, such as the Multilink model, incorporate features from earlier models, including RHM, BIA, and BIA+. Various studies testing these models have provided evidence for both single-store and separate-store models. Similarly, some studies supported selectivity of language processing, focusing on speakers selectively activating and attending to their languages in contrast to non-selectivity of language processing, suggesting that speakers activate all of their languages simultaneously. The executive control mechanism allows them to use task-specific language. These studies highlight various linguistic features and speaker characteristics that can influence the linguistic organisation and access. Among the most prominent linguistic features are cognate status, lexical frequency, exposure to a particular language, and the number of languages involved. In contrast, participant features include foreign language proficiency, age of onset, etc. Finally, the chapter concludes with a review of relevant studies in the context of indigenous Pakistani languages and participants to analyse lexical access in Pakistani multilingual participants.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter provides a comprehensive overview of the research methodology adopted for the present study. It outlines the research design, theoretical framework, participant profile, sampling procedures, software tools, selection and design of linguistic stimuli, experimental paradigms, ethical considerations, data collection timeline, procedures, instruments for data collection and analysis, and details of the pilot study.

Situated at the intersection of psycholinguistics and applied linguistics, the present study aims to empirically investigate a core principle of translanguaging: the existence of a unitary linguistic repertoire and the (non)selectivity of cognitive processing of linguistic resources. The unitary repertoire hypothesis posits the presence of a single, integrated mental lexicon in which all linguistic resources are simultaneously activated. Non-selectivity, in this context, refers to the concurrent activation of lexical items from multiple languages, which then compete for selection depending on the cognitive demands of the task.

While earlier psycholinguistic studies have explored these phenomena, the majority have focused on bilingual speakers and language pairs that are orthographically similar—such as English-French, Dutch-English, English-Spanish, and English-German—with only a few exceptions (e.g., Chinese-English, Hindi-English). In contrast, the current research addresses an underexplored language constellation by focusing on trilingual speakers of Punjabi, Urdu, and English—languages that are typologically and orthographically distinct. This study thus seeks to contribute to the growing body of research on multilingual processing by examining whether principles established in bilingual contexts also apply to more diverse linguistic configurations.

3.1 Theoretical Framework

The theoretical orientation of this study is grounded in the translanguaging framework (Wei, 2018) and the Multilink Model of lexical processing (Dijkstra et al., 2018), as elaborated in Chapter 1 (see pp. 7–10). The research investigates the structure and functioning of the mental lexicon among trilingual Pakistani speakers, with a particular focus on individuals whose first language is Punjabi. It explores how linguistic resources from English, Urdu, and Punjabi are organised, processed, accessed, and retrieved through three carefully designed psycholinguistic tasks: the picture-naming task, the Stroop task, and the translation-elicitation task.

3.2 Research Design

This study employs an experimental, cross-sectional design, situated epistemologically within the post-positivist paradigm, and employs a mixed-methods approach. This study was conducted within the post-positivist paradigm, which provides an appropriate philosophical foundation for investigating the cognitive processing of linguistic resources in translanguaging. The choice of this paradigm was necessary because the research problem required both the empirical rigor of experimental psycholinguistics and the interpretive depth of qualitative insights. Post-positivism, unlike strict positivism, acknowledges that while reality exists and can be measured systematically, our understanding of it is always partial, influenced by context, instruments, and human interpretation. This balance makes it the most suitable stance for studying translanguaging, which is at once a measurable cognitive phenomenon and a lived social practice.

A mixed methods design was adopted to capture the multifaceted nature of translanguaging. Cognitive processing can be investigated through quantifiable measures such as reaction times, error rates, and statistical comparisons (paired sample t-tests and MANOVA). However, such measures cannot fully account for how participants make meaning from their linguistic resources or how memory systems support cross-linguistic integration. To address this, qualitative analysis was incorporated to provide interpretive insights into participants' strategies and perceptions. Thus, the study followed a QUAN-qual sequence, where quantitative results formed the primary strand, and qualitative interpretation was used to deepen, contextualize, and triangulate the findings. This sequencing ensured that the study preserved the psycholinguistic rigor of experimental research while also addressing the broader translanguaging framework that foregrounds meaning-making and memory.

The post-positivist paradigm explicitly supports methodological pluralism. Unlike positivism, which privileges objectivity and measurement alone, post-positivism allows for the integration of multiple methods to approximate reality more closely. At the same time, unlike purely interpretivist paradigms, it does not dismiss the value of empirical measurement. This renders it particularly suitable for mixed-methods research, where the quantitative strand provides reliable and replicable evidence of facilitation and interference in cognitive processing. In contrast, the qualitative strand adds depth by interpreting participants' reflections, strategies, and experiences in making meaning through their multilingual repertoires. Anchoring the study in post-positivism enables the strands to function complementarily rather than in contradiction, yielding a more comprehensive and valid understanding of trilingual cognition.

Within the post-positivist framework, the study employed a quasi-experimental design for the quantitative phase, as participants were naturally grouped by proficiency and academic discipline rather than randomly assigned. This preserved ecological validity while still enabling rigorous statistical testing. For the qualitative phase, interpretive thematic analysis was used to analyze participants' accounts and reflections. This ensured that experimental findings were not treated in isolation but were grounded in the lived multilingual realities of the participants. The combination of these sub-designs is consistent with a QUAN-qual mixed methods approach under post-positivism: the quantitative results establish measurable trends. At the same time, the qualitative findings illuminate the underlying cognitive and experiential mechanisms.

The methodology integrates both qualitative and quantitative analyses to examine the structure of the multilingual mental lexicon. Qualitative data were gathered through a language background questionnaire, researcher observations, and analysis of participant responses and error patterns (White, 2015). Quantitative data were collected via three psycholinguistic experiments, namely, the Stroop task, the picture-naming task, and the translation-elicitation task, administered using DMDX software. Response times and performance accuracy were statistically analysed to draw inferences about lexical organisation and access among trilingual speakers.

The methodological framework is informed by previous psycholinguistic research, including Abunuwara (1992), Gullifer et al. (2013), and Tytus (2018), while extending their designs through the inclusion of a different language set and the theoretical lens of translanguaging. Unlike earlier studies, which often focused on orthographically similar languages, the present research examines English, Urdu, and Punjabi—three typologically and script-wise distinct languages. In doing so, it empirically investigates the translanguaging premise of a unitary linguistic repertoire and non-selective lexical access through task-based evidence across production and comprehension modalities.

3.3 Preparation and Presentation of Visual and Linguistic Stimuli

This section outlines a detailed process for preparing and presenting visual and linguistic stimuli, including the selection and determination of cognate status, as well as the use of psycholinguistic software to measure response times.

3.3.1 Psycholinguistic Software

In psycholinguistic experimental studies, the use of software is inevitable for stimulus presentation and measurement of responses. It requires millisecond precision to measure and record participants' responses for further statistical analysis. DMDX is a display software designed explicitly by Forster & Forster (2003) at the University of Arizona for psycholinguistic studies involving language processing to present visual and auditory stimuli and record response times. DMDX is an open-source software that is regularly updated and managed, making it available for psycholinguistic researchers to design and conduct experiments efficiently and effectively. It records and saves the response times of research participants for later statistical analyses, hypothesis testing, and evaluation. In this study, DMDX version 6.3.4.2 (Forster & Forster, 2003) is used to present stimuli for all three experiments.

3.3.2 Approaches for Establishing Cognate Status

One of the fundamental steps in psycholinguistic studies involving cognates is the establishment of a reliable corpus of cognate vocabulary, more precisely, in the case of the current study, a set of Punjabi-Urdu-English cognate and non-cognate vocabulary. The lexical items and their lexical frequency were drawn from the English Lexicon Project, an open-source database (Balota et al., 2007). After the selection of lexical items, the next phase was the determination of cognate status. To achieve this goal, an objective and scientific procedure for identifying cognates from the psycholinguistic perspective was required. During empirical history, psycholinguistic studies have employed two distinct methods of establishing cognate status.

In an earlier research, Taylor (1976) adopted a subjective approach to determining the status of cognates. She decided which lexical items were “dissimilar,” “misleading,” or “similar” cognates and preferred to use words that belonged to either of the two categories, that is, cognate or non-cognate. Using a subjective approach led to the unreliability of her research findings. Later, some researchers employed two distinct objective techniques for deciding the cognate status of lexical items. In the first of these studies, De Groot and Nas (1991) implemented a similarity rating task whereby the Dutch-English bilingual participants were given lists of translation pairs to assess the degree of similarity of lexical pairs on a 7-point rating scale. The mean scores of participants were used to affirm the categorisations of researchers. Kroll and Stewart (1994) introduced the second objective procedure, commonly called the translation-elicitation task. It required the participants to produce an equivalent English word for each of the words presented to them in the Dutch language. The participants received contextual cues as words were grouped under five categories: clothing, fruits, vegetables, etc. The underlying concept was that the lexical items with cognate status in the corresponding foreign language would coincide with their mother tongue translation to activate meaning. The ratio of correctly translated words determined the cognate status of lexical items; words translated correctly by more than half of the subjects were assigned cognate status.

To develop the dataset of cognates and non-cognates, the researcher employed a rigorous three-step process. Since the present study involved translingual practices among trilingual speakers, establishing the stimulus list involved determining triple cognates, double cognates, and control words. The three steps included the preparation of an initial lexical list, dictionary authentication, and interrater reliability.

The researcher compiled an initial vocabulary list of 180 words, divided into three major categories: triple cognates, double cognates, and unrelated words, in consultation with her supervisor. It was laborious to assemble a list of lexical items in all three categories. Next, the vocabulary list was authenticated from the Punjabi dictionary (Khan, 2012) to countercheck if the proposed lexical items were present in the Punjabi dictionary, along with the validation of English etymology. Finally, the interrater reliability of lexical items was obtained from two raters.

Interrater reliability refers to the degree to which two or more participants agree (Lange, 2011). For interrater reliability, the vocabulary list was alphabetically organised and presented to two faculty members from the Department of Pakistani Languages, NUML, Islamabad, to obtain interrater reliability of the status of triple cognates, double cognates, and unrelated words. The participants responded to the vocabulary items as to whether the words were the same across all of their languages in Punjabi and Urdu or were different in English, Urdu, and Punjabi. Cohen's kappa and percentage of agreement between two raters using SPSS. The results showed 97.5% agreement among raters, and $\kappa = .70$

3.3.3 Justification for the Use of Scripts for the Experimental Tasks

In the present study, three experimental tasks were designed to investigate the cognitive processing of linguistic resources among trilingual speakers. It is important to clarify that not all tasks required the use of the participants' indigenous language script. The first two experiments, the picture-naming task involving triple cognates, double cognates, and unrelated words, and the Stroop task comprising congruent, incongruent, and control trials, were primarily oral-production and reaction-time based. These tasks relied on participants' ability to recognize visual stimuli and produce lexical responses, making the written script of the indigenous language unnecessary. Lexical access and inhibitory control were measured through oral responses and reaction latencies, independent of orthographic familiarity.

However, the third experiment, the translation Elicitation Task, was different in its methodological demands. This task required participants to translate lexical stimuli across their three languages (L1, L2, L3), which ideally necessitates presenting items in their respective scripts for accuracy and control. While Urdu (L2) and English (L3) posed no difficulty since participants were proficient in their written forms, Punjabi (L1) presented a challenge. Despite being native speakers, participants were unfamiliar with the Shahmukhi script typically associated with Punjabi, as Punjabi in Pakistan is predominantly an oral language with limited standardized instruction in schools. To avoid confounding the results due to script unfamiliarity rather than linguistic competence, Punjabi stimuli were not presented in written form. Instead, the translation task was conducted using Urdu and English scripts using the hidden manipulation of triple cognates, double cognates, and unrelated words, which ensured that participants' performance reflected their linguistic processing rather than their literacy in a script with which they were not familiar.

This methodological decision was made deliberately to preserve the validity of the experimental findings. By minimizing orthographic bias and focusing on oral-lexical processing, the study ensured that observed outcomes represented authentic patterns of cross-linguistic activation and resource mobilization among trilingual participants.

3.4 Research Participants

Initial screening

1. Willingness to participate
2. Students of the undergraduate program at NUML
3. Trilinguals
4. Punjabi as their mother tongue

3.5 Sampling of Participants

The research participants selected for the current research were both male and female undergraduate university students from three different faculties of the National University of Modern Languages, Islamabad, Pakistan: the Faculty of Arts and Humanities, the Faculty of Business Administration, and the Faculty of Engineering and Computing, to constitute a homogeneous group of participants. The sampling frame for the current research consisted of 109 undergraduate students. The participants from three distinct faculties were all trilingual, able to speak English, Urdu, and the indigenous language of Punjabi.

A stratified sampling technique was employed for participant recruitment. It is a probability sampling technique in which the population is divided into distinct subgroups, or strata, based on shared characteristics, and participants are then randomly or proportionally selected from each subgroup (Larry et al., 2024). This method ensures that all significant segments of the population are adequately represented in the sample, thereby reducing sampling bias and increasing the generalizability of the results. In the context of the present study, stratification was carried out by dividing undergraduate students according to their faculty affiliation and further by their English language proficiency levels. This approach allowed the researcher to capture variations across both academic backgrounds and language abilities, which are essential for investigating patterns of cognitive processing in translanguaging. By ensuring representation from each stratum, the sample reflects the diversity of the target population more accurately than a simple random or convenience sample.

In this study, a stratified sampling technique was employed. Undergraduate students were selected from three distinct faculties at NUML: the Faculty of Arts and Humanities, the Faculty of Business Administration, and the Faculty of Engineering and Computing. These faculties served as strata to ensure that the sample represented students from diverse disciplinary backgrounds. Within each stratum, participants were further categorized based on their English language proficiency, which is a key variable in psycholinguistic processing. This approach allowed for a more balanced and representative sample across both academic domains and language proficiency levels, thereby enhancing the validity of the findings.

3.5.1 Rationale for Participant Recruitment from NUML

The participants for this study were selected from the National University of Modern Languages (NUML), Islamabad, which provided an appropriate site for investigating translanguaging within a psycholinguistic framework. NUML was chosen deliberately because it is a federally chartered, multilingual-focused institution where students routinely engage with multiple languages, particularly English, Urdu, and their regional languages. This environment ensured access to a sufficiently large pool of trilingual participants, a prerequisite for this study. The sample of participants drawn from

NUML was homogeneous, consisting of trilingual Punjabi-Urdu-English undergraduates, but reflected diversity along two key dimensions: academic/disciplinary diversity and geographic diversity. The participants were recruited from three distinct faculties: the Faculty of Arts and Humanities, the Faculty of Business Administration, and the Faculty of Engineering and Computing. This diversity in academic background ensured that the sample represented different cognitive orientations, disciplinary literacies, and language use patterns, reducing the risk of bias associated with restricting participants to a single discipline. The geographic diversity lies in the fact that NUML draws students from various cities across Pakistan. As a result, the participants brought with them a wide range of regional variations of indigenous languages and sociolinguistic repertoires in addition to Urdu and English. This geographic diversity added depth to the data, as it captured how translanguaging functions across different linguistic ecologies within Pakistan. Collectively, the sample offered both institutional coherence (all participants enrolled in the same university context where multilingual education is the norm) and internal diversity (across faculties and regions). This balance minimized sampling bias and enhanced the representativeness of the findings, making NUML an appropriate and justified site for investigating cognitive processing of linguistic resources in translanguaging.

3.5.2 Dialectal Considerations in Participant Selection

In addition to capturing academic and geographic diversity, the study also considered dialectal variation within Punjabi, which carries significant implications for how speakers process and access linguistic resources. Punjabi, as spoken in Pakistan, comprises several regional dialects such as Majhi (central Punjab), Potohari (northern Punjab), Jhangvi and Shahpuri (western Punjab), and Multani/Saraiki (southern Punjab). Each dialect differs in its phonological realization, lexical choices, and semantic associations, which in turn can shape how speakers process and retrieve linguistic resources. Since psycholinguistic processing is closely tied to familiarity and frequency of input, acknowledging the dialectal background of participants was an essential step in this study. The Punjabi-speaking participants in this research were not drawn from a single dialect group but reflected the regional diversity of NUML's student body. For example, some participants from central Punjab predominantly used the Majhi dialect, while others from northern Punjab regions used the Potohari dialect, which carries distinct phonological features and vocabulary. A smaller group represented southern Punjab, where the Multani variety is more dominant.

To ensure methodological clarity, participants were asked during the background screening phase to self-identify their home language variety. In experimental tasks, however, the participants responded to the stimuli in their respective dialects. By including speakers from multiple dialects, the study captured the real multilingual and multidialectal repertoire that shapes linguistic processing in Pakistan. It is also important to note that while participants often used their local dialects in informal communication, they demonstrated high cross-dialect comprehension due to exposure in media, social networks, and peer interaction. Therefore, dialectal diversity was not an obstacle but rather an added dimension of ecological validity, reflecting the way Punjabi functions dynamically in multilingual Pakistan. By explicitly considering dialectal variation, this study ensures that the findings on cognitive processing in translanguaging are not narrowly tied to one variety of Punjabi but instead reflect the broader linguistic reality of Punjabi speakers across the country.

Beyond dialectal variation, script familiarity emerged as another crucial methodological consideration, for the selection of participants as well as the use of the Punjabi script for stimuli presentation (as discussed in 3.3.3). While the participants were trilingual speakers, not all of them were literate in the written scripts of their mother tongue, Punjabi. This reflects a broader sociolinguistic reality in Pakistan, where many regional languages are predominantly oral and lack the same institutionalized teaching and standardized script exposure as Urdu and English. To address this, participants were primarily screened on oral and receptive proficiency in three languages—Urdu, English, and their regional language—rather than on written literacy across all three. All participants were able to understand and produce the Punjabi language orally, even if they were unable to read or write its script. This ensured that they authentically represented trilingual speakers who actively employ multiple linguistic resources in real-life communication.

Since most of the participants were not familiar with the Punjabi script, alternative strategies were employed to assess their Punjabi language proficiency; the participants were asked to respond orally to certain trial items in Punjabi, confirming that they could recognize and understand those items even if they could not read them in written form. This step filtered out individuals who lacked functional competence in their mother tongue. While script literacy varied, the psycholinguistic focus of this study was not on orthographic processing but on cognitive activation of multilingual resources. Thus, oral proficiency was the more relevant criterion for inclusion. By accommodating spoken competence, the study preserved ecological validity and reflected the actual multilingual practices of Pakistani speakers.

By clarifying the role of scripts in the selection process, the study acknowledges a common sociolinguistic phenomenon in Pakistan: strong oral proficiency in regional languages paired with limited script literacy. Instead of excluding such participants, which would have reduced representativeness, the design adopted flexible screening strategies that ensured participants were indeed trilingual in practice. This approach enhances the authenticity and validity of the findings while making the study more inclusive of Pakistan's diverse linguistic ecology.

The participants were all healthy and right-handed individuals with no history of psychological and neurological disorders or significant medical ailments. The researcher briefed the participants on the study's objectives, its significance, and the procedure. They were instructed about the expectations of them. After a detailed introduction to the nature, architecture, and design of the study and expectations from the participants, they were free to decide whether to take part in the study or to refuse to participate. Some participants refused after the introduction to the study, as they were apprehensive about the results, fearing that it would reveal anything unfavourable about their performance as students. The participants in the study provided their informed consent to take part in the research.

3.5.3 Criteria for Assessing Linguistic Proficiency

Since this study investigated the cognitive processing of trilingual participants, it was essential to establish a minimum threshold of proficiency in both Punjabi and Urdu to ensure that participants could reliably engage with the tasks. The following criteria were used:

3.5.3.1 Self-Reported Language Background

During the participant screening phase, students were asked to complete a language background questionnaire, adapted from widely used tools in bilingual and multilingual research. This questionnaire included information about the age of acquisition of Punjabi and Urdu, the contexts of use (such as home, school, and social settings), and the frequency of use, including the number of hours participants use their respective language and with whom they use it. Participants consistently reported Punjabi as their L1 and Urdu as an early-acquired L2, typically through schooling and media exposure.

3.5.3.2 Oral Proficiency Check

To ensure functional communicative competence, participants were asked to respond to a short set of oral prompts in both Punjabi and Urdu. Their ability to comprehend and respond appropriately was used as a basic indicator of oral proficiency.

3.5.3.3 Reading Comprehension Check in Urdu

Given that Urdu is the medium of education for most students, participants were asked to read and explain short Urdu sentences during screening. This ensured that all participants had adequate reading and receptive proficiency in Urdu, which was crucial for the experimental tasks.

3.5.3.4 Focus on Functional Bilingualism than Script Literacy in Punjabi

Since Punjabi is primarily oral in use for most participants, proficiency was assessed in terms of oral comprehension and production, rather than script literacy. Participants demonstrated familiarity with core vocabulary and could engage in spontaneous responses, which confirmed their active use of Punjabi in daily communication.

These combined measures ensured that all participants possessed native competence in Punjabi (L1) through lifelong use in family and community domains, and high functional proficiency in Urdu (L2), acquired through early schooling and daily interaction. The decision to use a multi-step, functional approach to proficiency assessment, rather than standardized language tests, was deliberate. It reflects the ecological realities of Pakistan's multilingual context, where bilingual and trilingual competence is best demonstrated through actual language practices rather than only formal literacy skills. This ensured that the participants selected were genuinely representative of trilingual speakers in the Pakistani context, while maintaining the validity of the study's psycholinguistic focus.

3.6 Ethical Considerations

This research was conducted in full compliance with established ethical guidelines governing studies involving human participants, with particular sensitivity to the cultural and educational context of Pakistan. Primary ethical considerations include informed consent, voluntary participation, confidentiality, and anonymity. Informed consent consists of two segments: the 'Informed' aspect must include some fundamental information about the researcher, the purpose and scope of research, the nature of data to be collected from participants, the method of data collection, the expected level of commitment from the participants, the utilisation and reporting of collected data and probable risks of taking part in the research and the 'consent' aspect include information regarding willing to participate, information on their right to withdraw at any time even if they have provided the required data, the confidentiality of participant identity, clarity of ownership of raw data, the right of participants to access their data, the right to ask for further details (Fleming & Zegward, 2018).

The participants of the study provided their informed consent before participating in the experiment. Those participants who willingly provided informed consent took part in the experiment. They have been provided with an explanation of the evaluation procedure, the purpose of the study, how the findings will be used, and who will have access to the findings. The participation of students in this research was purely voluntary. They voluntarily agreed to be part of the experiment and were informed of their right to withdraw at any stage without providing a reason and without facing any negative consequences. The information provided by the research participants will be kept strictly confidential. The identity of the participants remained anonymous in the analysis and evaluation of results. The study results were shared with the participants if they wished to know about them.

To uphold ethical standards of confidentiality and anonymity, all personal identifiers were removed from the data during analysis and reporting. Data was stored securely and used solely for this academic research. Findings were presented in aggregate form to prevent any identification of individual participants. These measures ensured that the study maintained rigour, integrity, and respect for the rights and dignity of the participants, in line with international research ethics and the specific cultural considerations of the Pakistani context.

3.7 Data Collection Tools

Mixed methods research frequently employs both qualitative and quantitative approaches to capture diverse forms of data from a single source (White, 2015), a design known as concurrent mixed methods. For instance, a survey designed to analyse participants' attitudes toward work may provide both qualitative data, such as their beliefs, opinions, and aspirations, and quantitative data on their level of commitment and skills (Walliman, 2021). For this study, participants completed a language background questionnaire and participated in three experimental tasks. The information gathered through language background and analysis of participants' responses to visual stimuli furnished qualitative data. In contrast, measuring response times for each stimulus provided quantitative data in milliseconds. The visual stimuli were presented to participants through DMDX version 6.3.4.2 software with a refresh rate of 15.63ms on a laptop screen, and response times were calculated to ensure millisecond precision of responses. The data was collected through the following qualitative and quantitative data collection tools for the analysis and evaluation of study hypotheses:

1. Quantitative data collection tools
   i. English language proficiency test
   ii. Psycholinguistic tests
      a. Experiment 1: the picture-naming task
      b. Experiment 2: the Stroop task

c. Experiment 3: the translation-elicitation task

2. Qualitative data collection tools

i. Language background questionnaire

ii. Integration of quantitative findings into qualitative interpretation

iii. Analysis of errors and responses

3.7.1 Quantitative Data Collection Tools

Quantitative analysis involves numerical data in the form of numbers and utilises mathematical operations to examine their characteristics (Walliman, 2021). Quantitative analyses are carried out to measure, explore, control, or explain phenomena, construct concepts and theories, examine relationships, make comparisons, make forecasts, and test hypotheses. For the present study, the quantitative data came from language proficiency tests and psycholinguistic tasks. Participants performed an online vocabulary test to examine their English language proficiency, and these scores were used to evaluate response times and whether they impacted their lexical organisation and access. The other source of quantitative values was response times from three experiments. The participants' response times were collected through DMDX and analysed and compared with other variables to analyse the trilingual mental lexicon.

3.7.1.1 Language Proficiency Test

The participants took part in LexTALE. LexTALE refers to the "Lexical Test for Advanced Learners of English." This test has been designed for cognitive and psycholinguistic research studies that include participants with high proficiency in English as a second language in an experimental setting. It can be administered online or incorporated into experimental software. LexTALE (Lemhofer & Broersma, 2012) is an open-access test that is valid and standardised to assess the English language proficiency of participants in psycholinguistic experiments. LexTALE is available in English, Dutch, and German to examine the objective language proficiency of participants for whom it is their second language.

LexTALE is an online test designed to measure the objective language proficiency in English, German, and Dutch of research participants whose objective language proficiency in a second language is required. It is a standardised and validated English test designed for psycholinguistic researchers studying cognitive language processing involving participants with high proficiency in English as a second language in an experimental setting. LexTALE is easy to administer for evaluating objective English language proficiency, either performed discretely or incorporated into some software and other psycholinguistic tests. The participants had to decide whether these were actual English words or not about sixty lexical items that appeared on the screen. It is a simple, un-speeded lexical decision task. On the completion of the test, the score of each participant was displayed on the screen and was shared with the researcher through email.

3.7.1.2 Psycholinguistic Experiments

Afterwards, the participants performed three psycholinguistic tests. Their response times were recorded and further analysed to validate or nullify the research hypotheses regarding the interactive pattern of various linguistic resources and facilitation or interference. The psycholinguistic tests were carefully selected for the present study to examine the objectives of the research. These tests included i. the picture-naming Task, ii. the Stroop task, and iii. the translation-elicitation task.

3.7.2 Qualitative Data Collection Tools

Qualitative data are expressed in beliefs, customs, ideas, and observation notes about various practices examined in studies involving human beings, social practices, and cultures (Walliman, 2021). The data collected by qualitative data collection tools cannot be counted or accurately measured. The qualitative data for the present study were collected through a language background questionnaire and evaluation of participants' performance of the visual stimuli. Analysing the accuracy of responses and errors provided valuable insights into the organisation and access to the trilingual mental lexicon.

3.7.2.1 Participant Language Background Questionnaire

The participants furnished informed consent to take part in the study. They voluntarily participated in the study. First, the participants filled in a participant language background questionnaire that provided complete details about their language history, their mother tongue, the number of languages they speak, any additional language that they speak, the age and context of acquisition of all of their languages, context, and degree of use of all of their languages daily and their subjective language proficiency in English, Urdu and indigenous language that is Punjabi.

The language background questionnaire was used to probe the linguistic repertoire of participants in various former studies (Schimpff, 2021; Kootstra et al., 2020; Li & Gollan, 2018b; Li et al., 2020). It has proven to be an effective tool, enabling psycholinguistic researchers to identify various factors responsible for interaction patterns among participants who use multiple languages. The current study is itemised concerning what is most pertinent to the study. In the scenario of the current study, participants needed to use all of their languages daily in addition to the age at which they learnt these languages. One of the main criteria for recruiting participants was that they speak and use all three of their languages regularly, ensuring that no language is dormant. Participants were also expected to report high scores on language usage and language proficiency in all their languages.

The language background questionnaire focused on the subjective language proficiency in all languages they spoke, including English. The participants rated their language proficiency on a scale from 1 to 10, 1 representing the weakest and 10 representing the highest proficiency level. To test their objective language proficiency in English, the participants then performed the LexTALE test (Lemhöfer & Broersma, 2012) as has been implemented in other studies (Poort & Rodd, 2017; Tytus, 2018) so that their objective language proficiency in English could be determined and compared with their subjective scores for analysis of language processing and lexical access.

3.7.2.2 Integration of Quantitative Findings into Qualitative interpretation

In this study, the quantitative results derived from experimental tasks were not treated in isolation. However, they were systematically integrated into the qualitative phase of analysis to provide deeper insight into participants' cognitive processing. The statistical patterns obtained from the picture naming, Stroop, and translation elicitation tasks were used as a foundation to identify areas of linguistic facilitation, interference, and non-selective activation. These patterns were then qualitatively interpreted by examining the nature of errors, participant strategies, and meaning-making processes in real-time performance. For instance, higher accuracy and faster reaction times in cognate and congruent trials were explored qualitatively to understand how participants mobilised cross-linguistic resources. In contrast, error types such as code-mixing or false cognates were analysed as evidence of adaptive translanguaging strategies. This integrative approach aligns with the mixed-methods QUAN-qual design, ensuring that numerical trends were contextualised within the lived linguistic repertoires of the participants, thereby offering a more comprehensive understanding of how multilingual speakers in Pakistan negotiate meaning and memory across their languages.

3.7.2.3 Analysis of Responses and Errors

Participants' performance on psycholinguistic tasks was analysed for the accuracy of responses, investigation of errors, and measurement of response times. The measurement of response time resulted in quantitative data. In contrast, the analysis of accuracy and errors yielded individual observations for each participant, which were combined with quantitative data to examine the data and test hypotheses. Accuracy of responses refers to validating the response if it were the same as anticipated. Similarly, examining errors led to the analysis of whether the error was a disfluent response, translation of the target word, reading of a non-target lexical item, or any other linguistic response that was not required. The observations of participants' responses and quantitative data assisted in exploring the nature of trilingual lexical organisation and processing.

3.8 Psycholinguistic Tasks

The present study employs three carefully selected psycholinguistic tasks, namely, the picture-naming task, the Stroop task, and the translation-elicitation task, to examine lexical access mechanisms in trilingual speakers. The rationale for the selection of these tasks is grounded not merely in their conventional usage in psycholinguistic research but in their specific capacity to target distinct yet complementary aspects of lexical processing, language control, and cross-linguistic interaction within a trilingual mental lexicon.

The picture-naming task is a well-established paradigm in psycholinguistic research, particularly suited for examining lexical retrieval processes in multilingual speakers. This task requires participants to retrieve and produce lexical items directly from visual stimuli, thereby minimising reliance on linguistic context and allowing for the observation of pure lexical access from a conceptual source. For trilingual speakers, this task is particularly informative as it activates the shared conceptual store while engaging multiple lexical representations across languages. It offers insight into cross-language lexical competition, the influence of language dominance, proficiency levels, and the role of cognitive control mechanisms during the lexical selection process (Costa et al., 2000; Kroll & Stewart, 1994).

The Stroop task, particularly in its cross-linguistic adaptations, provides a robust measure of cognitive control in language processing. It is widely recognized for revealing the automaticity of lexical access and the participant's ability to inhibit non-target language activation. In a trilingual context, this task captures interference effects across all three languages, offering critical insights into the mechanisms of inhibitory control and language selection (Green, 1998). The Stroop task, therefore, serves not only as a measure of lexical access but also of the executive functions necessary for managing language co-activation and suppression in complex multilingual systems.

The translation-elicitation task is instrumental in probing the interconnections between the mental lexicons of multiple languages. Unlike the picture-naming task, which proceeds from conceptual activation, translation tasks require access to lexical representations across linguistic systems, revealing patterns of asymmetric access, transfer, and mediation between L1, L2, and L3 (Kroll & Tokowicz, 2005). This task illuminates the degree to which trilingual speakers rely on direct lexical links versus conceptual mediation, providing empirical evidence on how lexical items are organized and accessed across languages within the multilingual mind.

Collectively, these three tasks offer a comprehensive and triangulated methodology for examining lexical access in trilingual individuals. The picture-naming task focuses on direct conceptual-to-lexical mapping, the Stroop task highlights the role of cognitive control in managing lexical competition, and the translation-elicitation task exposes the cross-linguistic activation and transfer mechanisms. Utilizing these tasks in combination allows for a nuanced exploration of activation, inhibition, and cross-linguistic influence, aligning with current theoretical models of multilingual lexical processing. Thus, the selected tasks are methodologically and theoretically justified as the most appropriate instruments to capture the complex dynamics of lexical access in trilingual speakers, fulfilling the aims of this study.

A brief description of the three tasks involved is presented in the following sections.

3.8.1 Experiment 1: The Picture-Naming Task

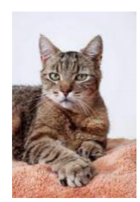
The picture-naming tasks have been extensively used in language processing studies (Tytus, 2018; Gollan et al., 2008; Kroll & Stewart, 1994; Wei et al., 2016). The participants were presented with colourful or monochromatic pictures of various objects, accompanied by the hidden manipulation of triple cognates, double cognates, and unrelated words. The initial list of pictures consisted of thirty words relating to each of the three categories, thus gathering ninety items for the picture-naming task, which was pilot-tested with twelve participants. The examples of lexical items of triple cognates, double cognates, and unrelated words are as follows:

Figure 22

Examples of Stimuli

bottle (triple cognate)

window (unrelated word)



cat (double cognate)

The pilot testing phase paved the way for eliminating items that elicited incorrect responses, omissions, and outliers; eight items were excluded from each category. The list of items finalised for the picture-naming experiment consisted of twenty-two items for each category. The participants were tested individually on an HP laptop. Each item was displayed for 2500ms with a delay of 10 frames. The participants were made to sit comfortably, were shown pictures, and asked to name them. The response times were recorded through DMDX. The manipulation of items regarding triple cognates, double cognates, and unrelated words was treated as an independent variable, and items and subjects were taken as random factors. After trimming the data for outliers, descriptive statistics, correlation coefficient, regression analysis, ANOVA, MANOVA, and paired-sample *t*-test were performed to analyse the statistical significance of the response times

3.8.2 Experiment 2: The Stroop Task

The Stroop task is a widely used Psycholinguistic test (Tytus, 2018; Van Heuven et al., 2013; Marian & Apivey, 2003; Costa et al., 2006; and Coderre & Heuven, 2013). It has been employed to measure the capability to obstruct cognitive interference, which takes place when the processing of a particular stimulus feature obstructs the simultaneous processing of another stimulus feature, commonly recognized as the Stroop Effect. The design of this experiment resembled the layout adopted by Heuven et al. (2013) and Tytus (2018). The stimulus types included control trials, congruent trials, and incongruent trials.

In the Stroop Task, the subjects were shown words and symbols written in coloured ink. The words comprised names of colours, including red, green, blue, yellow, and black, and symbols comprised of hash marks of the length of letters equivalent to the colour words. The participants were asked to pay attention to the colour of a word instead of the word itself. The items were either a symbol of hash marks or colour words in a congruent condition, that is, the name of the colour word written in the same ink, or an incongruent condition, that is, the name of the colour word written in ink that did not match the word, for instance, the word ‘red’ written in blue ink.

Table 1

Illustration of Sample Expected Responses Within- and Between-Language Conditions

Condition	L3-L3		L3-L2		L3-L1	
	Congruent	Incongruent	Congruent	Incongruent	Congruent	Incongruent
Trial	Blue	Blue	Blue	Blue	blue	Blue
Stimuli	in blue	in red	in blue	in red	in blue	in red
Response	Blue	Red	*Neela*	*Surkh*	*Neela*	*laal/sua/ratta*

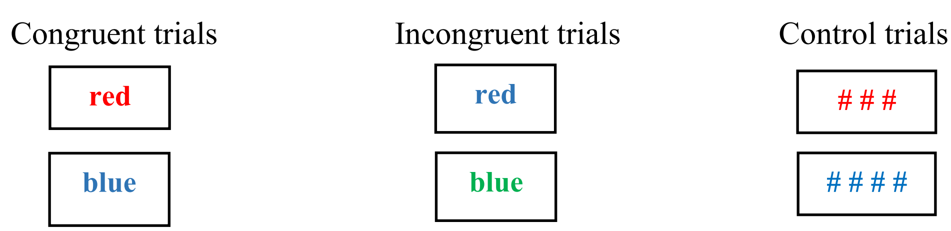
The presentation of linguistic stimuli remained constant; all items were presented in English, but the response languages varied. The experiment consisted of three segments:

the participants first completed the task in English, then in Urdu, and finally in Punjabi. The task conditions addressed language conditions, followed by language conditions involving Urdu and Punjabi. It was executed in this order to familiarise the participants with the pace of the task before performing it in their first language, as some participants reported moderate knowledge of their mother tongue.

The Stroop task was devised and executed using DMDX version 6.3.4.2 software (Forster & Forster, 2003), just like the picture-naming task. The current task's layout resembled the design of the study by Tytus (2018) and Van Heuvaen et al. (2011). The items presented to the participants were control items, congruent items, and incongruent items. The congruent items consisted of words that matched the ink colour; for instance, the colour word 'blue' was written in blue ink. Only focal colour terms in English were used for this task, which included red, green, yellow, blue, and black, as former studies (Tytus, 2018; Marian et al., 2013; Regier, Kay & Cook, 2005) reported better overall performance of their participants on focal colours as compared to non-focal colours such as pink, orange, brown, purple and grey. In another study, Tytus (2018) also employed focal colours to examine the patterns of language facilitation and interference. The incongruent items consisted of words that did not match their ink colour; for instance, the colour word 'red' was written in blue ink. The control trials were hash marks written in all colours; the number of hash marks matched the number of letters of the colour word, for instance, three red hash marks for red or four blue hash marks for blue. The congruent, incongruent, and control trials are illustrated through the examples of 'red' and blue'.

Figure 23

Illustration of Congruent, Incongruent, and Control Trials



The Stroop task for each language comprised 20 control trials, 20 congruent trials, and 20 incongruent trials. Table 2 demonstrates the matrix for preparing critical trials for each language condition.

Table 2

Composition of Trials for each Language Block

Colour	Yellow	Red	Blue	Green	Black
Yellow	4				4
Red	4	4			
Blue		4	4		
Green			4	4	
Black					4

In addition to the colour word trials, the control trials were formed by using hash marks corresponding to the number of letters for the ink colour in which the hash mark was written, for instance, written in red ink for red control trials. Four hash marks for each colour comprised of twenty control trials, twenty congruent trials, and twenty incongruent trials, amounting to a cumulative sixty trials of the Stroop task. Each item of the Stroop task was displayed for 2500ms. All the items were displayed in a continuous run mode to avoid interruption, followed by a blank screen for five frames. Five items were presented as practice trials to acquaint the participants with the procedure of the task. The practice trials were followed by the items of the actual task, which consisted of 60 items for each language condition. The items remained displayed until the participants responded verbally or until 2500 ms had elapsed. An inter-stimulus interval of 80 ms followed every item. The stimuli were presented, and response times were recorded through DMDX version 6.3.4.2 for the subsequent statistical analysis to analyse language interference and facilitation patterns in language organisation, processing, access, and retrieval.

3.8.3 Experiment 3: The Translation-Elicitation Task within Sentential Context

The translation-elicitation tasks have been extensively used in Psycholinguistic experiments (Gullifer et al., 2013; Kroll & Stewart, 1994; Kaushanskaya & Marian, 2007; La Heij et al., 2003; Altarriba & Basnight-Brown, 2009). The cognitive processing and access of language in inter-sentential language switching are assessed. The participants were presented with sentences and were required to make decisions about specific lexical items by providing a translation in the other language. The design of this experiment resembled the experimental layout employed by Gullifer et al. (2013). Translation latency scores and accuracy are the performance measures.

The material for the translation-elicitation task consisted of 30 sentences, which were presented in two parts. Part 1 consisted of 15 English and 15 Urdu sentences; either all English sentences were presented first, or all Urdu sentences were presented first, and vice versa. The sentences were displayed through RSVP (rapid serial visual presentation), whereby one word was presented at a time. Each non-target item was displayed for 300ms, whereas the target word remained displayed for 3500ms or until the participants made a response. The participants were asked to translate the target word, which was presented in red colour. The goal of this experiment was twofold; it was designed to examine the correlation between lexical access in a single language block and inter-sentential language switching to examine language interference in both conditions, on the one hand, and cognate facilitation effect and lexical frequency on the other hand.

3.8.4 Statistical Tests

The data from all three tasks is analysed to evaluate the study hypotheses. Descriptive statistics, which include reliability of scales, means, standard deviations, and measures of normality of data, are calculated to compile comprehensive latency scores of the participants corresponding to language conditions: triple cognates, double cognates, and unrelated words for the picture-naming task and the translation-elicitation task, congruent, incongruent, and control trials for the Stroop task. In addition to descriptive statistics, inferential statistics are used to compare performance across various linguistic stimuli and participant characteristics. The following table summarises the statistical tests, their purpose, and justification with reference to the hypotheses of the study.

Table 3

Statistical Tests with Reference to the Study Hypotheses

Hypothesis	Variables	Descriptive Statistics	Inferential Statistics
Primary Hypothesis: There is a unitary linguistic repertoire that includes the three languages.	Language (L1, L2, L3); Accuracy; Reaction Time	Means, Standard Deviations, Frequencies	Repeated Measures ANOVA / MANOVA
H1: Simultaneous activation of linguistic systems creates a repertoire in the lexicon.	Reaction Time (RT); Error Patterns across L1, L2, L3	Means, SDs, Error Frequencies	Repeated Measures ANOVA / Stroop Effect Analysis
H2: Competition among resources; language selection varies by task.	Task Type (Naming, Stroop, Translation); Language Choice; Accuracy	Frequencies; Means; SDs	(language choice); Repeated Measures ANOVA
H3: Facilitation/interference among linguistic resources.	Reaction Time (RT); Error Types (Interference vs. Facilitation); Accuracy	Means; SDs; Error Frequencies	Repeated Measures ANOVA; Paired Samples t-test

3.9 Timeframe of Data Collection

The present study collected data from undergraduate students tested individually on the NUML campus in Islamabad, Pakistan. Collecting data from 105 participants was an extensive process, as it involved multiple factors, including designing experiments, selecting stimuli, and the availability and willingness of participants to participate in the study. The data for pilot testing was collected in September 2022. The data collection process for the main study extended over six months, from September 2022 to February 2023.

3.10 Procedure

The volunteering participants were made to sit in a comfortable chair. They were given information about the study and guided through the procedure. They gave their informed consent. Then, they filled in the language background questionnaire. Next, they performed the LexTALE test to examine their objective language proficiency. Finally, they participated in the three Psycholinguistic tests designed on DMDX software.

The experiments were administered using an HP Pavilion g6 laptop through DMDX version 6.3.4.2. The material was presented on the laptop screen, and participants were required to respond to the items displayed. The participants voluntarily participated in the study. The recruitment of participants involved an initial screening test, which consisted of three questions: their trilingual status, mother tongue, and enrollment in the BS program. Each participant underwent individual testing on the premises of the NUML, Islamabad, Pakistan.

The participants selected after screening provided their informed consent to take part in the investigation. They then filled in a language background form and mentioned their self-rated language proficiency in all the languages they spoke, including English. They rated their language proficiency on a scale from 1 to 10, with 1 representing the weakest and 10 referring to the highest proficiency level. They then participated in the LexTALE test to determine their objective language proficiency in English.

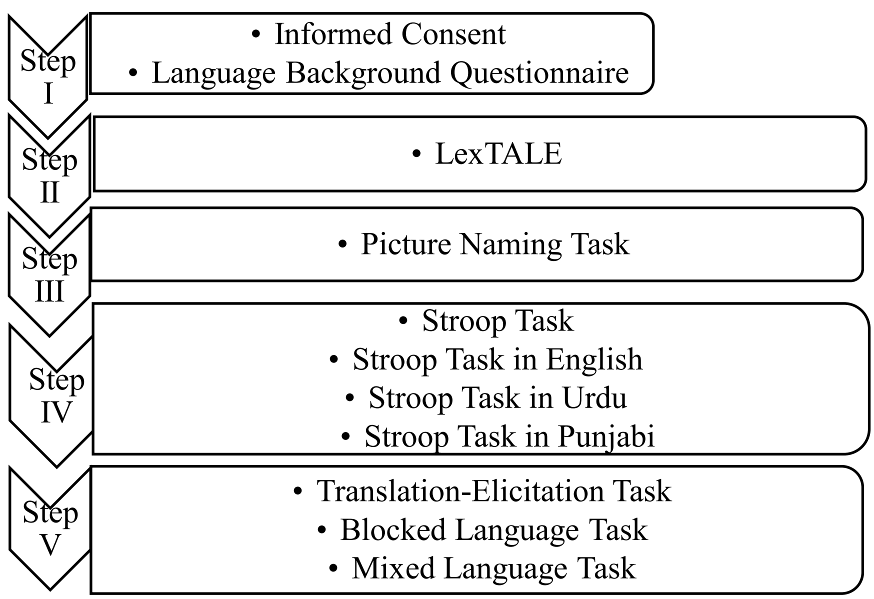
After the language proficiency test, the participants first participated in the picture-naming task. They were presented with coloured pictures on the laptop screen, displayed for 2500ms through DMDX; a delay of 10 frames followed each stimulus. They were required to name the pictures as quickly and accurately as possible. There was a practice trial of five items each for the picture-naming task and the Stroop task, and a practice trial of two items for the translation-elicitation task to familiarise the participants with the task. The response times of all participants were recorded through DMDX.

After completing the picture-naming task, the participants took part in the Stroop Interference paradigm. The Stroop interference task consisted of within- and cross-language conditions. The participants responded to visual stimuli in all three of their languages. The input language remained constant; the colour words were written in English for all three language conditions. The participants responded in English, Urdu, and, finally, in their mother tongue, Punjabi. The Stroop task in English focused on within-language conditions, followed by the Stroop task in Urdu and Punjabi, thus examining between-language conditions.

Finally, the participants took part in two phases of the translation-elicitation task, a blocked language and a mixed language paradigm, to examine any differences in response times between the two language blocks. Before each task, there was a practice block of five trials. The whole procedure took 30-40 minutes.

Figure 24

Illustration of Data Collection Phases of the Study



The data collection and evaluation are discussed in the following chapter, which consists of two phases: data presentation, evaluation, and discussion. The data collected through a language background questionnaire, language proficiency test, and latency scores obtained from three psycholinguistic experimental paradigms were further organized for subsequent analysis using statistical software SPSS and the Process Macro.

3.11 Pilot Study

Pilot testing was conducted with a small sample of participants (*N*=12) to examine the instruments, materials, and procedures and streamline them for the main study. The main objectives of the pilot testing are to:

- ascertain the efficacy of the experimental procedure, establishment of linguistic material, comprehension of items by participants, language difficulty, and construct clarity for the experimental target sample.
- study psychometric assessment of the instruments to be employed in the study.
- study trends in relationships between study variables as hypothesised.

3.11.1 Sample of Participants for the Pilot Study

The selection of participants for pilot testing also followed the same criteria detailed in the methodology section (see 3.5, page 127). Through a stratified sampling technique, participants were recruited, and data were collected from undergraduate students (n=12) of NUML, Islamabad, Pakistan, enrolled in the BS program. The age range was 21 years to 25 years (M=23, SD=2.34)

3.11.2 Results and Discussion of Pilot Testing

The primary purpose of the pilot study is to rationalise the experimental procedure and linguistic stimuli. The initial administration of experiments with participants paved the way for eliminating items that either procured incorrect responses or failed to gather responses from all of the participants. For experiment 1, the initial list of stimuli consisted of ninety items, which were reduced to sixty-six after the pilot study. The words that elicited the most incorrect responses included ‘calf’, ‘puppy’, ‘compass’, ‘rice’, ‘clock’ etc. The naming latencies for the picture-naming task from experiment 1, provided results presented in Table 4 corresponding to the three broad categories.

Table 4

Results of the Picture-Naming Task in Pilot Study

Linguistic Stimuli	Mean	SD
Triple cognates	785.97	162.17
Double Cognates	780.47	147.97
Unrelated words	894.59	166.01

The means and standard deviation (SD) reflected trends between languages and across languages that support the factor of language facilitation/interference as hypothesised, which can further be evaluated through inferential statistics with a large sample of participants in the primary investigation. The mean naming latencies and SD obtained from experiment 2 are presented in Table 5.

Table 5

Results of the Stroop Task in Pilot Study

Condition / Type	Congruent	Incongruent	Control Trial
the Stroop Task in English	596ms (132)	748ms (158)	573ms (112)
the Stroop Task in Urdu	622ms (157)	749ms (195)	661ms (167)
the Stroop Task in Punjabi	677ms (136)	763ms (221)	653ms (147)

Finally, the participants performed a translation-elicitation task. The mean translation latencies from L2-L3 and L3-L2 in a sentential context and translation latencies to a mixed language sentential context were collected. The lexical items eliciting the most incorrect responses were reviewed and removed from the study. It included lexical items such as ‘traveling’ and ‘mint’. The mean scores of the translation-elicitation task collected from the pilot testing are displayed in Table 6.

Table 6

Results of the Translation-Elicitation Task in Pilot Study

Scores	Mean	SD
Blocked Language L3-L2	1644.49	147

Blocked Language L2-L3	1631.57	244
Mixed Language	1671.96	282

The pilot study proved to be of immense significance for examining the psychometric properties of scales, establishing and refining linguistic stimuli, and evaluating the time frame for collecting naming latencies for the main study. The subsequent chapter details data analysis through descriptive and inferential statistics to evaluate study hypotheses.

3.12 Chapter Summary

The current chapter primarily focuses on a detailed discussion of the research methodology adopted to explore the nature of the trilingual mental lexicon through the theoretical lens of the translanguaging and multilink model, using Punjabi-Urdu-English trilingual speakers. The interdisciplinary nature of the study enables mixed-methods research, driven primarily by language background questionnaires, language proficiency tests, and psycholinguistic tasks. A detailed description of the qualitative and quantitative data collection tools has been presented. This section also presents an account of the theoretical framework, conceptual framework, research design, research participants, sampling of participants, description of the language proficiency test, description of software, selection, and status of linguistic stimuli, designing of experiments for the presentation of stimuli, ethical considerations, timeframe for collecting data from participants, the method of data collection and pilot study. The pilot study mirrored the procedure used for the main study. Finally, it discusses the means; the pilot study assisted in refining the study's linguistic stimuli and overall experimental design.

CHAPTER 4

DATA PRESENTATION AND INTERPRETATION

This chapter has been devoted to presenting and evaluating data highlighting the language organisation, access, and processing of multiple languages in translingual practices through three experimental paradigms: the picture-naming task, the Stroop Interference task, and the translation-elicitation task. The current study is an attempt to empirically examine the nature and organisation of the mental lexicon, in addition to the nature of lexical access, whether selective or non-selective, which is the fundamental theoretical foundation of the concept of translingualism. It seeks to employ a language combination of Punjabi, Urdu, and English, which has not been widely examined in psycholinguistic studies to examine the storage, access, and retrieval of the target language when multiple languages are stored in the mental lexicon of speakers, or more precisely, trilingual participants.

The chief objective of the current chapter is to examine the trilingual mental lexicon through three experiments focused on exploring lexical access in Punjabi-Urdu-English trilinguals, during language comprehension and production. More precisely, it is intended to test the following primary and secondary hypotheses: (1) there is a unitary linguistic repertoire including all linguistic resources, (2) there is simultaneous activation of linguistic systems creating repertoire in the mental lexicon of speakers, (3) there is a competition amongst various linguistic resources for selection and speakers select the language according to decision task, (4) there is facilitation/interference among various linguistic resources in the mental lexicon.

The experimental phase of the current investigation involved three sets of experiments. Experiment 1 was the picture-naming task with the hidden manipulation of cognate status, lexical frequency, and language proficiency. Experiment 2 was the Stroop task, consisting of congruent, incongruent, and control trials, which involved three segments, one in each of the languages of the participants. Experiment 3 was a translation-elicitation task involving sentential context within the cross-language paradigm. All of the experiments were performed using DMDX. In addition, other mechanisms that facilitated data collection included a language background questionnaire, which furnished information about the languages, context, and frequency of using languages spoken by participants, subjective language proficiency in Punjabi, Urdu, and English, and a vocabulary test in English through LexTALE to determine the objective English language proficiency of participants.

The collected data were examined using descriptive and inferential statistics through SPSS-21 and Process Macro. Descriptive statistics were computed for all three experiments' variables to analyse the general trend and examine the data's normality. Internal reliability consistency of the scales and subscales was evaluated by computing Cronbach’s alpha reliability measures. Furthermore, correlation coefficients were computed through Pearson Product-Moment Correlation in addition to a linear regression, moderation, a paired sample t-test, ANOVA, and MANOVA. The results of these statistical tests have been presented in tables and graphs.

The current section presents the findings of the three experiments along with the outcomes of the language background questionnaire and objective language proficiency test. The structural organisation of this section is as follows: Section 4.1 displays the findings of the language background questionnaire; Section 4.2 demonstrates the results of the objective English language proficiency test. Next, section 4.3 presents descriptive statistics and psychometric properties of the experiments. Then, section 4.4 presents relationships between study variables through correlation coefficients. After that, sections 4.5, 4.6, and 4.7 present the outcomes of the picture-naming task, the Stroop task, and the translation-elicitation task, respectively. Section 4.8 summarises the qualitative and quantitative analysis of the three experiments employed in the current study.

4.1 Qualitative Analysis of Language Background Questionnaire and Responses

This section provides information collected through a language background questionnaire. After giving informed consent, the participants filled in a language background questionnaire. The language background questionnaire included information about the languages spoken by the participants, age of acquisition, and extent and context of use for each language. The purpose was to ensure homogeneity among participant groups and confirm considerable use of all languages regularly so that no language of the participants is latent or dormant. It also aimed to categorise language characteristics that may influence the usage of a non-native language, such as English, particularly in the case of current research, thus making the language use even more complex in the presence of two second/foreign languages (Gas & Selinker, 2008; Jessner, 2006; Cenoz, Hufeison & Jessner, 2003). There is more significant across-language influence and linguistic facilitation and/or interference for trilingual speakers (Carvalho & Da Silva, 2006; De Angelis & Selinker, 2001; Melhorn, 2007; Bardel & Falk, 2007; Jessner, 2006; Maghsoudi, 2008; Leung, 2005; Herwig, 2001; Ecke, 2001; Dewaele, 2001; Hammarberg, 2001). Language organisation and processing may not follow a linear process, as learning one language may be interrupted by learning another language. In contrast to bilingualism, an additional language(s) may alter the whole mechanism of lexical organisation, access, and processing in tri/multilingualism. The current investigation aims to examine the effects of trilingualism on linguistic organisation and access in language comprehension, retrieval, and production.

Therefore, the details of the language background questionnaire reported in the present segment may help to explain the findings of psycholinguistic tasks. This sub-section has been organised as follows: subsection 4.1.1 discusses information concerning acquiring/learning Punjabi, Urdu, and English; subsection 4.1.2 presents self-estimated proficiency of English, Urdu, and Punjabi; subsection 4.1.3 discusses the frequency of use of Punjabi, Urdu and English, subsection; 4.1.4 presents information about ways of contact with English, Urdu, and Punjabi; and 4.1.5 gives information about qualitative analysis of responses.

One hundred and nine trilingual undergraduate students participated in the study. All of the participants spoke Punjabi as their mother tongue. They were undergraduate students at the National University of Modern Languages. Acquisition of English and Urdu varied across participants. To gather information about the languages spoken by the participants, including the age of onset of these languages, the degree of use, and methods of contact for each language, participants completed a language background questionnaire. Of 109 participants, 57 (52%) were male, and 52 (48%) were female, with an age range from 18 to 26 years, with a mean of 21.7 and a standard deviation of 1.53. The responses from 4 participants were excluded from the study on account of being too slow and missing responses to most of the items. The main study involved responses obtained from 105 participants. The subsequent subsection provides information regarding acquiring/learning Punjabi, Urdu, and English.

4.1.1 Information regarding acquiring/learning Punjabi, Urdu, and English

This subsection provides information regarding the mode of acquiring/learning all participants' languages, as the onset of any language is one of the critical factors that may bring variation in language processing. The participants responded to the mode and age of learning Punjabi, Urdu, and English. The participants made responses for each language separately. Figure 25 presents the responses of the participants.

Figure 25

Mode of Acquiring/Learning English, Urdu, and Punjabi

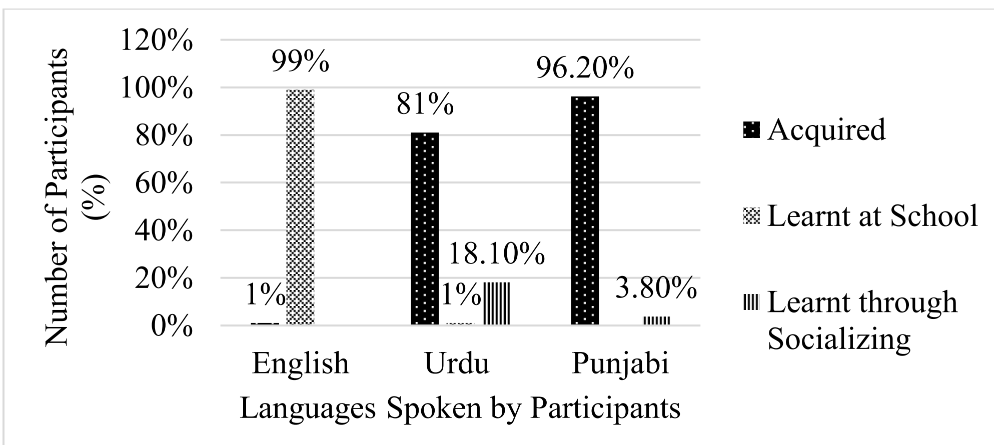


Figure 25 shows the mode of learning English, Urdu, and Punjabi languages by 105 participants. As shown in Figure 25, most participants (104) reported learning English at school, of which 60% (n=63) reported having learnt at the age of 3. In contrast, 40% of participants reported having the onset of English at 5-6 years old. Only one participant claimed to have acquired English simultaneously with Urdu and Punjabi through interaction with parents. In contrast to the English Language, most participants claimed to have acquired or learnt Urdu and Punjabi languages more or less simultaneously. 81% of participants acquired Urdu concurrently with Punjabi, and 18.10% reported learning it through socialising. 96.2% of participants reported acquiring the Punjabi language, whereas 3.8% claimed to have acquired/learnt it through socialising. Finally, from Figure 25, it is evident that the onset of all three languages took place simultaneously or till five years of age, thus constituting a homogeneous group of participants with the onset of languages as a constant factor. Next, the participants rated their proficiency in English, Urdu, and Punjabi.

4.1.2 Self-estimated proficiency in English, Urdu, and Punjabi

The participants rated their language proficiency in English, Urdu, and Punjabi on a scale of 1-10, with one being the weakest and 10 being the strongest. The participants reported their subjective language proficiency in all three languages. Table 7 shows the average, standard deviation, highest, and lowest subjective proficiency scores:

Table 7

Subjective Proficiency in English, Urdu, and Punjabi

	N	Minimum	Maximum	M	SD
Subjective English Proficiency	105	4	9	6.46	1.11
Subjective Urdu Proficiency	105	5	10	8.49	.97
Subjective Punjabi Proficiency	105	4	10	7.6	1.83

Note. N=number of participants; M=mean; SD=standard deviation

As shown in the table, the minimum and maximum values for subjective language proficiency across all languages did not differ significantly. The average proficiency is 6,46, 8.49, and 7.6 for English, Urdu, and Punjabi, respectively. It is evident from the table that the participants possess average to high proficiency in three languages. The proficiency rating for the English language is of particular significance as English is the second language for participants. Furthermore, it is possible to compare the subjective language proficiency scores with the LexTALE test, which measures participants' objective English language proficiency. The following subsection presents information obtained through a language background questionnaire about the frequency of use of English, Urdu, and Punjabi to furnish a detailed account of the interaction of participants with these languages.

4.1.3 Frequency of Use of English, Urdu, and Punjabi

In the language background questionnaire, participants provided information about the frequency of interaction with their language. The level of activation of languages and cross-linguistic competition is influenced by the frequency of interaction with a particular language (Marian & Spivey, 2003). The competition among languages increases with the frequent use of various languages. In the current study, participants were asked about the frequency of using English, Urdu, and Punjabi. Its purpose was to examine how frequently participants use these languages daily and whether it influences their language use.

Figure 26

Frequency of Using English, Urdu, and Punjabi

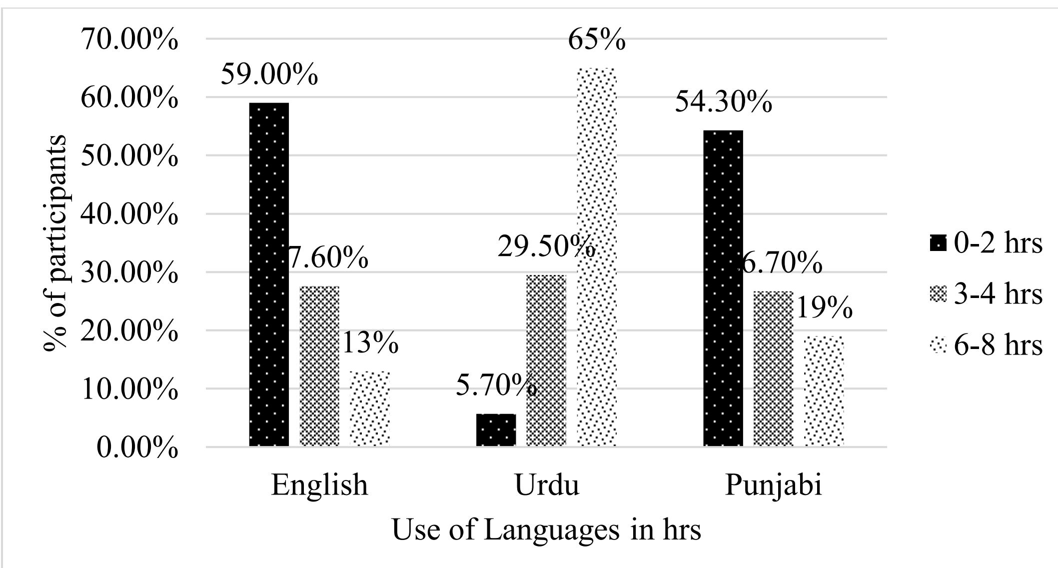


Figure 26 shows statistics for the frequency of use corresponding to each language of participants. Most participants, 59%, reported using English for a maximum of two hours, whereas 27.6% used English for about 3-4 hours, and 13% used it for 6-8 hours. The most frequently used language was that 65% of participants claimed to use it for 6-8 hours, and 29.5% used it for 3-4 hours. At the same time, only 5.70% of participants used it for about 2 hours. Similarly, 54.30% of participants used it for only up to two hours, whereas 26.7% used it for about 3-4 hours, and 19% used it for 6-8 hours. The interaction of language use frequency on various experimental language conditions is statistically analysed through an independent sample *t*-test and ANOVA in 4.6.

4.1.4 Ways of Contact with English, Urdu, and Punjabi

In the language background questionnaire, participants also provided information about the ways of contact with English, Urdu, and Punjabi. Participants mentioned various channels of contact with these languages. Table 8 provides information about the ways of contact with these languages.

Table 8

Ways of Contact with English, Urdu, and Punjabi

	English	Urdu	Punjabi
Family/ Friends	7.6%		98%
Classroom/University	61%	100%	-
University/Workplace	11.4%	(Mostly)	-
Movies, music, TV, Internet, video games	20%		2%

The table shows that participants reported having the most frequent contact with English in a university classroom setting, amounting to 61% of participants. In addition, they held part-time jobs, so their contact included both university and workplace interactions. Twenty % of the participants had interaction with English in their leisure time through contact with movies, video games, and other forms of entertainment. Regarding the Urdu language, all participants claimed to use Urdu most of the time for their daily activities in different social settings. Finally, 98% of participants reported using Punjabi with family only, and only 2% reported having exposure to the Punjabi language through music, movies, and entertainment sources. The majority of participants had confined their use to domestic settings with family and preferred to use Urdu most of the time in various settings.

4.1.5 Qualitative Analysis of Responses

The analysis of participants' responses to the picture-naming task, the Stroop task, and the translation-elicitation task resulted in the identification of various types of errors, including disfluencies, naming errors, language interference errors, and missed items. In experiment 1- the picture-naming task, participants' responses were affected by their English language proficiency. Participants with higher proficiency made fewer errors and responded more swiftly than participants with lower English language proficiency. In addition, participants with lower English language proficiency experienced more significant linguistic interference and exhibited more errors than proficient participants.

Similarly, the analysis of responses on the Stroop task also supported the interaction of English language proficiency with lexical access and retrieval on the Stroop task in English. In contrast, English language proficiency did not impact the other two variants of the Stroop task. In contrast, the Stroop task in Urdu and the Stroop task in Punjabi resulted in different errors, such as disfluencies, reading words, and between-language interference. Lastly, the analysis of responses on the translation-elicitation task replicated the findings of the picture-naming task in a sentential context. The analysis of responses and errors is further discussed in Chapter 5, which concerns mean response times collected through DMDX.

4.2 Language Proficiency Test

After completing the language background questionnaire, the trilinguals performed in LexTALE, an online test to measure objective English language proficiency. Since most participants learnt English at school, as demonstrated in Figure 26, assessing their objective language proficiency in English was essential. Firstly, it provides the premise for its comparison with subjective language proficiency. Secondly, the level of second language proficiency has proved to be a variable factor for second language access and processing. Table 9 presents the scores obtained through LexTALE and the participants' classification of proficiency. The participants who scored 70 or above on the proficiency test were categorised as possessing high proficiency or group 1. Similarly, participants who scored 60-69.9 were categorized as possessing medium proficiency or Group 2, and those who scored 50-59.9 were considered to have low proficiency or Group 3. The objective English language proficiency scores and groups of participants have been presented in Table 9.

Table 9

Language Proficiency Test Scores and categories of participants

Category	Proficiency Level	LexTALE Score	N
Group 1	Low	50-59.9	35
Group 2	Medium	60-69.9	35
Group 3	High	70-100	35

Note. LexTALE = Lexical Test for Advanced Learners of English; N = Number of participants

The scores obtained through LexTALE were related to the subjective language proficiency of participants. The comparison of subjective and objective proficiency in English revealed higher objective proficiency scores. The participants scored higher on the objective language proficiency test, as has been reported in previous research studies (Marian et al., 2013; Tytus, 2018), which established that participants tend to score better on objective language proficiency tests than on subjective language proficiency scores. The descriptive statistics for subjective and objective language proficiency are presented in Table 10.

Table 10

Comparison of Subjective and Objective English Proficiency

	N	Minimum	Maximum	M	SD
Objective English Proficiency	105	5	9.5	6.53	1.46
Subjective English Proficiency	105	4	9	6.46	1.11

Note. N=number of participants; M=mean; SD=standard deviation

Table 10 demonstrates the objective and subjective language proficiency scores. The comparison of the two reflects the overall better objective proficiency in the English language of the participants. The self-rated scores of participants were lower than the scores obtained through performing the language proficiency test. The statistics of the paired sample t-test are presented in Table 11.

Table 11

Paired-Sample t-Test for Objective and Subjective Language Proficiency (N=105)

Pairs	Paired Differences				t(df)	P	Cohen's d
	M	SD	95% CI				
			LL	UL			
English Language Proficiency							
Objective-Subjective	.07	.99	-.13	.26	.67(104)	.49	.06

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value.

The *p*-value is statistically significant, indicating better objective language proficiency. In addition, Cohen's d indicates effect size; Table 11 shows a high value of Cohen's d = .06, reflecting significantly better objective English language proficiency than self-rated language proficiency. This result is consistent with former studies, as mentioned earlier, which compared participants' subjective and objective language proficiency.

4.3 Descriptive Statistics and Psychometric Properties of Experiments

Tables 12, 13, and 14 show the descriptive statistics, including alpha reliability, mean latency scores, standard deviation, and minimum and maximum ranges of all categories of scales for the picture-naming task, the Stroop task, and the translation-elicitation task, respectively. All of the scales and subscales of the three experiments have alpha reliabilities within the acceptable range (Sylvia, Ysseldyke, & Bolt, 2010). According to Sylvia et al. (2010), the acceptable range of alpha reliabilities is from .69 to .98. So, the values of alpha reliabilities, as shown in tables 11, 12, and 13 for all scales, as well as subscales, fall within the acceptable range.

4.3.1 Descriptive Statistics and Psychometric Properties of the Picture-Naming Task

Table 12 presents Cronbach's alpha and descriptive statistics for the picture-naming task. Each trial comprised 66 items, of which 22 items were for each category: triple cognates, double cognates, and unrelated words. The categories were further divided into high and low-frequency items. The table shows alpha reliability scores for all categories and other measures. The range of alpha reliability is computed to be a minimum of .722 and a maximum of .897, which falls within the acceptable range of .69 to .98 (Salvia et al., 2010). The table also presents mean, standard deviation, minimum, and maximum latency scores for the picture-naming task.

Table 12

Cronbach's Alpha and Descriptive Statistics of the Picture-Naming Task of the Study (N = 105)

	Scales	*k*	α	Range	M	SD	Skewness	Kurtosis
1	**PNTC**	22	-.892	554.90-1286.72	857.86	185.34	.34	-.89
2	PNHTC	13	.741	542.96-1151.87	806.42	147.53	.28	-.60
3	PNLTC	9	.870	549.77-1520.84	933.60	267.04	.55	-.79
4	**PNDC**	22	.897	555.93-1310.55	870.72	160.90	.42	-.63
5	PNHDC	12	.836	551.64-1070.00	810.16	135.19	.08	-.99
6	PNLDC	10	.803	561.07-1653.73	943.38	206.88	.80	.52
7	**PNUW**	22	.870	752.29-1386.20	1041.18	158.42	.13	-.89
8	PNHUW	8	.722	710.99-1340.55	957.38	151.90	.19	-.85
9	PNLUW	14	.800	726.581472.52	1089.06	173.44	.16	.24

Note. k = Number of items; M = mean; SD = standard deviation; PNTC = Picture-Naming Task with Triple Cognates; PNHTC = Picture-Naming Task with High-Frequency Triple Cognates; PNLTC = Picture-Naming Task with Low-Frequency Triple Cognates; PNDC = Picture-Naming Task with Double Cognates; PNHDC = Picture-Naming Task with High-Frequency Double Cognates; PNLDC = Picture-Naming Task with Low-Frequency Double Cognates; PNUW = Picture-Naming Task with Unrelated Words; PNHUW = Picture-Naming Task with High-Frequency Unrelated Words; PNLUW = Picture-Naming Task with Low-Frequency Unrelated Words.

From the descriptive statistics for the picture-naming task, the highest mean is observed for unrelated words with low frequency, a subgroup of the category of unrelated words. In the same category, the high-frequency words have relatively lower mean latencies, thus conforming to the impact of the frequency of lexical items in the process of lexical access. Furthermore, comparing three broader categories, triple cognates, double cognates, and unrelated words, demonstrates lower latency scores for triple and double cognates than for unrelated words. These scores are presented in Figure 27.

Figure 27

Mean Reaction Time for Cognate Status in the Picture-Naming Task

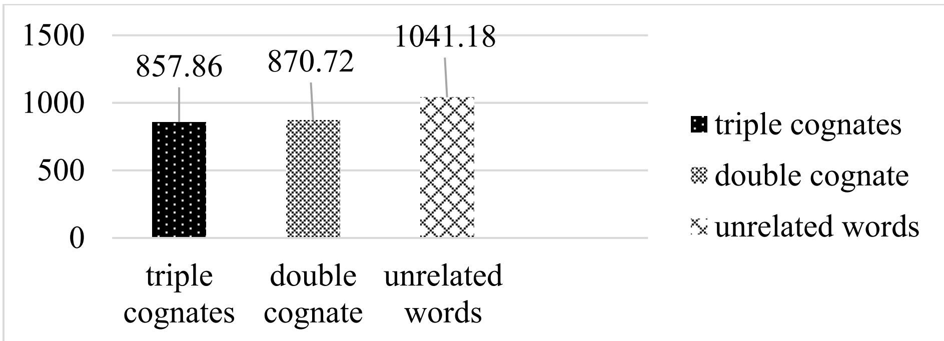
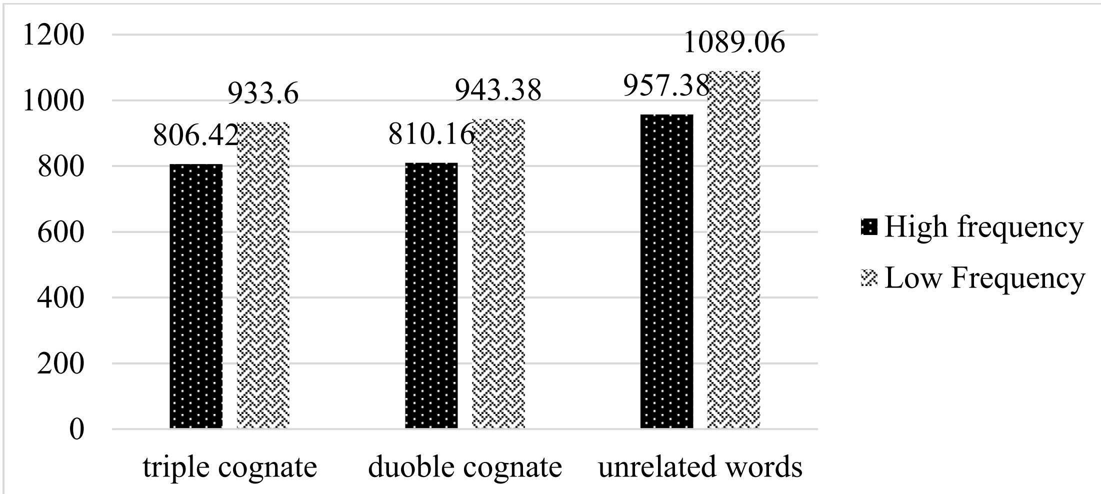


Figure 27 shows that the mean score for triple and double cognates is 856.86 and 870.72, respectively, which are considerably lower than the mean latency score for unrelated words, calculated to be 1041.18. Moreover, the mean score for double cognates is higher than for triple cognates, thus pointing to the facilitation of the cognate effect. However, the mean scores for triple and double cognates do not differ considerably. Apart from the cognate facilitation effect, another significant parameter is the lexical frequency, which was taken from the English Lexicon Project (Balota et al., 2007).

The descriptive statistics reveal that the frequency of lexical items also plays a significant role in the access and production of lexical items, as is identified in Table 12, across all three categories: triple cognates, double cognates, and unrelated words. Within the triple cognate category, the reported mean latency scores reveal that high-frequency words were processed faster as compared to low-frequency lexical items, with mean latency scores of 806.42 and 933.60, respectively. The difference in mean latency scores for low- and high-frequency lexical items is also evident in the other two categories. The mean scores for low- and high-frequency lexical items are reported to be 810.16 and 943.38, respectively. Similarly, the mean latency scores for unrelated words are 1340.55 and 1472.52. The naming latencies concerning lexical frequency, as well as cognate status, are presented in Figure 28.

Figure 28

Mean Naming Latency Scores for High- And Low-Frequency Words Concerning Cognate Status



It is evident from Figure 28 that the mean latency scores demonstrate cognate facilitation and frequency effect. These descriptive scores are analysed through inferential statistics as well.

4.3.2 Descriptive Statistics and Psychometric Properties of the Stroop Interference Task

Table 13 demonstrates descriptive statistics and psychometric properties of the Stroop interference task. The Stroop interference task consisted of three segments, one corresponding to each language of the participants. The participants first took part in the Stroop interference task in English, then in Urdu, and finally, they responded in Punjabi. The Stroop task in Urdu and Punjabi is of particular significance as it tests the cross-language interference condition, whereas the Stroop task in English tests the within-language condition. Each segment of the Stroop interference task consisted of 60 trials, comprising three stimulus conditions: congruent, incongruent, and control. The alpha reliabilities for all these segments of the Stroop interference task are calculated to range from .725 to .917, which falls within the acceptable range of .69 to .98 (Salvia et al., 2010). The table also presents the mean, standard deviation, and minimum and maximum latency scores for the Stroop interference task.

Table 13

Cronbach Alpha and Descriptive Statistics of the Stroop Task of the Study (N = 105)

Scales	*k*	A	Range	Mean	SD	Skewness	Kurtosis
STE	60	.848	531.37-739.15	611.08	45.52	.69	.31
STEC	20	.917	370.10-554.48	482.87	40.62	-.53	-.23
STEI	20	.787	785.33-1296.59	938.32	104.34	1.34	2.19
STECT	20	.898	348.38-483.91	412.05	30.84	-.26	-.60
STU	60	.837	563.12-872.46	717.14	73.18	-.13	-.43
STUC	20	.755	371.57-746.03	586.49	77.44	-.34	.01
STUI	20	.809	757.14-1513.93	964.45	152.07	1.24	1.41
STUCT	20	.733	430.56-764.88	600.50	69.73	-.35	-.14
STP	60	.862	481.00-789.88	618.73	70.19	.29	-.53
STPC	20	.879	350.10-620.92	448.75	63.03	.60	-.75
STPI	20	.836	568.51-1239.50	865.33	151.69	.52	-.24
STPCT	20	.725	386.19-778.42	542.11	65.81	.60	1.03

Note.k= number of items; STE = The Stroop Task in English; STEC=the Stroop Task in English with Congruent Trials; STEI = The Stroop Task in English with Incongruent Trials; STECT = The Stroop Task in English with Control Trials; STU = The Stroop Task in Urdu; STUC = The Stroop Task in Urdu with Congruent Trials; STUI = The Stroop Task in Urdu with Incongruent Trials; STUCT = The Stroop Task in Urdu with Control Trials; STP = The Stroop Task in Punjabi; STPC = The Stroop Task in Punjabi with Congruent Trials; STPI = The Stroop Task in Punjabi with Incongruent Trials; STPCT = The Stroop Task in Punjabi with Control Trials.

From the descriptive statistics for the Stroop interference task in English, the highest mean is observed for incongruent trials. The input items were displayed in English, and the output response was also required in the same language, English; the highest mean score for incongruent trials points to the interference within language as the participants were required to focus on the colour instead of the lexical item. Besides, errors were reported for incongruent trials in contrast to congruent and control trials. There were no errors for congruent and control trials in the English version of the Stroop interference task.

The mean scores for congruent items and control trials are reported to be 482.87 and 412.05, respectively, far less than those for incongruent trials, computed as 938.32 due to within-language interference. The higher error rate and the mean score for incongruent trials affirm language interference. The results of the Stroop task in English are presented in Figure 29.

Figure 29

The Stroop Task in English

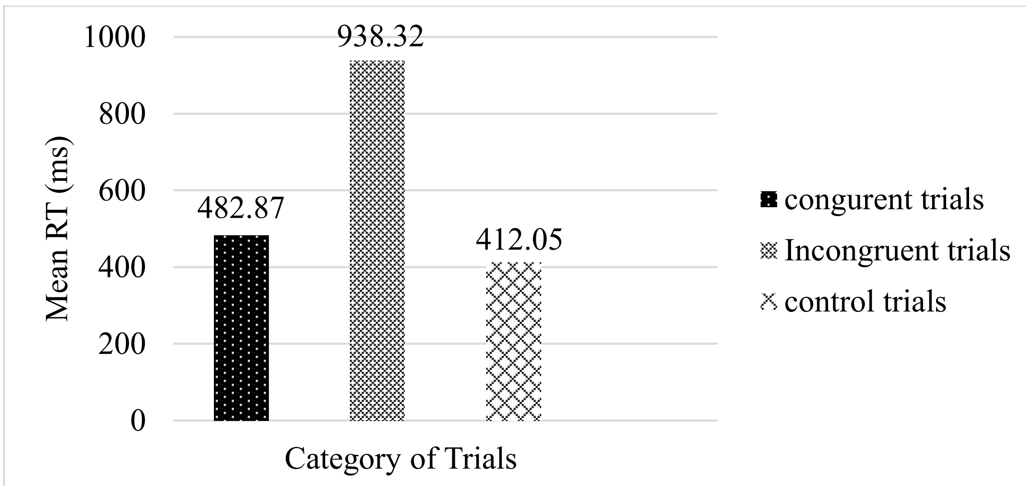


Figure 29 demonstrates the differences in the three types of trials; the mean response time for incongruent trials is higher than the control and congruent trials, which indicates the within-language Stroop effect, as the input and output were both in English. The Stroop task in English focuses on within-language interference, whereas the Stroop task in Urdu and Punjabi focuses on language interference. The next phase of the Stroop task was its execution in Urdu. The stimuli were kept constant; all colour words were presented in English, but the participants were supposed to respond to colour terms in Urdu.

The second phase of the Stroop interference task was its implementation in Urdu. From the descriptive statistics for the Stroop interference task in Urdu, the highest mean is once again observed for incongruent trials. The input stimuli were presented in English, and the output response was required in Urdu; the highest mean score for incongruent trials points to the interference across language as the participants were required to focus on the colour instead of the lexical item. Besides, the errors were higher for incongruent trials than for congruent and control trials. The errors of this segment consisted of output in

English, which was the translation of the expected output. Due to cross-language interference, the participants tended to translate the lexical item instead of focusing on the colour. The mean scores for congruent and control trials are reported to be 586.49 and 600.50, respectively, far less than those for incongruent trials, which are computed to be 964.45 due to both within and across language interference. The higher error rate and the higher mean score for incongruent trials affirm within-language interference. The results of the Stroop task in Urdu are presented in Figure 30.

Figure 30

The Stroop Task in Urdu

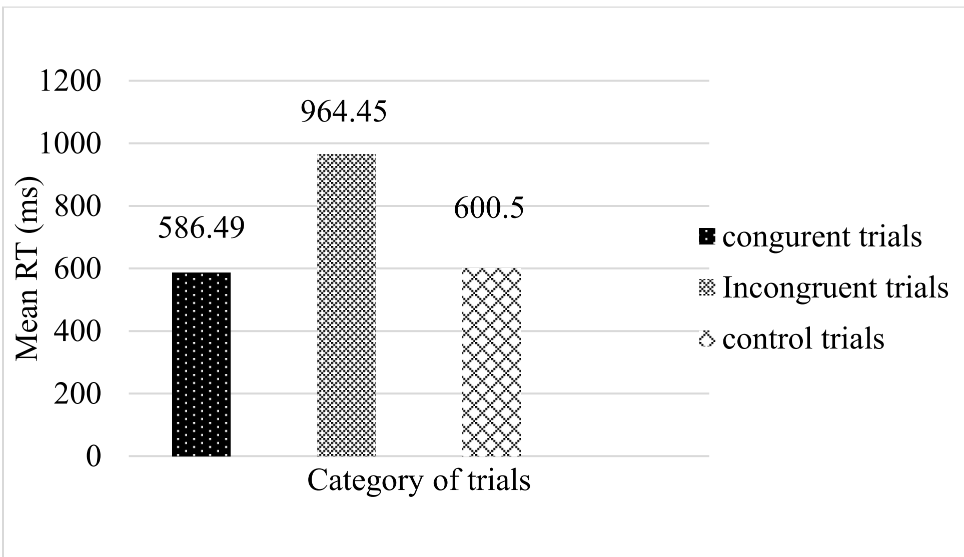
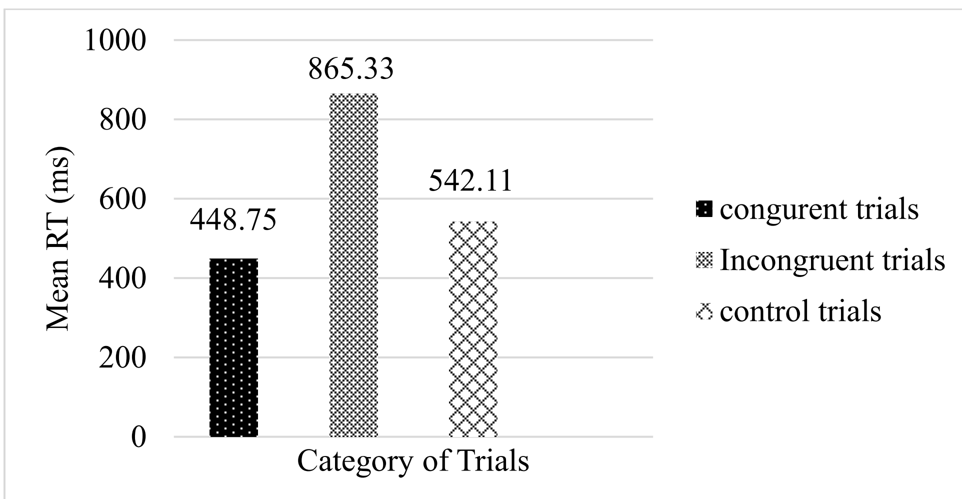


Figure 30 demonstrates marked differences in incongruent trials, and the other two types of trials, congruent and control trials, exhibit a strong Stroop effect. An important observation is that the participants translated the input into Urdu instead of responding to the colour, thus pointing to cross-language interference.

The third and final segment of the Stroop interference task was its enactment in Punjabi. From the descriptive statistics for the Stroop interference task in Punjabi, the highest mean is once again reported for incongruent trials. The input stimuli were presented in English, and the output response was required in Punjabi. Just as in the previous phase, in the Stroop interference task in Punjabi, the highest mean score is recorded for incongruent trials, which points to the interference across language conditions as the participants needed to concentrate on the colour in which the stimuli were presented instead of the lexical item. In this phase, errors were reported higher for incongruent trials than for congruent and control trials. The errors of this segment for all stimulus types consisted of output in English, which was the translation of the expected output, just as in the previous segment of the Stroop task. However, the participants had not translated any item so far as the layout of all experimental sections for all participants was kept constant. Due to cross-language interference, the participants tended to translate the lexical item instead of focusing on the colour. The mean scores for congruent and control trials are reported to be 448.75 and 542.11, respectively, which is far less than those for incongruent trials, which is computed as 865.33 as a consequence of both within and across language interference. The results of the Stroop task in Punjabi are presented in Figure 31.

Figure 31

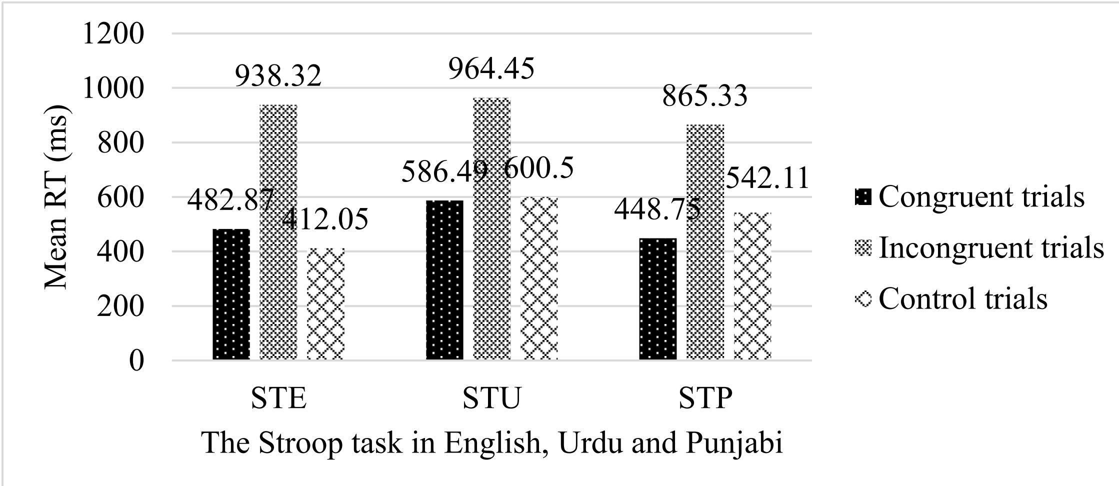
The Stroop Task in Punjabi



The higher error rate and the higher mean score for incongruent trials affirm within-language interference. Again, like the Stroop interference task in Urdu, the participants tended to read or translate the input into Punjabi instead of responding to the colour, thus pointing to cross-language interference. Figure 32 presents the comparison of response times of three variants of the Stroop task across all stimulus types:

Figure 32

Comparison of the Stroop Task across all Categories of Three Languages



4.3.3 Descriptive Statistics Psychometric Properties of the Translation-Elicitation Task

Table 13 presents Cronbach's alpha and descriptive statistics for the translation-elicitation task. Each trial comprised 60 items presented using RSVP, consisting of two phases: a blocked language condition and a mixed language condition, each comprising 30 items. The items were presented in a sentential context to analyse the impact of sentential context on lexical access and processing. The target items were used in the middle of sentences. The cognate status and lexical frequency of words were employed to construct the target sentences to analyse the cognate status of lexical items and lexical frequency in a sentential context. The participants translated the target word from L2 to L3 or L3 to L2. If the input was presented in English (L3), the participants needed to translate it into Urdu (L2) and vice versa. Part 1 consisted of two parts; all sentences were presented in English and then Urdu, or vice versa. In part 2, sentences were mixed and randomly presented to assess the cost of mixing languages and evaluate the across-language effect. Table 14 shows alpha reliability scores for all categories, along with other estimates. The range of alpha reliability is computed to be a minimum of .700 and a maximum of .977, which falls within the acceptable range of .69 to .98 (Salvia et al., 2010). The table also presents mean, standard deviation, minimum, and maximum translation latency scores for the translation-elicitation task.

Table 14

Cronbach Alpha and Descriptive Statistics of the Translation-Elicitation Task of the Study (N = 105)

	Scale	*k*	A	Range	Mean	SD	Skewness	Kurtosis
	TEBL	30	.903	1110.54-1647.41	1347.93	134.27	.06	-1.06
	TEBLH	14	.831	978.34-1479.15	1231.04	134.31	-.10	-1.07
	TEBLL	16	.823	1173.27-1812.88	1450.21	146.47	.19	-.78
	TEBLTC	10	.976	866.43-14044.47	1137.68	165.80	.02	-1.44
	TEBLDC	10	.977	1051.73-1479.09	1267.00	147.58	-.02	-1.39
	TEBLUW	10	.701	1295.32-2144.42	1639.40	199.05	.42	-.47
	TEBLE	15	.831	1023.00-1564.98	1271.33	140.25	.07	-1.02
	TEBLEH	7	.739	936.07-1466.81	1175.61	130.18	.03	-.86
	TEBLEL	8	.710	1067.17-1811.04	1355.08	168.09	-.05	-.61
	TEBLU	15	..829	1132.13-1729.85	1424.54	145.74	.07	.99
	TEBLUH	7	.707	962.72-1632.84	1286.47	161.64	.03	-.80
	TEBLUL	8	.707	1199.72-1892.43	1545.34	153.75	-.05	-.61
	TEML	30	.878	1047.89-1750.24	1391.59	172.35	-.06	-.95
	TEMLH	14	.783	958.10-1648.51	1297.27	167.90	-.08	-.98
	TEMLL	16	.783	1114.89-2004.47	1474.13	189.84	-.12	-.52
	TEMLTC	10	.911	779.59-1472.83	1111.56	186.58	-.19	-1.29
	TEMLDC	10	.779	1027.15-1841.79	1415.40	198.59	.10	-1.03
	TEMLUW	10	.700	1075.00-2103.56	1647.81	229.01	.02	-.67

Note. k= Number of items; TEBL = Translation-Elicitation Task in Blocked Language; TEBLH = Translation-Elicitation Task in Blocked Language using High-Frequency Words; TEBLL = Translation-Elicitation Task in Blocked Language using Low-Frequency Words; TEBLE = Translation-Elicitation Task in Blocked Language in English; TEBLEH = Translation-Elicitation Task in Blocked Language in English using High-Frequency Words; TEBLEL = Translation-Elicitation Task in Blocked Language in English using Low-Frequency Words; TEBLU = Translation-Elicitation Task in Blocked Language in Urdu; TEBLUH = Translation-Elicitation Task in Blocked Language in Urdu using High-

Frequency Words; TEBLUL = Translation-Elicitation Task in Blocked Language in Urdu using Low-Frequency Words; TEML = Translation-Elicitation Task in Mixed Language; TEMLH = Translation-Elicitation Task in Mixed Language using High-Frequency Words; TEMLL = Translation-Elicitation Task in Mixed Language using Low-Frequency Words.

From the descriptive statistics for the translation-elicitation task in blocked language, the minimum and maximum scores range from 1110.54 to 1647.41, respectively, with a mean translation latency of 1347.93. The two subcategories concerning the frequency are high- and low-frequency items with means of 1231.04 and 1450.21, respectively, demonstrating frequency effects in translation latency scores. Figure 33 demonstrates the difference in translation-elicitation latencies concerning lexical frequency:

Figure 33

Representation of the Translation Latencies for the Lexical Frequency of Words in a Blocked Language Task

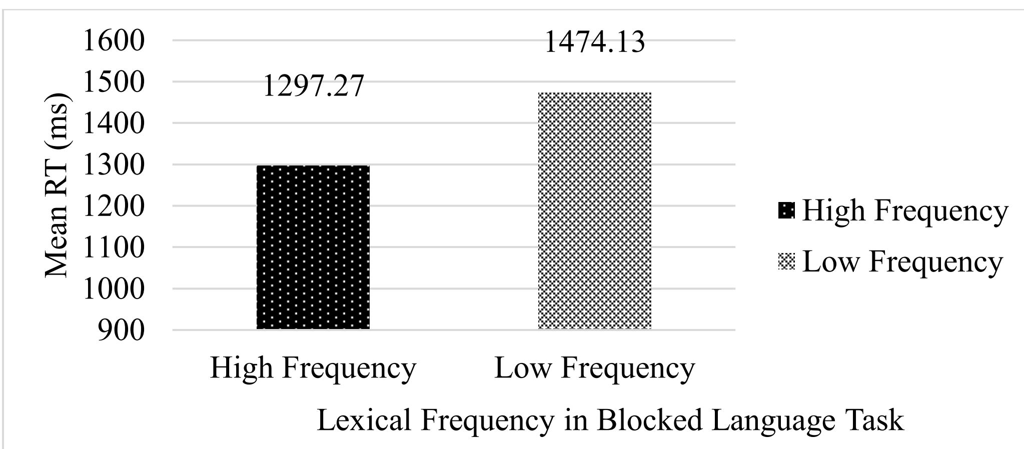


Figure 33 exhibits higher mean latency scores for low-frequency lexical items. Moreover, the upper and lower scores for high-frequency items are 978.34 and 1479.15, respectively, and the upper and lower limits for low-frequency lexical items are 1173.27 and 1812.88, respectively. In addition to lexical frequency, the translation-elicitation latencies are also calculated for the cognate status of lexical items.

The translation-elicitation latencies for cognate status in blocked language reflect that the highest mean latency is observed for unrelated words with low frequency, a subgroup of unrelated words. In the same category, the high-frequency words have relatively lower mean latencies, thus conforming to the effect of the lexical frequency in the process of lexical access. Furthermore, comparing three broader categories, triple cognates, double cognates, and unrelated words, demonstrates lower latency scores for triple and double cognates than for unrelated words. The mean scores for triple and double cognates are 1137.68 and 1267, respectively, considerably lower than the mean latency score for unrelated words, which is calculated to be 1639.4. Moreover, the mean score for double cognates is higher than for triple cognates, thus pointing to the facilitation of the cognate effect. However, the mean scores for triple and double cognates do not differ considerably. The translation-elicitation latencies concerning the cognate status of lexical items are presented in Figure 34.

Figure 34

Representation of the Translation Latencies for the Cognate Status of Words in a Blocked Language Task

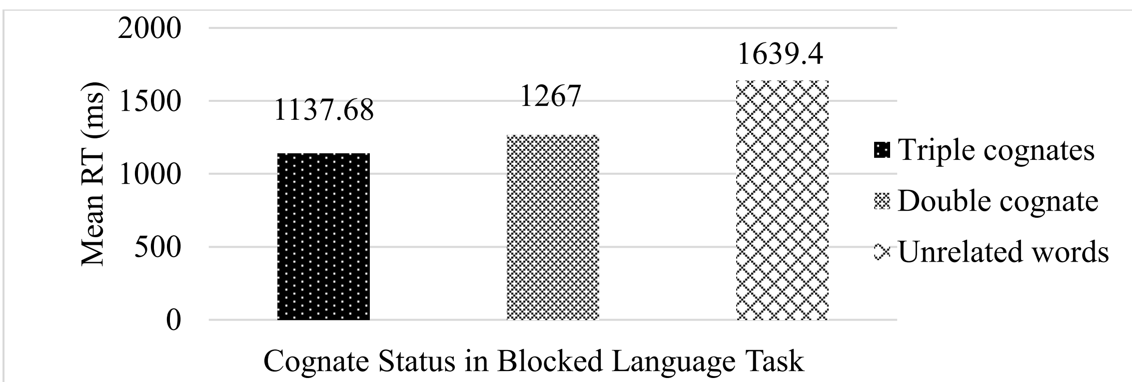


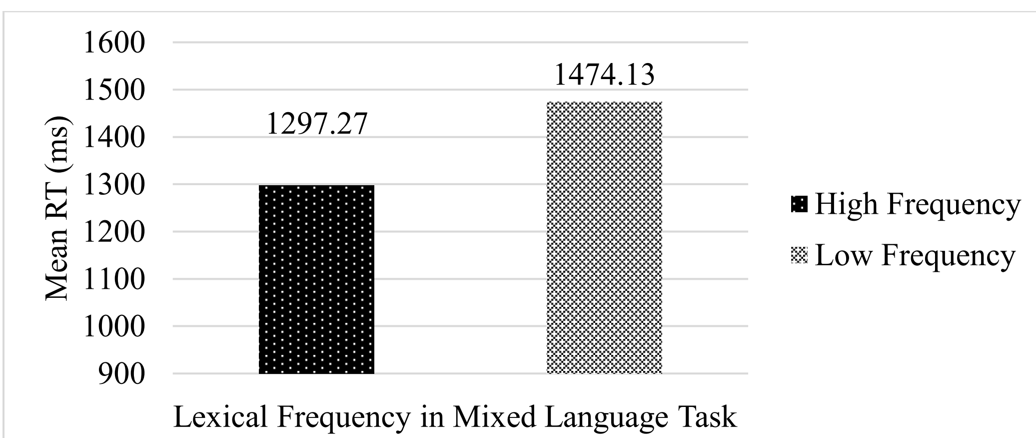
Figure 34 exhibits mean differences in the translation latencies concerning the cognate status of lexical items. The blocked language translation task consisted of two language blocks: the English language block and the Urdu language block. The descriptive statistics are presented for both language blocks exclusively. The minimum and maximum translation latency scores for the English language block are 1023.00 and 1564.98, respectively, with a mean score of 1271.33, and the minimum and maximum translation latency scores for the Urdu language block are 1132.13 and 1729.85, respectively, with a mean score of 1424.54. Besides, the minimum and maximum translation latency scores for high-frequency items are 936.07 and 1466.81, respectively, with a mean score of 1175.6

and the minimum and maximum latency scores for low-frequency English block are reported to be 1067.17 and 1811.04, with a mean score of 1355.08. Similarly, the higher and lower limits of translation latency score for the Urdu block are 1132.13 and 1729.85, with a mean score of 1424.54. Furthermore, in the Urdu language block, the minimum and maximum scores for high-frequency items are 962.72 and 1632.84, respectively, with a mean translation latency score of 1286.47 and the minimum and maximum scores for low-frequency items are recorded as 1199.72 and 1892.43, respectively, with a mean translation latency score of 1545.34.

From the descriptive statistics for the translation-elicitation task in mixed language presented in Table 14, the minimum and maximum scores range from 1047.89 to 1750.24, respectively, with a mean translation latency of 1391.59. The two subcategories concerning the frequency are high and low-frequency items, with means of 1297.27 and 1474.13, respectively, demonstrating lexical frequency effects in translation latency scores. Moreover, the upper and lower mean scores for high-frequency items are 958.10 and 1648.51, respectively, and the upper and lower limits for low-frequency words are 1114.89 and 2004.47, respectively. The results of lexical frequency for the mixed language experiment are presented in Figure 35.

Figure 35

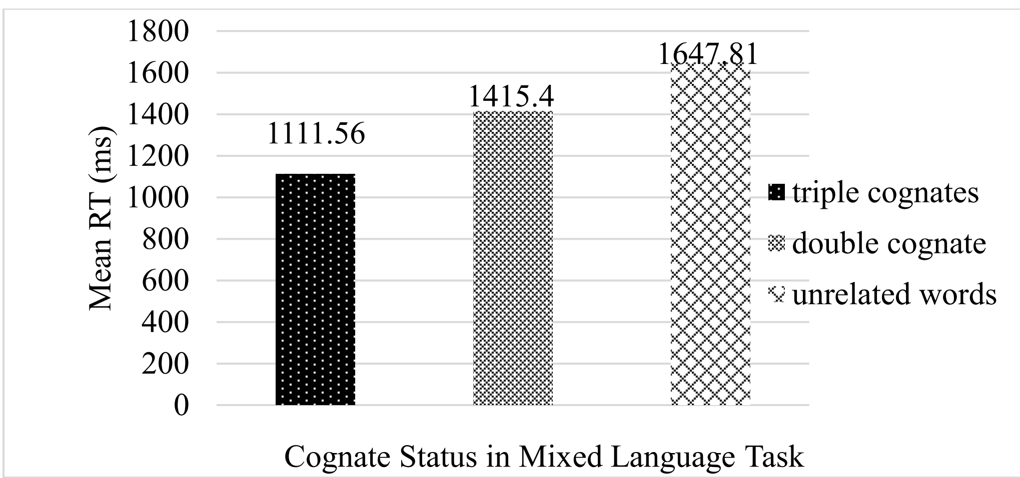
Representation of Low- and High-Frequency Words in the Mixed Language Task



In addition to the lexical frequency, the translation-elicitation latencies for cognate status in mixed language reflect that the highest mean latency is observed for unrelated words, with low-frequency words, a subgroup for unrelated words, just as is the case for the blocked language task. Once more, in the same category, the high-frequency words have relatively lower mean latencies, thus compatible with the effect of the frequency of words in the process of lexical access. Furthermore, comparing three broader categories, triple cognates, double cognates and unrelated words, demonstrates lower latency scores for triple and double cognates than for unrelated words. The mean scores for triple and double cognates are 1111.56 and 1415.4, respectively, considerably lower than the mean latency score for unrelated words, which is calculated to be 1647.81. Moreover, the mean translation latency score for double cognates is higher than the mean score for triple cognates, thus pointing to the cognate facilitation effect. Similarly, the mean score for triple and double cognates differs considerably, whereas triple cognates appear to take the lowest mean score. The translation-elicitation scores for the cognate status of lexical items are presented in Figure 36.

Figure 36

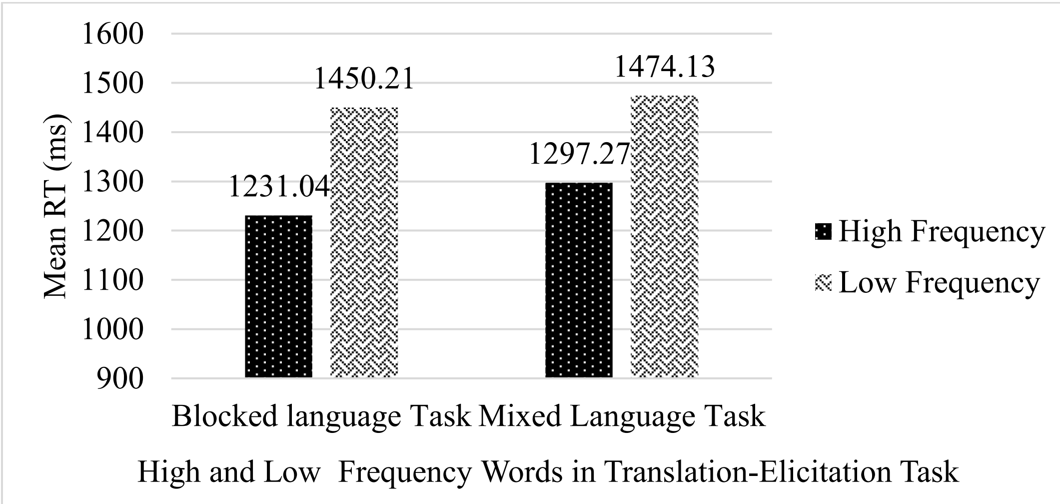
Representation of Cognate Status in Mixed Language Task



The mean translation latencies in both the blocked language task and mixed language task in the sentential context validate the cognate facilitation effect and lexical frequency effect, which have been tested through inferential statistics in the later part of this study to test the hypotheses proposed. The comparison of both parts of the task for lexical frequency is presented in Figure 37.

Figure 37

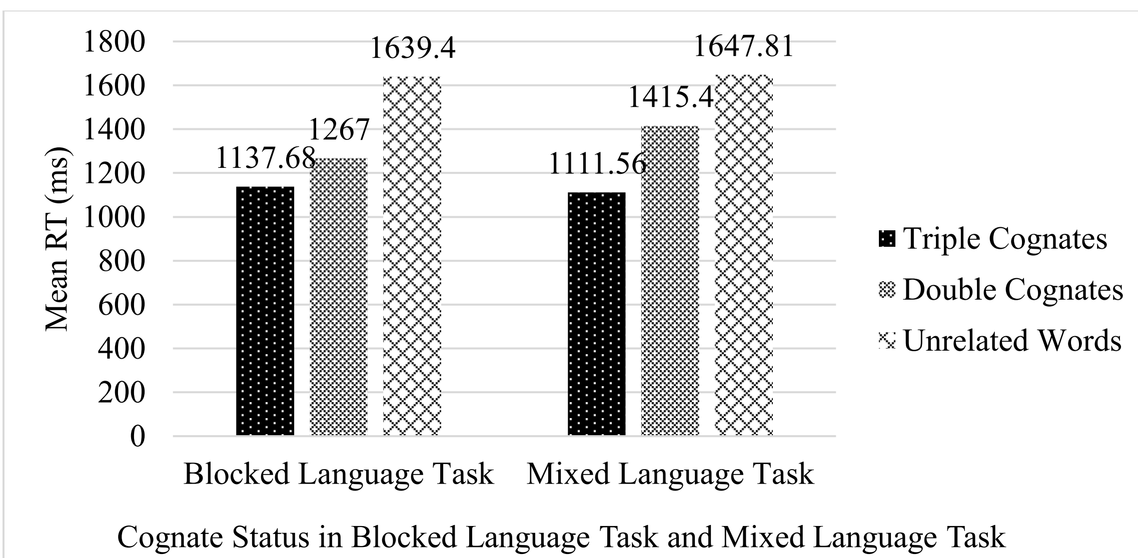
Comparison of Low- and High-Frequency Words in Blocked Language Task and Mixed Language Task



Similarly, the comparison of triple cognates, double cognates, and unrelated words in the blocked language task and the mixed language task is presented in Figure 38.

Figure 38

Comparison of Triple Cognates, Double Cognates and Unrelated Words in the Blocked Language Task and the Mixed Language Task



However, comparing mean translation latencies of the blocked and mixed language tasks yields insignificant differences, demonstrating no cost for both language conditions.

The lack of significant difference points to the phenomenon of whether participants respond in a single language in consecutive sentences or to mixed sentences in two languages, as is the case with this particular experiment; the results demonstrated no significant difference in the translation latencies of participants. It revealed an insignificant difference in the latencies of blocked and mixed language block, thus pointing to the simultaneous activation of all languages. The comparison of the two segments of the translation-elicitation task is presented in Figure 39.

Figure 39

Comparison of the Translation-Elicitation Latencies in the Blocked Language Task and the Mixed Language Task

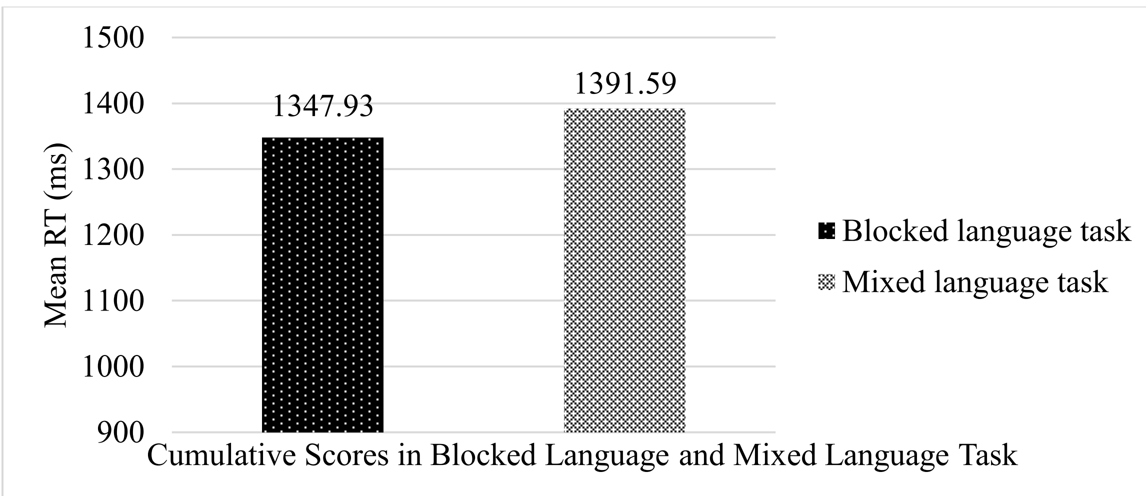


Figure 39 demonstrates no differences in mean latency scores when the lexical items are embedded in the sentential context. The comparison of scores in the blocked language task and the mixed language task reveals slight differences in both categories, indicating that blocking or mixing the language of the task does not significantly influence their responses. In addition to the descriptive statistics of the translation-elicitation latencies, correlation coefficients and inferential statistics have been executed to study the influence of linguistic features on the access and processing of languages in trilingual participants.

4.4 Relationship among Study Variables

To examine the relationship among various linguistic variables and participant groups, Pearson's Product-Moment Correlation was computed. Findings of the correlation analysis are reported in Table 15, reflecting that correlation coefficients between language proficiency (high, medium or low), cognate status (triple cognate, double cognate, or unrelated words), and lexical frequency (high or low) in three experimental paradigms, namely, the picture naming task, the Stroop task and the translation-elicitation task.

Table 15

Correlation Coefficients among Study Variables

	Variab	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	Test	-	-.88	-.77	-.87	-.81	-.83	-.75	-.68	-.74	-.61	-.64	-.21*	-.76	-.15	-.16	-.02	-.06	.04	-.07	-.87*	-.88*	-.79*	-.80*	-.81*	-.74*	-.98*	-.98*	-.21*	-.91*	-.88*	-.31*
2	PNTC		-	.93*	.96*	.85*	.84*	.79*	.70*	.73*	.64*	.59*	.33**	.61*	.17	.28**	.11	-.06	.10	.11	.80**	.80**	.73**	.77**	.78**	.70**	.87**	.85**	.25**	.76**	.83**	.39**
3	PNHT(			-	.78*	.74*	.78*	.66*	.61*	.64*	.56*	.61*	.32**	.58*	.20**	.27**	.10	.03	.10	.07	.70**	.72**	.63**	.70**	.73**	.63**	.77**	.75**	.22*	.69**	.75**	.37**
4	PNLT(				-	.85*	.80*	.82	70**	.72*	.64*	.52*	.31**	.58*	.13	.26**	.12	-.12	.09	.12	.79**	.78**	.74**	.74**	.75**	.68**	.87**	.85**	.25*	.74**	.81**	.36**
5	PNDC					-	.95*	.97*	.72*	.75*	.66*	.54*	.29**	.56*	.19*	.25**	.13	.05	.17	.11	.73**	.73**	.67**	.68**	.72**	.60**	.79**	.80**	.21*	.72**	.74**	.30**
6	PNHD(						-	.84*	.69*	.73*	.62*	.58*	.27**	.61*	.23**	.25**	.12	.07	.16	.13	.74**	.76**	.66**	.71**	.76**	.62**	.81**	.83**	.20**	.75**	.76**	.32**
7	PNLD(							-	.70*	.71*	.64*	.47*	.27**	.48*	.14	.24**	.13	-.15	.17	.09	.67**	.66**	.63**	.60**	.63**	.54**	.72**	.73**	.21**	.64**	.68**	.25**
8	PNUW								-	.91*	.98*	.55*	.31**	.54*	.22	.15	.17	.09	.29**	.20**	.69**	.70**	.62**	.61**	.60**	.57**	.66**	.68**	.33**	.61**	.64**	.32**
9	PNHU									-	.81*	.58*	.36**	.58*	.19*	.20*	.10	.16	.27**	.17	.73**	.74**	.65**	.66**	.65**	.63**	.72**	.73**	.32**	.68**	.70**	.34**
10	PNLU'										-	.49*	.27**	.49*	.22*	.12	.20*	.05	.28**	.20*	.62**	.56**	.63**	.54**	.51	.54**	.59**	.61**	.31**	.54**	.57**	.29**
11	STEC											-	.32*	.66*	.36*	.29**	.26**	.30**	.21**	.19	.56**	.50**	.59**	.53**	.49**	.54**	.63**	.64**	.14	.67**	.56**	.18
12	STEI												-	.13	.02	.60*	.13	.05	.53*	.29*	.30*	.25*	.33*	.35*	.35*	.31*	.21*	.20*	.29*	.23*	.30*	.33*
13	STECT													-	.18	.11	.10	.28*	.06	.05	.66*	.57*	.70*	58**	.54*	.58*	.75*	.74*	.16	.72*	.61*	.20*
14	STUC														-	.04	.72*	.14	.32*	.44*	.19*	.10	.13	.20*	.19	.19*	.16	.17	-.02	.19	.19	.13
15	STUI															-	.26*	.02	.55*	.22*	.22*	.18	.26*	.28*	.28*	.26*	.17	.15	.20*	.17	.25*	.28*
16	STUCT																-	.05	.43*	.50*	.06	,08	.03	.12	.12	.12	.04	.03	.07	.04	.09	.16
17	STPC																	-	.18	-.04	.09	.06	.12	.14	.14	.13	.06	.09	.07	.24*	.04	.08
18	STPI																		-	.50*	.15	.12	.16	.23*	.24*	.19*	.02	.05	.24*	.13	.15	.28
19	STPCT																			-	-.01	-.01	-.01	-.09	.07	.10	.06	.05	-.11	.08	.09	.04
20	TEBL																				-	.96**	.94**	.86**	.81**	.84**	.86**	.88**	.66**	.81**	.85**	.53**
21	TEBLI																					-	.82**	.85**	.81**	.82**	.87**	.89**	.53**	.83**	.85**	.52**
22	TEBLI																						-	.79**	.79**	.73**	.79**	.80**	.70**	.73**	.78**	.51**
23	TEML																							-	.95**	.97**	.80**	.79**	.48**	.84**	.92**	.77**
24	TEML																								-	.84**	.80**	.80**	.43**	.83**	.88**	.71**
25	TEML																									-	.73**	.73**	.48**	.79**	.89**	.77**
26	TEBLT																										-	.97**	.20**	.89**	.88**	.31**
27	TEBLI																											-	.22**	.89**	.86**	.31**
28	TEBLU																												-	.24**	.34**	.59**
29	TEML'																													-	.84**	.36**
30	TEML																														-	.53**
31	TEML W																															-

Note. PNTC = Picture-Naming Task with Triple Cognates; PNHTC = Picture-Naming Task with High Frequency Triple Cognates; PNLTC = Picture-Naming Task with Low Frequency Triple Cognates; PNDC = Picture-Naming Task with Double Cognates; PNHDC = Picture-Naming Task with High Frequency Double Cognates; PNLDC = Picture-Naming Task with Low Frequency Double Cognates; PNUW = Picture-Naming Task with Unrelated Words; PNHUW = Picture-Naming Task with High Frequency Unrelated Words; PNLUW = Picture-Naming Task with Low Frequency Unrelated Words; STEC = The Stroop Task in English with Congruent Trials; STEI = The Stroop Task in English with Incongruent Trials; STECT = The Stroop Task in

English with Control Trials; STUC = The Stroop Task in Urdu with Congruent Trials; STUI = The Stroop Task in Urdu with Incongruent Trials; STUCT = The Stroop Task in Urdu with Control Trials; STPC = The Stroop Task in Punjabi with Congruent Trials; STPI = The Stroop Task in Punjabi with Incongruent Trials; STPCT = The Stroop Task in Punjabi with Control Trials; TEBL = Translation-Elicitation Task in Blocked Language; TEBLH = Translation-Elicitation Task in Blocked Language using High Frequency Words; TEBLL = Translation-Elicitation Task in Blocked Language using Low Frequency Words; TEBLE = Translation-Elicitation Task in Blocked Language in English; TEBLEH = Translation-Elicitation Task in Blocked Language in English using High Frequency Words; TEBLEL = Translation-Elicitation Task in Blocked Language in English using Low Frequency Words; TEBLU = Translation-Elicitation Task in Blocked Language in Urdu; TEBLUH = Translation-Elicitation Task in Blocked Language in Urdu using High Frequency Words; TEBLUL = Translation-Elicitation Task in Blocked Language in Urdu using Low Frequency Words; TEML = Translation-Elicitation Task in Mixed Language; TEMLH = Translation-Elicitation Task in Mixed Language using High Frequency Words; TEMLL = Translation-Elicitation Task in Mixed Language using Low Frequency Words.

Table 15 indicates the coefficients of correlation between study variables. The correlation coefficient between participants' level of language proficiency and cognate status of linguistic stimuli indicates a negative correlation, which points to the phenomenon that more proficient participants took less time to respond. There is also a significantly negative correlation between naming latencies of cognate status and language proficiency, and participants' level of language proficiency, as the more proficient group took considerably less time to name triple cognates than double cognates and unrelated words. Similarly, all participant groups recorded the highest naming latencies for unrelated words. The naming latencies for double cognate lexical items were more significant than those for triple cognate but considerably less than those for unrelated words. In addition to cognate status, the other linguistic variable is lexical frequency. The correlation coefficients for low- and high-frequency lexical items also show a negative correlation, which means participants with high proficiency exhibited smaller naming latencies for high-frequency lexical items than for low-frequency lexical items. The relative difference in correlation coefficients is evident in all three proficiency groups of participants.

Besides the picture-naming task, Table 15 shows correlation coefficients for the Stroop task in English, Urdu, and Punjabi. Participants' response latencies exhibit significant differences in congruent, incongruent, and control trials in the Stroop task in English. However, the three groups of participants did not exhibit significant differences in the other two variants of the Stroop task, that is, the Stroop task in Urdu and Punjabi. This discrepancy in response latencies across the three languages of participants may be attributed to their proficiency and relative use. Since the participants reported using either Urdu or Punjabi most of the time, restricted the use of English to formal settings only, and had varied levels of English language proficiency, their performance in the Stroop task in English differed significantly from their performance in the Stroop task in Urdu and Punjabi. This shows that participants with higher English proficiency took smaller latencies and made fewer errors than the other two groups of participants. However, all participants performed equally on the Stroop task in Urdu and Punjabi.

Table 15 also presents correlation coefficients for the translation-elicitation task, which analyses the cognate status and lexical frequency in the translation-elicitation paradigm in a sentential context. The findings of experiment 1, the picture-naming task, are reinforced by the findings of the translation-elicitation task in a sentential context. The correlation coefficient between participants' level of language proficiency and the cognate status of linguistic stimuli in a sentential context shows a negative correlation, indicating that more proficient participants took less time to translate from L2-L3 and L3-L2 than participants with both medium and low proficiency. Similarly, all participant groups recorded the highest translation latencies for unrelated words. The translation latencies for double cognate lexical items were more significant than those for triple cognate but considerably less than those for unrelated words. In addition to cognate status, the other linguistic variable is the lexical frequency. The correlation coefficients for low- and high-frequency lexical items in a sentential context also show a negative correlation, which means participants with high proficiency exhibited smaller naming latencies for high-frequency lexical items than for low-frequency lexical items. The relative difference in correlation coefficients is evident in all three proficiency groups of participants.

4.6 Regression Analysis of the Interaction of the Language Background Questionnaire and Experimental Data

In order to examine the variance explained by the most significant predictors for cognate facilitation effect for triple and double cognates or interference effect for unrelated words separately for the picture-naming task, the Stroop task, and the translation-elicitation task, a linear regression analysis was conducted. Variables that are language proficiency scores were added as predictors in a linear regression for triple cognates, double cognates, and unrelated words as outcome variables for experiment 1- the picture-naming task. Similarly, variables, that is, English language proficiency scores, were added as predictors in a linear regression for congruent, incongruent and control trials as outcome variables for the three variants of the Stroop task. Finally, variables, that is, English proficiency scores, were added as predictors in a linear regression for triple cognates, double cognates and unrelated words as outcome variables in the translation-elicitation task in a sentential context.

4.6.1 Predictors of Triple Cognates in the Picture-Naming Task

Table 16 shows a linear regression analysis of English proficiency test scores for predicting response latencies of triple cognates in the picture naming task. The English proficiency test scores variable explained significant variance in triple cognates, $R^2 = .63$, F(1, 103)=177.95, p<.001. The test score, β=-.79, decreased the dependent variable of triple cognate by .79 standard deviations.

Table 16

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Triple Cognates in the Picture-Naming Task

	Triple Cognates								
								95%CI	
Variable	*R*	*ΔR²*	B	*Β*	*T*	*F*	*p*	LL	UL
(Constant)	.79	.63	1778.33		25.45		<.001	1639.75	1916.91
Test Score			-14.10	-.79	-13.34	177.95	<.001	-16.20	12.01

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.2 Predictors of Double Cognates in the Picture-Naming Task

Table 17 presents a linear regression analysis of English proficiency test scores for predicting response latencies of double cognates in the picture naming task. The English proficiency test scores variable explained a significant proportion of variance in double cognates, R^2 = .74, F(1, 103) = 126.84, p < .001. The test score, β = -.74, decreased the dependent variable of double cognate by .74 standard deviations.

Table 17

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Double Cognates in the Picture-Naming Task

	Double Cognates								
								95%CI	
Variable	*R*	*ΔR²*	B	*Β*	*T*	*F*	*p*	LL	UL
(Constant)	.74	.55	1616.61		24.10		<.001	1483.60	1749.63
Test Score			-11.43	-.74	-11.26	126.84	<.001	-13.44	9.42

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.3 Predictors of Unrelated Words in the Picture-Naming Task

Table 18 shows a linear regression analysis of English proficiency test scores for predicting response latencies of unrelated words in the picture-naming task. The English proficiency test scores variable explained significant variance in unrelated words, $R^2 = .62$, $F(1, 103) = 63.12$, $p < .001$. The test score, $\beta = -.62$, decreased the dependent variable of unrelated words by .62 standard deviations.

Table 18

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Unrelated Words in the Picture-Naming Task

	Unrelated Words								
								95%CI	
Variable	*R*	*ΔR²*	B	*Β*	*T*	*F*	*p*	LL	UL
(Constant)	.62	.38	1650.58		21.25		<.001	1496.53	1804.63
Test Score			-9.34	-.62	-7.95	63.12	<.001	-13.44	7.01

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.4 Predictors of Congruent Trials in the Stroop Task in English

Table 19 shows a linear regression analysis of English proficiency test scores for predicting response latencies of congruent trials in the Stroop task in English. The English proficiency test scores variable explained significant variance in congruent trials, $R^2 = .64$, F(1, 103) = 69.84, p < .001. The test score, β = -.64, decreased the dependent variable of congruent trials by .64 SD.

Table 19

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Congruent Trials in the Stroop Task in English

	Congruent Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*B*	*T*	*F*	*p*	LL	UL
(Constant)	.64	.40	545.82		67.10		<.001	529.68	561.95
Test Score			-31.47	-.64	-8.36	69.84	<.001	-38.94	-24.00

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; UW = unrelated words.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.5 Predictors of Incongruent Trials in the Stroop Task in English

Table 20 shows a linear regression analysis of English proficiency test scores for predicting response latencies of incongruent trials in the Stroop task in English. The English proficiency test scores variable explained a less significant proportion of variance in incongruent trials than in congruent trials, $R^2 = .23$, F(1, 103) = 5.88, p = .015. Test score, β = -.23, resulted in a decrease in the dependent variable of incongruent trials by .23 standard deviations, which indicated the participants exhibited a similar trend of interference pattern while responding to incongruent trials in English, regardless of their English language proficiency.

Table 20

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Incongruent Trials in the Stroop Task in English

	Incongruent Trials								
								95%CI	
Variable	*R*	*ΔR*^{2}	B	*B*	*T*	*F*	*p*	LL	UL
(Constant)	.23	.05	1089.63		17.24		<.001	964.31	1214.95
Test Score			-2.32	-.23	-2.32	5.88	.017	-4.22	.42

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.6 Predictors of Control Trials in the Stroop Task in English

Table 21 shows a linear regression analysis of English proficiency test scores for predicting response latencies of control trials in the Stroop task in English. The English proficiency test scores variable explained a significant proportion of variance in control trials, R^2 = .73, F(1, 103) = 118.37, p < .001. The test score, β = -.73, decreased the dependent variable of control trials by .73 standard deviations.

Table 21

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Control Trials in the Stroop Task in English

	Control Trials								
								95%CI	
Variable	*R*	*ΔR*^{2}	B	*B*	*T*	*F*	*P*	LL	UL
(Constant)	.73	.54	552.80		42.20		<.001	526.82	578.78
Test Score			-14.10	-.73	-10.88	118.37	<.001	-2.55	-1.76

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; UW = unrelated words.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.7 Predictors of Congruent Trials in the Stroop Task in Urdu

Table 22 shows a linear regression analysis of English proficiency test scores for predicting response latencies of congruent trials in the Stroop task in Urdu. The variable of English proficiency test scores explained an insignificant proportion of variance in congruent trials, R^2 = .13, F(1, 103) = 1.74, p = .19. Test score, β = -.13, resulted in a decrease in the dependent variable of congruent trials by .64 standard deviations which is reflective of insignificant differences in congruent trials in the Stroop task in Urdu regardless of their English language proficiency and may be attributed to Urdu language proficiency across all participants.

Table 22

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Congruent Trials in the Stroop Task in Urdu

	Congruent Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*β*	*T*	*F*	*p*	LL	UL
(Constant)	.13	.02	648.85		13.57		<.001	554.02	743.69
Test Score			-.96	-.13	-1.32	1.74	.19	-2.39	.48

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; UW = unrelated words.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.8 Predictors of Incongruent Trials in the Stroop Task in Urdu

Table 23 shows a linear regression analysis of English proficiency test scores for predicting response latencies of incongruent trials in the Stroop task in Urdu. The variable of English proficiency test scores explained an insignificant proportion of variance in incongruent trials, R^2 = .18, F(1, 103) = 3.44, p = .07. Test score, β = -.18, resulted in a decrease in the dependent variable of incongruent trials by .18 standard deviations which is reflective of insignificant differences in incongruent trials in the Stroop task in Urdu regardless of their English language proficiency and may be attributed to Urdu language proficiency across all participants.

Table 23

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Incongruent Trials in the Stroop Task in Urdu

	Incongruent Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*β*	*T*	*F*	*p*	LL	UL
(Constant)	.18	3.44	1135.07		12.19		<.001	950.34	1319.8
Test Score			-2.61	-.18	-1.86	3.44	.07	-5.4	.18

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; UW = unrelated words.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.9 Predictors of Control Trials in the Stroop Task in Urdu

Table 24 shows a linear regression analysis of English proficiency test scores for predicting response latencies of control trials in the Stroop task in Urdu. The variable of English proficiency test scores explained an insignificant proportion of variance in control trials, R^2 = .03, F(1, 103) = .12, p = .73. Test score, β = -.03, resulted in a decrease in the dependent variable of control trials by .03 standard deviations which is reflective of insignificant differences in control trials in the Stroop task in Urdu regardless of their English language proficiency and may be attributed to Urdu language proficiency across all participants.

Table 24

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Control Trials in the Stroop Task in Urdu

	Control Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*β*	*T*	*F*	*p*	LL	UL
(Constant)	.03	.001	615.14		14.18		<.001	529.08	701.21
Test Score			-.22	-.03	-.66	.12	.73	-1.52	1.08

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; UW = unrelated words.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.10 Predictors of Congruent Trials in the Stroop Task in Punjabi

Table 25 shows a linear regression analysis of English proficiency test scores for predicting response latencies of congruent trials in the Stroop task in Punjabi. The variable of English proficiency test scores explained an insignificant proportion of variance in congruent trials, R^2 = .14, F(1, 103) = -.14, p = .16. Test score, β = -.14, resulted in a decrease in the dependent variable of congruent trials by .14 standard deviations which is reflective of insignificant differences in congruent trials in the Stroop task in Punjabi regardless of their English language proficiency and may be attributed to high Punjabi language proficiency across all participants as it is their L1.

Table 25

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Congruent Trials in the Stroop Task in Punjabi

	Congruent Trials								
								95%CI	
Variable	*R*	ΔR^2	B	*β*	*T*	*F*	*p*	LL	UL
(Constant)	.14	.02	503.19		12.95		<.001	426.11	580.28
Test Score			-.83	-.14	-1.42	-.14	.16	-2.00	.33

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.11 Predictors of Incongruent Trials in the Stroop Task in Punjabi

Table 26 shows a linear regression analysis of English proficiency test scores for predicting response latencies of incongruent trials in the Stroop task in Punjabi. The variable of English proficiency test scores explained an insignificant proportion of variance in incongruent trials, R^2 = .07, F(1, 103) = .55, p = .46. Test score, β = -.07, resulted in a decrease in the dependent variable of incongruent trials by .07 standard deviations which is reflective of insignificant differences in incongruent trials in the Stroop task in Punjabi regardless of their English language proficiency and may be attributed to high Punjabi language proficiency across all participants as it is their L1.

Table 26

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Incongruent Trials in the Stroop Task in Punjabi

	Incongruent Trials								
								95%CI	
Variable	*R*	ΔR^2	B	*B*	*t*	*F*	*p*	LL	UL
(Constant)	.07	.005	934.14		9.92		<.001	747.31	1120.97
Test Score			-1.05	-.07	-.74	.55	.46	-3.88	1.77

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

**p*< .05. ***p*< .01. ****p* < .001.

4.6.12 Predictors of Control Trials in the Stroop Task in Punjabi

Table 27 shows a linear regression analysis of English proficiency test scores for predicting response latencies of control trials in the Stroop task in Punjabi. The variable of English proficiency test scores explained an insignificant proportion of variance in control trials, R^2 = .06, F(1, 103) = .41, p = .52. Test score, β = -.06, resulted in a decrease in the dependent variable of control trials by .06 standard deviations which is reflective of insignificant differences in control trials in the Stroop task in Punjabi regardless of their English language proficiency and may be attributed to high Punjabi language proficiency across all participants as it is their L1.

Table 27

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Control Trials in the Stroop Task in Punjabi

	Control Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*β*	*T*	*F*	*p*	LL	UL
(Constant)	.06	.004	567.96		13.89		<.001	486.86	649.06
Test Score			-.40	-.06	-.64	.41	.52	-1.62	.83

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

*p< .05. **p< .01. ***p < .001.

4.6.13 Predictors of Blocked English and Urdu Trials in the Translation-Elicitation Task

Table 28 shows a linear regression analysis of English proficiency test scores for predicting response latencies of blocked English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained significant variance in blocked English and Urdu trials, R^2 = .79, F(1, 103) = 169.10, p < .001. The test score, β = -.79, decreased the dependent variable of triple cognate by .79 standard deviations.

Table 28

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of the Translation-Elicitation in the Blocked Language Task

	Blocked English and Urdu Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*B*	*T*	*F*	*p*	LL	UL
(Constant)	.79	.62	2008.48		39.05		<.001	1906.47	2110.50
Test Score			-10.12	-.79	- 13.00	169.10	<.001	-11.67	8.58

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

*p< .05. **p< .01. ***p < .001.

4.6.14 Predictors of Mixed English and Urdu Trials in the Translation-Elicitation Task

Table 29 shows a linear regression analysis of English proficiency test scores for predicting response latencies of mixed English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained significant variance in mixed English and Urdu trials, $R^2 = .73$, F(1, 103) = 119.67, p < .001. The test score, β = -.73, decreased the dependent variable of mixed English and Urdu trials by .73 standard deviations.

Table 29

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of the Translation-Elicitation in Mixed Language Task

	Mixed English and Urdu Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*B*	*T*	*F*	*p*	LL	UL
(Constant)	.73	.54	2180.05		29.87		<.001	2035.30	2324.81
Test Score			-12.08	-.73	- 10.94	119.67	<.001	-14.27	-9.89

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
*p< .05. **p< .01. ***p < .001.

4.6.15 Predictors of Triple Cognates in Blocked Language Trials in the Translation-Elicitation Task

Table 30 shows a linear regression analysis of English proficiency test scores for predicting response latencies of triple cognates in blocked English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained significant variance in triple cognates, $R^2 = .98$, F(1, 103) = 3169.75, p < .001. The test score, β = -.98, decreased the dependent variable of triple cognate by .98 standard deviations.

Table 30

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Triple Cognates in the Translation-Elicitation Blocked Language Task

	Triple Cognates in Blocked English and Urdu Trials								
								95%CI	
Variable	*R*	*ΔR*^{2}	B	*Β*	*T*	*F*	*P*	LL	UL
(Constant)	.98	.97	1535.49		201.76		<.001	1520.40	1550.58
Test Score			-198.91	-.98	-56.46	3187.75	<.001	-205.89	-191.92

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.16 Predictors of Double Cognates in Blocked English and Urdu Trials in the Translation-Elicitation Task

Table 31 shows a linear regression analysis of English proficiency test scores for predicting response latencies of double cognates in blocked English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained significant variance in double cognates, R^2 = .98, F(1, 103) = 2920.05, p < .001. The test score, β = .98, increased the dependent variable of double cognate by .98 standard deviations.

Table 31

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Double Cognates in the Translation-Elicitation Blocked Language Task

	Double Cognates in Blocked English and Urdu Trials								
								95%CI	
Variable	*R*	ΔR^2	B	*B*	*T*	*F*	*P*	LL	UL
(Constant)	.98	.97	1619.87		201.76		<.001	1605.88	1633.86
Test Score			-176.43	.98	-56.46	2920.05	<.001	-182.91	-169.96

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.17 Predictors of Unrelated Words in Blocked English and Urdu Trials in the Translation-Elicitation Task

Table 32 shows a linear regression analysis of English proficiency test scores for predicting response latencies of unrelated words in blocked English and Urdu trials in the translation-elicitation task. The variable of English proficiency test scores explained an insignificant proportion of variance in unrelated words, $R^2 = .21$, F(1, 103) = 4.78, p = .03. Test score, β = -.21, resulted in a decrease in the dependent variable of unrelated words by .21 standard deviations. The insignificant variance indicates a similar trend towards unrelated words across all participants, regardless of their English language proficiency.

Table 32

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Unrelated Words in the Translation-Elicitation Blocked Language Task

	Unrelated Words in Blocked English and Urdu Trials	
		95%CI

Variable	*R*	*ΔR²*	B	*Β*	*T*	*F*	*P*	LL	UL
(Constant)	.21	.04	1741.60		34.50		<.001	1641.47	1841.71
Test Score			-51.10	-.21	--2.19	4.78	.03	-97.44	-4.75

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.18 Predictors of Triple Cognates in Mixed English and Urdu Trials in the Translation-Elicitation Task

Table 33 shows a linear regression analysis of English proficiency test scores for predicting response latencies of triple cognates in mixed English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained a significant amount of variance in triple cognates, $R^2 = .91$, $F(1, 103) = 464.17$, $p < .001$. The test score, $\beta = -.91$, decreased the dependent variable of triple cognate by .91 standard deviations.

Table 33

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Triple Cognate in the Translation-Elicitation Mixed Language Task

	Triple Cognates in Mixed English and Urdu Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*β*	*t*	*F*	*P*	LL	UL
(Constant)	.91	.82	1523.04		73.83		<.001	1482.13	1563.95
Test Score			-205.74	-.91	-21.55	464.17	<.001	-224.68	186.80

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.19 Predictors of Double Cognates in Mixed English and Urdu Trials in the Translation-Elicitation Task

Table 34 shows a linear regression analysis of English proficiency test scores for predicting response latencies of double cognates in mixed English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained a significant amount of variance in double cognates, $R^2 = .88$, $F(1, 103) = 367.07$, $p < .001$. The test score, $\beta = -.88$, decreased the dependent variable of double cognate by .88 standard deviations.

Table 34

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Double Cognate in the Translation-Elicitation Mixed Language Task

	Double Cognates in Mixed English and Urdu Trials								
								95%CI	
Variable	*R*	*ΔR²*	B	*B*	*t*	*F*	*P*	LL	UL
(Constant)	.88	.78	1843.22		76.42		<.001	1795.38	1891.05
Test Score			-213.91	-.88	-19.16	367.07	<.001	-236.05	191.76

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.
**p*< .05. ***p*< .01. ****p* < .001.

4.6.20 Predictors of Unrelated Words in Mixed English and Urdu Trials in the Translation-Elicitation Task

Table 35 shows a linear regression analysis of English proficiency test scores for predicting response latencies of unrelated words in mixed English and Urdu trials in the translation-elicitation task. The English proficiency test scores variable explained an insignificant proportion of variance in unrelated words, $R^2 = .31$, $F(1, 103) = 10.85$, $p = .001$. The test score, $\beta = .31$, increased the dependent variable of unrelated words by .31 standard deviations. The insignificant variance indicates a similar trend towards unrelated words across all participants, regardless of their English language proficiency.

Table 35

Linear Regression Analysis of English Proficiency Test Scores for Predicting Response Latencies of Unrelated Words in the Translation-Elicitation Mixed Language Task

	Unrelated Words in Mixed English and Urdu Trials	
		95%CI

Variable	R	ΔR^2	B	β	T	F	P	LL	UL
(Constant)	.31	.10	1820.14		32.21		<.001	1639.75	1916.91
Test Score			-86.16	.31	-3.29	10.85	.001	-16.20	12.01

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; UW = unrelated words.
**p*< .05. ***p*< .01. ****p* < .001.

4.7 Moderation Analysis

Moderation analysis was calculated using SPSS (Process macro) to analyse the moderating role of the frequency of language use for all three languages of participants, that is, English, Urdu, and Punjabi. Participants reported using these languages in varying degrees, divided into three categories for analysis. Numerous moderation analyses were conducted for each of the participants' languages, corresponding to the three divisions of language used, through Process Macro (Hayes, 2018). However, in this study, only significant moderation analyses are reported.

4.7.1 Moderation of the Frequency of Using English

Moderation analysis was carried out through Process Macro by Hayes (2018), in which the frequency of using the English language was used as a moderator for the latency scores of congruent trials in Punjabi.

Table 36

Moderation Effect of Frequency of Using English for Congruent Trials in Punjabi (N=105)

	Frequency of Using English		
		95% *CI*	
Predictor	B	*LL*	*UL*
Constant	268.81	86.58	451.04
Cong.	2.52	-.24	5.29
Test Score	167.19*	51.74	282.63
R^2	.09		

ΔR^2	.07
F	7.76

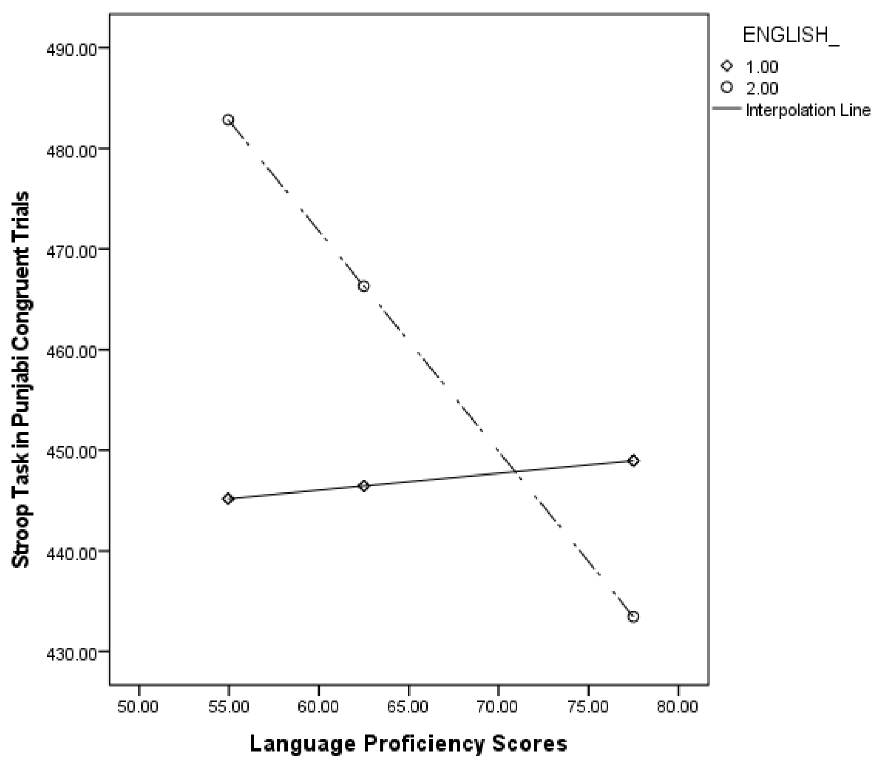
Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; Cong.=Congruent Trials

**p*< .05. ***p*< .01. ****p* < .001.

Table 36 illustrates the moderating effect of the frequency of using English for congruent trials in Punjabi. The main effect of the frequency of using English significantly negatively predicts mean scores in congruent trials in Punjabi. The intersection effect of the frequency of using English for congruent trials in Punjabi is significant. The moderation effect is further elaborated using a mod graph in Figure 40.

Figure 40

Mod Graph Showing the Interaction of Frequency of Using English on Congruent Trials in the Stroop Task in Punjabi



The mod graph (Figure 40) illustrates the moderating effect of the frequency of using English on congruent trials in the Stroop task in Punjabi. It can be observed that scores on congruent trials decrease significantly with increasing English language proficiency scores.

4.7.2 Moderation of Frequency of Using Urdu

Moderation analysis was carried out through Process Macro by Hayes (2018). The frequency of using the Urdu language was used as a moderator for the latency scores of congruent trials in the Stroop task in Urdu. Table 37 presents the results of the moderation effect.

Table 37

Moderation Effect of Frequency of Using Urdu for Congruent Trials in the Stroop Task in Punjabi (N=105)

	Frequency of Using Urdu		
		95% *CI*	
Predictor	B	*LL*	*UL*
Constant	268.81	86.58	451.04
Cong.	2.52	-.24	5.29
Test Scores	167.19*	51.74	282.63
R^2	.09		
ΔR^2	.07		
F	7.76		

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; DC=double cognate

*$p< .05$. **$p< .01$. ***$p < .001$.

Table 37 illustrates the moderating effect of the frequency of using Urdu for congruent trials in Punjabi. The main effect of the frequency of using Urdu significantly negatively predicts mean scores in congruent trials in Punjabi. The intersection effect of the frequency of using English for congruent trials in Punjabi is significant.

4.7.3 Moderation of Frequency of Using Punjabi

Moderation analysis was carried out through Process Macro by Hayes (2018). The frequency of using the Punjabi language was used as a moderator for congruent trials in the Stroop task in Urdu. Table 38 presents the moderation effect.

Table 38

Moderation Effect of Frequency of Using Punjabi for Congruent trials in the Stroop task in Urdu (N=105)

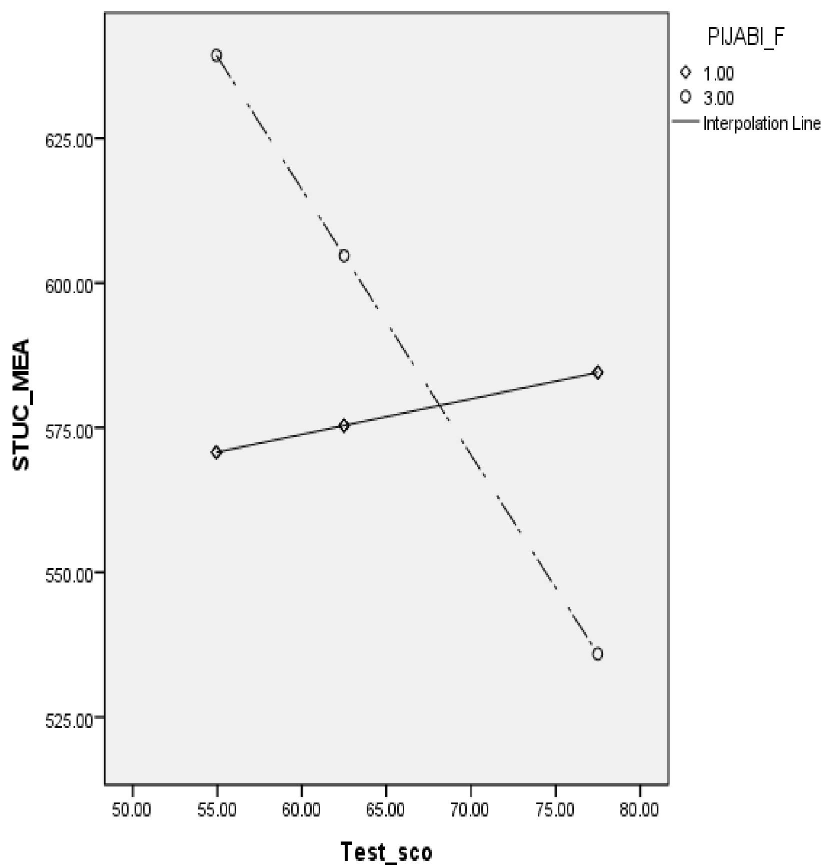
	Frequency of Using English		
		95% *CI*	
Predictor	B	*LL*	*UL*
Constant	268.81	86.58	451.04
Cong.	2.52	-.24	5.29
Frequency of Using Punjabi	167.19*	51.74	282.63
R^2	.09		
ΔR^2	.07		
F	7.76		

Note. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit; DC=double cognate
**p*< .05. ***p*< .01. ****p* < .001.

Table 38 illustrates the moderating effect of the frequency of using Punjabi for congruent trials in Urdu. The main effect of the frequency of using Punjabi significantly negatively predicts mean scores on congruent trials in Urdu. The intersection effect of the frequency of using Punjabi for congruent trials in Urdu is significant. The moderation effect is further elaborated using a mod graph in Figure 41.

Figure 41

Mod Graph Showing the Interaction of Frequency of Using English on Congruent Trials in the Stroop Task in Punjabi



The mod graph (Figure 41) illustrates the moderating effect of the frequency of using Punjabi on congruent trials in the Stroop task in Urdu. It can be observed that scores on congruent trials decrease significantly with increasing English language proficiency scores. The moderation effects of other linguistic variables and participant variables were also calculated. The main effect of gender and other linguistic variables is non-significant. The male and female participants exhibited insignificant differences in mean naming latencies.

4.8 Interaction of Frequency of Using English, Urdu, and Punjabi on Study Variables

The participants involved in the study reported using their languages to varying degrees. Since the frequency of interaction with a particular language influences its usage, analyses have been made to examine the effect of using English, Urdu, and Punjabi on the response latencies.

4.8.1 Interaction of Frequency of Using English

The data collected from the language background questionnaire showed that 62 participants reported using English for only two hours, 29 participants reported using it for about four hours, and 14 participants used it for about eight hours, as they worked part-time. ANOVA was computed to assess the influence of varying degrees of interaction with the English language.

Table 39

ANOVA Results Comparing Frequency of Using English across all Language Conditions (N=105)

	1-2 hrs (n=62)	3-4 hrs (n=29)	6-8 hrs (n=14)				95% CI	
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Test Score	1.77(.79)	2.24(.73)	2.5(.75)	6.90**	3-4hrs English Use >1-2hrs English Use	.47*	.04	.89
PNTC	910.09(184.05)	792.5(162.07)	761.91(163.76)	6.83**	1-2hrs English Use >3-4hrs English Use	117.59*	21.35	213.83
					1-2hrs English Use >5-8hrs English Use	148.18*	21.59	274.76
PNHTC	848.56(142.53)	753.05(141.37)	722.86(115.81)	7.5***	1-2hrs English Use >3-4hrs English Use	95.51*	19.34	171.67
					1-2hrs English Use >5-8hrs English Use	125.70*	25.52	225.88
PNLTC	998.97(270.94)	849.48(215.16)	818.33(275.39)	4.95*	1-2hrs English Use >3-4hrs English Use	149.49*	8.52	290.46
PNDC	904.05(167.64)	839.43(142.75)	787.92(128.39)	3.94*	1-2hrs English Use >5-8hrs English Use	116.13*	3.39	228.87
PNHDC	837.79(141.58)	780.37(115.55)	749.52(117.54)	3.58*				
PNLDC	983.56(212.00)	910.31(198.72)	833.99(152.97)	3.68*	1-2hrs English Use >5-8hrs English Use	149.56*	4.26	294.87
PNUW	1074.27(153.33)	1006.15(146.14)	967.19(174.95)	3.78*				
PNHUW	990.72(148.77)	939.68(144.51)	846.39(128.45)	5.94**	1-2hrs English Use >5-8hrs English Use	144.34*	39.78	248.89
PNLUW	1122.01(167.67)	1044.13(156.17)	1036.21(208.62)	2.84				
STEC	494.18(33.46)	472.25(44.77)	454.81(43.79)	7.59***	1-2hrs English Use >3-4hrs English Use	21.93*	.97	42.88
					1-2hrs English Use >5-8hrs English Use	39.37*	7.04	192.12
STEI	957.30(112.97)	895.59(94.55)	942.74(46.26)	3.64*	1-2hrs English Use >3-4hrs English Use	61.71*	5.98	117.45
STECT	419.94(29.65)	406.74(27.67)	388.12(29.35)	7.51***	1-2hrs English Use >5-8hrs English Use	31.82*	10.87	52.76
STUC	599.46(76.01)	569.49(69.66)	564.24(91.82)	2.2				
STUI	995.05(164.01)	923.38(133.35)	914.03(97.54)	3.21*				
STUCT	611.80(65.96)	587.49(68.83)	577.36(81.99)	2.14				
STPC	443.93(62.92)	464.61(65.85)	437.23(55.21)	1.34				
STPI	885.89(155.02)	814.64(136.60)	879.31(152.27)	2.30				

STPCT	546.22(63.38)	521.43(58.32)	566.11(65.81)	2.62				
TEBL	1383.09(133.85)	1303.85(116.30)	1283.52(134.27)	5.79**	1-2hrs English Use >3-4hrs English Use	79.24*	8.8	149.60
					1-2hrs English Use >5-8hrs English Use	99.58*	7.04	192.12
TEHBL	1266.88(132.51)	1192.29(109.79)	1152.60(140.89)	6.41**	1-2hrs English Use >3-4hrs English Use	74.58*	4.59	144.58
					1-2hrs English Use >5-8hrs English Use	114.28	22.21	206.35
TELBL	1484.78(146.59)	1401.47(136.80)	1398.07(128.64)	4.50*	1-2hrs English Use >3-4hrs English Use	83.31	5.68	160.95
TEBLTC	1184.73(162.48)	1088.32(150.86)	1031.54(137.48)	7.48***	1-2hrs English Use >3-4hrs English Use	96.41*	10.79	182.02
					1-2hrs English Use >5-8hrs English Use	153.19*	40.58	265.80
TEBLDC	1307.15(147.12)	1227.53(121.71)	1170.95(137.72	7.06***	1-2hrs English Use >3-4hrs English Use	79.62*	3.29	155.95
					1-2hrs English Use >5-8hrs English Use	136.20*	35.81	236.59
TEBLUW	1657.73(200.93)	1596.06(186.58)	1648.06(216.00)	0.96				
TEML	1428.65(166.58)	1342.00(163.88)	1330.21(182.96)	3.71*				
TEHML	1331.86(165.52)	1254.15(1165.84)	1233.41(148.09)	3.44*				
TELML	1513.34(182.99)	1418.88(170.95)	1414.91(224.33)	3.38*				
TEMLTC	1159.94(175.95)	1059.50(170.53)	1005.17(202.97)	6.02**	1-2hrs English Use >3-4hrs English Use	100.43*	2.87	198.01
					1-2hrs English Use >5-8hrs English Use	154.77*		
TEMLDC	1463.25(191.75)	1351.16(193.93)	1336.39(187.55)	4.74*	1-2hrs English Use >3-4hrs English Use	111.99*	6.95	217.03
TEMLUW	1662.76(207.06)	1615.25(207.06)	1649.07(290.45)	0.42				

Note. PNTC = Picture-Naming Task with Triple Cognates; PNHTC = Picture-Naming Task with High Frequency Triple Cognates; PNLTC = Picture-Naming Task with Low Frequency Triple Cognates; PNDC = Picture-Naming Task with Double Cognates; PNHDC = Picture-Naming Task with High Frequency Double Cognates; PNLDC = Picture-Naming Task with Low Frequency Double Cognates; PNUW = Picture-Naming Task with Unrelated Words; PNHUW = Picture-Naming Task with High Frequency Unrelated Words; PNLUW = Picture-Naming Task with Low Frequency Unrelated Words; STEC = The Stroop Task in English with Congruent Trials; STEI = The Stroop Task in English with Incongruent Trials; STECT = The Stroop Task in English with Control Trials; STUC = The Stroop Task in Urdu with Congruent Trials; STUI = The Stroop Task in Urdu with

Incongruent Trials; STUCT = The Stroop Task in Urdu with Control Trials; STPC = The Stroop Task in Punjabi with Congruent Trials; STPI = The Stroop Task in Punjabi with Incongruent Trials; STPCT = The Stroop Task in Punjabi with Control Trials; TEBL = Translation-Elicitation Task in Blocked Language; TEBLH = Translation-Elicitation Task in Blocked Language using High Frequency Words; TEBLL = Translation-Elicitation Task in Blocked Language using Low Frequency Words; TEBLE = Translation-Elicitation Task in Blocked Language in English; TEBLEH = Translation-Elicitation Task in Blocked Language in English using High Frequency Words; TEBLEL = Translation-Elicitation Task in Blocked Language in English using Low Frequency Words; TEBLU = Translation-Elicitation Task in Blocked Language in Urdu; TEBLUH = Translation-Elicitation Task in Blocked Language in Urdu using High Frequency Words; TEBLUL = Translation-Elicitation Task in Blocked Language in Urdu using Low Frequency Words; TEML = Translation-Elicitation Task in Mixed Language; TEMLH = Translation-Elicitation Task in Mixed Language using High Frequency Words; TEMLL = Translation-Elicitation Task in Mixed Language using Low Frequency Words.

Table 39 shows the mean differences across all variables based on the frequency of using English. The results of the picture-naming task show that mean scores for those speaking English for about 1-2 hours (M = 910.09, SD = 184.05) are higher than those speaking English for 3-4 hours (M = 792.5, SD = 162.07), and also from those speaking English for 5-8 hours (M = 761.91, SD = 163.76), F = 6.83, p<.05 on triple cognates. The groups show a similar trend with on high-frequency triple cognates as well, where mean scores for those speaking English for about 1-2 hours (M = 848.56, SD=142.53) are higher than those speaking English for 3-4 hours (M = 753.05, SD = 141.37), and also from those speaking English for 5-8 hours (M = 722.86, SD = 115.81), F = 7.5, p<.05 on high-frequency triple cognates. On low-frequency triple cognates, the mean scores for those speaking English for about 1-2 hours (M = 998.97, SD = 270.94) are higher than those speaking English for 3-4 hours (M = 849.48, SD = 215.16), F = 4.95, p<.05.

Similarly, the participants who used English for 1-2 hours scored (M = 904.05, SD = 167.64) higher on double cognates than those speaking English for 5-8 hours (M = 787.92, SD = 128.39), F = 3.94, p < .05. The groups exhibit similar trend on low-frequency double cognates in which the participants who used English for 1-2 hours scored (M = 983.56, SD = 212) significantly higher on low-frequency double cognates than those speaking English for 5-8 hours (M = 833..99, SD = 152.97.), F = 3.68, p < .05. The same trend is observed in high-frequency unrelated words, where the participants who used English for 1-2 hours scored (M = 990.72, SD = 148.77) significantly higher on high-frequency double cognates than those speaking English for 5-8 hours (M = 846.39, SD = 128.45). F = 5.94, p < .05.

In addition to the picture-naming task, the table shows mean differences across all three variants of the Stroop task. The findings of the Stroop task in English exhibit statistically significant results on English congruent, incongruent, and control trials. The mean latency scores show that participants who used English for 1-2 hours scored (M = 494.18, SD = 33.46) significantly higher on congruent trials than those speaking English for 3-4 hours (M = 472.25, SD = 44.77.), and also those speaking English for 5-8 hours (M = 454.81, SD = 43.79), F = 7.59, p < .001. For incongruent trials in the Stroop task in English, the participants who used English for 1-2 hours scored (M = 957.30, SD = 112.97) significantly higher than those speaking English for 3-4 hours (M = 895.59, SD = 94.55.), F = 3.64, p < .05. Similarly, for control trials, the participants who used English for 1-2 hours scored (M = 419.94, SD = 29.65) significantly higher than those speaking English for 5-8 hours (M = 388.12, SD = 29.35), F = 7.51, p < .001. However, the frequency of using English yielded insignificant results for congruent, incongruent, and control trials of both the Stroop task in Urdu and the Stroop task in Punjabi, which points to the effect of language proficiency on language processing, access, and production.

Finally, Table 39 shows mean differences for the translation-elicitation task across various linguistic stimuli. The results reflect that in the translation-elicitation task, mean scores for those speaking English for 1-2 hours (M = 1383.09, SD = 133.85) are higher than those speaking English for 3-4 hours (M = 1303.85, SD = 116.30), and also from those speaking English for 5-8 hours (M = 1283.52, SD = 134.27), F = 5.79, p < .01 on blocked language task. The groups exhibit similar results on high-frequency words in sentential context where mean scores for those speaking English for 1-2 hours (M = 1266.88, SD = 132.51) are higher than those speaking English for 3-4 hours (M = 1192.29, SD = 109.79), and also from those speaking English for 5-8 hours (M = 1152.60, SD = 140.89), F = 6.41, p < .01 on blocked language task. The results show a significant difference in mean scores for those speaking English for 1-2 hours (M = 1484.78, SD = 146.59) are higher than those speaking English for 3-4 hours (M = 1401.47, SD = 136.80), F = 4.50, p < .05 on low-frequency words on the blocked language task.

For triple cognates in blocked language, the mean scores for those speaking English for 1-2 hours (M = 1184.73, SD = 162.48) are higher than those speaking English for 3-4 hours (M = 1088.32, SD = 150.86), and also from those speaking English for 5-8 hours (M = 1031.54, SD = 137.48), F = 7.48, p < .001 in sentential context. Similar trends are observed in double cognates in the translation-elicitation task in sentential context in which the mean scores for those speaking English for 1-2 hours (M = 1307.15, SD = 147.12) are higher than those speaking English for 3-4 hours (M = 1227.53, SD = 121.71), and also from those speaking English for 5-8 hours (M = 1170.95, SD = 137.72), F = 7.06, p < .001 in sentential context. Triple cognates in mixed language task also exhibit parallel findings; the mean scores for those speaking English for 1-2 hours (M = 1159.94, SD = 175.95) are higher than those speaking English for 3-4 hours (M = 1059.50, SD = 170.53), and also from those speaking English for 5-8 hours (M = 1005.17, SD = 202.97), F = 6.02, p < .01

in sentential context. Another significant result is reported for double cognates in the mixed language task, in which the mean scores for those speaking English for 1-2 hours (M = 1463.25, SD = 191.75) are higher than those speaking English for 3-4 hours (M = 1351.16, SD = 193.93), F = 4.74, $p < .05$ in the translation-elicitation task. The mean differences were insignificant on all other variables, including unrelated words in the blocked language task, high and low-frequency mixed language task, and unrelated words in the mixed language task. The participants did not reflect significant differences in these linguistic conditions due to differences in the frequency of English use.

4.8.2 Interaction of Frequency of Using Urdu with English Language Proficiency Scores

ANOVA was computed to analyse the role of frequency of using the Punjabi language as reported by participants in the language background questionnaire on the study variables. Fifty-seven participants reported interacting using Punjabi for 1-2 hours, twenty-eight participants reported using it for 3-4 hours, and 20 participants claimed to use it for 7-8 hours. Table 40 shows ANOVA for exploring the effect of frequency of using Punjabi to varying degrees across all study variables.

Table 40

ANOVA Results Comparing Frequency of Using Punjabi across all Language Conditions (N=105)

	Frequency of Using Punjabi							
	1-2 hrs (n=57)	3-4 hrs (n=28)	6-8 hrs (n=20)			95% CI		
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Score	2.16(.80)	1.86(.85)	1.75(.79)	2.48				
PNTC	827.00(176.11)	895.20(212.02)	893.52(162.72)	1.75				
PNHTC	786.90(143.76)	837.37(160.02)	813.49(138.68)	1.14				
PNLTC	884.93(252.73)	978.72(308.31)	1009.11(225.57)	2.20				
PNDC	836.17(158.64)	910.04(169.88)	914.12(136.66)	2.99				
PNHDC	780.15(127.20)	839.53(143.60)	854.58(130.37)	3.28				
PNLDC	903.40(215.15)	994.65(209.19)	985.57(158.43)	2.40				
PNUW	1008.72(158.90)	1072.57(155.32)	1089.72(146.92)	2.78				
PNHUW	928.77(154.13)	989.36(149.27)	994.15(138.67)	2.27				
PNLUW	1054.41(173.07)	1120.12(168.94)	1144.32(166.10)	2.69				
STEC	473.79(42.37)	491.31(34.66)	496.95(38.34)	3.38				
STEI	903.42(70.11)	988.98(141.42)	966.83(91.59)	8.24***	3-4hrs Punjabi Use > 1-2hrs Punjabi Use 5-8hrs Punjabi Use > 1-2hrs Punjabi Use	85.56 63.41	30.64 1.57	140.47 125.25
STECT	405.97(32.44)	418.28(30.91)	420.67(22.38)	2.52				
STUC	579.29(72.19)	584.80(80.23)	609.35(87.22)	1.13				
STUI	934.42(135.86)	1013.44(172.13)	981.48(153.37)	2.78				
STUCT	595.01(68.77)	595.25(67.48)	623.49(74.30)	1.35				
STPC	455.98(62.66)	432.31(55.82)	451.16(71.98)	1.35				
STPI	840.43(150.15)	894.07(163.60)	896.09(131.91)	1.70				
STPCT	526.41(59.19)	550.98(52.72)	574.44(86.45)	4.59*	5-8hrs Punjabi Use > 1-2hrs Punjabi Use	48.02	7.76	88.28

TEBL	1329.49(136.73)	1364.78(125.59)	1376.90(137.27)	1.23				
TEHBL	1206.42(131.93)	1252.77(130.56)	1270.80(137.95)	2.25				
TELBL	1437.17(153.20)	1462.80(133.13)	1469.75(148.04)	.502				
TEBLTC	1105.18(155.93)	1169.49(183.70)	1185.77(154.12)	2.52				
TEBLDC	1236.59(139.27)	1292.65(155.97)	1317.77(143.31)	2.93				
TEBLUW	1647.05(203.56)	1632.21(196.05)	1627.68(199.05)	.09				
TEML	1358.31(163.97)	1417.93(174.16)	1449.59(179.85)	2.60				
TEHML	1267.69(160.48)	1311.19(168.66)	1362.07(175.09)	2.54				
TELML	1437.59(179.20)	1511.32(196.19)	1526.17(197.53)	2.41				
TEMLTC	1082.68(186.63)	1129.81(185.93)	1168.36(179.94)	1.77				
TEMLDC	1379.01(187.61)	1455.07(192.07)	1463.57(225.80)	2.15				
TEMLUW	1613.23(248.04)	1668.91(248.04)	1716.84(201.25)	1.70				

Note. PNTC = Picture-Naming Task with Triple Cognates; PNHTC = Picture-Naming Task with High Frequency Triple Cognates; PNLTC = Picture-Naming Task with Low Frequency Triple Cognates; PNDC = Picture-Naming Task with Double Cognates; PNHDC = Picture-Naming Task with High Frequency Double Cognates; PNLDC = Picture-Naming Task with Low Frequency Double Cognates; PNUW = Picture-Naming Task with Unrelated Words; PNHUW = Picture-Naming Task with High Frequency Unrelated Words; PNLUW = Picture-Naming Task with Low Frequency Unrelated Words; STEC = The Stroop Task in English with Congruent Trials; STEI = The Stroop Task in English with Incongruent Trials; STECT = The Stroop Task in English with Control Trials; STUC = The Stroop Task in Urdu with Congruent Trials; STUI = The Stroop Task in Urdu with Incongruent Trials; STUCT = The Stroop Task in Urdu with Control Trials; STPC = The Stroop Task in Punjabi with Congruent Trials; STPI = The Stroop Task in Punjabi with Incongruent Trials; STPCT = The Stroop Task in Punjabi with Control Trials; TEBL = Translation-Elicitation Task in Blocked Language; TEBLH = Translation-Elicitation Task in Blocked Language using High Frequency Words; TEBLL = Translation-Elicitation Task in Blocked Language using Low Frequency Words; TEBLE = Translation-Elicitation Task in Blocked Language in English; TEBLEH = Translation-Elicitation Task in Blocked Language in

English using High Frequency Words; TEBLEL = Translation-Elicitation Task in Blocked Language in English using Low Frequency Words; TEBLU = Translation-Elicitation Task in Blocked Language in Urdu; TEBLUH = Translation-Elicitation Task in Blocked Language in Urdu using High Frequency Words; TEBLUL = Translation-Elicitation Task in Blocked Language in Urdu using Low Frequency Words; TEML = Translation-Elicitation Task in Mixed Language; TEMLH = Translation-Elicitation Task in Mixed Language using High Frequency Words; TEMLL = Translation-Elicitation Task in Mixed Language using Low Frequency Words.

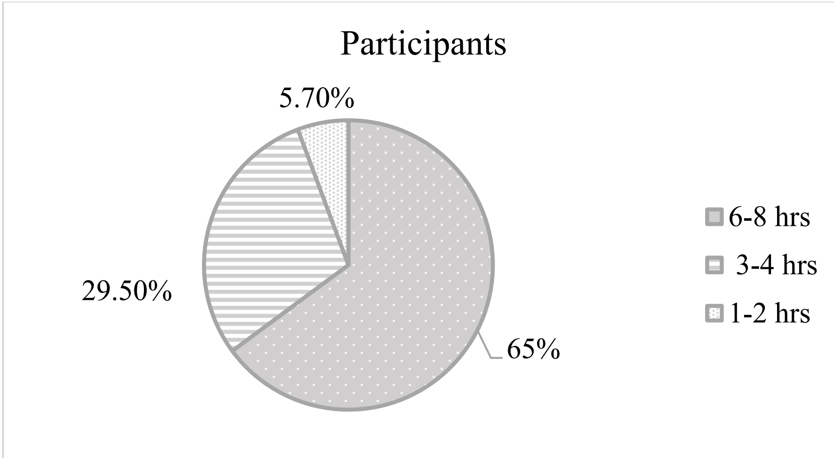
Table 40 shows the mean differences across all variables involved in the study based on the frequency of using Punjabi. The result reflects that on the Stroop task in English, the participants who used Punjabi for 3-4 hours (M = 988.98, SD = 141.42) and for 5-8 hours (M =966.83, SD = 91.59) scored higher on incongruent trials than those who used Punjabi for 1-2 hours (M = 903.42, SD = 70.11), $F=8.24$, $p < .05$. Similarly, the findings of the Stroop task in Punjabi exhibit that the participants who used Punjabi for 5-8 hours (M =574.44, SD = 86.45) scored higher on Punjabi control trials as compared to the participants who used Punjabi for 1-2 hours (M = 526.41, SD = 59.19). On all other variables, the mean differences were insignificant, as the frequency of using Punjabi did not interfere with the tasks.

4.8.3 Interaction of Frequency of Using Urdu with English Language Proficiency Scores

An independent sample *t*-test was computed to examine the role of frequency of using the Urdu language as reported by participants in the language background questionnaire on the study variables. Frequency of Using Urdu as reported by participants in the language background questionnaire (Figure 41) shows that 5.70% of participants reported using Urdu for only two hours, 29.50% for about 4 hours, and 65% of participants for 6-8 hours. Since the frequency of using Urdu for about two hours was reported by 5.70% of participants only, as is shown in Figure 42, it was merged with the frequency of using Urdu for up to 4 hours for two reasons so that group-wise comparison may be conducted to examine the effect of frequency of use on latency scores which resulted in two groups for the frequency of using Urdu.

Figure 42

Percentage of Participants Representing the Frequency of Using Urdu



To compare two groups that differed concerning the frequency of using Urdu for a minimum of 4 hours (n=37) and 6-8 hours (n=68), an independent samples t-test was computed (see Table 41). The results in Table 41 show mixed effects; some pairs demonstrate significant differences in latency scores, while others do not show any significant effect for various linguistic conditions. The findings did not yield any significant effect on latency scores in both the picture-naming task and the Stroop task, except for slightly significant differences in the six categories. The comparison of the two groups exhibited significant results for the translation-elicitation task. As is evident in Table 41, the two groups yield significant effects for both the blocked language translation-elicitation task and the mixed language translation-elicitation task, in addition to a significant effect for cognate facilitation in triple and double cognate trials. The two groups show the highest differences in response latencies for unrelated words in both the blocked and mixed language conditions, with the values of Cohen's d of .74 and .48, respectively, thus exhibiting a high effect.

Table 41

t-test Results Comparing Frequency of Using Urdu across all Language Conditions (N=105)

	Frequency of Using Urdu						
	1-4 hrs (n=37)	5-8 hrs (n=68)			95% CI		
	M(SD)	M(SD)	t(103)	P	LL	UL	Cohen's d

Score	2.11(.81)	1.94(.83)	.99	.32	-.17	.50	
PNTC	840.62(174.25)	867.24(191.70)	-.70	.49	-101.89	48.65	
PNHTC	796.49(135.43)	810.28(154.47)	-.46	.65	-73.79	46.22	
PNLTC	904.35(261.86)	949.51(270.40)	-.83	.41	-153.51	63.20	
PNDC	853.71(152.71)	879.97(165.45)	-.80	.43	-91.56	39.04	
PNHDC	800.83(126.60)	815.24(140.29)	-.52	.60	-69.38	40.55	
PNLDC	917.17(198.23)	957.54(211.52)	-.96	.34	-124.32	43.38	
PNUW	1020.46(155.21)	1052.45(160.15)	-.99	.33	-96.18	32.20	
PNHUW	925.75(137.87)	974.59(157.32)	-1.59	.12	-109.94	12.26	
PNLUW	1074.58(177.52)	1096.94(172.00)	-.63	.53	-92.84	48.11	
STEC	482.94(48.19)	482.84(36.24)	.013	.99	-16.43	16.64	
STEI	945.81(79.93)	934.24(115.84)	.54	.59	-30.85	53.99	
STECT	405.71(29.27)	415.50(31.27)	-1.57	.12	-22.20	2.61	
STUC	595.99(71.70)	581.32(80.43)	.93	.36	-16.73	46.07	
STUI	950.52(125.22)	972.04(165.24)	-.69	.49	-83.29	40.25	
STUCT	606.09(72.32)	597.45(68.64)	.60	.55	-19.71	36.97	
STPC	457.26(70.70)	444.12(58.47)	1.02	.31	-12.40	38.66	
STPI	873.61(143.40)	860.83(156.88)	.41	.68	-48.93	74..48	
STPCT	553.05(74.01)	536.16(60.64)	1.26	.21	-9.69	43.48	
TEBL	1314.58(124.98)	1366.08(136.54)	-1.90	.06	27.09	-105.23	
TEHBL	1202.94(132.47)	1246.33(133.78)	-1.59	.11	-97.41	10.61	

TELBL	1412.26(128.60)	1470.86(152.27)	-1.99	.04	-114.40	-2.79	.42
TEBLTC	1117.41(157.25)	1148.70(170.39)	-.92	.36	-.98.51	35.93	
TEBLDC	1247.86(148.21)	1277.41(146.82)	-.98	.33	-89.24	30.12	
TEBLUW	1578.73(217.69)	1672.42(181.38)	-2.35	.03	-177.62	-9.75	.74
TEML	1354.23(157.17)	1411.92(177.89)	-1.65	.10	-126.95	11.56	
TEHML	1268.24(156.38)	1313.06(172.92)	-1.31	.19	-112.62	22.97	
TELML	1429.47(175.29)	1498.43(194.24)	-1.80	.08	-145.06	7.14	
TEMLTC	1092.58(193.98)	1121.89(183.06)	-.77	.45	-105.05	46.44	
TEMLDC	1392.71(184.24)	1427.75(206.26)	-.86	.39	-115.59	45.52	
TEMLUW	1577.39(226.25)	1686.13(222.89)	-2.38	.02	-200.38	-17.11	.48

Note. PNTC = Picture-Naming Task with Triple Cognates; PNHTC = Picture-Naming Task with High Frequency Triple Cognates; PNLTC = Picture-Naming Task with Low Frequency Triple Cognates; PNDC = Picture-Naming Task with Double Cognates; PNHDC = Picture-Naming Task with High Frequency Double Cognates; PNLDC = Picture-Naming Task with Low Frequency Double Cognates; PNUW = Picture-Naming Task with Unrelated Words; PNHUW = Picture-Naming Task with High Frequency Unrelated Words; PNLUW = Picture-Naming Task with Low Frequency Unrelated Words; STEC = The Stroop Task in English with Congruent Trials; STEI = The Stroop Task in English with Incongruent Trials; STECT = The Stroop Task in English with Control Trials; STUC = The Stroop Task in Urdu with Congruent Trials; STUI = The Stroop Task in Urdu with Incongruent Trials; STUCT = The Stroop Task in Urdu with Control Trials; STPC =

The Stroop Task in Punjabi with Congruent Trials; STPI = The Stroop Task in Punjabi with Incongruent Trials; STPCT = The Stroop Task in Punjabi with Control Trials; TEBL = Translation-Elicitation Task in Blocked Language; TEBLH = Translation-Elicitation Task in Blocked Language using High Frequency Words; TEBLL = Translation-Elicitation Task in Blocked Language using Low Frequency Words; TEBLE = Translation-Elicitation Task in Blocked Language in English; TEBLEH = Translation-Elicitation Task in Blocked Language in English using High Frequency Words; TEBLEL = Translation-Elicitation Task in Blocked Language in English using Low Frequency Words; TEBLU = Translation-Elicitation Task in Blocked Language in Urdu; TEBLUH = Translation-Elicitation Task in Blocked Language in Urdu using High Frequency Words; TEBLUL = Translation-Elicitation Task in Blocked Language in Urdu using Low Frequency Words; TEML = Translation-Elicitation Task in Mixed Language; TEMLH = Translation-Elicitation Task in Mixed Language using High Frequency Words; TEMLL = Translation-Elicitation Task in Mixed Language using Low Frequency Words.

Table 41 shows the mean differences across all variables based on the frequency of using Urdu. The result reflects that on the translation-elicitation task in blocked language in English, mean scores for those speaking Urdu for 5-8 hours (M = 1470.86, SD = 152.27) are higher than those who speak Urdu for 1-4 hours (M = 1412.26, SD = 128.60), t = -1.99, p < .05. The groups showed similar trend for both unrelated words in the translation-elicitation in English block and mixed language block. The participants who used the Urdu language for 5-8 hours (M = 1672.42, SD = 181.38) scored higher on unrelated words in the translation-elicitation task in blocked language compared to those using Urdu for 1-4 hours (M = 1578.73, SD = 217.69, t = -2.35, p < .05). Similarly, on the translation-elicitation task in mixed language for unrelated words, those using Urdu for 5-8 hours (M = 1686.13, SD = 181.38) scored higher than those using Urdu for 1-4 hours (M = 1577.39, SD = 226.25), t = -2.38, p < .05. On all other variables the mean differences were insignificant as all participants were proficient in Urdu; it also supports the effect of language proficiency on translation latencies.

4.9 Interaction of English Language Proficiency with Experimental Conditions

A multivariate analysis of variance (MANOVA) is a statistical procedure that contrasts the means of two or more categories across multiple dependent variables (Ross & Willson, 2017). It may involve one or more independent variables, and the "multivariate" part refers to the involvement of multiple dependent variables. A multivariate analysis of variance is required to compare groups across multiple dependent variables (Ross & Willson, 2017).

For the analysis of variables involved in the present study, a multivariate analysis of variance is computed with English language proficiency as the independent variable for all three experiments and different linguistic conditions as the dependent variables, depending on the nature of the experiment. For experiment 1, the dependent variables were the cognate status of lexical items, such as triple cognates, double cognates, and unrelated words, entered as fixed effects. Similarly, for Experiment 2, congruence status, such as congruent, incongruent, and control trials, entered as fixed effects, were the dependent variables for the three variants of the Stroop task. Finally, for Experiment 3, participants were compared across various experimental conditions involved in the translation-elicitation task, both in blocked and mixed language tasks.

A MANOVA is computed for three groups of participants corresponding to their English language proficiency obtained through LexTALE. The outcomes of the multivariate analysis of variance for the picture-naming task, in which English language proficiency served as the independent variable and cognate status of lexical items served as the dependent variable, are presented in Table 42.

Table 42

MANOVA for the Picture-Naming Task (N=105)

	English Language Proficiency							
	Group 1 (n=35)	Group 2 (n=35)	Group 3 (n=35)				95% CI	
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Score								
TC	1074.96(90.45)	819.43(87.18)	679.18(79.87)	.049	Group 1 > Group 2	255.53*	206.66	304.39
					Group 1 > Group 3	395.79*	346.92	444.65
					Group 2 > Group 3	140.26*	91.39	189.12
DC	1041.68(113.36)	848.10(83.49)	722.37(78.08)	2.27	Group 1 > Group 2	193.58*	140.74	246.42
					Group 1 > Group 3	319.32*	266.47	372.16
					Group 2 > Group 3	125.74*	72.89	178.58
UW	1171.45(146.26)	1044.55(110.78)	907.53(158.42)	2.52	Group 1 > Group 2	126.91*	60.52	193.29
					Group 1 > Group 3	263.92*	197.53	330.30
					Group 2 > Group 3	137.01*	70.63	203.40

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; TC=triple cognate; DC=double cognate; UW=unrelated words.

A MANOVA was computed for the picture-naming task with English language proficiency as the independent variable. Cognate status, such as triple cognates, double cognates, and unrelated words, entered as fixed effects, were the between-subjects variables. According to Wilk's Lambda (.19), the English language proficiency of participants had a significant effect on the set of naming latencies, $F (2, 102) = 43.54$, $p <.001$, $\eta = .57$. The results in Table 42 show that group 1 ($M = 1074.96$, $SD = 90.45$) scored higher as compared to group 2 ($M = 819.43$, $SD = 87.18$) and also as compared to group 3 ($M = 679.18$, $SD = 79.87$), $F(2, 102) = .049$, $p <.05$ for triple cognates. The three groups exhibit similar trends of naming latencies on double cognates and unrelated words. On double cognates, the results indicate that group 1 ($M = 1041.68$, $SD = 113.36$) scored higher as compared to group 2 ($M = 848.10$, $SD = 83.49$) and also as compared to group 3 ($M = 722.37$, $SD = 78.08$), $F(2, 102) = 2.27$, $p < .05$. Similarly, the results indicate that group 1 ($M = 1171.45$, $SD = 146.26$) scored higher as compared to group 2 ($M = 1044.55$, $SD = 110.78$) and also as compared to group 3 ($M = 907.53$, $SD = 158.42$), $F(2, 102) = 2.52$, $p < .05$ on unrelated words. The findings of the MANOVA of the picture-naming task for exploring English language frequency exhibit significant differences. MANOVA was also computed for three groups of participants based on their language proficiency to examine mean differences in congruent, incongruent, and control trials for all three variants of the Stroop task, the Stroop task in English, the Stroop task in Urdu, and the Stroop task in Punjabi.

Table 43

MANOVA for the Stroop Task in L3 (English)

	English Language Proficiency						95% CI	
	Group 1 (n=35)	Group 2 (n=35)	Group 3 (n=35)					
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Score								
Cong.	505.98(23.63)	499.61(35.99)	443.04(26.85)	2.43	Group 1 > Group 3	62.94*	46.28	79.60
					Group 2 > Group 3	56.57*	39.92	73.23
Incong.	955.63(102.27)	957.48(130.68)	901.83(60.88)	4.17				
ConTr.	435.25(22.40)	422.59(13.62)	378.32(19.56)	5.41	Group 1 > Group 2	12.66*	1.92	23.40
					Group 1 > Group 3	56.93*	46.20	67.67
					Group 2 > Group 3	44.27*	33.54	55.01

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; Cong.=congruent; Incong.=incongruent; ConTr.=Control trial.

A MANOVA was calculated for the Stroop task in English, with English language proficiency as the independent variable. The results are presented in Table 43. Linguistic stimuli status, such as congruent, incongruent, and control trials, entered as fixed effects, were the between-subjects variables. According to Wilk's Lambda (.31) English language has a significant influence on the latency scores of the Stroop task in English, $F(2, 102) = 27.06$, $p < .001$, $\eta = .45$. The results reflect that on congruent trials group 1 ($M = 505.98$, $SD = 23.63$) scored higher as compared to group 3 ($M = 443.04$, $SD = 26.85$) and group 2 ($M = 499.61$, $SD = 35.99$) also scored higher as compared to group 3 ($M = 443.04$, $SD = 26.85$), $F(2, 102) = 2.43$, $p < .001$. The table shows significant results for control trials in which group 1 ($M = 435.25$, $SD = 22.40$) scored higher as compared to group 2 ($M = 422.59$, $SD = 13.62$) and also as compared to group 3 ($M = 378.32$, $SD = 19.56$); and group 2 ($M = 422.59$, $SD = 13.62$), scored higher as compared to group 3 ($M = 378.32$, $SD = 19.56$), $F = 5.41$, $p < .001$ on the Stroop task in English. The mean differences show that group 3 – highly proficient participants, took smaller latencies to respond compared to the other two groups, and group 2 – medium proficient participants, took even smaller latencies than group 1 – the least proficient participants. The table exhibits insignificant results for incongruent trials across all groups of participants, indicating that all participants performed equally on incongruent trials.

The MANOVA was also computed for the Stroop task in Urdu. To examine the effect of English language proficiency on linguistic stimuli conditions, such as congruent, incongruent, and control trials with input language English and response language Urdu. The findings of MANOVA are presented in Table 44.

Table 44

MANOVA for the Stroop Task in L2 (Urdu)

	English Language Proficiency							
	Group 1 (n=35)	Group 2 (n=35)	Group 3 (n=35)				95% CI	
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Score								

Cong.	604.06(74.63)	579.78(78.60)	575.62(78.17)	.21
Incong.	988.26(140.63)	977.20(178.05)	927..81(130.84)	.91
Con. T	607.05(63.95)	590.55(71.46)	603.89(74.30)	.58

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value; Cong.=congruent; Incong.=incongruent; ConTr.=Control trial.

Table 44 shows insignificant results for all linguistic conditions of the Stroop task in Urdu, with English language proficiency as the independent variable. Linguistic stimuli status, such as congruent, incongruent, and control trials, entered as fixed effects, were the between-subjects variables. According to Wilk's Lambda (.898), English language proficiency has an insignificant influence on the latency scores of the Stroop task in Urdu, $F (2, 102) = 1.84$, $p < .09$, $\eta = .052$. The three groups showed the non-significant effect of English language proficiency on the Stroop task in Urdu, which may be attributed to their proficiency in the Urdu language.

Next, MANOVA was calculated for the Stroop task in Punjabi with English language proficiency as the independent variable. Linguistic stimuli status, such as congruent, incongruent, and control trials, entered as fixed effects, were the between-subjects variables. The results are displayed in Table 45.

Table 45

MANOVA for the Stroop Task in L1=Punjabi (N=105)

	English Language Proficiency							
	Group 1 (n=35)	Group 2 (n=35)	Group 3 (n=35)				95% CI	
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Score								
Congruent	419.78(46.50)	516.92(43.09)	409.55(30.04)	6.45	Group 2 > Group 1	97.14*	74.11	120.17
					Group 2 > Group 3	107.37*	84.34	130.40
Incongruent	855.04(139.59)	901.42(180.15)	839.54(127.72)	3.41				
Control Trial	552.49(73.92)	532.13(60.59)	541.71(62.41)	.22				

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit

Table 45 presents the findings of the Stroop task in Punjabi. The results reveal significant mean differences in groups for congruent trials. According to Wilk's Lambda (.39) English language proficiency has significant influence on the latency scores of the Stroop task in Punjabi, $F (2, 102) = 20.05$, $p < .001$, $\eta = .38$. The results show that group 2 ($M = 516.92$, $SD = 43.09$) scored higher as compared to group 1 ($M = 419.78$ $SD = 46.50$) and also as compared to group 3 ($M = 409.55$, $SD = 30.04$), $F = 6.45$, $p < .05$. The mean scores of groups exhibited non-significant effect of English language proficiency on the Stroop task in Punjabi for incongruent and control trials which may be attributed to their higher proficiency of Punjabi language.

Finally, a multivariate analysis of variance was computed for the analysis of variables involved in experiment 3 – the translation-elicitation task. The translation-elicitation task aimed to analyse the impact of English language proficiency on processing and access in a sentential context. The first MANOVA for experiment 3 was calculated to examine the mean differences between groups of participants in the English language and the Urdu language block. Then, the groups of participants were compared across blocked language tasks and mixed language tasks to analyse the effect of blocking or mixing the language of stimuli. Table 46 presents the results of MANOVA for the English and Urdu language blocks of the translation-elicitation task.

Table 46

MANOVA for the Translation-Elicitation Task in Sentential Context (N=105)

	English Language Proficiency						95% CI	
	Group 1 (n=35)	Group 2 (n=35)	Group 3 (n=35)					
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Language								
English	1415.01(77.97)	1270.95(80.14)	1128.02(72.63)	.44	Group 1 > Group 2	144.06*	100.30	187.83
					Group 1 > Group 3	286.99*	243.22	330.75
					Group 2 > Group 3	142.93*	99.16	186.69
Urdu	1558.62(92.65)	1438.55(100.20)	1276.45(71.17)	2.91	Group 1 > Group 2	120.07*	69.55	170.60.
					Group 1 > Group 3	282.16*	231.64	332.69
					Group 2 > Group 3	162.09*	111.57	212.61

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit.

Table 46 compares groups of participants in English and Urdu language blocks. The results reveal significant mean differences in groups in the translation-elicitation task in both English and Urdu language blocks. According to Wilk's Lambda (.22) English language proficiency has significant influence on the latency scores of the translation-elicitation task, $F (2, 102) = 37.82$, $p < .001$, $\eta = .53$. The results show that group 1 ($M = 1415.01$, $SD = 77.97$) scored higher as compared to group 2 ($M = 1270.95$, $SD = 80.14$) and also as compared to group 3 ($M = 1128.02$, $SD = 72.63$), $F = .44$, $p < .05$ on English language block. Similar trends of mean differences were observed for Urdu language block where group 1 ($M = 1558.62$, $SD = 92.65$) scored higher as compared to group 2 ($M = 1438.55$ $SD = 100.20$) and also as compared to group 3 ($M = 1276.45$, $SD = 71.17$), $F = 2.91$, $p < .05$. The mean scores of groups exhibit a significant effect of English language proficiency on English and Urdu language block in the translation-elicitation task; participants with low English language proficiency took longer to translate as compared to participants with medium English language proficiency and participants with medium proficiency took longer as compared to participants with high English proficiency.

In addition to comparing blocked language mean differences across groups, mean scores of groups of participants were compared through MANOVA for the blocked language condition and mixed language condition of the translation-elicitation task. Table 47 presents the results of MANOVA for the translation-elicitation task in blocked and mixed language.

Table 47

MANOVA for the Translation-Elicitation Task in Blocked and Mixed Language (N=105)

	English Language Proficiency						95% CI	
	Group 1 (n=35)	Group 2 (n=35)	Group 3 (n=35)					
	M(SD)	M(SD)	M (SD)	F	i-j	D(i-j)	LL	UL
Condition								
Blocked	1486.81(70.28)	1354.75(71.30)	1202.24(58.03)	1.69	Group 1 > Group 2	132.07*	94.08	170.05
					Group 1 > Group 3	284.58*	246.59	322.56
					Group 2 > Group 3	152.51*	114.52	190.49
Mixed	1553.34.(98.22)	1405.30(116.57)	1216.14(93.83)	1.29	Group 1 > Group 2	193.58*	140.74	246.42
					Group 1 > Group 3	319.32*	266.47	372.16
					Group 2 > Group 3	125.74*	72.89	178.58

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit.

Table 47 compares groups of participants on blocked and mixed language blocks. The results reveal significant mean differences in groups in the translation-elicitation task in the blocked and mixed language tasks. According to Wilk's Lambda (.22) English language proficiency has significant influence on the latency scores of the translation-elicitation task, $F(2, 102) = 37.82$, $p < .001$, $\eta = .53$. The results show that group 1 ($M = 1486.81$, $SD = 70.28$), scored higher as compared to group 2 ($M = 1354.75$, $SD = 71.30$) and also as compared to group 3 ($M = 1202.24$, $SD = 58.03$), $F = .44$, $p < .05$ on blocked language task. Similar trends of mean differences were observed for mixed language task where group 1 (1553.34, $SD = 98.22$) scored higher as compared to group 2 ($M = 1405.30$ $SD = 116.57$) and also as compared to group 3 ($M = 1216.14$, $SD = 93.83$), $F = 2.91$, $p < .05$. The mean scores of groups exhibit significant effect of English language proficiency on both blocked and mixed language task in the translation-elicitation task; participants with low English language proficiency took longer to translate as compared to participants with medium English language proficiency and participants with medium proficiency took longer as compared to participants with high English proficiency.

4.10 Analysis of Within-group Interaction

To compare response latencies concerning language conditions, a paired-sample t-test was computed for all linguistic conditions of three experiments - the picture-naming task, three variants of the Stroop task, and various categories of the translation-elicitation task. Paired-sample t-test is used to make a comparison between the mean scores of two equivalent cases or groups of people (Ross & Willson, 2017)

From the data collected for experiment 1-the picture-naming task, pair-wise comparisons are calculated to identify the differences among different linguistic groups. A paired samples t-test was computed for three categories of linguistic items of the picture-naming task, equating the mean latency scores for triple cognates and double cognates, triple cognates and unrelated words, and double cognates and unrelated words for the same group of participants. The Bonferroni test was applied to minimise type I error for the multiple comparisons. The results of the paired-sample t-test concerning cognate status in the picture-naming task are displayed in Table 48. The paired differences table shows a t-value of -1.34, -13.86, -14.66, $df=104$, and p-value of .18, <.001, <.001, respectively, for three language pairs. Since $p > .05$ for triple and double cognates, it reveals no significant difference between the mean scores for the triple and double cognates. For the other two pairs, that is, triple cognates and unrelated words, and double cognates and unrelated words, $p < .001$, which exhibits a statistically significant effect between the mean scores of the two groups, thus pointing to the cognate facilitation effect in both pairs in contrast to unrelated words.

Table 48

Paired-sample t-test for the Picture-Naming Task concerning cognate status (N=105)

Pairs	Paired Differences				*t*(df)	*P*	Cohen's *d*
	M	*SD*	95% CI				
			LL	*UL*			
Picture Naming							
TC-DC	-12.86	98.33	-31.89	6.17	-1.34(104)	.18	.10
TC-UW	-183.32	135.58	-209.56	-157.08	-13.86(104)	<.001	1.06
DC-UW	-170.46	119.19	-193.53	-147.39	-14.66(104)	<.001	1.07

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value; TC=triple cognate; DC=double cognate; UW=unrelated words.

Similarly, a paired samples t-test was calculated for two subgroups of three categories of linguistic stimuli of the picture-naming task, equating the mean latency scores for high-frequency triple cognates and low-frequency triple cognates, high-frequency double cognates and low-frequency double cognates, high-frequency unrelated words, and low-frequency unrelated words, for the same group of participants. The findings of the paired-sample t-test for high and low-frequency words in the picture-naming task are displayed in Table 49. The paired differences table shows a t-value of -7.37, -11.43, and -13.15, df=104, and p-value <.001 for the three pairs. Since $p < .05$ for high and low-frequency pairs across all three language conditions. There are statistically significant differences in high and low-frequency words across all language conditions.

Table 49

Paired-sample t-test for the Picture-Naming Task concerning Lexical Frequency (N=105)

Pairs	Paired Differences				*t*(df)	*P*	Cohen's *d*
	M	*SD*	95% CI				
			LL	*UL*			
Picture Naming							
HFTC-LFTC	-128.18	178.29	-162.68	-93.67	-7.37(104)	<.001	.59
HFDC-LFDC	-133.22	119.39	-156.32	-110.11	-11.43(104)	<.001	.76
HFUW-LFUW	-131.68	102.62	-151.54	-111.82	-13.15(104)	<.001	1.07

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value; HFTC= high-frequency triple cognate; LFTC = low-frequency triple cognate; HFDC= high-frequency double cognate; LFDC= low-frequency double cognate; HFUW= high-frequency unrelated words; LFUW= low-frequency unrelated words.

From the data collected for experiment 2 – the Stroop task, pair-wise comparisons are computed to test the task's experimental conditions for the three Stroop task variants. A paired-sample t-test was computed for three categories of linguistic stimuli of the Stroop task in English, equating the mean latency scores for congruent and incongruent, congruent and control trials, and incongruent and control trials for the same group of participants. The outcomes of the paired-sample t-test for the three pairs of the Stroop task in English are reported in Table 50. The paired differences table demonstrates a t-value of -47.07, 23.43, 51.37, df=104, and p-value <.001 for all three language conditions. Since $p < .001$ for all pairs, it shows a statistically significant difference between the mean scores of the three pairs, thus pointing to the Stroop interference effect. Cohen's *d* determines the effect size for the pairs under investigation; higher values for Cohen's *d* are reported at 5.75 and 6.84 for both congruent and incongruent pairs and incongruent and control trial pairs, respectively, in contrast to congruent and control trial pairs, which are calculated to be 1.96.

Table 50

Paired-Sample t-Test for the Stroop Task in English

Pairs	Paired Differences				t(df)	P	Cohen's *d*
	M	SD	95% CI				
			LL	UL			
ST in English							
Cong.-Incong.	-455.44	99.14	-474.63	-436.26	-47.07(104)	<.001	5.75
Cong.-ConTr.	70.82	30.97	64.82	76.81	23.43(104)	<.001	1.96
Incon.-ConTr.	526.26	104.98	505.95	546.58	51.37(104)	<.001	6.84

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value; ST=The Stroop task; Cong.=congruent; Incong.=incongruent; Contr.=Control trial.

Besides the Stroop task in English, the Stroop task was conducted in Urdu to examine experimental conditions of the Stroop task across different languages; a paired-sample t-test was computed for three categories of linguistic stimuli of the Stroop task in Urdu, comparing the mean latency scores for congruent and incongruent, congruent and control trial and incongruent and control trials, for the same group of participants. The outcomes of the paired-sample t-test for the three pairs of the Stroop task in Urdu are reported in Table 51. The paired differences table determines a t-value of -23.07, 2.56, 24.89, df=104, and p-value <.001 for all three language conditions. Since p< .001 for all three conditions, it shows a statistically significant difference between the means of the three pairs, thus pointing to the Stroop interference effect. Cohen's *d* determines the effect size for the pairs under exploration; higher values for Cohen's *d* are reported at 3.13 and 3.08 for both congruent and incongruent pairs and incongruent and control trial pairs, respectively, in contrast to the congruent and control trial pair, which is calculated to be .19.

Table 51

Paired-Sample t-Test for the Stroop Task in Urdu

Pairs	Paired Differences				t(df)	p	Cohen's *d*
	M	SD	95% CI				
			LL	UL			
ST in Urdu							
Cong.-Incong.	-377.96	167.84	-410.45	-345.48	-23.07(104)	<.001	3.13
Cong.-ConTr.	-14.01	56.04	-24.85	-3.16	-2.56(104)	<.001	.19
Incon.-ConTr.	363.95	149.84	334.96	392.95	24.89(104)	<.001	3.08

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value; ST=The Stroop task; Cong.=congruent; Incong.=incongruent; Contr.=Control trial.

Similarly, to test experimental conditions of the Stroop task across different languages, another paired-sample t-test was computed for three groups of linguistic stimuli of the Stroop task in Punjabi, comparing the mean latency scores for congruent and incongruent, congruent and control trials, and incongruent and control trials, for the same group of participants. The results of the paired-sample t-test for the three pairs of the Stroop task in Punjabi are reported in Table 52. The paired differences table determines a t-value of --27.77, -10.30, 25.15, df=104, and p-value <.001 for all three language conditions. Since $p < .001$ for all three conditions, it shows a statistically significant difference between the means of the three pairs, thus pointing to the Stroop interference effect. Cohen's *d* determines the effect size for the pairs under exploration; higher values for Cohen's *d* are reported at 6.61 and 2.76 for both congruent and incongruent pairs and incongruent and control trial pairs, respectively, in contrast to congruent and control trial pairs, which is calculated to be 1.45.

Table 52

Paired-Sample t-Test for the Stroop Task in Punjabi

Measures	Paired Differences						
			95% CI				
	M	SD	LL	UL	t(df)	P	Cohen's *d*
ST in Punjabi							
Cong.-Incong.	-416.58	153.73	-446.33	-386.83	-27.77(104)	<.001	6.61
Cong.-ConTr.	-93.36	92.85	-111.33	-75.39	-10.30(104)	<.001	1.45
Incon.-ConTr.	323.22	131.71	297.73	348.71	25.15(104)	<.001	2.76

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; df=degree of freedom; p=significance value; ST=The Stroop task; Cong.=congruent; Incong.=incongruent; ConTr.=Control trial.

For the data collected through experiment 3- the translation-elicitation task, various paired-sample t-tests are computed to analyse differences in variables under study. A paired-sample t-test was computed for three categories of linguistic stimuli of the translation-elicitation task in blocked language, equating the mean latency scores for triple cognates and double cognates, triple cognates and unrelated words, and double cognates and unrelated words for the same group of participants. The outcomes of the paired-sample t-test for the blocked language translation elicitation task are presented in Table 53. The paired differences table shows a t-value of -31.47, -22.07, -17.37, df=104, and p-value <.001 for three language pairs. Since p < .001 for all pairs, all pairs exhibit statistically significant differences between the mean scores of the two groups. The findings reflect the cognate facilitation effect in three pairs where triple cognates take significantly less time than double cognates and unrelated words; similarly, double cognates take significantly less time than unrelated words, even when placed in a sentential context. Cohen's *d* determines the effect size for the pairs under exploration; higher values for Cohen's *d* are reported at .82, 2.74, and 2.13, respectively, for the triple cognate and double cognate pair, the triple cognate and unrelated words pair and the double cognate and unrelated words pair. The effect size is smaller for triple and double cognate pairs, which points to a lower magnitude of differences in this pair compared to pairs that are unrelated words. Thus, the values of Cohen's *d* support the cognate facilitation effect and interference of unrelated words.

Table 53

Paired-Sample t-Test for the Translation-Elicitation Task in Blocked Language

Pairs	Paired Differences				t(df)	p	Cohen's *d*
	M	SD	95% CI				
			LL	UL			
T. E Task							
TC-DC	-129.66	42.11	-137.47	-121.17	-31.47(104)	<.001	.82
TC-UW	-501.73	233.29	-546.87	-456.58	-22..04(104)	<.001	2.74
DC-UW	-372.41	219.73	-414.93	-329.88	-17.37(104)	<.001	2.13

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; t=t-score; df=degree of freedom; p=significance value; T. E. Task=translation-elicitation task; TC=triple cognate; DC=double cognate; UW=unrelated words.

Similarly, another paired-sample t-test was computed for three categories of linguistic stimuli of the translation-elicitation task in mixed language, equating the mean latency scores for triple cognates and double cognates, triple cognates and unrelated words, and double cognates and unrelated words for the same group of participants. The outcomes of the paired-sample t-test for the mixed language translation-elicitation task are presented in Table 54. The paired differences table shows a t-value of -28.55, -23.04, -11.35, df=104, and p-value <.001 for three language pairs. Since $p < .001$ for all pairs, it shows that all pairs exhibit statistically significant differences between the means of the two groups, thus pointing to the cognate facilitation effect in three pairs where triple cognates take significantly less time than both double cognates and unrelated words, similarly double cognates take significantly less time as compared to unrelated words even when placed in sentential context in randomly mixed sentences. Cohen's *d* determines the effect size for the pairs under exploration; higher values for Cohen's *d* are reported as 1.58, 2.57, and 1.08, respectively, for the triple cognate and double cognate pair, triple cognate and unrelated words pair and double cognate and unrelated words pair. The effect size is smaller for triple and double cognate pairs, which points to a lower magnitude of differences in this pair compared to pairs that are unrelated words. Thus, the values of Cohen's *d* support the cognate facilitation effect and interference of unrelated words in the translation-elicitation task in a sentential context.

Table 54

Paired-Sample t-Test for the Translation-Elicitation Task in Mixed Language

Pairs	Paired Differences				t(df)	p	Cohen's *d*
	M	SD	95% CI				
			LL	UL			
T. E. Task							
TC-DC	-303.84	109.04	-324.94	-282.74	-28.55(104)	<.001	1.58
TC-UW	-536.25	238.46	-582.40	-490.10	-23.04(104)	<.001	2.57
DC-UW	-232.41	209.80	273.01	191.81	-11.35(104)	<.001	1.08

Note. N=number of participants; M=mean; SD=standard deviation; LL=lower limit; UL=upper limit; t=t-score; df=degree of freedom; p=significance value; T. E. Task=translation-elicitation task; TC=triple cognate; DC=double cognate; UW=unrelated words.

In addition to the analysis of cognate status in a sentential context, a paired-sample t-test was calculated for two subgroups of three categories of linguistic stimuli of the translation-elicitation task in a sentential context, equating the mean latency scores for low-frequency English lexical items, high-frequency English lexical items, low-frequency Urdu lexical items, and high-frequency Urdu lexical items, for the same group of participants. The outcomes of the paired-sample t-test for both language blocks are presented in Table 55. The paired differences table shows a t-value of -15.95 and -22.18 for English and Urdu language blocks, respectively, df=104, and p-value <.001 for two pairs, and Cohen's *d* is calculated to be 1.19 and 1.64 for both language pairs, respectively. Since $p < .05$ for high and low-frequency pairs across all three language conditions. Both language conditions have statistically significant differences in high and low-frequency words.

Table 55

Paired-Sample t-Test for the Picture-Naming Task Concerning Lexical Frequency in English and Urdu Language Block (N=105)

Pairs	Paired Differences				*t*(df)	*P*	Cohen's *d*
	M	*SD*	95% CI				
			LL	*UL*			
T. E. Task							
HFE-LFE	-179.47	115.28	-201.78	-157.16	-15.95(104)	<.001	1.19
HFU-LFU	-258.87	119.61	-282.02	-235.72	-22.18(104)	<.001	1.64

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; t= t-score; df=degree of freedom; p=significance value; T. E. Task = translation-elicitation task; HFE= high-frequency lexical items in English block; triple cognate; LFE=low frequency lexical items in English block; HFU= high-frequency lexical items in Urdu block; LFDC= low-frequency lexical items in Urdu block.

In experiment 3, the translation-elicitation task consisted of two distinct segments: the blocked language task and the mixed language task. A paired-sample t-test is computed for comparing cognate status across the two language blocks, equating the mean latency scores for triple cognates in blocked language task and triple cognates in mixed language task, double cognates in blocked language task and double cognates in mixed language task and unrelated words in blocked language task and unrelated words in mixed language task for the same group of participants. The outcomes of the paired-sample t-test for triple cognates, double cognates, and unrelated words are presented in Table 56. The paired differences table shows a t-value of 3.14, -14.51, -.44, df=104, and p-value .002, <.001, .66 for three language conditions respectively. Since p > .001 for triple cognates and unrelated words, it reveals that there is no significant difference between the mean scores for the triple cognates and unrelated words. The participants exhibited parallel response latencies for the two language conditions. However, p<.001 for double cognates in blocked language task and mixed language task. This difference may be attributed to varied lexical items in the two blocks.

Table 56

Paired-Sample t-Test for the Translation-Elicitation Task in Blocked Language and Mixed Language Conditions

Pairs	Paired Differences				t(df)	*p*	Cohen's *d*
	M	SD	95% CI				
			LL	UL			
T. E. Task							
TBL-TML	26.11	85.20	9.63	42.60	3.14(104)	.002	.15
DBL-DML	-148.40	104.84	-168.69	128.12	-14.51(104)	<.001	.85
UBL-UML	-8.41	195.65	-46.09	29.45	-.44(104)	.66	.04

Note. N=number of participants; M=mean; SD=standard deviation; LL=lower limit; UL=upper limit; t=t-score; df=degree of freedom; p=significance value; T. E. Task = translation-elicitation task; TBL=triple cognate in blocked language; TML=triple cognate in mixed language; DBL=double cognate in blocked language; DML=double cognate in mixed language; UBL=unrelated words in blocked language; UML=unrelated words in mixed language.

In addition to analysing cognate status in a sentential context across blocked language context and mixed language context, a paired-sample t-test was computed for two subgroups of lexical items: low-frequency lexical items and high-frequency lexical items in the translation-elicitation task in the sentential context for the same group of participants. The outcomes of the paired-sample t-test are presented in Table 57.

Table 57

Paired-Sample t-Test for the Translation-Elicitation Task Concerning Lexical Frequency in Blocked Language and Mixed Language Condition (N=105)

Pairs	Paired Differences				*t*(df)	*P*	Cohen's *d*
	M	*SD*	95% CI				
			LL	*UL*			
T. E. Task							

HB-LB	-219.17	85.37	-235.77	-202.57	-26.18(104)	<.001	1.56
HM-LM	-176.86	103.64	-196.91	-156.80	-17.48(104)	<.001	.99

Note. N=number of participants; M=mean; SD=standard deviation; CI=confidence Interval; LL=lower limit; UL=upper limit; t=t-score; df=degree of freedom; p=significance value; T. E. Task = translation-elicitation task; HB= high-frequency lexical items in blocked language condition; LB=low frequency lexical items in blocked language condition; HM= high-frequency lexical items in mixed language condition; LM= low-frequency lexical items in mixed language condition.

The comparison of low- and high-frequency words in blocked and mixed language tasks is presented in Table 57. The paired differences table shows a t-value of -26.18 and -17.48 for high- and low-frequency words, df=104, and p-value <.001 for both pairs. Since p < .05 for high and low-frequency pairs across all three language conditions. There are statistically significant differences in high and low-frequency words across the blocked and mixed language blocks. Overall, the findings of the picture-naming task are supported by the translation-elicitation task in the sentential context, which supports the finding that cognate status and lexical frequency do not only influence language organisation, processing, and access in isolation but also in the sentential context.

While the statistical analyses establish significant differences across the experimental conditions, these results require further interpretation to describe their cognitive and linguistic significance. Quantitative findings, when considered in isolation, risk reducing complex processes to numerical contrasts. Accordingly, the subsequent section presents a qualitative interpretation of the data, grounded in the theoretical perspectives of translanguaging and psycholinguistic processing, to contextualize and deepen the understanding of the observed patterns.

4.11 Qualitative Interpretation of the Results of the Experimental Tasks

The quantitative analyses of the three experimental tasks (Picture Naming, Stroop, and Translation Elicitation) revealed significant trends across conditions. However, to fully capture the cognitive and theoretical significance, it is essential to interpret these results qualitatively through the lens of translanguaging, particularly highlighting the processes of meaning-making, memory retrieval, and non-selectivity in multilingual processing.

In the picture-naming task, participants responded fastest to triple cognates, followed by double cognates, with the slowest responses for unrelated words. Quantitatively, this demonstrated significant differences in reaction times across word types. Qualitatively, these findings reveal how shared lexical representations across Punjabi, Urdu, and English enhance memory retrieval and conceptual activation. The speed with which participants accessed triple cognates highlights the principle of non-selectivity in language processing, where multiple languages remain simultaneously activated, facilitating faster retrieval when there is greater overlap. The slower responses for unrelated words, on the other hand, reflect the additional cognitive effort required when no cross-linguistic facilitation exists. This result highlights how trilingual speakers strategically utilize their entire linguistic repertoire to maximize efficiency in meaning-making.

The Stroop task further demonstrated this dynamic interplay between facilitation and interference. The shortest reaction times occurred in congruent trials, followed by slower times in control trials, and the longest delays in incongruent trials. Beyond the statistical significance, these results qualitatively demonstrate the interplay of facilitation and interference in trilingual processing. In congruent trials, where the word meaning and ink color aligned, participants quickly accessed and integrated cues across languages, thereby reinforcing the translanguaging view that resources are pooled for efficient meaning-making. Incongruent trials, however, demanded greater cognitive control to manage conflicting cues, producing interference effects. Rather than viewing this interference as a weakness, it reflects the flexible negotiation strategies central to translanguaging: speakers dynamically suppress, inhibit, or prioritize competing resources to construct meaning. The Stroop results, therefore, demonstrate the adaptability of multilingual cognition in complex communicative contexts.

The translation elicitation task further highlighted the impact of task structure and lexical type on language processing. Participants performed equally efficiently in the blocked language condition and the mixed condition, indicating that switching between languages did not result in higher cognitive demands. However, in the blocked language condition and the mixed language block, responses to triple and double cognates were significantly faster than to unrelated words. This suggests that switching does not increase processing cost; shared lexical representations across languages facilitate language processing, enabling participants to rely on cross-linguistic memory links for faster retrieval. In translanguaging terms, this task reveals the adaptive capacity of trilingual speakers: they fluidly utilise resources across languages depending on task demands, with cognate facilitation acting as a bridge in managing switching costs.

Across all three tasks, the findings converge on a consistent conclusion: trilingual participants did not compartmentalize their languages into separate systems, but instead the trilingual speakers utilized their complete linguistic repertoire, characterised by non-selective access, which is subject to cross-linguistic facilitation and interference. Congruent trials and cognate conditions enabled participants to activate shared linguistic resources, thereby enhancing the speed and accuracy of meaning construction. Even in incongruent or unrelated conditions, where interference effects appeared, participants demonstrated dynamic strategies of negotiation and control. These patterns underscore that translanguaging is not a random or chaotic practice of code-switching; it is a systematic, cognitively grounded process that reflects how the brain organizes and retrieves linguistic resources.

The implications of these findings are twofold. Cognitively, they affirm that translanguaging is an integrated, non-selective process in which multiple languages are simultaneously active, and memory networks across languages are continuously drawn upon. Participants appeared to retrieve and integrate lexical and semantic associations across Punjabi, Urdu, and English, revealing the role of unitary repertoire and simultaneous activation of memory systems in trilingual cognition. Practically, the findings extend beyond the laboratory to suggest that in everyday communicative contexts, multilingual speakers draw flexibly on cross-linguistic resources to maximize comprehension, memory, and efficiency. Interactions that embrace such fluidity, rather than enforcing strict monolingual boundaries, more accurately reflect the lived experiences of multilingual individuals in Pakistan.

Conclusively, the three tasks provide complementary evidence for how trilingual speakers in Pakistan cognitively process their linguistic repertoires. The presence of cognates and congruent trials enabled participants to activate shared linguistic resources, enhancing the speed and accuracy of meaning construction. Shared conceptual and lexical networks across Punjabi, Urdu, and English facilitated faster retrieval in triple and double cognates, showing how translanguaging taps into distributed memory systems. The consistent activation of multiple languages, even when only one was required, demonstrates that trilingual processing is inherently non-selective and resource-integrative. From a broader perspective, the qualitative interpretation of these quantitative results highlights that translanguaging is not a random practice, but a systematic, cognitively grounded strategy. It reflects how trilingual speakers engage in dynamic, repertoire-based processing to optimize comprehension, memory, and meaning-making.

4.12 Qualitative Analysis of Errors

The statistical analyses confirmed systematic variation in reaction times across conditions and lexical categories; however, a comprehensive account of trilingual processing emerges through close examination of the errors observed in the experimental tasks. Errors are not simply failures of performance; instead, they reveal the cognitive strategies participants employed when navigating their multilingual repertoires. By analyzing substitutions, omissions, mixed responses, and other error patterns across the picture naming, Stroop, and translation elicitation tasks, it becomes evident that trilingual speakers in Pakistan engage in non-selective, repertoire-based processing. Such patterns highlight the dynamic and adaptive nature of translanguaging, where apparent deviations from target responses often function as strategic solutions to lexical competition, retrieval difficulty, or cross-linguistic interference.

In the picture naming task, participants were asked to produce lexical items corresponding to visual stimuli across three categories: triple cognates, double cognates, and unrelated words. A qualitative analysis of errors revealed several patterns, including lexical substitutions, the use of alternative lexical items, omissions, and disfluent responses. Participants substituted a target word with a semantically related alternative from another language. This error type was most frequent in unrelated words, where distinct lexical representations across all three languages appeared to heighten interference. Rather than producing a monolingual response, some participants engaged in a translanguaging mode, blending lexical forms such as an English root with an Urdu suffix. These instances highlight the integrated nature of the trilingual repertoire and suggest that so-called “errors” are often the outcome of natural cognitive processing strategies rather than deficiencies. In a smaller number of cases, participants paused, hesitated, or omitted responses altogether. These omissions occurred predominantly with unrelated words, reflecting the increased retrieval difficulty in the absence of cross-linguistic facilitation. Overall, the picture-naming errors illustrate the non-selective activation of lexical representations across languages: substitutions and translanguaging responses demonstrate participants’ reliance on their full repertoires in meaning-making. At the same time, phonological approximations suggest the influence of literacy practices and dominant-language exposure.

The Stroop task, which required participants to name font colors while ignoring printed words, produced a distinct set of error types that shed light on cognitive control in a multilingual context. In incongruent trials, participants often produced semantic intrusions by reading the word rather than naming the font color (e.g., saying “red” instead of naming the blue color in which “red” was printed). Such intrusions reveal the automaticity of word recognition, especially in Urdu and English, the languages of literacy and education. In addition, language-switching errors occurred when participants produced the correct color but in a language other than the required one (e.g., “neela” instead of “blue”), demonstrating the fluid accessibility of multiple lexical labels for a single concept. Slips of attention also appeared in control trials, where participants occasionally misnamed neutral strings such as “XXXX.” These lapses were likely due to inattention to task demands rather than linguistic interference. Finally, under increased cognitive load, some participants translated the printed item instead of naming the colour. Such responses reflect translanguaging under pressure rather than simple task failure. Taken together, these error patterns highlight the competition between automatic word recognition and colour naming in trilinguals. The prevalence of intrusions in incongruent trials demonstrates that language activation can override executive control, while switching and mixed responses demonstrate the integrated and flexible nature of the trilingual lexicon.

In the translation elicitation task, where participants were required to produce equivalent lexical items under sentential contexts across the categories of triple cognates, double cognates, and unrelated words, the error patterns closely mirrored those observed in the picture naming task. Participants frequently substituted target items with semantically related alternatives drawn from another language, demonstrating the same kind of cross-linguistic lexical competition. As in the picture naming task, such substitutions were most common in unrelated words, where the lack of shared conceptual overlaps across the three languages heightened retrieval difficulty and interference. Instances of translanguaging were also observed, with participants blending forms across languages—for example, producing a hybrid construction that combined an English lexical base with an Urdu or Punjabi affix. These blended forms again underscore the integrated and dynamic nature of the trilingual repertoire, revealing that what appear as "errors" are often natural manifestations of adaptive processing rather than evidence of deficiency. Omissions and hesitations are similarly aligned with patterns in the picture naming task, occurring predominantly in unrelated items where the absence of cognate support increased processing load. In summary, the translation elicitation errors reinforce the findings from the picture naming task by highlighting the non-selective activation of lexical representations across languages, the reliance on flexible translanguaging strategies to manage retrieval challenges, and the influence of literacy practices on shaping lexical access. These converging patterns across three distinct experimental contexts strengthen the conclusion that trilingual participants draw on their entire linguistic repertoire in meaning-making, relying on adaptive, repertoire-wide strategies rather than strictly compartmentalised systems.

Across all three experiments, the qualitative analysis of errors converges on several key aspects. First, errors consistently point to the simultaneous activation of multiple languages, even when the task required responses in a single target language. Second, what appear as "errors" are often better understood as communicative strategies, whereby participants mobilised their full repertoires to maintain fluency, resolve interference, or bridge lexical gaps. Third, Urdu and English, as languages of literacy and education, exerted a more substantial influence on error patterns. At the same time, Punjabi, despite being the participants' L1, was sometimes marginalised due to limited literacy and unfamiliarity with the script. Finally, error types such as mixed responses, disfluent productions, literal translations, and omissions underscore the adaptive and flexible nature of trilingual processing. Rather than indicating deficiencies, these responses reflect how participants dynamically navigate cross-linguistic competition, thereby reaffirming the translanguaging perspective that multilingual cognition is repertoire-based, integrative, and strategically adaptive.

In relation to the quantitative results, the error patterns provide a qualitative complement that reinforces the observed statistical trends. The higher frequency of omissions and hesitations for unrelated words corresponds to the slower reaction times recorded in this category, underscoring the difficulty of retrieval in the absence of cross-linguistic facilitation. Similarly, semantic intrusions and interference in the Stroop task align with the significantly longer reaction times in incongruent trials, highlighting the cognitive cost of managing competing cues. In the translation elicitation task, the prevalence of false cognates and literal translations mirrors the quantitative evidence that double cognates were more difficult than triple cognates, reflecting partial facilitation and heightened confusion. Collectively, these qualitative observations extend the quantitative findings by demonstrating that statistical differences are not merely numerical contrasts but manifestations of underlying processing strategies and repertoire-based adaptations characteristic of translanguaging.

4.13 Meaning-Making and Memory in Translanguaging: Psycholinguistic Insights

The present study investigated the cognitive processing of linguistic resources in translanguaging through experimental tasks designed to capture accuracy, speed, and interference in the responses of trilingual speakers. While these quantitative results demonstrate patterns of facilitation and interference, their full significance can only be appreciated when situated within the broader psycholinguistic dimensions of meaning-making and memory, which are central to translanguaging. Both constructs offer a deeper understanding of how multilingual speakers manage their repertoires and why translanguaging becomes an effective communicative strategy in the Pakistani context.

Translanguaging, unlike traditional views of code-switching, is not simply about shifting between languages but about using the entire semiotic repertoire to make meaning. From a psycholinguistic perspective, this implies that processing is not restricted to lexical activation in a single code but is a dynamic integration of conceptual, contextual, and affective resources across languages. The findings of this study provide evidence of such integration. For example, in triple/double cognates or congruent trials where stimulus meanings aligned across Punjabi, Urdu, and English, participants exhibited faster response times and higher accuracy. This facilitation effect suggests that meaning is constructed holistically rather than sequentially. Participants did not need to "choose" one language over another; instead, both languages contributed to a richer, more efficient meaning-making process.

On the Contrary, in the case of unrelated words or incongruent conditions, where meanings diverged across languages, interference effects were observed. These slower response times and increased errors highlight the cognitive negotiation multilinguals must undertake when meanings conflict. Notably, this interference does not undermine translanguaging as a strategy but instead underscores that meaning-making involves active resolution of competing linguistic cues. In real-life communication, such negotiation is not a "failure" but an adaptive feature, allowing multilinguals to select the most contextually appropriate meaning from among several available options. Thus, the quantitative results of facilitation and interference can be reinterpreted not as mere cognitive costs and benefits but as indicators of the flexible meaning-making process that defines translanguaging.

Memory is a central component of psycholinguistic processing, intricately interwoven with meaning-making. It facilitates the storage, retrieval, and integration of linguistic resources, rendering it inseparable from the construction of meaning. Translanguaging relies on multilinguals' ability to store, retrieve, and integrate linguistic resources across their three languages. This requires not only access to lexical memory but also to episodic and semantic memory systems that support comprehension and recall. In the present study, memory processes were indirectly evident in the performance patterns. The speed with which participants retrieved equivalent or related lexical items across languages in Triple or double cognates or congruent trials suggests that memory representations are non-selective. That is, words and concepts are stored in an interconnected network, accessible through multiple linguistic pathways. This aligns with non-selective access theories in bilingual processing and the Multilink model, which propose that lexical access activates candidates from all languages simultaneously.

Moreover, the interference effects observed in Unrelated words or incongruent trials can be interpreted as a memory-based phenomenon. Competing memory traces from different languages are activated simultaneously, and participants must inhibit irrelevant representations to produce a response. Such inhibitory control is cognitively demanding, yet it also demonstrates the resilience and adaptability of multilingual memory systems. Rather than functioning as separate compartments, memory in translanguaging operates as an integrated resource, where cross-linguistic activation is the default mode. This integrated memory processing has significant implications for education in Pakistan. Students are often required to learn in English while retaining strong ties to Urdu and regional languages. Their ability to recall and apply knowledge is enhanced when instruction acknowledges and utilises their full memory repertoire rather than restricting them to a single linguistic code.

Although meaning-making and memory may be conceptualised as distinct cognitive processes, translanguaging reveals their profound interdependence. Meaning-making depends on the retrieval of relevant linguistic and conceptual resources from memory, while memory itself is shaped by the way meanings are encoded across multiple languages. For instance, when a participant encodes a concept in both Urdu and English, memory traces are strengthened through dual coding, leading to greater recall flexibility. This was evident in the facilitation effects of cognates or congruent trials, where bilingual memory representations allowed participants to process information more efficiently. On the other hand, when meanings are encoded differently across languages, memory retrieval may trigger competing representations, as observed in incongruent trials. Here, meaning-making involves resolving cross-linguistic conflict by drawing on contextual cues, pragmatic knowledge, and task demands. Thus, translanguaging is best understood not merely as a communicative strategy but as a cognitive activity where meaning-making and memory co-construct each other. This dual process explains why multilinguals can fluidly shift between resources, retrieving from memory what is necessary and reconstructing meaning dynamically in interaction.

Foregrounding meaning-making and memory highlights the ecological validity of translanguaging in Pakistan's multilingual setting. participants frequently switch between Urdu, English, and regional languages such as Punjabi, Pashto, or Sindhi. Their meaning-making is not confined to one code but emerges from the combined effect of resources, supported by an integrated memory system. Pedagogically, this means that translanguaging should not be viewed as an interference or deficiency, but rather as an asset for comprehension and retention. Instruction that allows students to encode and retrieve knowledge across their languages strengthens memory and facilitates a more profound understanding. For psycholinguistic research, this perspective advances the argument that translanguaging is not simply a social practice. However, a cognitive reality grounded in how memory and meaning-making operate in multilingual minds.

By situating the experimental results within the frameworks of meaning-making and memory, the findings gain greater interpretive depth. The facilitation effects demonstrate how translanguaging supports efficient meaning-making through multiple memory pathways. In contrast, the interference effects highlight the cognitive effort required when meanings diverge, but also the adaptive strategies trilinguals use to resolve such conflicts. The overall performance patterns confirm that multilingual memory is integrated and non-selective, enabling meaning-making across linguistic boundaries. Thus, the discussion of meaning-making and memory strengthens the central claim of this research: that translanguaging in the Pakistani context is both a cognitive process and a communicative resource, grounded in the psycholinguistic realities of how multilinguals process, store, and use language.

4.14 Chapter Summary

This chapter presents the data collected through a language proficiency test, language background questionnaire, and three psycholinguistic tasks: the picture-naming task, the Stroop task, and the translation-elicitation task. The LexTALE scores divided the participants into three proficiency groups: high, medium, and low. As participants responded to visual and linguistic stimuli, their responses were analysed to examine the accuracy rate and error types. It was observed that highly proficient participants made fewer errors and responded more accurately than the other two groups of participants. The response times collected through DMDX were statistically analysed. First, descriptive statistics and correlation coefficients for all variables involved in the study were presented for all three experiments, illustrating the mean scores corresponding to each variable. Later, regression analysis, moderation analysis, ANOVA, MANOVA, and paired-sample *t*-tests were conducted for all experiments to examine the relationships among study variables. The qualitative interpretation of quantitative tests and analysis of errors followed this. Finally, the qualitative and quantitative psycholinguistic insights are integrated with the role of meaning-making and memory in translanguaging. The findings of the experiment are discussed in the subsequent chapter for the exploration of research hypotheses.

CHAPTER 5

RESULTS AND DISCUSSION

This section presents a detailed discussion of the results reported in the previous section obtained through three distinct empirical paradigms, the picture-naming task, the Stroop task, and the translation-elicitation task, to examine the nature of the lexical organisation, access, and processing. The main objective of this research study is to analyse the nature of lexical organisation by employing three distinct experimental tasks. It was hypothesised that all linguistic resources are stored in a unitary store, thus constituting a unitary repertoire with simultaneous activation of all linguistic resources, involving even the ones not required by task demand.

The aim of the current research is twofold. At the very onset, it is designed to examine if the cognate facilitation or interference generally achieved for the same script language combination in the lexical decision task and other psycholinguistic tasks will also be present for a cross-script language constellation that had not been studied before, like Punjabi-Urdu-English. Secondly, instead of using a simple lexical decision task, three distinct experimental paradigms, such as the picture-naming task, the Stroop task, and the translation-elicitation task, are employed to examine the nature of the trilingual mental lexicon, which focuses on diverse aspects of language processing, organisation, and access.

In psycholinguistic studies involving trilingual speakers, the primary concern revolves around two fundamental concepts: a unitary mental lexicon versus separate lexical stores corresponding to each of the speakers' languages, and second, selective versus nonselective lexical access. To examine these two aspects, various experimental paradigms have been employed with diverse language constellations to analyse the nature of the trilingual lexicon. The present investigation has employed the picture-naming task, the Stroop task, and the translation-elicitation task with Punjabi-Urdu-English trilingual speakers. Experiment 1 involved the picture-naming task, which was carried out to examine variables such as the effect of English language proficiency, cognate status, lexical frequency, and duration of interaction with each language. Experiment 2 was a

Stroop task consisting of three segments; participants completed the Stroop task in all three of the languages of the participants. Performing the Stroop task in all of the languages of the participants served a dual purpose. It assisted in determining across-language interference and within-language interference, which is the standard Stroop effect. Experiment 3 was a translation-elicitation task, which focused on L2-L3 and L3-L2 translation-elicitation in a sentential context to examine the impact of the cognate status of lexical items and the lexical frequency of stimuli in both a single language block and a mixed language block. The purpose of this experiment is to further authenticate or reject the findings of experiment 1 – the picture-naming task by employing a different approach, that is, the translation-elicitation paradigm, to examine if the findings of the picture-naming task hold in a sentential context as well. In the subsequent sections, a detailed discussion and analysis, along with findings from relevant prior research studies, are presented first exclusively for each experiment and then generally to examine the research hypotheses.

5.1 Findings from Experiment 1: The Picture-Naming Task

The hypotheses under investigation regarding the structure and nature of the trilingual lexicon in the current research are intended to analyse the nature of the mental lexicon, whether integrated or separate, and the stimulation of all or only the target language by the trilingual participants. To examine the research hypotheses, the independent variables are the English language proficiency (L3) and the cognate status of lexical items. English language proficiency and cognate status are between–subjects variables.

The picture-naming experiment is set to examine the nature of a trilingual lexicon and to analyse the interaction among the three languages of participants, if it exhibits any facilitation or interference patterns with the use of cognate status, lexical frequency, and English language proficiency. It attempts to test whether the higher proficiency of participants in English has any effect on latency scores for triple cognates, double cognates, and unrelated words compared to participants with average and low proficiency in English. Furthermore, it intends to examine whether pictures depicting triple cognates would have any effect on response time compared to pictures that depicted objects with double cognates or unrelated control words in all three languages. Similarly, double cognates also have an impact on response time as compared to naming latencies of pictures that depicted items with unrelated words in all of the languages of participants. Previous studies furnish mixed results for the picture-naming task; some support no facilitation effect, whereas others advocate bilingual or multilingual advantage for language processing. Most of these studies have focused on language processing in bilingual participants. Regarding tri- or multilingual language processing, a few studies have explored the interaction of multilinguals' languages in various psycholinguistic paradigms, including reading, hearing, speaking, and typing, using distinct experimental designs. The present study aims to contribute valuable insights into the nature and architecture of translingual practices by adding to the existing body of literature, exploring the linguistic interactions of trilingual participants, particularly those involving the indigenous languages of Pakistan: Punjabi, Urdu, and English. The analysis of the outcomes of the picture-naming task presented in Chapter 4 has demonstrated the following significant findings:

1. The trilingual participants in the present research displayed the cognate facilitation effect for both triple cognates and double cognates. The participants performed faster on words shared or similar across all participants' languages, such as triple cognates, and also on lexical items shared in participants' two languages, such as double cognates, compared to unrelated words. This pattern demonstrates that participants drew on overlapping conceptual representations across their repertoires, which not only facilitated retrieval but also supported efficient meaning-making through shared cross-linguistic memory networks.
2. In contrast, participants exhibited interference effects in the picture-naming task, reflected in significantly longer naming latencies for unrelated words. These instances of slowed retrieval point to the activation of distinct lexical representations across the three languages. However, rather than being interpreted as processing deficits, such interference can be understood as evidence of the dynamic negotiation of meaning in multilingual cognition, where participants must reconcile competing cues from their repertoires.
3. The results further reveal that the cognate facilitation effect extended to language combinations that do not share the same writing script. This finding highlights that facilitation stems from shared conceptual and semantic memory

traces, rather than merely from orthographic similarity. Meaning-making in translanguaging thus relies on deep memory associations across languages, even when their scripts are visually distinct.

4. English language proficiency significantly influenced mean latency scores in the picture-naming task. Participants with higher proficiency produced faster responses than those with medium or low proficiency, suggesting that more robust memory encoding and retrieval pathways in the dominant literacy language supported quicker access to meaning. At the same time, the persistence of cognate facilitation across all proficiency groups highlights that memory traces from other languages in the repertoire remained active and available for meaning-making.
5. Beyond proficiency and cognate status, lexical frequency also shaped naming latencies. Participants responded more rapidly to high-frequency words compared to low-frequency ones, confirming that repeated exposure strengthens memory representations and facilitates retrieval. This effect demonstrates how everyday language experience and memory consolidation processes directly influence the speed and ease of meaning-making during lexical access.

Overall, these findings converge to show that trilingual participants do not compartmentalize their languages when processing. Instead, they draw on a shared memory system that integrates lexical and semantic representations across languages. Cognate facilitation, proficiency effects, and frequency patterns all point to the same conclusion: meaning-making in translanguaging is enabled by memory networks that cut across linguistic boundaries, allowing participants to flexibly mobilize their entire repertoires in the service of comprehension and communication.

5.2 Findings from Experiment 2: The Stroop Task

In Experiment 2, the present research focuses on the performance of trilingual participants in the Stroop task, specifically examining colour word incongruities, input and output incompatibilities, and their interaction patterns in relation to language proficiency. The general findings of variants of the Stroop experiment have demonstrated the classic

Stroop effect across all language conditions, English-English, English-Urdu, and English-Punjabi, which is calculated by comparing response latencies of congruent and incongruent trials for all language conditions in line with earlier research (Tytus, 2018; Marian et al., 2013; Abunuwara, 1994; Van Heuven, Conklin, Coderre, Guo & Dijkstra, 2011). The Stroop task was administered to assess cognitive interaction between various languages, thus focusing on both within-language and between-language interference patterns to address the issue of selective or nonselective lexical access and unitary or separate lexical store for the linguistic resources of three languages. The study's findings demonstrate the activation of two types of cognitive control processes in trilingual participants. One cognitive mechanism enabled participants to control congruent or incongruent conditions in the task. In contrast, the other mechanism allowed them to disregard irrelevant tasks or language and focus on the task. The analysis of the results of the Stroop task has demonstrated the following noteworthy findings:

1. The trilingual participants in the current research demonstrated the classic Stroop effect across all their languages. The participants took considerably less time when the word and ink colour matched, in contrast to incongruent trials in which the lexical item and colour term did not match across all three languages. The participants took even less time on control trials as this condition involved a hash mark instead of a colour term. This pattern reflects not only the expected automaticity of word recognition but also the activation of deeply stored lexical and conceptual memory traces. Meaning-making in these tasks required participants to navigate between competing linguistic cues, illustrating how multilingual memory networks are engaged even when the task demands focus only on colour identification.
2. Participants' English language proficiency has shown a significant impact on the Stroop task in English. It did not relate to the Stroop task in Urdu and the Stroop task in Punjabi. All the participants performed equally on the Stroop task in Urdu and Punjabi regardless of their English language proficiency, indicating that dominant languages in everyday communicative practices provided stronger and more stable memory pathways. This finding demonstrates the role of frequency and use in consolidating memory representations: repeated,

meaningful use of Urdu and Punjabi enabled more efficient processing and reduced reliance on proficiency in English.

3. The Stroop effect within the same language was more robust, as more significant differences were observed in the means of congruent and incongruent items in contrast to the Stroop effect between different language conditions, such as English-Urdu and English-Punjabi conditions. The increased difficulty of the between-language tasks, where participants had to name the colour in Urdu or Punjabi while ignoring an English lexical item, reflects the simultaneous activation of multiple languages in memory. Errors such as translating the English word, producing disfluent responses, or reading the lexical item instead of naming the colour indicate that participants were continuously negotiating meaning across languages. This demonstrates that memory activation is non-selective, drawing on the entire repertoire even when only one language is required.
4. The intensity of the Stroop effect varied across three language conditions. The degree of the between-language Stroop effect was higher than within the language condition. Within the same language, the disparity existed only between congruent and incongruent conditions, whereas participants had to cope with language disparity and congruency conditions in between-language conditions. The frequent translation of English words into the target language, despite the task requiring only colour naming, highlights the involuntary activation of linguistic memory traces. Such activation points to the deeply integrated nature of multilingual memory, where retrieval is shaped not only by task instructions but also by the habitual meaning-making strategies that trilinguals employ.
5. Participants' English language proficiency significantly influenced the number of errors; highly proficient participants tended to make fewer errors in both within and between-language conditions than average and low-proficient participants, thus exhibiting robust cognitive control mechanisms for inhibiting the irrelevant task and language. Participants with low English language proficiency made more errors, indicating more interference from inappropriate

tasks and language. Importantly, these patterns reveal that memory strength shaped by proficiency and use supports more efficient meaning-making by enabling participants to inhibit competing cues and focus on task-relevant information.

6. An essentially distinct finding is the naming of colour terms in the Stroop task in Punjabi. The participants did not respond to all colour terms equally fluently in Punjabi. The participants responded relatively more disfluently on naming the equivalent colour terms for red and green in Punjabi. They exhibited difficulty retrieving colour terms for red and green in Punjabi, in contrast to equivalent terms for blue, yellow, and black. This unevenness indicates weaker memory encoding for less frequently used terms, suggesting that gaps in lexical memory directly affect the fluency of meaning-making in translanguaging contexts.
7. Finally, the participants' frequency of using each language immediately influences their lexical processing, thus demonstrating the language dominance effect. The greater use of a language exhibited quicker and swifter access to the lexical items and resulted in fewer errors. This demonstrates that meaning-making in translanguaging is grounded in lived linguistic practices: the frequent activation of memory pathways strengthens accessibility, while less frequently used terms or languages create retrieval challenges.

The Stroop findings support the notion that translanguaging relies on shared memory systems that transcend linguistic boundaries. Meaning-making is not simply the outcome of task performance but the result of participants dynamically engaging their multilingual repertoires, with memory traces, frequency of use, and proficiency shaping how effectively they manage interference and construct responses.

5.3 Findings from Experiment 3: The Translation-Elicitation Task

Experiment 3, the translation-elicitation task, aims to examine the linguistic interaction patterns among the various languages of participants in a sentential context. In addition to exploring linguistic interaction patterns in the picture-naming and the Stroop tasks, the translation-elicitation task is designed to test the findings of the earlier two experiments to see if these results hold for the translation-elicitation task when words are presented in a sentential context. It aims to examine the facilitation and interaction patterns in a sentential context. The theoretical orientation for current research draws on translanguaging; the cognitive component of basic translanguaging principles furnishes a theoretical background. The hypotheses under investigation regarding the organisation of the trilingual lexicon in the present research aimed to examine the nature of the mental lexicon, whether integrated or separate, and activation of all or only the target language by the trilingual participants when words are presented in a sentential context. It was anticipated that the participants with higher proficiency would have smaller translation latency scores than participants with average and low proficiency in English. Furthermore, it was predicted that lexical items depicting triple cognates would take less mean response time than lexical items depicting objects with double cognates or unrelated control words in a sentential context in all three languages. Similarly, double cognates were also expected to take less mean response time as compared to translation latencies of lexical items that depicted items with unrelated words in all of the languages of participants. Previous studies furnish mixed results for the translation-elicitation tasks; some support no facilitation effect, whereas others advocate bilingual, trilingual, or multilingual advantage for language processing. Most of these studies have focused on language processing in bilingual participants. Regarding multilingual language processing, a few studies have dealt with the interaction of multilingual languages in various psycholinguistic paradigms, including the translation-elicitation task in sentential contexts. The present study aims to contribute valuable insights into the nature and architecture of translingual practices to the existing body of literature by exploring the linguistic interactions of trilingual participants, particularly those involving the indigenous languages of Pakistan: Punjabi, Urdu, and English. The analysis of the results of the translation-elicitation task has demonstrated the following significant findings:

1. The trilingual participants in the present research demonstrated a robust cognate facilitation effect for both triple and double cognates in the translation-elicitation task, conducted in a sentential context. These results reinforce the earlier findings of the picture-naming task, confirming that facilitation extends beyond isolated lexical access to contexts where words must be retrieved,

integrated, and re-expressed within meaningful sentences. Participants translated triple cognates, and to a slightly lesser extent double cognates, with greater speed and accuracy than unrelated words, highlighting how shared lexical and conceptual representations across languages enhance memory retrieval. From a translanguaging perspective, this facilitation highlights how participants drew on their full repertoires to support meaning-making, utilizing stored memory networks that spanned Punjabi, Urdu, and English. The quantitative differences observed in comparison with the picture-naming and Stroop tasks further suggest that the sentential context engages additional layers of meaning construction, demonstrating how translanguaging practices are grounded in both lexical memory and contextualized meaning-making.

2. Alongside cognate facilitation, participants also exhibited interference in the translation-elicitation task, particularly when translating unrelated words. This mirrors the interference pattern observed in the picture-naming task, where unrelated lexical items produced higher latencies. Such interference reflects the activation of distinct, non-overlapping lexical entries across the three languages, which required greater cognitive effort for retrieval. Importantly, this interference is not indicative of a deficiency. Instead, it highlights the dynamic negotiation of meaning across languages, where participants navigate competing cues and resolve cross-linguistic tension through memory-driven strategies. Errors, disfluencies, and longer latencies in unrelated words, therefore, highlight the adaptive role of translanguaging: meaning-making is achieved not by bypassing interference but by strategically engaging with it.
3. Participants' English language proficiency significantly impacts the mean latency scores in the translation-elicitation task. The participants with high English language proficiency responded faster and translated target lexical items than the other two groups of participants. Similarly, participants with medium proficiency also responded faster than participants with low proficiency. This pattern illustrates how the depth of exposure and practice enhances memory encoding, facilitating faster retrieval during meaning-making tasks. Participants with medium proficiency also performed more efficiently

than those with low proficiency, underscoring that memory accessibility scales with proficiency and use. In translanguaging terms, proficiency levels shaped the robustness of participants' memory networks, thereby influencing how effectively they could mobilize their repertoires to construct meaning across languages.

4. The results of experiments reflect the cognate facilitation effect for language combinations that do not share the same writing script. This demonstrates that facilitation is not confined to orthographic similarity but extends to cross-script lexical representations. The effect reflects how conceptual and semantic memory networks transcend scriptal boundaries, allowing participants to retrieve meaning efficiently even when the surface forms differ. This finding strongly supports the translanguaging view that multilingual memory is organized conceptually rather than restricted by script or orthography.
5. Besides language proficiency and cognate facilitation and interference effect, another noteworthy observation is the influence of lexical frequency on naming latencies in the translation-elicitation task. Participants translated high-frequency lexical items more quickly than low-frequency items, reflecting the impact of repeated exposure on memory strength. Frequent lexical encounters appear to consolidate memory traces, facilitating faster retrieval, while less frequent items require greater cognitive effort. These results highlight the interaction of memory and meaning-making in translanguaging practices: multilingual speakers rely not only on cross-linguistic overlap but also on the strength of lexical memory shaped by everyday use.
6. The presentation of stimuli in a single language, either English or Urdu, or in the presentation of mixed sentences, does not show any differences. This shows that presenting the stimuli in one language exclusively or mixing them does not significantly impact the translation latency scores. This suggests that participants were equally proficient at drawing on their trilingual memory systems and constructing meaning in both conditions. The lack of additional processing cost in the mixed condition further reinforces the translanguaging perspective: switching across languages in real-time does not impede meaning-

making but rather reflects the natural integration of multilingual resources within a shared cognitive and memory system.

The findings from the translation-elicitation task highlight that meaning-making and memory are central to trilingual processing in Pakistan. Cognate facilitation, proficiency effects, and lexical frequency all demonstrate how participants access shared conceptual and lexical networks to construct meaning efficiently. At the same time, interference and errors illustrate the adaptive strategies employed when memory retrieval was more demanding. The results confirm that translanguaging is not random switching but a systematic, memory-driven process that enables multilingual speakers to flexibly mobilise their repertoires to achieve meaning-making across diverse linguistic and communicative contexts.

5.4 Discussion

Discussion of the findings has been organised in four sub-sections. Section 5.4.1 discusses the findings from experiment 1 (the picture-naming task), Similarly, the discussion in section 5.4.2 focuses on the findings from experiment 2 (the Stroop task); section 5.4.3 considers the discussion of findings from experiment 3 (the translation-elicitation task); and section 5.4.4 presents the general discussion by combining the findings from all three tasks through studies that have employed multiple psycholinguistic tasks. Finally, section 5.4.5 discusses hypothesis-driven discussion.

5.4.1 Discussion of Findings from Experiment 1 (The Picture-Naming Task)

The outcomes of the picture-naming task demonstrated a cognate facilitation effect when participants responded to cognates, whether triple cognates or double cognates, and inhibition/interference when the participants named unrelated control words. The participants took less time to respond to lexical items that shared identical form and meaning in all languages, while trilingual participants responded faster than unrelated control words. The paired sample t-test analysis of response times of triple cognates, double cognates, and unrelated words revealed that participants took significantly less time to name triple cognates ($M = 857.86$, $SD = 185.34$) and double cognates ($M = 870.72$, $SD = 160.90$) as compared to unrelated control words ($M = 1041.18$, $SD =158.42$) which show cognate facilitation effect. It has been noted that the paired sample t-test for triple and double cognates did not yield any significant result, which indicates a robust cognate facilitation effect in contrast to unrelated words. The shorter naming latencies for cognates, pointing to the facilitation effect, are the outcome of the cumulative frequency effect of a particular lexical item. Moreover, the simultaneous activation of all linguistic resources activates the same item across all languages, so it causes a facilitation effect for the retrieval of lexical items, thus resulting in reduced response time. Since there is no competition for selection in lexical items across different languages, words are processed faster which is consistent with findings of former studies on the picture-naming task involving bilinguals (Li & Gollan, 2021; Ivanova & Costa, 2008; Kohnert, 2004; Blumenfeld & Marian, 2007; Hoshino & Kroll, 2008; Altaribba & Basnight-Brown, 2009; Costa et al., 2005; Fox, 1996). Other studies reinforced these findings for tri-/multilingual participants using various experimental paradigms (Szubko-Sitarek, 2011; Lijewska & Chmiel, 2015; Lemhofer et al., 2004).

These studies have proposed cognate facilitation and inhibition effects through various paradigms. In line with the current study's findings concerning the picture-naming task, Blumenfeld & Marian (2007) examined the impact of the cognate status of lexical items on German–English bilingual speakers in the picture-naming task. It analysed the effect of language proficiency and cognate status on cross-language activation. The study maintained that the higher level of English language proficiency of participants and the cognate status of lexical items amplified the simultaneous activation of lexical items in the picture-naming task. The findings of the present study maintain this finding, as the participants with higher English proficiency took less time to respond to cognates. Lemhofer et al. (2004) implemented a lexical decision task and reported a cognate facilitation effect in trilingual speakers, but the scope of the research was narrow as it focused on the presentation of lexical items; thus, it provided direct and quicker access to the form, phonology, and morphology of words, resulting in activation of related lexical nodes in non-target languages. On the contrary, the current study used the picture-naming task to analyse the activation of language nodes and their effect on languages not required by the task for the group of trilingual speakers who had not been tested earlier. Additionally, the languages involved in the current study have not been previously considered in psycholinguistic experiments examining lexical organisation and access in trilingual Pakistani participants, who use the indigenous languages of Pakistan.

In a picture-naming task, the stimulus is a picture instead of a lexical item, so the presentation of words is purposely withheld so that the participants are free to choose lexical labels and, accordingly, retrieve them from the linguistic repertoire and link them to the items presented through pictures. This design of study and findings aligned with the findings of Costa et al. (2000), who conducted a picture-naming task with bilingual participants using cognate and non-cognate lexical items from Catalan and Spanish. The finding confirmed that the magnitude of the cognate effect was more significant when participants completed the task in their L3. Likewise, another study (Poarch & Van Hell, 2014) reported a cognate facilitation effect for both triple and double cognates in a picture-naming task when the speakers completed the picture-naming task in their L2 and L3. In general, it seems plausible to conclude that the overlap of lexical items in L2 and L3 gets the advantage of the "overspill" (Tytus, 2018, p.13) of activation of lexical items from the mother tongue, even in the absence of a task requirement of the mother tongue. On the contrary, when the participants performed the picture-naming task exclusively in L1, the higher activation of L1 may eclipse the activation of other non-native languages.

Another notable study (Szubko-Sitarek, 2011) examining multilingual lexical access and retrieval examined word recognition in Polish–German-English trilingual participants. The participants performed word recognition in their weakest language (L3). The stimuli consisted of German control words, Polish-German double cognates, and Polish-German-English triple cognates. The findings of the word recognition task reproduced the classic cognate effect for the combination of languages involved in the task, which is consistent with findings of the picture-naming task. The relative difference in scores of triple and double cognates, and double cognates and control words, further reinforces nonselective lexical access for visual word recognition. However, there is an insignificant difference in double cognates and triple cognates in the picture-naming task, contrary to the findings of a former study.

The effect of response language, whether L1 or L3, has a significant effect on lexical access and retrieval, as demonstrated by Tytus (2018), who conducted two experiments, the Stroop task and the picture-naming task with trilingual participants, to analyse the interaction patterns of all languages of participants. These findings may be compared to other studies (Poarch & Van Hell, 2014; Costa et al., 2000), which differ in response language. The study affirmed that the experiment showed no cognate facilitation effect for triple or double cognates in the picture-naming task with German, French, and English trilingual participants. The speakers completed the picture-naming task in their dominant language, German (L1). The study reported a cognate effect in the reversed direction for the German-French language pair, where the double cognates took even higher naming latencies than unrelated control words. Moreover, the study reported no significant effect on the level of English and French language proficiency as the participant performed the task in German. Therefore, task demand makes the proficiency level of participants in L2 and L3 irrelevant when the participants performed the task in L1, the most dominant language of the participants. This finding has been justified by the assumption that all three languages may not be activated in parallel as the task was executed in L1, the most dominant language of the participants. Alternatively, the higher activation of the German language disregarded the activation of French and English. The findings of experiment 1 (the picture-naming task), are inconsistent with the study conducted by Tytus (2018) due to the fundamental difference in response language involved in performing the task. As stated earlier, this finding is consistent with the findings of former studies (Poarch & van Hell, 2014; Costa et al., 2000). These findings help to conclude that cognate facilitation occurs when participants perform the task in their less dominant languages instead of their mother tongue. Khan (2012) affirmed a similar influence of response language with Urdu-English bilingual participants, as the study performed masked priming in both participants' languages and noted differences in results. The significant results are observed for English and not for Urdu, which is consistent with the findings of the current study.

A former study by Khan (2012) is of particular interest in the present study, as it analysed the Urdu-English language pair and the linguistic interaction of Pakistani bilingual speakers, which partially connects with the mechanisms employed in the present study. It differs from present research at multiple levels. First, the present research involves trilingual participants in contrast to the study mentioned earlier, which involved bilingual participants. Second, the present study focused on the interaction of three languages spoken by participants: Punjabi, Urdu, and English, whereas the previous research focused on interaction patterns between English and Urdu only. Third, it differed in the psycholinguistic experiments employed; the earlier study used a picture-naming task, the Stroop task, and the translation-elicitation task, whereas this study used a masked priming task to examine lexical access and retrieval, in contrast to the previous study. Lastly, it differed in terms of the experimental design's architecture and theoretical orientation. Despite these differences, the study reported some common findings that are consistent with the current research. It reported differences in cognate facilitation when the picture-naming task was performed in two languages. For instance, the study consisted of two broad segments, each performed in a different language by bilingual participants. The study showed no cognate facilitation and inhibition effect in the picture-naming task when English-Urdu bilingual speakers completed the task in Urdu. As it was the participants' dominant language, its higher activation level overshadowed the cognate effect. This finding is consistent with the findings of the Stroop task in the present study. However, the participant exhibited robust cognate facilitation and inhibition effects for the English segment of the task, thus pointing to nonselective lexical access. Overall, the study supported the cognate facilitation effect and nonselective lexical access. Moreover, frequency-balanced and frequency-unbalanced were addressed, which was discussed later. The study generally points to the cognate facilitation effect of triple and double cognates.

Higher naming latency scores for the unrelated words support the second finding that participants experience interference from activating lexical items in non-target languages, in contrast to lower naming latencies for cognates. As in the case of the present study, the speakers completed the picture-naming task in English, and the higher mean naming scores for unrelated words reflect interference among the corresponding words in the other two languages. This finding is in agreement with former studies (Szubko-Sitarek, 2011; Poarch & Van Hell, 2014; Costa et al., 2000; Lijewska & Chmiel, 2015; Lemhofer et al., 2004) that have reported cognate facilitation effects through various experimental paradigms. These studies support lexical interference in addition to the cognate facilitation effect. This finding that participants experience interference for unrelated words is consistent with the findings of studies that demonstrate the cognate facilitation effect. The differences between groups indicate cognate facilitation and interference effects for the lexical items. Poarch and Van Hell (2014) reported a cognate facilitation effect with English-German-Dutch trilingual participants through a picture naming paradigm. The participants displayed the smallest latency scores for triple cognates, thus conforming to the activation of all three languages simultaneously. In the same way, the participants' latency scores for double cognates were higher than those for triple cognates but lower than those for unrelated words. The cognate facilitation and interference effect functions in parallel; the significantly lower scores on cognate items indicate the cognate facilitation effect in contrast to significantly higher mean naming scores on unrelated control words, reflecting the activation of corresponding lexical items in all of the participants' languages and competition for selection. However, it differed from the current investigation as the naming latencies were lowest for triple cognates but did not differ significantly; there were significant differences in latency scores of cognate and unrelated words.

The results of the picture-naming task illustrate cognate facilitation and interference effects for language combinations that do not share the same writing script. Therefore, cognate facilitation is not restricted to orthographically similar languages and extends to sets of languages that employ varied writing scripts. It shows that the cognate facilitation effect does not rely exclusively on the orthographic similarity of languages, as earlier studies attributed it to the same writing scripts. Later studies examined language combinations that did not share the same writing script involving bilingual and multilingual participants. The present study also examined the language combination of Punjabi, Urdu, and English, which employ distinct writing scripts. English is written in the Latin alphabet, while Urdu and Punjabi are written in a script derived from the Arabic writing system. The results indicate cognate facilitation and interference effects even in the absence of similar writing scripts. This finding is consistent with previous studies involving bilinguals (Hoshino & Kroll, 2008; Allen & Conklin, 2013; Kim & Devis, 2003; Voga & Grainger, 2007; Mishra & Singh, 2013; Khan, 2012) and multilinguals (Costa et al., 2000; van Heuven et al., 2011) that examined lexical access and retrieval for groups of languages written in distinctive writing scripts.

Furthermore, apart from the impact of language proficiency and the facilitation and interference effect of cognates, another crucial factor to reflect on is the effect of lexical frequency in determining naming latencies during lexical access and retrieval. The participants with high English language proficiency responded faster than the other two groups of participants. Similarly, participants with medium proficiency also responded faster than participants with low proficiency. Lexical frequency refers to how often or seldom participants come across specific lexical items, and the lexical frequency also influences the retrieval of target lexical items. Participants' performance on the picture-naming task exhibited differences concerning the lexical frequency of items presented in the picture-naming task. The mean naming latencies indicate that participants respond more quickly to high-frequency lexical items than low-frequency lexical items. This finding is consistent with a former study (Khan, 2012) examining the impact of high- and low-frequency lexical items with English-Urdu bilingual participants. Another notable study, particularly significant in the context of the current study, is by Blumenfeld and Marian (2007). Its findings support the findings of the current study, including cognate facilitation and inhibition and the role of high language proficiency. The study supports the role of high proficiency in non-native languages in boosting parallel language activation.

Conclusively, the findings of the picture-naming task support the existence of a unitary repertoire for the linguistic resources of speakers. The findings also demonstrate the simultaneous activation of the three languages used by participants, resulting in facilitation or interference effects. In addition, the difference in writing scripts of languages does not affect the cross-language activation. Participants' language proficiency demonstrates a significant contribution to lexical organisation and retrieval.

5.4.2 Discussion of Findings from Experiment 2 (The Stroop Task)

The findings from the three segments of the Stroop task, English-English, English-Urdu, and English-Punjabi, are consistent to varying degrees with the findings and previously identified patterns of language proficiency and language coactivation (Marian et al., 2013; Van Hell & Dijkstra, 2002; Abunuwara, 1992; Magiste, 1985; Tytus, 2018) along with the numerous and distinct levels of executive control suggested by Multilink (2018). This model places immense significance on the level of language proficiency, as it influences both non-selective access and executive control, which is responsible for facilitating and interfering with cross-language processing. The executive control mechanism of the model allows for facilitation and inhibition effects. In the Stroop task, the executive control mechanism mediates interference, as in the case of reading words in opposition to naming ink colour. The finding of the classic Stroop effect, that is, higher naming latencies on incongruent trials in contrast to congruent trials, can be attributed to the activation of both the colour-naming schema and the reading schemas, as both lead to the same item in congruent trials, whereas in incongruent trials, the competition between both results in longer latencies.

Furthermore, item analysis and error analysis highlight the mean differences and types of errors made by the participants in the Stroop task. Item analysis reflects differences in mean scores of congruent, incongruent, and control trials across all variants of the Stroop task. The classic Stroop effect is observed for English-English, English-Urdu, and English-Punjabi Stroop tasks to varying degrees, thus pointing to differences between-language and within-language conditions. The maximum mean difference occurs between the mean scores of congruent trials and the mean scores of incongruent trials in the English–English Stroop task, representing a more substantial Stroop effect. The mean differences in congruent and incongruent trials of Urdu and Punjabi revealed lower latency scores expressing both the within-language Stroop effect and cross-language interference. Like mean differences in item analysis, error analysis also reveals significant differences across three variants of the Stroop task. In the English-English Stroop task, participants made errors in disfluent responses, reading the input, and word naming errors. In contrast, in the instance of Urdu-English and Punjabi-English Stroop tasks, an additional type of error interference of the input language was observed in reading and translating the input, demonstrating between-language interference. These observations are consistent with the findings of a former study by Marian et al. (2013). They examined Stroop interference in multilingual participants.

The evaluation of results of the trilingual Stroop task reveals that English language proficiency makes a significant contribution to the English-English Stroop task, as the error types, accuracy, and mean latency scores indicate. The participants with high English proficiency revealed higher speed and greater accuracy on the English-English Stroop task, and it was quicker as compared to both Urdu-English and Punjabi-English Stroop tasks. This finding partially aligns with a former investigation by Marian et al. (2013), which illustrated that the performance of participants on the Stroop task declined with a decline in their language proficiency. In the current study, the outcomes of the Stroop task show that language proficiency in English significantly impacts the English-English Stroop task. However, all participants performed equally on the Urdu-English and Punjabi-English Stroop tasks. Moreover, participants' responses were slower and less accurate due to between-language interference in the event of between-language conditions. These findings align with a previous study (Khan, 2012) on a masked priming task with English-Urdu bilingual participants. The study reported no cognate effect when participants completed the task in Urdu, their dominant language, compared to the second segment of the study in which the participants completed the task in English, resulting in a considerable cognate facilitation effect.

In addition to the analysis of mean latency scores between groups, the nature of errors further supported the impact of non-native language proficiency on Stroop performance in a multilingual context. The types of errors included reading input, disfluencies, and translating in the target language. Reading input was the natural outcome of competition between reading input and colour naming schemas, which results in colour word incongruities, particularly in the case of the Stroop task in English. The occurrence of disfluent responses is indicative of both within and between-language interference. As observed in former studies, disfluent responses represent planning difficulties and challenges during language production (Clark & Tree, 2002; Marian et al., 2013). In another study, Engelhardt et al. (2010) have concluded that inhibitory control functions as an integral part of language production, which prevents the articulation of inappropriate responses. Consequently, disfluencies are representative of competition among multiple linguistic choices or tasks. Therefore, disfluencies are the natural outcome when an automatic response needs reconsideration.

Another finding was that greater disfluencies were observed for incongruent trials than in congruent trials when participants responded in L2 and L3. It is the result of cognitive resources, which are responsible for monitoring the automatic reading of stimuli presented during ink naming, arising from the availability of additional resources. In addition to higher disfluent responses in the incongruent trial, greater disfluencies were observed for L1 (Punjabi) and L2 (Urdu). In the context of overall Stroop performance, such a finding is consistent with the findings of Marian et al. (2013), which analysed Stroop performance of multilinguals and reported higher disfluent responses for dominant languages compared to lower disfluencies for L3. Participants responded significantly more disfluent in Urdu-English and Punjabi-English Stroop tasks on incongruent trials than on congruent trials. It may be attributed to the existence of cognitive resources committed to managing the spontaneous input reading during the task of naming ink leading to the availability of several resources to fetch the anticipated target. Disfluencies were also observed in the case of the English-English Stroop task in incongruent trials. Since the input and response language aligned, the disfluencies were comparatively less in English than in Urdu and Punjabi. This observation does not support the effect of the dominant language on the weaker language. The finding of greater disfluencies in Urdu and Punjabi but not in English may be ascribed to the effect of stimuli presentation; the language of stimuli and response both were English, so there was only within language interference representing simultaneous triggering of both reading and naming faculty. Activating reading and naming schemas results in the Stroop effect regardless of the languages involved. On the other hand, higher disfluencies in Urdu and Punjabi variants of the Stroop task signal between-language interference, which highlights the activation of all linguistic resources irrespective of the task demand or target language involved, in addition to the demonstration of the classic Stroop effect.

Apart from comparing performance on language congruence and language incongruence, the evaluation of the Stroop effect across all variants was computed to analyse the Stroop effect between various languages. The results show that Stroop effects between different languages are less prominent than those within the same language. In the case of the cross-language Stroop task, the multilingual participants not only cope with the conflict between the colour-naming schema and the reading schema. This competition results in not only the classic Stroop effect but also requires choosing the relevant language required by the task demand by raising its level of activation and by inhibiting all other competing languages that are not required by the task demand. The stimulation of the target language and obstruction of unrelated languages is indispensable, as all languages of trilingual speakers are simultaneously activated even if the task does not require these (Marian et al., 2013; Kroll, 2008; Kaushanskaya & Marian, 2007; Blumenfeld & Marian, 2007). The results of the present investigation demonstrate that the disparity between stimulus language and response language significantly influences participants' naming latencies. It hampers their response speed in the required language by overlooking the language presented to them. The results show a stronger within–language Stroop effect, as shown in the English-English Stroop task, compared to the across-languages Stroop effect in the case of the Urdu-English Stroop task and Punjabi–English Stroop task. The findings of a robust Stroop effect for the within-language condition compared to the Stroop effect across languages align with earlier studies (Tytus, 2018; Marian et al., 2013). These findings help validate the research hypothesis of the present study, which posits that all languages simultaneously activate and compete for selection, resulting in different types of errors and longer response times in between-language conditions. The findings support simultaneous activation and competition of all languages, which are basic features of the Multilink model.

In the present investigation, it is plausible to conclude that interference from non-target languages of trilingual participants results in slower naming latencies in L1 and L2 and interfere with congruent and incongruent conditions. This verdict is partially in line with the results of Marian et al. (2013), which reported lower performance of participants in non-native response languages in both incongruent and congruent items that efficiently reduced the across-language Stroop effect in the case of L2 and L3 response languages. In contrast, the Stroop effect was the highest in L3 in the present investigation. This cross-language interference contrasts the findings of Costa et al. (1999), which claimed that translation pairs from the input language result in cross–linguistic facilitation during the picture naming task. Costa et al. (1999) employed the paradigm of picture-word interference to give evidence for a language-selective perspective. The study established that in the picture-naming task, translation counterparts from the non-target language provided facilitation when translation counterparts were also presented along with the picture, since both language nodes were activated compared to the presentation of unrelated words from the non-target language. These results of cross-language facilitation, rather than interference, were used as evidence for the language-selective language production model. Such language-selective models advocate the activation of information at the lemma level while naming, whereas participants activate lexical levels and choose the task-specific language. Notably, in the context of between-language interference in the present investigation, if the task of naming the colour were language-selective, between–language facilitation of colour matches (corresponding to the translation counterparts) for congruent trials would occur due to their shared conceptual nature. In contrast, interference would occur for incongruent trials, as it would activate dissimilar concepts. On the contrary, if linguistic access were not selective, interference from between-language congruent trials would be expected due to the activation and competition of two separate lexical items. Interference would also be anticipated for between-language incongruent trials due to the activation and competition of distinctive concepts and lexical items.

The finding that participants exhibited higher latency scores and lower accuracy on language mismatch trials (when the input and the response languages were dissimilar) in comparison to language match trials (when the input and response languages were the same) recommends the interplay of executive control, which is needed to suppress the irrelevant language for between-languages Stroop task and to inhibit the incongruent linguistic information for within language Stroop task. When participants performed the Stroop task in English (L3), only the within-language Stroop effect was observed due to the stimulus presentation, as the input and response language were the same. Moreover, the participants with higher English language proficiency exhibited the most substantial Stroop effect compared to the other two groups. Participants with medium proficiency also showed lower mean naming latencies than participants with low English language proficiency. Stroop effects within language were observed for all of the languages of the participants. However, the interlanguage Stroop effect was lower than the intralanguage Stroop effect due to the interference of both congruence status and the presence of irrelevant language. These patterns of results advocate that the interplay between the two types of interference – both between languages and within language – is moderated by participants' language proficiency, as is the essential feature of the Multilink model. The model strongly emphasises the role of non-native language proficiency during the lexical organisation, access, and retrieval.

Precisely, the comparison of three variants of the Stroop task reflects that during the execution of the Stroop task in English (L3), participants with high proficiency in English displayed more incredible speed and accuracy, representing an input language and response language match, in contrast to participants with medium and low proficiency. However, at the same time, all groups exhibited a more significant Stroop effect for the Stroop task in English compared to the Stroop task in Urdu (L2) and Punjabi (L1), thus pointing to the incompatibility of stimulus language and response language. On the other hand, participants did not show any colour difference–naming latencies on the Stroop task in Urdu and the Stroop task in Punjabi based on their English language proficiency. This finding shows that the relative level of language proficiency influences linguistic activation. For highly proficient participants, naming colours in English was more automatic, and inhibition of other languages was effortless as stimulus language and response language were compatible. The executive control mechanism inhibited the irrelevant language. The other groups also performed significantly faster on the Stroop task in English. On the contrary, naming colours in L2 and L1 was more effortful, and inhibition of irrelevant languages was more challenging, resulting in a decline in performance on both incongruent and congruent trials. The cost of stimulus and response language incompatibility is evident in higher colour–naming latencies even on control trials in the Stroop task in Urdu (L2) and Punjabi (L1). The irrelevant languages interfered with the color-naming task, thus resulting in comparatively higher latencies on all trials. This finding aligns with the results of earlier research (Blumenfeld & Marian, 2007) that cross-language interference is vigorous when the target language is less proficient compared to the irrelevant language.

The asymmetrical findings in cross–language interference during the Stroop task propose that the effect would be higher in the case of the within-language Stroop effect, and the Stroop interference was considerably decreased for trilingual participants when languages were written in different writing scripts. These findings are consistent with previous results with trilingual participants (Van Heuven et al., 2011; Abunuwara, 1992). Abunuwara (1992) examined the performance of trilingual participants, as is the case in the present investigation, and reported that colour-naming was quicker when the language of stimulus and response matched; in contrast, they were slower on trials in which there was a mismatch between stimulus and response language.

The finding of a lower between-language Stroop effect aligns with the findings of earlier research (Van Heuven et al., 2011), which examined the role of similarities of languages in within–language and across–language Stroop effects through three groups of trilingual participants. The three groups of participants differed in their writing scripts for their languages – Uyghur-Chinese-English, Chinese-English-Malay, and German-English-Dutch trilingual participants. The study exhibited an identical within–language Stroop effect across the three groups of participants. The across–language interference was influenced by the between-language similarity, particularly the writing script of languages. Participants whose three languages were written in distinct writing scripts exhibited a higher across–language Stroop effect, in contrast to the observations of the present investigation. The current study reveals a higher within–language and lower across–language Stroop effect, even though the three languages differed in terms of writing scripts. Van Heuven et al. (2011) attributed the higher between–language Stroop effect to the degree of dissimilarity of writing scripts, and the across–language Stroop effect will increase with growing dissimilarity between languages.

The extent of the Stroop effect differed concerning the response language, as has already been discussed. A more significant Stroop effect has been observed for within-language conditions, whereas the Stroop effect decreased for cross–language conditions. However, this finding contradicts the findings of an earlier study (Tytus, 2018); participants in the present study did not exhibit similar responses to colour-word incongruities across all three of their languages. Tytus (2018) reported similar latency scores on both between–language and within–language conditions. Alternatively, in the present study, participants exhibited the shortest response latencies on English congruent and control trials, which is consistent with their L3 being relatively weaker than their other two languages, Urdu and Punjabi, in contrast to Urdu and Punjabi congruent and control trials. This finding may be attributed to between-language interference, as the language of the stimuli was English; the language remained constant for the other two segments of the Stroop task to examine cross-language interference. In the Urdu and Punjabi segment of the Stroop task, the respondents were faced with colour word incongruities and between-language interference. The challenge for participants was twofold; they were required to deal with cross-linguistic competition and colour word incongruities.

The similarity of patterns of between–language interference in responding to language–match and mismatch conditions in L2 and L3 aligns with earlier studies during colour–naming, which support the presence of between–language interference instead of the facilitation of translation equivalents as reported by Hermans (2004). The simultaneous activation of colour names across different languages tends to interfere with the colour naming task, resulting in higher naming latencies and more significant errors, particularly in the case of the Stroop task in L2 Urdu and the Stroop task in L1 Punjabi. Therefore, the Stroop task results imply that the lexical selection process during colour–naming exhibits language nonselective lexical access in L2 and L1 as the competition occurs between the input language and response language. On the contrary, it is plausible that in the case of the Stroop task in English, in which a more robust Stroop task was observed, lexical access functionally appears language-selective. In particular, in L3 production, fewer cognitive resources were required to select appropriate responses with minimum cross-linguistic interference from L1 and L2 through executive control mechanisms. Lexical items not required by the task are successfully inhibited during L3 colour naming. Such a layout may facilitate communication instead of interfering during cross-linguistic language match conditions, supported by translation equivalents without lexical competition. In contrast, interference may persist during cross-linguistic incongruent conditions due to the activation of colour terms at the conceptual level. Therefore, it is essential to note that proficiency in both input language and response language plays a role in determining the success of cross-linguistic inhibitions at the level of words and subsequently influences the degree of functional language selectivity while naming in the cross-linguistic Stroop task.

In instances of language switches, errors are mainly observed when participants use unrelated language to make the response. This furnishes strong evidence in favour of asymmetry in patterns of interference and helps to determine that all languages of participants are simultaneously activated. In the present investigation, significantly greater errors in L2 and L1 compared to L3 are observed, which point to higher interference patterns in cross–linguistic conditions. The higher level of interference in L2 and L1 in between-language conditions indicates that inhibiting the co-activation of more dominant languages is more challenging, a finding in line with former research (Meuter, 2005). Consistent with the findings of former studies of the bilingual Stroop effect (Costa et al., 2008) and multilingual Stroop effect (Tytus, 2018; Van Heuven, 2011; Marian et al., 2013; Abunuwara, 1994), the findings of the present investigation support that low language proficiency results in higher between-language interference errors. This indicates that the level of cross-linguistic interference may rise as the proficiency in the target language weakens and the proficiency in non-target languages strengthens.

Another significant observation is the naming of colour terms in the Stroop task in Punjabi. The participants did not name all colour terms equally fluently in Punjabi. The participants made relatively more disfluent responses and errors in naming the equivalent colour terms for red and green in the Punjabi language. The participants exhibited difficulty accessing colour terms for red and green in Punjabi, in contrast to equivalent terms for blue, yellow, and black. One probable explanation for this difficulty is the interference of corresponding colour terms in Urdu and English. The colour terms for blue, green, and yellow are double cognates in Urdu and Punjabi. The activation of cognate colour terms in both languages reinforces the activation process, thus resulting in the cognate facilitation effect. On the other hand, distinct terms for red and green across all three languages resulted in competition among the corresponding colour terms, causing disfluent responses and errors. Apart from the classic Stroop effect, the overlap of colour terms in Urdu and Punjabi enabled the investigation of the cognate effect in the case of colour terms. The existence of cognate colour terms supports the findings of cognate facilitation and interference effect obtained in the picture-naming task.

The research findings demonstrate that two distinct executive control mechanisms are activated in the Stroop performance of trilingual participants. The first mechanism is responsible for controlling classic Stroop interference, and the other is the language control mechanism, which governs the inhibition of irrelevant language. The necessity to implement multiple control mechanisms, integral to the multilingual Stroop task, indicates the cognitive challenges that trilingual or multilingual speakers face in their daily communicative practices. These interaction patterns of the three languages spoken by participants support the research hypotheses for the current study, which advocate for the existence of a unitary repertoire in which all resources are simultaneously activated and compete for selection.

5.4.3 Discussion of Findings from Experiment 3 (The Translation-Elicitation Task)

The finding of the cognate facilitation effect is in line with earlier studies in various language processing domains. Studies have furnished evidence for faster cognate processing in hearing (Blumenfeld & Marian, 2007), reading (Cop et al., 2017), speaking (Gullifer et al., 2013; Costa et al., 2000), and typewriting (Woumans et al., 2021) by bilingual participants who spoke those languages. Whereas studies reported evidence for interference in cross-linguistic homophones in reading (Dijkstra et al., 1999) and listening (Lagrou et al., 2015) in the same way as for homographs interfered in speaking (Jared & Szucs, 2002), listening (Lagrou et al., 2011a, b), and reading (Dijkstra et al., 2000). The findings of all these studies indicate that all participants' languages are simultaneously activated, which either facilitates or interferes with each other. Similarly, the findings in the present study suggest facilitation for cognates, as such lexical items face no competition for selection, whereas simultaneous activation of unrelated words across all languages and their mutual competition for selection results in longer response times. These findings are consistent with former investigations that lexical items are stored in an integrated linguistic repertoire, activated simultaneously, and compete for selection, thus resulting in either facilitation or interference. The lexical items that are similar across languages result in a facilitation effect. In contrast, similar lexical items across different participants' languages result in interference due to the competition for selection during a particular task.

The cognate facilitation and interference effect in a sentential context is consistent with the findings of an earlier study (Gullifer et al., 2013). The experimental design of the current study partially draws from it, as it examined lexical access and retrieval in the sentential context in a single or mixed language context. The study examined the language interaction of speakers with Spanish–English bilingual participants when participants translated lexical items presented in the context of sentences. This study is of particular interest in the context of the present study as it seeks to underpin the difference in response time in a single language block, in contrast to a mixed language block. Participants performed two translation-elicitation experiments. In experiment 1, participants responded to stimulus words embedded in English or Spanish and vice versa, whereas in experiment

2, the participants responded to lexical items in mixed language conditions. The underlying motif was to compare whether the effect of one or mixed language contexts impacts translation scores. The outcomes exhibited a cognate facilitation effect in the sentential context for words overlapping in their second language. It also showed an interference effect for unrelated words, as activation of unrelated words across two languages resulted in competition and higher translation latency scores, in contrast to lexical items representing cognates, which resulted in lower translation scores and lexical access. In addition, the study did not reveal any significant switching cost when the languages were switched during the task. These results are consistent with the results of the present investigation.

Investigation of linguistic interaction in a sentential context has taken varied forms employing diverse experimental designs; one such design is the integration of the picture-naming task in a sentential context. To examine lexical access and retrieval, Starreveld et al. (2014) merged pictures in a sentential context. The purpose was to compare the response times when participants responded to pictures in isolation and the sentential context in two separate experiments. Dutch-English participants responded to cognate and non-cognate lexical items. The findings exhibited a cognate facilitation effect for both experiments, but the language and sentence constraints modulated the findings. The cognate effect was more significant for L2 than L1; it was smaller for high-constraint sentences than for low-constraint ones. It reinforced the cognate effect not only in isolation but also in a sentential context during word production. Thus, the cognate facilitation effect demonstrates the parallel activation of the non-target language. In a similar study, Lagrou et al. (2013) employed a visual word paradigm to assess across-language lexical activation with Dutch–English bilingual participants in 2 experiments when they heard sentences in their second language and native language, respectively. The study also focused on the magnitude of phonological resemblance across two languages. In experiment 1, when the participants heard in their second language, they paid closer attention to the competitor pictures, which were phonologically related to the target word in their non-target language, than to phonologically unrelated pictures. In contrast, in experiment 2, when participants heard in their native language, the fixation was still observed when the names of target pictures in

L1 and competitor pictures in L2 were phonologically similar. These results show evidence of cross-language competition during the comprehension of L1 and L2 sentences.

Another similar study (Woumans et al., 2021) examined lexical access and retrieval by implementing a similar experimental design, except for differences in the elicitation of responses. It fused the picture-naming task in a sentential context. It examined the cognate facilitation effect in Dutch–English bilingual participants to examine if the effect persists in written word production. The former studies focused on either the picture-naming task or lexical recognition only and elicited responses through speech; in contrast, Woumans et al. (2021) integrated the picture-naming task within a sentential context, and participants responded by typing their responses in their second language. The findings demonstrated that low-constraint sentences displayed a cognate facilitation effect, while the response to pictures placed in high-context sentences did not yield a cognate facilitation effect. Since this study elicited responses through typing, the variation in participants' ability to type could affect their responses compared to the responses corresponding to their speech. Overall, the study advocated for the activation of similar words across languages, resulting in the cognate facilitation effect in reading, speaking, and writing. Moreover, the interaction effect with sentential context suggested that restrictions from grammatical and semantic components might overrule the interlingual facilitation effect. The cognate effect persisted regardless of the response mode, whether reading, speaking, or writing. The finding of persistence of the cognate effect aligns with the findings of the current investigation, in which participants reflect the facilitation effect for cognates as compared to unrelated words in a sentential context during the translation-elicitation task.

Besides the cognate facilitation effect in isolation and in a sentential context, Cop et al. (2017) examined the cognate facilitation effect while reading narrative text. The participants of the research, Dutch–English bilinguals, read a novel in their mother tongue; the findings reported a facilitation effect due to the orthographic similarity between Dutch and English. The study examined how orthographic similarity with corresponding translation equivalents in the other language influenced reading nouns in the mother tongue. Eye movements of participants reading a novel in their mother tongue furnished evidence for the cognate facilitation effect, which is the persistence of the cognate effect even in the presence of the complex semantic context of a novel. The contextual framework of the novel did not inhibit the simultaneous activation of two languages in natural reading. The study reported non-identical cognate facilitation in L1, and high-frequency nouns reflected the cognate facilitation effect. Besides the facilitation effect for orthographic overlap, the study was an earlier attempt to demonstrate the cognate facilitation effect in the mother tongue reading of a narrative text. The study proved that lexical activation and access are not limited to the target language while reading a narrative text like a novel in L1; participants simultaneously activated all of their languages automatically, even when performing a task in their native language.

To examine the lexical representation and access in a sentential context, trilingual participants performed the translation-elicitation task in the present study. A similar former study (Lijewska & Chmiel, 2014) employed a translation-elicitation paradigm with trilingual participants and examined the impact of sentential context on cognate facilitation in L3-L1 and L3-L2 translation tasks. It differed from the present investigation in terms of the participants and languages involved in the study. The study compared the performance of interpreting and non-interpreting trainees on translation production directions mentioned earlier. The findings showed that the task of translating from L3 to L2 was more challenging compared to the task of translation from L3 to L1, with an overall low accuracy rate. The findings of the study demonstrated evidence for the impact of sentential context on the translation task, thus resulting in shorter translation latency scores for semantically constrained sentences in contrast to non-constraining sentences. In addition, the study reported a significant cognate facilitation effect in L3 to L1, where participants translated cognate items significantly faster than non-cognate control words. The sentential context of target items modulated the cognate facilitation effect. However, the reported modulation pattern conflicts with similar studies involving bilingual participants, which suggests an explanation in terms of the distinctive processing patterns employed by bilinguals and trilinguals. Moreover, the study observed no difference between the two groups of trainees who interpreted and those who did not, which suggests that professionally interpreting participants did not exhibit enhanced semantic processing. This outcome is in line with the results of another study (Christoffels et al., 2006), which found no significant differences when interpreting and non-interpreting teachers translated single words. The study concluded that the efficient access and retrieval of lexical items was not exclusively pertinent to the interpreting participants who received professional training for interpreting; it is a language skill. The study also emphasised the role of language proficiency, which determined participants' performance on language tasks. This finding aligns with the observations of the current study that participants' language proficiency level influences their performance on language tasks. The study also advocated the influence of language proficiency on the performance of language tasks in contrast to the availability of cognitive resources.

In another study, Li & Gollan (2021) compared lexical access and retrieval in and out of context to analyse the cognate facilitation effect with Spanish–English bilingual participants. The participants performed three experiments and named pictures in isolation and within a sentential context where a lexical item was presented in a sentential context. The findings exhibited that cognates significantly accelerated the naming process and decreased switching costs. Most importantly, the study showed that sentential context did not modulate the cognate effect. The cognate facilitation effect persisted in the sentential context as well. However, sentential context resulted in higher switch costs, which reflected the significant effect of the dominant language, differences in switch costs, and differences in the cognate facilitation effect, all of which were lacking in the mere picture-naming task. The findings show that default language selection is mainly determined by increasing the stimulation of the default language instead of inhibiting the non-default language. Participants rely more on reactive control to switch between languages than when naming words out of context. This suggests that there is a dynamic tradeoff in language control mechanisms.

The findings of the translation-elicitation task are consistent with the findings of former studies that support the cognate facilitation effect within the sentential context in the absence of a similar writing script, which reflects that translation is done through semantic mediation. Semantic mediation invalidates the differences in writing scripts. Consequently, the lexical access adopts a holistic semantic approach and shows the absence of a bottom-up approach.

5.4.4 General Discussion

In the present study, three experiments were conducted with one main objective and two secondary objectives. The first objective was to examine the nature of the lexical organisation, access, and retrieval, whether a unitary linguistic repertoire or separate lexical stores for three languages exist in the trilingual mental lexicon. The second objective was to examine the nature of language processing, whether selective or non-selective, by addressing certain dynamic features that influence participants' performance, such as language-related factors, participant characteristics, and task dependency. The language-related factors include lexical status, such as triple cognates, double cognates, and unrelated words, as well as lexical frequency, including high- and low-frequency lexical items. Likewise, participant characteristics include level of language proficiency. The third objective was to examine the facilitation and interference patterns of three languages of trilingual speakers, as these patterns are indicative of linguistic organisation and access in the mental lexicon of trilingual speakers.

All three experiments examined participants' performance by measuring response time, accuracy, and error rate. In all three experiments, the task demands changed to analyse the linguistic interaction patterns to check the influence of task dependency. In all 3 experiments, cognate status, frequency of lexical items, and level of English language proficiency were examined in addition to response times, accuracy, and error analysis. Besides, experiment 2 - the Stroop task was conducted in all three of the participants' languages to evaluate the within and cross-language interference patterns by keeping the input language constant; the response language varied concerning the task. These experiments led to several noteworthy conclusions about trilinguals' cognate organisation and processing, which are stated in sections 5.1, 5.2, and 5.3, respectively. They will be generally discussed in this section later.

The findings of experiments demonstrate that trilingual participants processed cognates more rapidly and accurately than control words, consistent with previous findings in the literature (Li & Gollan, 2021; Tytus, 2018; Ivanova & Costa, 2008; Blumenfeld & Marian, 2007; Hoshino & Kroll, 2008; Altaribba & Basnight-Brown, 2009; Szubko-Sitarek, 2011; Lijewska & Chmiel, 2015; Lemhofer et al., 2004) through varied experimental paradigms. The convergence of form and meaning across languages facilitates lexical access. The existence of similar forms and meanings accelerates the activation process, thus resulting in shorter latency scores for triple cognates. Before delving into a more in-depth examination of the experiment results, it is essential to reaffirm the most likely explanations of the cognate facilitation effect based on the conducted experiments. The literature on bilinguals and multilinguals has proposed various explanations for the observed bilingual and trilingual cognate effects, depending on how cognates are organised in the trilingual mental lexicon.

One possible explanation for the facilitatory effect of orthographically identical and non-identical cognates involves semantic features. This explanation suggests that when a person encounters a cognate, the stimulation of the semantic representation in one language spreads to the same semantic representation in other languages, leading to quicker and more precise recognition and production of the word. This explanation is supported by research showing that the facilitatory effect of cognates is stronger when the words have a high level of semantic overlap across languages (Van Hell & Dijkstra, 2002; Dijkstra et al., 1999). In addition, this explanation can account for the observed facilitatory effect of non-identical cognates, as the semantic feedback mechanism can still operate even when the cognates have different orthographic representations in each language. However, it is essential to note that this explanation does not entirely rule out the possibility of a cumulative frequency effect contributing to the facilitatory effect of cognates. Overall, the nature of cognate processing and representation in the trilingual mental lexicon is intricate and multifaceted, requiring further investigation to comprehend the nature of lexical organisation and retrieval fully. This can be achieved by employing other experimental paradigms and varying groups of participants with diverse linguistic and participant characteristics.

Another possible explanation for the facilitatory effect of cognates is that they stimulate the corresponding conceptual representation, even in the absence of identical orthographic representations across all languages, thus representing the top-down approach. This is because their meanings overlap across different languages. As a result, in the case of cognates, multiple lexical representations activate and help in quicker retrieval, whereas the unrelated lexical representations result in cross-language competition. This explanation is consistent with the Multilink model, which suggests that lexical activation and access adhere to a top-down approach in the absence of similar orthographic forms. The top-down approach, the activation of overlapping conceptual, phonological, and semantic representations in two or more languages, is a prominent feature of the Multilink model.

This explanation of the cognate effect is also supported by recent investigations on bilingual and multilingual lexical recognition, which suggests that the semantic-to-orthographic response plays a crucial role in word recognition. The data from the experiments demonstrated in Chapter 4 can be construed within the localist connectionist framework, which suggests that the facilitatory effect of cognates is an instance of a special relation to non-cognate translations where the lexical items share semantic, phonological, and/or orthographic representations over multiple languages (Voga & Grainger, 2007). Based on this evaluation, the cognate facilitation effect observed while reading or speaking might be an outcome of the semantic-orthographic priming effect, where overlapping semantic and orthographic representations from the two languages stimulate the presentation of one of the readings of the cognate. This leads to a facilitated recognition of cognates in contrast to unrelated control words. The cognate facilitation effect of the model is contingent on the similarity between languages and the frequency of the lexical items. It has been suggested that the similarity between the two readings of a cognate and its frequency of occurrence contribute to the strength of the shared semantic representation. Former studies also support the cognate facilitation effect for both similar scripts (Poarch & Van Hell, 2014; Shook et al., 2015; Titone et al., 2011; Tytus, 2018; Libben & Titone, 2009) and cross-script languages (Hu & Zhang, 2023; McPhedran & Lupker, 2020; Mishra & Singh, 2013; Van Heuven et al., 2011; Hoshino & Kroll, 2008; Allen & Conklin, 2013; Kim & Devis, 2003; Voga & Grainger, 2007; Wu & Thierry, 2010).

Furthermore, the approaches and explanations discussed in former studies (as mentioned in 5.1, 5.2, and 5.3) can be extended to the trilingual context and are in line with the findings of the present investigation. Just as the bilingual cognate effect has been construed as the co-activation of two languages, it is justifiable to infer that the data from three experiments support the simultaneous activation of all three languages during distinct tasks in trilingual participants. The findings of Experiment 1 and 3 indicate that the cognate effect builds up across languages, with cognate status in one language resulting in quicker recognition, and additional cognate status in another language further accelerating responses. This suggests that the concepts of a unitary mental lexicon and non-selective lexical access, which have gained support in the bilingual domain, can also be extended to trilingual participants and their three languages —Punjabi, Urdu, and English—involved in the indigenous languages of Pakistan.

In Experiments 1-3, each experiment focused on distinct aspects that were anticipated to affect lexical connections among the languages spoken by the participants. It was projected that if these factors were strong enough to promote stronger links with only one language, the facilitation effect would be observed only for that specific pair of languages. The absence of the facilitation effect does not indicate a lack of any connection with the other language. Instead, the connections may not be strong enough to produce this effect. On the contrary, the absence of a facilitation effect may signal an interference effect, as has been indicated in the findings of all three experiments, in the case of unrelated control words in experiment 1 and experiment 3, and between-language interference in the case of different variants of the Stroop task.

Generally, these results offer valuable insights into the processing and representation of the lexical organisation in trilingual participants. More precisely, it examines how lexical items, including cognates and unrelated words across participants' three languages, interact in a trilingual mental lexicon and highlights the complex interplay between linguistic factors and cognitive mechanisms involved in trilingual lexical processing embedded in distinctly structured experimental paradigms to capture the processing of three languages, particularly involving the indigenous languages of Pakistan. The findings of the present study are partially consistent with the findings of Tytus (2018). The former study used the picture-naming task and the Stroop task with German-English-French trilingual participants. The study reported cross-language facilitation and interference from both L1 and L2 and claimed to observe the least influence of L3, as it appeared to be the dormant language. The French language, being L3, was reported not to influence L1 and L2 processing. The present investigation also employed the picture-naming task and the Stroop task in addition to the translation-elicitation task, however, with Punjabi-Urdu-English trilingual participants. Consistent with the findings of the previous study, the current investigation supports the effects of cross-language facilitation and interference. However, the Punjabi language, being the least frequently used language though L1, is observed to encounter greater interference from the other two languages, Urdu and English, L2 and L3 respectively.

The findings of the picture-naming task demonstrated that when participants performed the task in their weakest language, the processing of words in the picture-naming task in L3 led to automatic and simultaneous activation of target lexical items in both the dominant (L1) and more robust (L2) languages. This supports the non-selective access hypothesis, which suggests that the presentation of a stimulus automatically stimulates lexical items in both the target and non-target languages simultaneously. As a result, cross-linguistic effects may occur mutually in both directions, not only in the weaker or the stronger language.

The second experiment, the Stroop task, aimed to verify three hypotheses. First, it analysed the influence of English language proficiency and whether knowledge of a weaker language can affect performance in the non-dominant language in a weaker language context. This would provide further assistance for non-selective access in the trilingual lexicon. Second, it examined within-language interference and between-language interference, as well as whether response times reflect the impact of stimulus presentation and response language, by comparing participants' performance on three Stroop task variants. Third, it examined the activation of three languages in the absence of cognates.

The results of the experiments support the findings of studies mentioned in the previous sections of this chapter and extend the simultaneous activation of all languages and the non-selective lexical access by Pakistani trilinguals, in particular, Punjabi-Urdu-English trilinguals. The results show that the English language proficiency of participants (in this case, L3) affects target word processing in the non-dominant language (L3) and second language (L2), in all experimental paradigms, that is, the picture naming task, the Stroop task, and the translation-elicitation task, thus supporting the developmental aspect of foreign language proficiency. This finding is consistent with previous studies, particularly Gill (2013), as both analyse lexical access by participants with a similar language background. In the case of the translation-elicitation task, participants' performance reinforced the findings of the picture-naming task. Additionally, it was demonstrated that the English language proficiency of participants affects target word processing in both blocked and mixed language conditions. This suggests that the language processing system of trilinguals is profoundly non-selective regarding language, both in isolation and in a sentential context, consistent with previous studies (Cop et al., 2017; Gullifer et al., 2013). However, the influence of non-native languages on the mother tongue was not addressed for both L2 and L3 in experiment 3, as the translation-elicitation focused on L2-L3 and L3-L2 translation directions in blocked and mixed language contexts. Triple cognates that were identical across all participants' languages were processed and responded to faster than their matched unrelated control words. Triple cognates and double cognates did not yield statistically significant results, whereas both cognate categories produced statistically significant results in contrast to unrelated control words.

The findings of the Stroop task are in line with Marian et al.'s (2013) study. As far as the experimental layout is concerned, the status of language and presentation of stimuli remained constant for all three variants of the Stroop task, consistent with the former study, which analysed the Stroop effect in all three languages of the participants, keeping the presentation of stimuli constant. It examined both within and between language interference. However, the present study differed from it concerning the language pairs and presentation of stimuli. The former study employed the most dominant language for presenting stimuli. In contrast, the current study followed the reverse pattern, as participants claimed to be familiar with the oral skills of their mother tongue. The stimuli were presented in English, but the response language changed in all three variants of the Stroop task. Participants' performance on the Stroop task in Punjabi and Urdu furnished non-significant results; in other words, all participants performed equally on the Stroop task in Punjabi due to Punjabi and Urdu being their dominant and most frequently used languages. Moreover, in experiment 2, the Stroop task in Punjabi, the participants made faster responses to cognate colour term ‘red’, ‘green’, and ‘blue’ colours as these words overlapped in their mother tongue thus resulting in facilitatory effect in the naming latencies due to cognate status of lexical items in contrast to names of colour terms ‘red’ and ‘green’ which were different in all three languages, in particular, their L2 the most frequently used language which results in dominant language effect (Li & Gollan, 2018).

The interference of colour terms from non-target languages on all three variants of languages reinforces the simultaneous activation of all languages of trilingual participants, consistent with the findings of Marian et al. (2013).

Furthermore, comparing the results for triple cognates, double cognates, and unrelated lexical items from experiment 1 and experiment 3, particularly and from experiment 2 for the Punjabi version, revealed a considerable difference in reaction times for the triple cognates, double cognates, and unrelated words by the same group of subjects. As discussed earlier, both of the experiments exhibited a cognate facilitation effect. The two experiments differed concerning their basic architecture, as the first focused on naming. In contrast, the last experiment required a translation-elicitation in a sentential context, and experiment 2 focused on naming colours while overlooking the lexical items. It reflects variations in the performance of participants depending on the task of the experiment. The findings demonstrate that task demands also influence nonselective access in the instance of three languages, and the presentation of stimuli and tasks may influence participants' performance. This suggests that, apart from some differences in cumulative scores due to task dependency, the nonselective lexical access hypothesis for trilingual participants is validated across all experimental paradigms, including the picture-naming task, the Stroop task, and the translation-elicitation task in a sentential context, as well as the Stroop task.

The results of the experiments support and extend the non-selective access hypothesis to three languages of trilingual speakers. It exhibited that the English language proficiency of participants (in this case, L3) affects target word processing in the non-dominant language (L3) and second language (L2), in both the picture-naming task and the translation-elicitation task. In the case of the translation-elicitation task, participants' performance reinforced the findings of the picture-naming task. Additionally, it was demonstrated that the English language proficiency of participants (L3) can affect target word processing in both blocked language and mixed language conditions. This suggests that the language processing system of trilinguals is profoundly non-selective in its approach to language. However, the influence of non-native languages on L1 was not addressed for both L2 and L3 in experiment 3, as the translation-elicitation focused on L2-L3 and L3-L2 translation directions in blocked language context and mixed language context. Triple cognates that were identical across all languages of participants were processed and responded to faster than unrelated words. Triple cognates and double cognates did not yield statistically significant results, whereas both cognate categories produced statistically significant results in contrast to unrelated control words. This suggests that the non-selective lexical access hypothesis in the case of three languages is validated for both the picture-naming task and the translation-elicitation in a sentential context. Moreover, comparing the results for cognates from both experiments revealed different reaction times for a similar list of stimulus items recognised by the same participants. This suggests that task demands also influence non-selective access in trilingual participants.

Experiment 2 (the Stroop task) demonstrated that the processing of lexical items in the most robust language (L1) can be influenced by the knowledge of a non-dominant language, specifically L2 knowledge. However, the lack of effect from L1 on L3 suggests that a certain level of L3 proficiency is mandatory for its effects to become perceptible in L3 processing. Experiment 3 used the same group of participants with three proficiency levels in L3 to further examine the cross-linguistic influence. The analyses of scores on the Stroop task demonstrated significant results only for the English language. The performance of participants on the Stroop task in Urdu and Punjabi furnished non-significant results; in other words, all participants performed equally on the Stroop task in Urdu and Punjabi due to the status of being dominant and more frequently used languages. This finding is consistent with the findings of Khan (2012), who employed Urdu-English bilingual participants and examined lexical processing through a masked priming task, which reported significant results for English only, and the scores were nonsignificant for Urdu. The present investigation extends these findings to the three languages of trilingual participants, incorporating the indigenous Punjabi language of Pakistan.

The findings of experiment 3 (the translation-elicitation task) are consistent with those of experiment 1 and experiment 2, showing that translation latency scores for triple cognates were comparatively smaller than those for double cognates. Scores for double cognates were significantly smaller than those for non-cognates, consistent with the findings of a former study (Cop et al., 2017). The former study claims a cognate facilitation effect for the narrative reading task through an eye-tracking paradigm with Dutch-English bilingual participants. It reports the cognate facilitation effect in the context of complex semantics during the native language reading task. The current investigation extends the cognate facilitation effect in a sentential context through a translation-elicitation task to three languages, including the indigenous languages of Pakistan, Punjabi, Urdu, and English. Additionally, responses to blocked language trials and mixed language trials did not reflect statistically significant results in line with the findings of the former study (Gullifer et al., 2013). The findings of the absence of effect in single language block and mixed language block and cognate facilitation effect for the two languages of bilinguals as reported by Gullifer et al. (2013) are extended to three languages, Punjabi-Urdu-English, during L2-L3 and L3-L2 translation-elicitation task in the light of the findings of the current study. However, the current study differed from it in terms of participants, the number of languages involved, and the writing scripts used. The English language proficiency demonstrated significant results for experiment 1 and experiment 3. However, English language proficiency demonstrated significant results for the Stroop task in English. These findings suggest that the proficiency level in L3 exerted an influence on L3 processing. However, it is still possible that non-native language proficiency may play a role in cross-language lexical activation, and weaker language knowledge may influence performance in the dominant language as trilinguals gain more proficiency in the weaker language.

The final experiment proved to be of particular significance as it highlighted the simultaneous activation of all languages from distinct language families. The last experiment was intended to examine the effect of psychotypology as reported by Szubko-Sitarek (2015) and the status of the non-native languages (L2 and L3) on the cognate representation in the trilingual lexicon. However, contrary to expectations, no results were found to support the role of psychotypology. The findings of Experiment 3 suggest that the cumulative effect of these factors was weak enough to establish any robust links between typologically related languages of trilingual participants. Since English employs the Latin writing script, while Urdu and Punjabi use the modified Arabic script, the languages differ in their writing scripts. The differences did not influence the results of the experiments in writing scripts. This finding is consistent with earlier studies that used varied writing scripts. Various studies have demonstrated the finding of cross-script activation of languages by taking distinct language pairs in literature (Hishino & Kroll, 2008; Allen & Conklin, 2013; Mishra & Singh, 2013; Khan, 2012).

In particular, Khan (2012) demonstrated a cognate facilitation effect in the cross-script Urdu-English language pair with bilingual participants through masked priming tasks. The present study extends this finding of cross-language activation across distinct writing scripts to Punjabi-Urdu-English trilingual participants' three languages through the picture-naming task, the Stroop task, and the translation-elicitation task. The findings of the present study supported the cognate facilitation effect when stimuli are presented not only in isolation but also within a sentential context. Khan (2012) reported both facilitation and inhibition when the participants performed the task in English, whereas no significant advantage was observed when the task was performed in Urdu. Similarly, the present investigation is consistent with the finding of cross-language facilitation and inhibition when participants performed the task in English and simultaneously extended it to the three languages of trilingual participants. The finding of a non-significant effect is also consistent when the trilingual participants performed the Stroop task in Urdu and the Stroop task in Punjabi. The present investigation supports simultaneous cross-lingual activation involving dissimilar writing scripts for cognates, as depicted in all of the experiments involving both cognates and non-cognates, particularly the translation-elicitation task. The findings of the translation-elicitation task support the cognate facilitation effect within the sentential context in the case of dissimilar writing scripts, which reflects that translation is done through semantic mediation. Semantic mediation disregards the differences in writing scripts. Consequently, the lexical access adopts a holistic semantic approach and shows the absence of a bottom-up approach.

Furthermore, robust lexical connections between L2 and L3 may have been established due to learning habits or learning experiences, and the most frequent use of L2 and L3. Since L3 was the weakest language being spoken, the significance of the learning experience was more crucial than that to the more advanced L2. The impact of the learning experience may be further analysed in future investigations. This feature may be decisive enough to establish stronger links between languages used extensively and simultaneously in education.

Another significant study regarding the Punjabi-Urdu-English trilingual participants is reported by Gill (2013). The current investigation also involved participants with similar linguistic constellations, and both addressed the lexical organisation and access in trilingual participants. The significant distinction in the two studies lies in the theoretical orientation, which in turn guides the data collection and analysis. The current investigation employed a concurrent mixed-method research design involving psycholinguistic tasks. However, the former study employed a phenomenological theoretical orientation in its data collection and analysis, utilizing essay writing, focus group discussions, and semi-structured interviews. Some of the findings from the former study are reinforced by the quantitative findings of the present investigation, as both advocate for the developmental aspect of trilingual language processing, the role of English language proficiency, and the cognitive control mechanism that inhibits the non-target language.

The present study examines language organisation and access in trilingual Punjabi-Urdu-English Pakistani speakers through the picture-naming task, the Stroop task, and the translation-elicitation task, which has not been addressed in former studies; thus, it fills this research gap. The findings of the experiments support the cognate facilitation effect, therefore pointing to the existence of a unitary linguistic repertoire and simultaneous activation of all of the linguistic resources. In addition, the frequency of language use also has a profound influence on the cognate facilitation effect. Owing to the higher frequency of L2, the triple and double cognates did not differ significantly. The study also supports the high magnitude of the classic Stroop effect for the most non-dominant language, as has been demonstrated in the significant values for the correlation scores of the Stroop task in English, in contrast to the non-significant values for the Stroop task in Urdu and the Stroop task in Punjabi. The current study not only analyses lexical access in isolation, as is demonstrated in the picture-naming task and the Stroop task, but also in a sentential context. The findings of lexical access in isolation were also confirmed for lexical access within the sentential context when the participant translated from L2-L3 and L3-L2. The study supports a unitary linguistic repertoire and the simultaneous activation of all linguistic resources in trilingual speakers, in addition to a holistic semantic approach.

5.4.5 Hypothesis Driven Discussion

This section presents a critical discussion of the findings from the three psycholinguistic experiments conducted in this study. The discussion is organised around the study's primary and secondary hypotheses. Each section synthesises relevant results from the picture-naming task, the Stroop task, and the translation-elicitation task, aligning them with the research hypotheses and the theoretical frameworks outlined in chapter 1, section 1.5 (p.7)-specifically the translanguaging perspective and the Multilink model (Dijkstra et al., 2018).

Hypothesis 1 proposed that trilingual participants possess a unitary linguistic repertoire that integrates the lexical and semantic representations of their three languages. Evidence from all three experimental tasks supports this hypothesis. In the picture-naming task, participants demonstrated greater accuracy and faster response times when naming triple and double cognates than when naming unrelated words. This facilitation effect implies the co-activation and integration of similar lexical items across languages, pointing to a shared mental lexicon that indicates integration rather than separation. Additionally, error patterns further reinforced this interpretation, with frequent substitutions from non-target but semantically related words, thus suggesting interconnected lexical networks. The translation-elicitation task reinforced this interpretation. Participants exhibited a dynamic and integrated linguistic repertoire when translating from L2 to L3 and L3 to L2 in a sentential context, reinforcing the view of a unified, dynamically accessed lexicon.

Even the Stroop task in three languages supports the primary hypothesis of an integrated lexicon by demonstrating automatic co-activation of multiple languages during cognitive processing, building upon the assumptions of the Multilink model (Dijkstra et al., 2018) as discussed in chapter 1, section 1.5 (p.7). Together, these results substantiate the claim that trilingual speakers in the Pakistani context use a shared, dynamic linguistic repertoire, in line with translanguaging theory (Wei, 2018).

Hypothesis 2 proposed that trilingual language processing involves the non-selective, simultaneous activation of multiple languages. The Stroop task provided particularly compelling evidence. Incongruent trials elicited significantly slower responses and higher error rates across all three languages, indicating the cognitive load associated with managing simultaneous activation. The most pronounced interference occurred when ink colour and word meaning conflicted across language boundaries, further validating the hypothesis of parallel activation.

The picture-naming task provided complementary evidence. Participants often hesitated or erred when naming pictures with dissimilar lexical representations across languages. These patterns point to competition among simultaneously activated lexical items. In the translation-elicitation task, the findings of the picture naming task were reinforced for linguistic stimuli within a sentential context. This automatic cross-language activation further highlights non-selective processing. These findings strongly support the theoretical frameworks (as discussed in chapter 1, section 1.5), the Multilink model's prediction of parallel activation across language systems, and support translanguaging theory's emphasis on the linguistic resources. As discussed in Chapter 1, translanguaging challenges traditional assumptions of language separation in cognition, instead framing such fluidity as an inherent characteristic of multilingual competence.

Hypothesis 3 suggested that trilingual speakers experience cross-linguistic interference and that cognitive control mechanisms mediate the selection and inhibition of competing lexical items.. The Stroop task offered robust evidence: incongruent trials consistently resulted in delayed response times and increased error rates, particularly in the less dominant language (Punjabi), indicating that proficiency and frequency influence cognitive control. The translation-elicitation task also revealed interference in both blocked and mixed-language blocks. Participants' response times to unrelated words were significantly higher in comparison to double cognates and triple cognates. This phenomenon reinforces the findings of the picture naming task and aligns with prior studies on cross-language activation and cognitive control. Interference was also prominent in the picture-naming task, where control items resulted in greater errors due to cross-linguistic competition. This pattern confirms the involvement of cognitive control in resolving lexical competition.

Collectively, these findings reinforce the claim that trilingual language use involves continuous negotiation among competing resources and that executive control is essential for resolving cross-linguistic interference. These insights align with both the Multilink model's assumptions regarding inhibitory control and translanguaging theory's emphasis on the active, strategic use of multiple languages, as discussed in Chapter 1.

In conclusion, the combined findings from all three experimental tasks support the core premise that trilingual individuals possess a unitary linguistic repertoire characterised by simultaneous activation and moderated by interference and cognitive control. The Multilink model offers a robust explanatory framework for these dynamics, detailing how lexical connections across languages vary in strength according to factors such as proficiency, frequency, and semantic overlap. At the same time, the translanguaging framework offers a socio-cognitive lens to interpret these processes not as errors or deficits, but as evidence of linguistic fluidity, dynamicity, and adaptive communication. Together, these frameworks (as discussed in Chapter 1) offer a robust foundation for understanding the cognitive architecture of trilingual language processing.

5.5 Chapter Summary

This chapter presents a detailed discussion based on the statistical findings obtained through psycholinguistic experimental tasks and an analysis of participants' responses. The findings of the experiments are first presented sequentially for each experiment and then discussed generally to evaluate the study hypothesis. The study's findings supported the basic principles of translanguaging, which posits that all languages of participants are stored in a unitary linguistic repertoire and are simultaneously activated. The linguistic items either facilitate the activation of similar lexical items across various languages or compete for selection. The study exhibited both within- and across-language interference patterns.

Based on the observations made in the three experiments, some tentative recommendations can be made regarding how the conclusions could be applied to foreign language learning and teaching, in addition to the pedagogical and linguistic implications of the study as to the revitalisation and revival of indigenous languages. These recommendations will be offered in the subsequent section in addition to the conclusion of the study.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

The present research aims to examine the nature of the trilingual mental lexicon, the representation of lexical items, and whether there is a unitary repertoire or separate stores for different languages. Secondly, it aims to examine the nature of language processing, specifically whether it is selective or non-selective. Finally, the study examines the facilitation and interference patterns of languages. To achieve these objectives, three psycholinguistic experiments, a picture naming task, a Stroop task, and a translation-elicitation task are employed in addition to a language background questionnaire. The mixed-method research design is used to collect, evaluate, and compute data statistically. The quantitative data on response times are collected through DMDX software, whereas qualitative data are collected through language background questionnaires and analysis of participants' responses. The response times are statistically analysed for the analysis of research hypotheses. The study endeavoured to seek answers to the following research hypotheses.

Primary Hypothesis:

1. There is a unitary linguistic repertoire that includes the linguistic resources from the three languages of the trilinguals.

Secondary Hypotheses:

2. There is simultaneous activation of linguistic systems, creating repertoire in the mental lexicon of speakers.
3. There is competition amongst various linguistic resources for selection, and speakers select the language according to the decision task.
4. There is facilitation/interference among various linguistic resources in the mental lexicon.

The results from the language background questionnaire and all three experiments highlight language interaction patterns in the selected trilingual speakers. The lexical stimuli affected participants' reaction times, accuracy, and error rates. The facilitation and interference patterns for different lexical items offered valuable insights. Compared to the high mean scores on cognates, the lower mean scores on unrelated control words support a unitary linguistic repertoire. The lower latency scores on cognates result from the facilitation effect, as cognates represent similar words or concepts across all languages; thus, their cumulative frequency and lack of competition across other languages result in lower response times. Similarly, in contrast to cognates, unrelated words across all languages cause competition among lexical items; these distinct lexical items are activated simultaneously and compete for selection, resulting in higher response times. In addition, analysis of errors such as translation and language interference also supports the existence of a unitary linguistic repertoire for trilingual participants. The lexical access in trilingual participants follows a holistic semantic approach.

The present study conducted three experiments to examine how trilinguals access and use their lexicons during language comprehension and English production. The study focused on language features such as cognate status, lexical frequency, and participant characteristics, including participants' proficiency levels, to assess the nature and organisation of the mental lexicon. By examining how cognates are processed in a task where only English is used, the study aimed to observe any processing cost effects that might extend beyond the target language due to shared representation across the trilinguals' three languages. Overall, the study shed light on the complex nature of lexical access in trilingual individuals.

Experiment 1 involved a picture-naming task that included cognates from the participants' three languages. The participants responded to 66 pictures. The study was designed to record response time and analyse the accuracy while the participants performed the task. The experiment's findings reflected the facilitation effects of both triple cognate and double cognates (Punjabi-Urdu-English and Urdu-English) on the comprehension and production of all participants. However, double cognates (English-Urdu) showed little difference compared to triple cognates. This lack of difference between the L2 and L3 connections and the abundant use of the Urdu language may be appropriate, as has been reported by participants in the language background questionnaire. Moreover, English language proficiency significantly influenced the naming latencies in the picture-naming task. These findings are consistent with previous studies, as discussed earlier. These findings suggest that the lexical processing of cognates in trilingual participants is complex and influenced by various factors, such as the number of languages involved, the frequency of language use, and the cognate status of lexical items.

Experiment 2 involved a Stroop task in which trilingual participants were shown colour words and instructed to name the ink colour in which the lexical item was written by overlooking the written word. The participants performed the task in all their languages: English, Urdu, and Punjabi. The linguistic stimuli were English, which was kept constant to address both within-language and cross-language facilitation and interference patterns. The analysis of response times exhibited the classic Stroop effect for all languages. However, the size of the Stroop effect was most significant for the English version of the Stroop task. Moreover, the English language proficiency of participants yielded substantial results for the Stroop task in English. It did not exhibit any significant effects for the Stroop task in Urdu and the Stroop task in Punjabi. These findings suggest that trilingual participants may require more significant processing costs to respond to incongruent trials as they faced the challenge of deciding between reading the word or naming the colour. In addition, the higher cost of response latencies was observed for even congruent trials of the Stroop task in Urdu and the Stroop task in Punjabi due to the compatibility of linguistic stimuli and response language. This cost-effect reveals the interference language not demanded by the task.

Experiment 3 involved a translation-elicitation task using a blocked language and mixed language paradigm design. The blocked language task required participants to translate lexical items presented randomly in a sentential context from English to Urdu and vice versa. In contrast, in the mixed language task, English and Urdu sentences were mixed and presented randomly. The experiment's results reinforce the findings of the picture-naming task, thereby establishing that cognates are processed more quickly, whether in isolation or in a sentential context. These findings are consistent with those of earlier studies presented in the literature. These findings suggest that the processing of cognates in trilingual participants is complex and influenced by various factors, such as the cognate status, lexical frequency, and level of English proficiency; the dissimilarity between the writing scripts of languages involved does not influence the lexical processing due to semantic mediation and lack of a bottom-up approach.

Overall, based on the findings of the three experiments, it can be determined that triple cognates, which share similar form and meaning across trilinguals' three languages, facilitate the comprehension and production of tasks even if it is a monolingual task. The facilitation effect is evident in the picture-naming task as triple cognates and double cognates take considerably less time in contrast to unrelated words. However, there was considerable linguistic interference in the other two experiments and control words of the picture-naming task, indicating simultaneous activation of all linguistic resources even in the absence of a similar writing script, which indicates holistic semantic feature and an absence of a bottom-up approach. These findings suggest that the lexical access process in trilingual individuals differs from that of bilinguals. All languages of trilinguals are active in language production and comprehension, leading to a difference in processing cost depending on various factors that facilitate or interfere with the process. However, participants' performance indicates that executive control enables trilingual participants to inhibit non-target languages not required by the task.

The findings of this study support the hypothesis that all languages of trilingual speakers are activated even during monolingual tasks. Furthermore, the results support the non-selective view of lexical access and suggest an asymmetry in the linguistic organisation of trilingual speakers, where the lexical connections are stronger between L1 and L2 and L2 and L3, as compared to L1 and L3. This suggests that trilingual individuals have a unique way of organising their lexicon, which differs from that of bilingual individuals and adheres to a holistic semantic approach. The lexical access does not follow a bottom-up approach. The study sheds light on the complex nature of trilingualism, providing insights into how trilingual individuals process language and access their lexicons in various contexts. In conclusion, the study on language processing in trilingual participants, conducted within the theoretical framework of translanguaging and the multilink model, has provided valuable insights into the cognitive processes involved in trilingual language use.

Through the analysis of language comprehension and production tasks involved, the study has demonstrated that trilingual individuals possess a dynamic repertoire of linguistic resources that they can draw upon to enhance communication and meaning-making. The findings support the concept of translanguaging as a fluid and interconnected language practice, highlighting the importance of recognising and utilising multiple languages within the same individual, particularly depending on their language proficiency. Furthermore, the study has shown that languages are interconnected networks in the minds of trilingual speakers, as suggested by the multilink model. Activation of one language can influence the processing of another, indicating the complex interplay between languages during language tasks. The research findings have implications for language teaching methodologies and interventions for trilingual speakers. By acknowledging and leveraging the translanguaging practices and interconnectedness of languages, educators can create more inclusive and effective learning environments for language acquisition.

The results of this study add to the ongoing debate on lexical access and the trilingual mental lexicon by examining an additional language combination, Punjabi-Urdu-English. The use of three different task genres, including the picture-naming task, the Stroop task, and the translation-elicitation task in a sentential context, provides valuable insights into the lexical processing and organisation of trilingual individuals. It contributes to the understanding of language processing in trilingual contexts and highlights the importance of translanguaging and the multilink model in examining the cognitive mechanisms underlying trilingual language use. Additionally, this study contributes new data to understanding trilingualism in the Pakistani context. However, this study has limitations, and further research is necessary to understand the intricacies of multilingualism fully. Future studies could analyse other indigenous language combinations and employ further diverse experimental paradigms, such as studies focusing on brain activities, to provide an in-depth understanding of how multilingual speakers process and organise their lexicon.

6.1 Implications of the Study

The findings of the current study support unitary linguistic repertoire and non-selective access; these findings have far-reaching pedagogical and linguistic implications. The following subsection of the investigation presents the pedagogical implications of the findings, including how the results can inform language teaching strategies and curriculum development for trilingual individuals. By exploring these areas, research and investigations into the nature of language organisation and access can advance our understanding of how trilingual speakers process and organise their lexicons, contributing to the broader field of multilingualism research and its practical applications.

6.1.1 Implications for Language-in-Education Policy

The findings emphasise the non-selectivity of trilingual processing: students do not compartmentalise their languages but instead draw flexibly from their entire linguistic repertoire. This has clear implications for language policy in Pakistan, where current approaches often prioritise monolingual or bilingual models (Urdu and English) while marginalising indigenous languages. Recognising translanguaging as a natural cognitive process suggests that policies should be more inclusive of indigenous languages, not as ‘deficits’ but as resources for learning. Policy makers could therefore design frameworks that encourage the integration of students’ home languages into educational spaces, thereby aligning policy with actual cognitive practices of learners.

6.1.2 Implications for Curriculum and Pedagogy

This sub-section of the study discusses the implications for curriculum and pedagogy. The findings of the present investigation can inform language teaching strategies and curriculum development for trilingual individuals. For example, teachers could incorporate cognate words into their lessons to facilitate vocabulary acquisition in trilingual students. Additionally, the findings of the study suggest that exposing pupils to multiple languages may be beneficial for enhancing their overall lexical processing abilities by maximising their linguistic resources. By considering the pedagogical implications of the current research, educators can help to optimise language learning and support the linguistic development of trilingual individuals.

The biographical questionnaire used in the present study gathered information about the participants' frequency of using English, which could be of interest to foreign language teachers. The questionnaire revealed that participants used L1 and L3 for the shortest periods of time, which may impact their language processing abilities. Additionally, some students reported exposure to English through various media, including the internet, movies, music, video games, TV, and radio, outside the formal educational system. Their primary purpose of learning and using English was for professional or academic purposes. These findings could be helpful for foreign and second language teachers in designing language-learning activities that incorporate these types of media to enhance students' exposure to the language and improve their overall language proficiency.

The main objective of the present investigation was to examine the lexical organisation and access in trilingual participants, and the findings suggest that cognates occupy a unique representation in their languages. As a result, English language teachers could employ this facility in processing cognates to assist pupils in assimilating into a new language. Alternatively, introducing a new foreign or second language to pupils by introducing already known words, such as cognates, may be a practical technique. By doing so, students can more readily acquire new vocabulary and improve their overall language proficiency. This approach could be beneficial for trilingual individuals who have prior knowledge of languages that share cognates with the target language, as it can help them make connections between different languages and facilitate their language-learning process.

The findings of the present research propose that all of a trilingual individual's linguistic knowledge plays a role in language comprehension and production, even if it is a monolingual task. As a result, when teaching or learning a new language, it is essential to consider the learner's background knowledge of previously known languages and employ it as a facilitator in the language acquisition process. By doing so, teachers can help learners make connections between different languages and leverage their existing linguistic knowledge to improve their overall language proficiency. This approach could benefit trilingual speakers, as they may have prior knowledge of languages that share similarities with the target language, such as cognates and other linguistic patterns or phonological features, which can facilitate their language learning process. Teachers may develop vocabulary-building activities that consciously utilise cognates and cross-linguistic links between Urdu, English, and regional languages to enhance retention and comprehension. They may incorporate translanguaging pedagogies, where students are encouraged to brainstorm, discuss, and write across languages, thereby mirroring their natural cognitive processing strategies. Educators may rethink language classrooms not as monolingual spaces, but as multilingual ecologies, where translanguaging can scaffold learning in English and Urdu while simultaneously sustaining indigenous languages. Overall, by considering the learner's knowledge of previously learned languages and using it as a facilitator in language learning, teachers can optimise language learning and support the linguistic development of trilingual speakers.

6.1.3 Implications for Teacher Education

Teacher training programs in Pakistan often emphasise strict language separation in classrooms. This study demonstrates that such separation does not align with how students actually process language cognitively. The practical integration of translanguaging strategies into teacher education curricula would enable teachers to recognise the cognitive benefits of cross-linguistic activation, utilise students' existing linguistic repertoires to build bridges to academic content, and reduce language anxiety by validating students' natural multilingual practices.

6.1.4 Implications for Higher Education and Academic Research

In higher education, where English dominates as the medium of instruction, students frequently struggle with comprehension and memory load. The results of this study suggest that translanguaging can be leveraged as a cognitive and pedagogical strategy to make complex concepts more accessible. Furthermore, the study contributes to academic research by providing a psycholinguistic evidence base for translanguaging in South Asian multilingual contexts — an area that has been underexplored compared to European and North American contexts.

6.1.5 Linguistic Implications

This section of the study highlights the importance of linguistic inclusivity in a country where regional languages face endangerment. By showing that these languages are not barriers but resources in cognitive processing, the research challenges the marginalisation of regional tongues in formal domains. The implementation and use of indigenous languages have pedagogical significance. The participants would not only utilise their entire repertoire but also maintain their linguistic identity. Consequently, this practice would serve as a revitalising factor for the indigenous languages. It would strengthen the connection between speakers and their language. The participants could strengthen the linguistic connections between their non-native language and their native language. It would save the languages from language desertion, as has been the case with many local and underprivileged languages. The speaker learns new languages for various academic and professional reasons, which is standard practice. However, abandoning its use and replacing it with other non-native languages would endanger indigenous languages. The study supports the simultaneous use of all languages, protecting the local languages from being added to the list of endangered languages.

The language background questionnaire used in the current study gathered information about how frequently and with whom they used their mother tongue (Punjabi). Most participants reported using Punjabi with their grandparents, and this was often for a brief period. The translanguaging practice would allow speakers to incorporate their knowledge of their mother tongue into formal settings alongside Urdu and English. It would benefit them in multiple ways: they could use their linguistic store fully, their linguistic identity would be protected, and the indigenous languages would avoid endangerment as the speakers would continue to use them. This aligns with broader goals of language revitalisation, equity, and cultural sustainability, linking the study to dimensions of identity and social justice in academia and beyond.

6.2 Limitations of the Study

This section of the study discusses the limitations of the research. One limitation of the current research is the unfamiliarity of research participants with the Punjabi writing script, which hindered the implementation of the translation elicitation task in the Punjabi language. Another was the small sample size of participants for all three tasks. The selection criteria for participants included English language proficiency and general knowledge of other languages. The recruitment of undergraduate students limited the availability of a larger pool of participants; participants were often in a hurry to complete their assignments, projects, and other tasks. It took a longer time to collect data from participants.

Comparison of Findings with a Control Group: Another limitation of the study is the lack of control for knowledge of other languages among the control group in all three experiments. Since the study involved only an experimental group of participants who performed the task, controlling for language diversity in the control group would provide more robust results.

6.3 Future Recommendations

This section suggests areas for further investigation based on the findings and limitations of the present study. Future psycholinguistic studies could aim to recruit a more extensive and diverse group of participants to increase the generalizability of the findings in the Pakistani context. Additionally, further research could analyse other factors that may affect lexical access and processing in trilingual individuals, such as the level of language proficiency in different languages of participants, language dominance, and the age of onset of languages.

Future studies could include the recruitment of a control group. The researchers may recruit a control group with similar language backgrounds to the experimental group or control for language diversity through language assessments. This would enable researchers to understand better the impact of tri- or multilingualism on lexical access and processing in trilingual individuals. Future studies could also involve participants from diverse fields and/or with varying age groups to extend the findings of trilingual language processing to larger groups of participants.

Expanding on the suggestion to examine the influence of non-native languages (L2 and L3) on the native language (L1), a cross-language priming experiment could be designed in the participants' L1 to analyse the effects of the two foreign languages on the native language. Additionally, replicating the cross-language priming experiment of the present study in another foreign language (English) could be beneficial to determine if Urdu has the same interference in naming pictures in English.

Furthermore, the present study could be replicated by recruiting participants with other indigenous languages of Pakistan, such as Pashto, Sindhi, Balochi, Saraiki, or other indigenous languages, to evaluate if the exact effects of the foreign language (English) are observed with a typologically closer language to the L1 that is more distant from the L3, in this case, Punjabi. These suggestions offer potential avenues for further research in the field of trilingualism, providing insights into how trilingual individuals process and access their lexicon across different language combinations and contexts. Exploring other language combinations could provide valuable insights into the similarities and differences in lexical processing across various multilingual contexts, particularly the indigenous languages of Pakistan. Future studies could examine language processing by recruiting participants with diverse indigenous linguistic backgrounds to investigate lexical access and retrieval patterns.

In addition, lexical access may be examined using the eye movement technique with different tasks, such as the visual word paradigm, which involves processing written stimuli. Another possibility for the eye movement technique would be to examine the processing of other linguistic categories, rather than cognates, focusing on the activation and interaction of lexical items in comprehending English words that are not cognates. Furthermore, the studies could focus on an auditory word paradigm that involves listening to the stimuli instead of focusing on the visual lexical recognition and production.

The Multilink model has been widely used to account for the nature of the lexical organisation, access, and retrieval of the bilingual, trilingual, and multilingual mental lexicon. The current research examined its theoretical features through psycholinguistic experiments and did not examine the model for computer simulations, as it did not fall within the domain of current research. Future studies may examine computer simulations for the Multilink model and combine the findings with the experimental data from this study.

Neuroimaging studies: Integrating neuroimaging techniques, such as electroencephalography (EEG) or functional magnetic resonance imaging (fMRI), with psycholinguistic experiments could offer a more comprehensive understanding of the neural mechanisms underlying lexical access in multilingual individuals. This would provide insights into the neural networks involved in language processing across multiple languages.

Influence of L2 and L3 on L1: An intriguing suggestion for future research on tri- or multilingual lexical access could involve examining how non-native languages (L2 and

L3) influence the comprehension and production processes of L1. An eye-tracking study on sentence comprehension could be carried out in the participants' strongest language, usually their L1. This investigation could delve into whether the same helpful effects of triple cognates observed in a non-dominant foreign language (like English) also apply to the native language (L1). Such findings would provide compelling evidence either in favour of or against the idea of non-selective lexical access. This would enhance our understanding of how multilingual individuals process and access their lexicons, particularly in relation to their native language, and contribute to the broader field of multilingualism research.

Investigation of different language combinations: The present study involved Punjabi-Urdu-English trilingual participants, as the researcher's mother tongue is also Punjabi, which assisted in the compilation of material for the psycholinguistic tasks. This study did not involve trilingual participants having native languages other than Punjabi. Future studies could involve trilinguals with other indigenous languages of Pakistan.

Examination of additional task genres: Expanding the range of task genres beyond sentence comprehension, narrative production, and eye-tracking study could help uncover further aspects of lexical access and organisation in multilingual individuals. Semantic categorisation, word association, or lexical decision tasks could provide a more comprehensive understanding of how multilingual individuals process and organize their lexicons.

Exploration of individual differences: Examining individual differences, such as language proficiency, language dominance, and language exposure, could shed light on how these factors influence lexical access and processing in trilingual individuals. Examining the effects of these variables on different aspects of the trilingual mental lexicon could provide a more nuanced understanding of the complexities of tri-/multilingualism.

Longitudinal studies: Conducting longitudinal studies that track the development of the trilingual or multilingual mental lexicon over time could provide insights into how multilingual individuals' lexical organisation, access, and retrieval evolve. Comparing the lexicons of individuals at different stages of language learning and proficiency could help uncover the dynamic nature of the tri-/multilingual mental lexicon.

These suggestions offer potential avenues for further research in lexical access and the trilingual mental lexicon. By exploring these areas, researchers can advance understanding of how trilingual speakers process and organise their lexicons, contributing to the broader field of multilingualism research.

This study concludes that trilingual speakers make use of their entire linguistic repertoire even when the task needs them to use only one language. This phenomenon suggests the existence of a unitary repertoire in which all languages are simultaneously activated, and linguistic items across different languages compete for selection. The findings of the investigation suggest that the principles of translanguaging and the Multilink model provide a valuable framework for understanding the complex and dynamic nature of language use in trilingual contexts. By acknowledging the existence of a unitary linguistic repertoire, individuals can tap into their full range of linguistic and cognitive resources to create and comprehend meaning. This approach has the potential to transform communication practices and facilitate more inclusive and equitable interactions across linguistic and cultural boundaries. Overall, this research highlights the importance of embracing linguistic diversity and promoting translanguaging practices to foster more effective communication in multilingual societies.

REFERENCES

Abunuwara, E. (1992). The structure of the trilingual lexicon. *European Journal of Cognitive Psychology, 4*(4), 311-322. https://doi.org/10.1080/09541449208406190

Aitchison, J. (2012). *Words in the mind: An introduction to the mental lexicon* (4th ed.). John Wiley & Sons.

Alam, M. F. (2020). Translanguaging practices in the multilingual classroom: A case study of Pakistani university English language learners. *Global Regional Review*, *3*, 354-363.

Allen, D. B., & Conklin, K. (2013). Cross-linguistic similarity and task demands in Japanese-English bilingual processing. *PLoS One, 8*(8), e72631.https://doi.org/10.1371/journal.pone.0072631

Altarriba, J., & Basnight-Brown, D. M. (2009). An overview of semantic processing in bilinguals: Methods and findings. In A. Pavlenko (Ed.), *The bilingual mental lexicon: Interdisciplinary approaches.* 79–98, Multilingual Matters.

Altenberg, E. P., & Cairns, H. S. (1983). The effects of phonotactic constraints on lexical processing in bilingual and monolingual subjects. *Journal of Verbal Learning and Verbal Behavior*, *22*(2), 174-188. https://doi.org/10.1016/S0022-5371(83)90134-2

Ameel, E., Malt, B. C., Storms, G., & Van Assche, F. (2009). Semantic convergence in the bilingual lexicon. J*ournal of Memory and Language, 60*(2), 270-290. https://doi.org/10.1016/j.jml.2008.10.001

Aparicio, X., & Lavaur, J. M. (2016). Masked translation priming effects in visual word recognition by trilinguals. *Journal of Psycholinguistic Research*, *45*, 1369-1388. https://doi.org/10.1007/s10936-015-9409-8

Atta, A. (2024). Prospective prognostication: An examination of translanguaging in Pakistan's educational landscape through the lens of teachers' and students' perceptions. *Language Teaching Research*, 13621688241259640.

Baker, C. (2001). *Foundations of bilingual education and bilingualism* (3rd ed.). *Bilingual education and bilingualism*. Multilingual Matters.

Balota, D. A., Yap, M. J., Hutchison, K. A., Cortese, M. J., Kessler, B., Loftis, B., Neely, J. H., Nelson, D. L., Simpson, G. B., & Treiman, R. (2007). The English lexicon project. *Behavior Research Methods, 39*(3), 445–459. https://doi.org/10.3758/BF03193014

Bardel, C., & Falk, Y. (2007). The role of the second language in third language acquisition: The case of Germanic syntax. *Second Language Research, 23*(4), 459–484. https://doi.org/10.1177/0267658307080557

Batool, Z., Shahzadi, K., & Malik, S. (2022). Teachers' perceptions towards translanguaging strategy in ESL classroom settings of Pakistani private universities. *Pakistan Journal of Social Research, 4*(3), 423–432.

Beauvillain, C., & Grainger, J. (1987). Accessing interlexical homographs: Some limitations of a language-selective access. *Journal of Memory and Language, 26*(6), 658–672. https://doi.org/10.1016/0749-596X(87)90108-2

Bijeljac-Babic, R., Biardeau, A., & Grainger, J. (1997). Masked orthographic priming in bilingual word recognition. *Memory & Cognition, 25*(4), 447–457. https://doi.org/10.3758/BF03201121

Blackledge, A., & Creese, A. (2017). Translanguaging in mobility. In S. Canagarajah (Ed.), *The Routledge handbook of migration and language* 31–46. Routledge. https://doi.org/10.4324/9781315754512

Bloem, I., & La Heij, W. (2003). Semantic facilitation and semantic interference in word translation: Implications for models of lexical access in language production. *Journal of Memory and Language, 48*(3), 468–488. https://doi.org/10.1016/S0749-596X(02)00503-X

Blommaert, J. (2008). *Grassroots literacy: Writing, identity and voice in Central Africa*. Routledge.

Blumenfeld, H. K., & Marian, V. (2007). Constraints on parallel activation in bilingual spoken language processing: Examining proficiency and lexical status using eye-tracking. *Language and Cognitive Processes, 22*(5), 633–660. https://doi.org/10.1080/01690960601000746

Brysbaert, M., & Duyck, W. (2010). Is it time to leave behind the Revised Hierarchical Model of bilingual language processing after fifteen years of service? *Bilingualism: Language and Cognition, 13*(3), 359–371. https://doi.org/10.1017/S1366728909990344

Brysbaert, M., Van Dyck, G., & Van de Poel, M. (1999). Visual word recognition in bilinguals: Evidence from masked phonological priming. *Journal of Experimental Psychology: Human Perception and Performance, 25*(1), 137–148. https://doi.org/10.1037/0096-1523.25.1.137

Busch, B. (2012). The linguistic repertoire revisited. *Applied Linguistics, 33*(5), 503–523. https://doi.org/10.1093/applin/ams056

Canagarajah, S. (2011). Translanguaging in the classroom: Emerging issues for research and pedagogy. *Applied Linguistics Review, 2*(1), 1–28. https://doi.org/10.1515/9783110239331.1

Caramazza, A., & Brones, I. (1979). Lexical access in bilinguals. *Bulletin of the Psychonomic Society, 13*(4), 212–214. https://doi.org/10.3758/BF03335062

Carvalho, A. M., & Da Silva, A. J. B. (2006). Cross-linguistic influence in third language acquisition: The case of Spanish-English bilinguals' acquisition of Portuguese. *Foreign Language Annals, 39*(2), 185–202. https://doi.org/10.1111/j.1944-9720.2006.tb02261.x

Cenoz, J. (2008). Achievements and challenges in bilingual and multilingual education in the Basque Country. *AILA Review, 21*(1), 13–30. https://doi.org/10.1075/aila.21.03cen

Cenoz, J., Hufeisen, B., & Jessner, U. (2003). Why investigate the multilingual lexicon? In J. Cenoz, B. Hufeisen, & U. Jessner (Eds.), *The multilingual lexicon*. 1–9. Springer. https://doi.org/10.1007/978-0-306-48367-7_1

Chambers, C. G., & Cooke, H. (2009). Lexical competition during second-language listening: Sentence context, but not proficiency, constrains interference from the native lexicon. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35*(4), 1029–1040. https://doi.org/10.1037/a0015901

Christoffels, I. K., De Groot, A. M., & Kroll, J. F. (2006). Memory and language skills in simultaneous interpreters: The role of expertise and language proficiency. *Journal of Memory and Language, 54*(3), 324–345. https://doi.org/10.1016/j.jml.2005.12.004

Clark, H. H., & Tree, J. E. F. (2002). Using *uh* and *um* in spontaneous speaking. *Cognition, 84*(1), 73–111. https://doi.org/10.1016/S0010-0277(02)00017-3

Coderre, E. L., & Van Heuven, W. J. (2013). Modulations of the executive control network by stimulus onset asynchrony in a Stroop task. *BMC Neuroscience, 14*, Article 79. https://doi.org/10.1186/1471-2202-14-79

Conteh, J. (2018). Translanguaging. *ELT Journal, 72*(4), 445–447. https://doi.org/10.1093/elt/ccy034

Cook, M. P. (2006). Visual representations in science education: The influence of prior knowledge and cognitive load theory on instructional design principles. *Science Education, 90*(6), 1073–1091. https://doi.org/10.1002/sce.20164

Cop, U., Dirix, N., Van Assche, E., Drieghe, D., & Duyck, W. (2017). Reading a book in one or two languages? An eye movement study of cognate facilitation in L1 and L2 reading. *Bilingualism: Language and Cognition, 20*(4), 747–769. https://doi.org/10.1017/S1366728916000213

Costa, A., Albareda, B., & Santesteban, M. (2008). Assessing the presence of lexical competition across languages: Evidence from the Stroop task. *Bilingualism: Language and Cognition, 11*(1), 121–131. https://doi.org/10.1017/S1366728907003252

Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(5), 1283–1296. https://doi.org/10.1037/0278-7393.26.5.1283

Costa, A., Miozzo, M., & Caramazza, A. (1999). Lexical selection in bilinguals: Do words in the bilingual's two lexicons compete for selection? *Journal of Memory and Language, 41*(3), 365–397. https://doi.org/10.1006/jmla.1999.2651

Costa, A., Santesteban, M., & Caño, A. (2005). On the facilitatory effects of cognate words in bilingual speech production. *Brain and Language, 94*(1), 94–103. https://doi.org/10.1016/j.bandl.2004.12.002

Creese, A., & Blackledge, A. (2015). Translanguaging and identity in educational settings. *Annual Review of Applied Linguistics, 35,* 20–35. https://doi.org/10.1017/S0267190514000233

Dandurand, F., Grainger, J., & Dufau, S. (2010). Learning location-invariant orthographic representations for printed words. *Connection Science, 22*(1), 25–42. https://doi.org/10.1080/09540090903085768

De Angelis, G., & Selinker, L. (2001). Interlanguage transfer and competing linguistic systems in the multilingual mind. In J. Cenoz, B. Hufeisen, & U. Jessner (Eds.), *Cross-linguistic influence in third language acquisition: Psycholinguistic perspectives.* 42–58. Multilingual Matters. https://doi.org/10.21832/9781853595509-004

De Bot, K. (2004). The multilingual lexicon: Modelling selection and control. International *Journal of Multilingualism, 1*(1), 17–32. https://doi.org/10.1080/14790710408668176

De Groot, A. M. (1992). Determinants of word translation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18*(5), 1001–1018. https://doi.org/10.1037/0278-7393.18.5.1001

De Groot, A. M., & Hoeks, J. C. (1995). The development of bilingual memory: Evidence from word translation by trilinguals. *Language Learning, 45*(4), 683–724. https://doi.org/10.1111/j.1467-1770.1995.tb00458.x

De Groot, A. M., & Nas, G. L. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language*, *30*(1), 90-123. https://doi.org/10.1016/0749-596X(91)90012-9

De Los Reyes, R. A. (2018). Translanguaging in multilingual third grade ESL classrooms in Mindanao, Philippines. *International Journal of Multilingualism, 16*(3), 302–316. https://doi.org/10.1080/14790718.2018.1472268

Dewaele, J. M. (2001). Activation or inhibition? The interaction of L1, L2 and L3 on the language mode continuum. In J. Cenoz, B. Hufeisen, & U. Jessner (Eds.), *Cross-*

linguistic influence in third language acquisition: Psycholinguistic perspectives 42–48. Multilingual Matters.

Dijkstra, T. (2003). Lexical processing in bilinguals and multilinguals: The word selection problem. In: Cenoz, J., Hufeisen, B., Jessner, U. (eds) *The multilingual lexicon*. Springer. https://doi.org/10.1007/978-0-306-48367-7_2

Dijkstra, T. (2007). Task and context effects in bilingual lexical processing. In I. Kecskes & L. Albertazzi (Eds.), *Cognitive aspects of bilingualism.* 213–235. Springer Netherlands. https://doi.org/10.1007/978-1-4020-5935-3_10

Dijkstra, T., Wahl, A., Buytenhuijs, F., Van Halem, N., Al-Jibouri, Z., De Korte, M., & Rekké, S. (2018). Multilink: A computational model for bilingual word recognition and word translation. *Bilingualism: Language and Cognition, 22*(4), 657–679. https://doi.org/10.1017/S1366728918000287

Dijkstra, T., & Rekké, S. (2010). Towards a localist-connectionist model of word translation. *The Mental Lexicon, 5*(3), 401–420. https://doi.org/10.1075/ml.5.3.08dij

Dijkstra, T., & Van Hell, J. G. (2003). Testing the language mode hypothesis using trilinguals. *International Journal of Bilingual Education and Bilingualism, 6*(1), 2–16. https://doi.org/10.1080/13670050308667769

Dijkstra, T., & Van Heuven, W. J. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition, 5*(3), 175–197. https://doi.org/10.1017/S1366728902003012

Dijkstra, T., Grainger, J., & Van Heuven, W. J. (1999). Recognition of cognates and interlingual homographs: The neglected role of phonology. *Journal of Memory and Language, 41*(4), 496–518. https://doi.org/10.1006/jmla.1999.2654

Dijkstra, T., Miwa, K., Brummelhuis, B., Sappelli, M., & Baayen, H. (2010). How cross-language similarity and task demands affect cognate recognition. *Journal of Memory and Language, 62*(3), 284–301. https://doi.org/10.1016/j.jml.2009.12.003

Dijkstra, T., Timmermans, M., & Schriefers, H. (2000). On being blinded by your other language: Effects of task demands on interlingual homograph recognition. *Journal of Memory and Language, 42*(4), 445–464. https://doi.org/10.1006/jmla.1999.2697

Dijkstra, T., Van Heuven, W. J., & Grainger, J. (1998). Simulating cross-language competition with the Bilingual Interactive Activation model. *Psychologica Belgica, 38*(3/4), 177–196. https://doi.org/10.5334/pb.933

Dong, Y., Gui, S., & MacWhinney, B. (2005). Shared and separate meanings in the bilingual mental lexicon. *Bilingualism: Language and Cognition, 8*(3), 221–238. https://doi.org/10.1017/S1366728905002270

Dufau, S., Lété, B., Touzet, C., Glotin, H., Ziegler, J. C., & Grainger, J. (2010). A developmental perspective on visual word recognition: New evidence and a self-organising model. *European Journal of Cognitive Psychology, 22*(5), 669–694. https://doi.org/10.1080/09541440903031230

Dufour, R., & Kroll, J. F. (1995). Matching words to concepts in two languages: A test of the concept mediation model of bilingual representation. *Memory & Cognition, 23*(2), 166–180. https://doi.org/10.3758/BF03197219

Dunabeitia, J. A., Dimitropoulou, M., Uribe-Etxebarria, O., Laka, I., & Carreiras, M. (2010). Electrophysiological correlates of the masked translation priming effect with highly proficient simultaneous bilinguals. *Brain Research, 1359*, 142–154. https://doi.org/10.1016/j.brainres.2010.08.066

Ecke, P. (2001). Lexical retrieval in a third language: Evidence from errors and tip-of-the-tongue states. In J. Cenoz, B. Hufeisen, & U. Jessner (Eds.), *Cross-linguistic influence in third language acquisition: Psycholinguistic perspectives*. 90–114. Multilingual Matters. https://doi.org/10.21832/9781853595509-007

Engelhardt, P. E., Corley, M., Nigg, J. T., & Ferreira, F. (2010). The role of inhibition in the production of disfluencies. *Memory & Cognition, 38*(5), 617–628. https://doi.org/10.3758/MC.38.5.617

Ervin, S. M., & Osgood, C. E. (1954). Second language learning and bilingualism. *Journal of Abnormal and Social Psychology, 49*(4), 139–146. https://doi.org/10.1037/h0059345

Escobar, C. F. (2019). Translanguaging by design in EFL classrooms. *Classroom Discourse, 10*(3–4), 290–305. Routledge. https://doi.org/10.1080/19463014.2019.1628789

Finkbeiner, M., Forster, K. I., Nicol, J., & Nakamura, K. (2004). The role of polysemy in masked semantic and translation priming. *Journal of Memory and Language, 51*(1), 1–22. https://doi.org/10.1016/j.jml.2004.01.004

Fleming, J., & Zegwaard, K. E. (2018). Methodologies, methods and ethical considerations for conducting research in work-integrated learning. *International Journal of Work-Integrated Learning, 19*(3), 205–213.

Forster, K. I., & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments, & Computers, 35*(1), 116–124. https://doi.org/10.3758/BF03195503

Fox, E. (1996). Cross-language priming from ignored words: Evidence for a common representational system in bilinguals. *Journal of Memory and Language, 35*(3), 353–370. https://doi.org/10.1006/jmla.1996.0020

Francis, W. S., & Gallard, S. L. (2005). Concept mediation in trilingual translation: Evidence from response time and repetition priming patterns. *Psychonomic Bulletin & Review, 12*(6), 1082–1088. https://doi.org/10.3758/BF03206447

Garcia, O. (2009). Education, multilingualism and translanguaging in the 21st century. In *Social justice through multilingual education.* 140–158. Multilingual Matters. https://doi.org/10.21832/9781847691910-011

García, O. (2019). Translanguaging: A coda to the code? *Classroom Discourse, 10*(3–4), 369–373. https://doi.org/10.1080/19463014.2019.1638277

García, O., & Lin, A. M. (2016). Translanguaging in bilingual education. In *Bilingual and multilingual education*, 117-130. Springer. https://doi.org/10.1007/978-3-319-02258-1_9

García, O., & Otheguy, R. (2020). Plurilingualism and translanguaging: Commonalities and divergences. *International Journal of Bilingual Education and Bilingualism*, *23*(1), 17-35. https://doi.org/10.1080/13670050.2019.1598932

García, O., & Wei, L. (2014). Translanguaging and education. In *Translanguaging: Language, bilingualism and education*. 63-77, Palgrave Macmillan.

García, O., Makar, C., Starcevic, M., & Terry, A. (2011). The translanguaging of Latino kindergarteners. In K. Potowski & J. Rothman (Eds.), *Bilingual youth: Spanish in English-speaking societies, 42*, 33-55. https://doi.org/10.1075/sibil.42.05gar

Gass, M. S., & Selinker, L. (2008). *Second language acquisition: An introductory course.* (3rd ed.). Taylor & Francis Group.

Geffen, A. V. (2019). *Reducing noise from competing neighbours: Word retrieval with lateral inhibition in Multilink* (Master's thesis, Radboud University). Radboud University Repository. https://theses.ubn.ru.nl/handle/123456789/xxxx

Gerard, L. D., & Scarborough, D. L. (1989). Language-specific lexical access of homographs by bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*(2), 305. https://doi.org/10.1037/0278-7393.15.2.305

Gill, A. (2013). *A phenomenological study of multilingual memory and lexical access* (Doctoral dissertation, National University of Modern Languages, Islamabad). Pakistan Scientific and Technological Information Centre Repository. https://repository.pastic.gov.pk

Goertz, R. (2018). *A boat in a boot: Cognate effects during interlingual homograph translation* (Master's thesis, Radboud University Nijmegen). Radboud University Repository.

Gollan, T. H., Montoya, R. I., Cera, C., & Sandoval, T. C. (2008). More use almost always means a smaller frequency effect: Aging, bilingualism, and the weaker links hypothesis. *Journal of Memory and Language, 58*(3), 787-814. https://doi.org/10.1016/j.jml.2007.07.001

Grainger, J., & Dijkstra, T. (1992). On the representation and use of language information in bilinguals. *Advances in Psychology, 83*, 207-220. https://doi.org/10.1016/S0166-4115(08)61496-X

Grainger, J., Midgley, K., & Holcomb, P. J. (2010). Re-thinking the bilingual interactive-activation model from a developmental perspective (BIA-d). *Language Acquisition across Linguistic and Cognitive Systems, 52*, 267-283. https://doi.org/10.1075/lald.52.18gra

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. Bilingualism: *Language and Cognition, 1*(2), 67-81. https://doi.org/10.1017/S1366728998000133

Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology, 25*(5), 515-530. https://doi.org/10.1080/20445911.2013.796377

Grosjean, F. (1998). Transfer and language mode. Bilingualism: *Language and Cognition, 1*(3), 175-176. https://doi.org/10.1017/S1366728998000285

Gullifer, J. W., Kroll, J. F., & Dussias, P. E. (2013). When language switching has no apparent cost: Lexical access in sentence context. *Frontiers in Psychology*, 4, 278. https://doi.org/10.3389/fpsyg.2013.00278

Gumperz, J. J. (1964). Linguistic and social interaction in two communities. *American Anthropologist*, *66*(6), 137-153. https://doi.org/10.1525/AA.1964.66.SUPPL_3.02A00100

Gynne, A. (2016). *Languaging and social positioning in multilingual school practices: Studies of Sweden Finnish middle school years* (Doctoral dissertation, Mälardalen University). 2016•diva-portal.org

Hammarberg, B. (2001). Roles of L1 and L2 in L3 production and acquisition. In J. Cenoz, B. Hufeisen, & U. Jessner (Eds.), *Cross-linguistic influence in third language acquisition: Psycholinguistic perspectives.* 21–41. Multilingual Matters.

Hayes, A. F. (2018). Partial, conditional, and moderated moderated mediation: Quantification, inference, and interpretation. *Communication Monographs, 85*(1), 4–40. https://doi.org/10.1080/03637751.2017.1352100

Herdina, P., & Jessner, U. (2002). *A Dynamic Model of Multilingualism: Perspectives of change in psycholinguistics.* Multilingual Matters. https://doi.org/10.21832/9781853595547.

Heredia, R. R. (1995). *Concreteness effects in high-frequency words: A test of the revised hierarchical and the mixed models of bilingual memory representations* (Doctoral dissertation, University of California, Santa Cruz).

Heredia, R. R. (1996). Bilingual memory and hierarchical models: A case for language dominance. *Current Directions in Psychological Science*, *6*(2), 34-39. https://doi.org/10.1111/1467-8721.ep11512617

Hermans, D. (2004). Between-language identity effects in picture-word interference tasks: A challenge for language-nonspecific or language-specific models of lexical access? *International Journal of Bilingualism,* *8*(2), 115–125. https://doi.org/10.1177/13670069040080020201

Herwig, A. (2001). Plurilingual lexical organisation: Evidence from lexical processing in L1–L2–L3–L4 translation. In J. Cenoz, B. Hufeisen, & U. Jessner (Eds.), *Cross-linguistic influence in third language acquisition: Psycholinguistic perspectives*. 115–137. Multilingual Matters. https://doi.org/10.21832/9781853595509-008

Hornberger, N. H., & Link, H. (2012). Translanguaging in today's classrooms: A biliteracy lens. *Theory into Practice,* *51*(4), 239–247. https://doi.org/10.1080/13670050.2012.658016

Hoshino, N., & Kroll, J. F. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition,* *106*(1), 501-511. https://doi.org/10.1016/j.cognition.2007.02.001

Hoshino, N., Beatty-Martínez, A. L., Navarro-Torres, C. A., & Kroll, J. F. (2021). Do cross-language script differences enable bilinguals to function selectively when speaking in one language alone?. *Frontiers in Communication, 6*, 668381. https://doi.org/10.3389/fcomm.2021.668381

Hussain, S., & Khan, H. K. (2021). Translanguaging in Pakistani higher education: a neglected perspective!. *Journal of Educational Research and Social Sciences Review*, *1*(3), 16-24.

Hu, Z., & Zhang, H. (2023). Non-selective language activation in L2 lexical inference and text comprehension: Comparing skilled and less-skilled readers. *Heliyon, 9*(1), e12818. https://doi.org/10.1016/j.heliyon.2023.e12818

Ivanova, I., & Costa, A. (2008). Does bilingualism hamper lexical access in speech production? *Acta Psychologica,* *127*(2), 277–288. https://doi.org/10.1016/j.actpsy.2007.06.003

Jared, D., & Kroll, J. F. (2001). Do bilinguals activate phonological representations in one or both of their languages when naming words?. *Journal of Memory and Language, 44*(1), 2-31. https://doi.org/10.1006/jmla.2000.2747

Jared, D., & Szucs, C. (2002). Phonological activation in bilinguals: Evidence from interlingual homograph naming. *Bilingualism: Language and Cognition, 5*(3), 225-239. https://doi.org/10.1017/S1366728902003024

Jessner, U. (2006). *Linguistic awareness in multilinguals: English as a third language*. Edinburgh University Press. https://doi.org/10.1515/9780748626540

Jonsson, C. (2012). the Translanguaging as pedagogy for language learning in a bilingual school. *NALDIC Quarterly. 10* (1). 20-24.

Jorgensen, J. N. (2008). Polylingual languaging around and among children and adolescents. *International Journal of Multilingualism, 5(3), 161-76.* https://doi.org/10.1080/14790710802387562

Kaushanskaya, M., & Marian, V. (2007). Bilingual language processing and interference in bilinguals: Evidence from eye tracking and picture naming. *Language Learning*, *57*(1), 119-163. https://doi.org/10.1111/j.1467-9922.2007.00401.x

Kerkhofs, R., Dijkstra, T., Chwilla, D. J., & De Bruijn, E. R. (2006). Testing a model for bilingual semantic priming with interlingual homographs: RT and N400 effects. *Brain Research*, *1068*(1), 170-183. https://doi.org/10.1016/j.brainres.2005.10.087

Khan, Q. H. (2012). *Lexical representation and processing in cross-script Urdu-English bilinguals: The case of frequency-balanced and frequency-unbalanced cognates and noncognates*. (Doctoral dissertation, University of Windsor). https:// scholar.uwindsor.ca

Khan, S.M. (2019). *Punjabi Urdu dictionary,* (2nd ed.).. Punjabi Adbi board.

Kim, J., & Davis, C. (2003). Task effects in masked cross-script translation and phonological priming. *Journal of Memory and Language*, 49(4), 484-499. https://doi.org/10.1016/S0749-596X(03)00093-7

Kirsner, K., Brown, H. L., Abrol, S., Chadha, N. K., & Sharma, N. K. (1980). Bilingualism and lexical representation. *The Quarterly Journal of Experimental Psychology*, *32*(4), 585-594. https://doi.org/10.1080/14640748008401847

Kohnert, K. (2004). Cognitive and cognate-based treatments for bilingual aphasia: A case study. *Brain and Language*, *91*(3), 294-302. https://doi.org/10.1016/j.bandl.2004.04.001

Kolers, P. A. (1963). Interlingual word associations. *Journal of Verbal Learning and Verbal Behavior*, *2*(4), 291-300. https://doi.org/10.1016/S0022-5371(63)80097-3

Kolers, P. A. (1966). Reading and talking bilingually. *The American Journal of Psychology*, *79*(3), 357-376. https://doi.org/10.2307/1420877

Kootstra, G. J., Dijkstra, T., & Van Hell, J. G. (2020). Interactive alignment and lexical triggering of code-switching in bilingual dialogue. *Frontiers in Psychology*, *11*, 1747. https://doi.org/10.3389/fpsyg.2020.01747

Kress, G. (2015). Semiotic work: Applied linguistics and a social semiotic account of multimodality. *AILA Review, 28*(1), 49–71. https://doi.org/10.1075/aila.28.03kre

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations.

Journal of Memory and Language, 33(2), 149-174. https://doi.org/10.1006/jmla.1994.1008

Kroll, J. F., and Curley, J. (1988). Lexical memory in novice bilinguals: The role of concepts in retrieving second language words. In M. Gruneberg, P. Morris, & R. Sykes (Eds.), *Practical aspects of memory, Vol. 2*. 389-395. John Wiley & Sons.

Kroll, J. F., Sumutka, B. M., & Schwartz, A. I. (2005). A cognitive view of the bilingual lexicon: Reading and speaking words in two languages. *International Journal of Bilingualism, 9*(1), 27-48. https://doi.org/10.1177/13670069050090010301

La Heij, W. (2005). Selection Processes in Monolingual and Bilingual Lexical Access. In J. F. Kroll & A. M. B. de Groot (Eds.), Handbook of bilingualism: Psycholinguistic approaches, 289–307. Oxford University Press.

La Heij, W., Heikoop, K. W., Akerboom, S., & Bloem, I. (2003). Picture naming in picture context: Semantic interference or semantic facilitation?. *Psychology Science*, *45*(1), 49-62. ISSN 1614-9947.

Lagrou, E., Hartsuiker, R. J., & Duyck, W. (2011). Knowledge of a second language influences auditory word recognition in the native language. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37*(4), 952. https://doi.org/10.1037/a0023217

Lagrou, E., Hartsuiker, R. J., & Duyck, W. (2015). Do semantic sentence constraint and L2 proficiency influence language selectivity of lexical access in native language listening?. *Journal of Experimental Psychology: Human Perception and Performance, 41*(6), 1524. https://doi.org/10.1037/a0039782

Lange, R. T. (2011). Inter-rater reliability. In J. S. Kreutzer, J. DeLuca, & B. Caplan (Eds.), *Encyclopedia of clinical neuropsychology* (p. 1348). Springer. https://doi.org/10.1007/978-0-387-79948-3_1203

Larry, B., Christensen, J., Burke, R., & Turner, L. A. (2024). *Research methods, design, and analysis* (Global ed.). Pearson Education.

Lemhofer, K., & Broersma, M. (2012). Introducing LexTALE: A quick and valid lexical test for advanced learners of English. *Behavior Research Methods, 44*(2), 325-343. https://doi.org/10.3758/s13428-011-0146-0.

Lemhofer, K., Dijkstra, T., & Michel, M. C. (2004). Three languages, one ECHO: Cognate effects in trilingual word recognition. *Language and Cognitive Processes, 19*(5), 585–611. https://doi.org/10.1080/01690960444000007

Lemhofer, K., Dijkstra, T., Schriefers, H., Baayen, R. H., Grainger, J., & Zwitserlood, P. (2008). Native language influences on word recognition in a second language: a megastudy. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(1), 12. https://doi.org/10.1037/0278-7393.34.1.12.

Leung, Y. (2005). Biliterate and Trilingual: Actions in response to the economic restructuring of Hong Kong. *Bulletin Suisse de Linguistique Appliquée, 82*, 167-179.

Levelt, W. J. M. 1989. *Speaking. From intention to articulation*. MIT Press.

Lewis, G., Jones, B., & Baker, C. (2012). Translanguaging: Developing its conceptualisation and contextualisation. *Educational Research and Evaluation, 18*(7), 655-670. https://doi.org/10.1080/13803611.2012.718490

Lewy, N., & Grosjean, F. (1997). A computational model of bilingual lexical access [Manuscript in preparation]. University of Neuchâtel.

Li, C., & Gollan, T. H. (2018). Cognates interfere with language selection but enhance monitoring in connected speech. *Memory & Cognition*, *46*(6), 923-939. https://doi.org/10.3758/s13421-018-0812-x

Li, C., & Gollan, T. H. (2021). What cognates reveal about default language selection in bilingual sentence production. *Journal of Memory and Language, 118*, 104214. https://doi.org/10.1016/j.jml.2020.104214

Li, L., Abutalebi, J., Zou, L., Yan, X., Liu, L., Feng, X., ... & Ding, G. (2015). Bilingualism alters brain functional connectivity between “control” regions and “language” regions: Evidence from bimodal bilinguals. *Neuropsychologia*, *71*, 236-247. https://doi.org/10.1016/j.neuropsychologia.2015.04.007

Li, P., Zhang, F., Yu, A., & Zhao, X. (2020). Language history questionnaire (LHQ3): An enhanced tool for assessing multilingual experience. *Bilingualism: Language and Cognition*, *23*(5), 938-944. https://doi.org/10.1017/S1366728918001153

Libben, M. R., & Titone, D. A. (2009). Bilingual lexical access in context: evidence from eye movements during reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35*(2), 381-390. https://doi.org/10.1037/a0014875

Lijewska, A., & Chmiel, A. (2015). Cognate facilitation in sentence context–translation production by interpreting trainees and non-interpreting trilinguals. *International Journal of Multilingualism, 12*(3), 358-375. https://doi.org/10.1080/14790718.2014.959961

Lin, A. M. (2019). Theories of trans/languaging and trans-semiotizing: Implications for content-based education classrooms. *International Journal of Bilingual Education and Bilingualism, 22*(1), 5-16. https://doi.org/10.1080/13670050.2018.1515175

Lormans, E. H. (2012). *Multilink: A computational model for word translation*. (MA thesis, Radboud University Nijmegen) Lormans_E_MA_Thesis_2012.pdf

Macnamara, J. (1967). The linguistic independence of bilinguals. *Journal of Verbal Learning and Verbal Behavior, 6*(5), 729-736. https://doi.org/10.1016/S0022-5371(67)80078-1

Macnamara, J., & Kushnir, S. L. (1971). Linguistic independence of bilinguals: The input switch. *Journal of Verbal Learning and Verbal Behavior, 10*(5), 480-487. https://doi.org/10.1016/S0022-5371(71)80018-X

MacSwan, J. (2017). A multilingual perspective on translanguaging. *American Educational Research Journal*, *54*(1), 167-201. https://doi.org/10.3102/0002831216683935

MacWhinney, B., Kroll, J. F., & De Groot, A. M. B. (2005). A unified model of language acquisition. In Kroll, J.F., and De. Groot, A.M.B., (Eds) *Handbook of bilingualism: Psycholinguistic approaches*, *4967*, 50-70. http://repository.cmu.edu/psychology

Maghsudi, M. (2007). Learning English as third language--A comparative study between Iranian and Indian bilinguals. *Language in India*, *7*(6). ISSN 1930-2940

Mägiste, E. (1985). Development of intra-and interlingual interference in bilinguals. *Journal of Psycholinguistic Research, 14*(2), 137-154. https://doi.org/10.1007/BF01067626

Mahmood, F., Batool, Z., Iqbal, M. J., & Hameed, M. (2024). A description of the effects of translanguaging on English pronunciation of undergrads. *Journal of Applied Linguistics and TESOL (JALT)*, *7*(4), 1628-1642.

Marian, V., & Spivey, M. (2003). Competing activation in bilingual language processing: Within-and between-language competition. *Bilingualism: Language and Cognition*, *6*(2), 97-115. https://doi.org/10.1017/S1366728903001068

Marian, V., Blumenfeld, H. K., Mizrahi, E., Kania, U., & Cordes, A. K. (2013). Multilingual Stroop performance: Effects of trilingualism and proficiency on inhibitory control. *International Journal of Multilingualism, 10*(1), 82-104. https://doi.org/10.1080/14790718.2012.708037

McClelland, J. L., & Rumelhart, D. E. (1981). An interactive activation model of context effects in letter perception: I. An account of basic findings. *Psychological Review, 88*(5), 375. https://doi.org/10.1037/0033-295X.88.5.375

McPhedran, M. J., & Lupker, S. J. (2021). L2-L1 noncognate masked translation priming as a task-specific phenomenon. *Bilingualism: Language and Cognition*, *24*(3), 507-523. https://doi.org/10.1017/S1366728920000504

Mehlhorn, G. (2007). From Russian to Polish: Positive transfer in third language acquisition. In *16th International congress of phonetic sciences, Saarbrucken* ,17451748, 1745-1748. www.icphs2007.de/conference/Papers/1709/1709.pdf

Meuter, R. F. I. (2005). Language selection in bilinguals. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches*. 349–370. Oxford University Press.

Mishra, R. K. (2019). A few suggestions on broadening the cross-linguistic relevance of the Multilink model. *Bilingualism: Language and Cognition, 22*(4), 691-692. https://doi.org/10.1017/S1366728918000834

Mishra, R. K., & Singh, N. (2013). Language non-selective activation of orthography during spoken word processing in Hindi–English sequential bilinguals: An eye-tracking visual world study. *Reading and Writing: An Interdisciplinary Journal, 27*(1), 129-151. https://doi.org/10.1007/s11145-013-9436-5

Mulder, K., Van Heuven, W. J., & Dijkstra, T. (2018). Revisiting the neighborhood: How L2 proficiency and neighborhood manipulation affect bilingual processing. *Frontiers in Psychology, 9*, 264802. https://doi.org/10.3389/fpsyg.2018.01860

Mushtaq, M. (2023). Translanguaging as a pedagogical tool: opportunities and challenges in higher education of Pakistan. *UCP Journal of Languages & Literature, 1*(1), 1-30.

Otheguy, R., García, O., & Reid, W. (2015). Clarifying translanguaging and deconstructing named languages: A perspective from linguistics. *Applied Linguistics Review*, *6*(3), 281-307. https://doi.org/10.1515/applirev-2015-0014

Otsuji, E., & Pennycook, A. (2010). Metrolingualism: Fixity, fluidity, and language in flux. *International Journal of Multilingualism*, *7*(3), 240-254. https://doi.org/10.1080/14790710903414331

Panezai, A., Channa, L. A., & Bibi, B. (2023). Translanguaging in higher education: exploring interactional spaces for meaning-making in the multilingual universities of Pakistan. *International Journal of Bilingual Education and Bilingualism*, *26*(4), 514-527.

Pavlenko, A. (2009). Conceptual representation in the bilingual lexicon and second language vocabulary learning. In A. Pavlenko (Ed.), *The bilingual mental lexicon: Interdisciplinary approaches*. 125–160. Multilingual Matters. https://doi.org/10.21832/9781847691262-008

Peacock, J. L. (2015). *Modeling lexical effects with Multilink: Frequency, cognate status, and translation asymmetry*. (MA thesis in Linguistics, Radboud University Nijmegen) theses.ubn.ru.nl

Peeters, D., Dijkstra, T., & Grainger, J. (2013). The representation and processing of identical cognates by late bilinguals: RT and ERP effects. *Journal of Memory and Language*, *68*(4), 315-332. https://doi.org/10.1016/j.jml.2012.12.003

Pennycook, A., & Otsuji, E. (2014). Metrolingual multitasking and spatial repertoires: 'Pizza mo two minutes coming'. *Journal of Sociolinguistics*, *18*(2), 161-184. https://doi.org/10.1111/josl.12079

Perea, M., Dunabeitia, J. A., & Carreiras, M. (2008). Masked associative/semantic priming effects across languages with highly proficient bilinguals. *Journal of Memory and Language, 58*(4), 916-930. https://doi.org/10.1016/j.jml.2008.01.003

Poarch, G. J., & Van Hell, J. G. (2014). Cross-language activation in same-script and different-script trilinguals. *International Journal of Bilingualism, 18*(6), 693-716. https://doi.org/10.1177/1367006912472262

Poort, E. D., & Rodd, J. M. (2017). The cognate facilitation effect in bilingual lexical decision is influenced by stimulus list composition. *Acta Psychologica, 180*, 52-63. https://doi.org/10.1016/j.actpsy.2017.08.008

Potter, M. C., So, K. F., Von Eckardt, B., & Feldman, L. B. (1984). Lexical and conceptual representation in beginning and proficient bilinguals. *Journal of Verbal Learning and Verbal Behavior*, *23*(1), 23-38. https://doi.org/10.1016/S0022-5371(84)90489-4

Prada, J. (2019). Exploring the role of translanguaging in linguistic ideological and attitudinal reconfigurations in the Spanish classroom for heritage speakers. *Classroom Discourse, 10*(3-4), 306-322. https://doi.org/10.1080/19463014.2019.1628793

Rahman, T. (2006). Language policy, multilingualism and language vitality in Pakistan. In A. Saxena & L. Borin (Eds.), *Lesser-known languages of South Asia: Status and policies, case studies and applications of information technology*. 73–106. De Gruyter Mouton. https://doi.org/10.1515/9783110197785.1.73

Rampton, B. (1995). Language crossing and the problematisation of ethnicity and socialisation. *Pragmatics. Quarterly Publication of the International Pragmatics Association (IPrA)*, *5*(4), 485-513. https://doi.org/10.1075/prag.5.4.04ram

Regier, T., Kay, P., & Cook, R. S. (2005). Focal colors are universal after all. *Proceedings of the National Academy of Sciences*, *102*(23), 8386-8391. https://doi.org/10.1073/pnas.0503281102

Rodriguez-Fornells, A., Rotte, M., Heinze, H. J., Nösselt, T., & Münte, T. F. (2002). Brain potential and functional MRI evidence for how to handle two languages with one brain. *Nature, 415*(6875), 1026-1029. 10.1038/4151026a

Ross, A., & Willson, V. L. (2017). *Basic and advanced statistical tests*. Sense Publishers. https://doi.org/10.1007/978-94-6351-086-8

Rymes, B. (2014). Marking communicative repertoire through metacommentary. In A. Blackledge & A. Creese (Eds.), *Heteroglossia as practice and pedagogy*. 301–316. Springer. https://doi.org/10.1007/978-94-007-7856-6_16

Saleem, T., Latif, S., Khan, A. A., Javaid, M., & Khan, B. S. A. (2023). Bridging linguistic divides in higher education: An exploration of translanguaging practices in Pakistan. *Ampersand*, *11*, 100160.

Salvia, J. S., Ysseldyke, J. E., & Bolt, S. (2010). *Assessment in special and inclusive education* (10th ed.). Wadsworth.

Scarborough, D. L., Gerard, L., & Cortese, C. (1984). Independence of lexical access in bilingual word recognition. *Journal of Verbal Learning and Verbal Behavior*, *23*(1), 84-99. https://doi.org/10.1016/S0022-5371(84)90519-X

Schimpff, A. (2021). *Cognate effects in intra-sentential codeswitching in trilinguals-evidence from a read-aloud task*. (MA Thesis, Lund University). lup.lub.lu.se

Schwartz, A. I., & Kroll, J. F. (2006). Bilingual lexical activation in sentence context. *Journal of Memory and Language, 55*(2), 197-212. https://doi.org/10.1016/j.jml.2006.03.004

Shah, M., Pillai, S., & Sinayah, M. (2019). Translanguaging in an academic setting. *Lingua*, *225*, 16-31.

Sherkina, M. (2003). The cognate facilitation effect in bilingual speech processing. *Toronto Working Papers in Linguistics, 21*, 167–178. https://twpl.library.utoronto.ca/index.php/twpl/article/view/6227

Shook, A., Goldrick, M., Engstler, C., & Marian, V. (2015). Bilinguals show weaker lexical access during spoken sentence comprehension. *Journal of Psycholinguistic Research*, *44*(6), 789-802. https://doi.org/10.1007/s10936-014-9322-6

Starreveld, P. A., De Groot, A. M., Rossmark, B. M., & Van Hell, J. G. (2014). Parallel language activation during word processing in bilinguals: Evidence from word production in sentence context. *Bilingualism: Language and Cognition, 17*(2), 258-276. https://doi.org/10.1017/S1366728913000308

Sunderman, G., & Kroll, J. F. (2006). First language activation during second language lexical processing: An investigation of lexical form, meaning, and grammatical class. *Studies in Second Language Acquisition, 28*(3), 387-422. https://doi.org/10.1017/S0272263106060177

Szubko-Sitarek, W. (2011). Cognate facilitation effects in trilingual word recognition. *Studies in second language learning and teaching, 1*(2), 189-208. https://doi.org/10.14746/ssllt.2011.1.2.2

Szubko-Sitarek, W., & Szubko-Sitarek, W. (2015). Exploring the cognate facilitation effect in multilingual word recognition. In *Multilingual lexical recognition in the mental lexicon of third language users,* 129-167. Springer.

Taylor, I. (1976). Similarity between French and English words—a factor to be considered in bilingual language behavior?. *Journal of Psycholinguistic Research*, *5*, 85-94. https://doi.org/10.1007/BF01067950

Titone, D., Libben, M., Mercier, J., Whitford, V., & Pivneva, I. (2011). Bilingual lexical access during L1 sentence reading: The effects of L2 knowledge, semantic constraint, and L1–L2 intermixing. *Journal of Experimental Psychology:*

Learning, Memory, and Cognition, 37(6), 1412.–1431. https://doi.org/10.1037/a0024492

Toassi, P. F. P. (2016). *Investigating lexical access in multilinguals: A study on the processing of English as L3* (Doctoral dissertation). Universidade Federal de Santa Catarina.

Tomaz, Â., Oliveira, H. M., Soares, A. P., Casalis, S., & Comesaña, M. (2023). The representation and processing of synonyms and translations: A masked priming study with European Portuguese–English bilinguals. *International Journal of Bilingualism, 27*(4), 550–570. https://doi.org/10.1177/13670069231164257

Torpsten, A. C. (2018). Translanguaging in a Swedish multilingual classroom. *Multicultural Perspectives, 20*(2), 104-110. https://doi.org/10.1080/15210960.2018.1447100

Tulving, E., & Colotla, V. A. (1970). Free recall of trilingual lists. *Cognitive Psychology, 1*(1), 86-98. https://doi.org/10.1016/0010-0285(70)90006-X

Tytus, A. E. (2018). Active and dormant languages in the multilingual mental lexicon. *International Journal of Multilingualism, 16*(3), 357-374. https://doi.org/10.1080/14790718.2018.1502295

Van Assche, E., Duyck, W., & Brysbaert, M. (2013). Verb processing by bilinguals in sentence contexts: The effect of cognate status and verb tense. *Studies in Second Language Acquisition, 35*(2), 237-259. https://doi.org/10.1017/S0272263112000873

Van Hell, J. G., & De Groot, A. M. (2008). Sentence context modulates visual word recognition and translation in bilinguals. *Acta Psychologica*, *128*(3), 431-451. https://doi.org/10.1016/j.actpsy.2008.03.010

Van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Psychonomic Bulletin & Review, 9*(4), 780-789. https://doi.org/10.3758/BF03196335

Van Heuven, W. J. B., & Dijkstra, T. (2001). The semantic, orthographic and phonological interactive activation (SOPHIA) model. In *XII ESCOP Conference. Edinburgh.*

Van Heuven, W. J., & Wen, Y. (2019). The need for a universal computational model of bilingual word recognition and word translation. *Bilingualism: Language and Cognition, 22*(4), 695-696. https://doi.org/10.1017/S1366728918000688

Van Heuven, W. J., Conklin, K., Coderre, E. L., Guo, T., & Dijkstra, T. (2011). The influence of cross-language similarity on within-and between-language Stroop effects in trilinguals. *Frontiers in Psychology, 2,* 374. https://doi.org/10.3389/fpsyg.2011.00374

Vanlangendonck, F., Peeters, D., Rueschemeyer, S. A., & Dijkstra, T. (2020). Mixing the stimulus list in bilingual lexical decision turns cognate facilitation effects into mirrored inhibition effects. *Bilingualism: Language and Cognition, 23*(4), 836-844. https://doi.org/10.1017/S1366728919000531

Velasco, P., & García, O. (2014). Translanguaging and the writing of bilingual learners. *Bilingual Research Journal, 37*(1), 6-23. https://doi.org/10.1080/15235882.2014.893270

Voga, M., & Grainger, J. (2007). Cognate status and cross-script translation priming. *Memory & Cognition, 35*, 938-952. https://doi.org/10.3758/BF03193467

Vogel, S., & García, O. (2017). Translanguaging. In O. García, N. Flores, & M. Spotti (Eds.), *The Oxford research encyclopedia of education*. Oxford University Press. https://doi.org/10.1093/acrefore/9780190264093.013.181

Walliman, N. (2021). *Research methods: The basics*. Routledge. ISBN 9781032524610

Warren, P. (2013). *Introducing psycholinguistics*. Cambridge University Press. ISBN. 9780511978531. https://doi.org/10.1017/CBO9780511978531

Wei, L. (2003). Activation of lemmas in the multilingual mental lexicon and transfer in third language learning. In: Cenoz, J., Hufeisen, B., Jessner, U. (Eds) *The multilingual lexicon*. Springer, Dordrecht. https://doi.org/10.1007/978-0-306-48367-7_5

Wei, L. (2013). Conceptual and methodological issues in bilingualism and multilingualism research. *International Journal of Bilingualism*, *17*(1), 5–15.

Wei, L. (2018). Translanguaging as a practical theory of language. *Applied Linguistics, 39*(1), 9-30. https://doi.org/10.1093/applin/amx039

Wei, L., & Lin, A. M. (2019). Translanguaging classroom discourse: Pushing limits, breaking boundaries. *Classroom Discourse*, *10*(3-4), 209-215. DOI: 10.1080/19463014.2019.1635032

Wei, T., & Schnur, T. T. (2016). Long-term interference at the semantic level: Evidence from blocked-cyclic picture matching. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 42*(1), 149–157. https://doi.org/10.1037/xlm0000164

Weinreich, U. (1953). *Languages in contact: Findings and problems*. Linguistic Circle of New York.

Woumans, E., Clauws, R., & Duyck, W. (2021). Hands down: Cognate effects persist during written word production. *Frontiers in Psychology, 12, 647362*. https://doi.org/10.3389/fpsyg.2021.647362

Wu, Y. J., & Thierry, G. (2010). Chinese-English bilinguals reading English hear Chinese. *Journal of Neuroscience, 30*(22), 7646-7651. https://doi.org/10.1523/JNEUROSCI.1602-10.2010

Yuvayapan, F. (2019). Translanguaging in EFL classrooms: Teachers' perceptions and practices. *Journal of Language and Linguistic Studies, 15*(2), 678-694. https://doi.org/10.17263/jlls.586811

APPENDICES

Appendix-1
Language Background Questionnaire

Department: ____________________

2. First Language (L1): ____________________

3. Name the Languages you can proficiently use:

3. Language spoken at home: ____________________

4. Language spoken with friends in university: ____________________

5. Language spoken with fiends in neibourhood:____________________

6. Language spoken in class: ____________________

7. Language proficiency:

Language	1-10
Punjabi	
Urdu	
English	
other language	

Specify other language: _________________

8. Age of acquisition of L1: ____________________

9. Age of acquisition of L2: ____________________

10. Age of acquisition of L3: ____________________

11. Number of hours for L1____________________ Context of L1 use

12. Number of hours for L2 ____________________ Context of L1 use

13. Number of hours for L3 ____________________ Context of L1 use

Appendix-2
Participant Consent Form

I volunteer to participate in the research study "Cognitive Processing of Linguistic Resources in Translanguaging: A Psycholinguistic Exploration in Pakistani Context" conducted by Ms. Bushra Ashraf.

2. I have the right to withdraw and discontinue my participation at any time.

3. I have been assured that my identity and the information obtained from these tests will not be disclosed and that my confidentiality as a participant in this study will remain anonymous.

4. However, the access to the above-mentioned information is strictly open to the researcher and her supervisor.

5. I have read and understood the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

____

Participant's Signature with date

Adapted from: Bhupathi, P. A., & Ravi, G. R. (2017). Comprehensive format of informed consent in research and practice: a tool to uphold the ethical and moral standards. *International journal of clinical pediatric dentistry*, *10*(1), 73.

Appendix-3
Inter-Coder Consent Form

1. I volunteer to participate as a coder for determining the cognate status of lexical items in the research study “Cognitive Processing of Linguistic Resources in Translanguaging: A Psycholinguistic Exploration in Pakistani Context” conducted by Ms. Bushra Ashraf.

2. I have the right to withdraw and discontinue my participation at any time.

3. I have been assured that my contribution will be duly acknowledged

4. However, access to the above-mentioned information is strictly open to the researcher and her supervisor.

5. I have read and understood the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

______________________________ ______________________________

Signature   Name

Adapted from: Bhupathi, P. A., & Ravi, G. R. (2017). Comprehensive format of informed consent in research and practice: a tool to uphold the ethical and moral standards. *International journal of clinical pediatric dentistry*, *10*(1), 73.

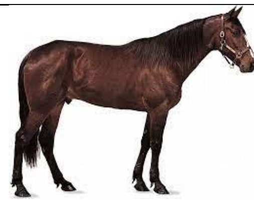
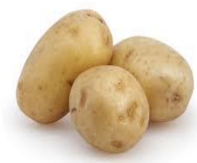
Appendix-4
List of Pictures (Triple Cognates) Used for the Picture Naming Task

	Lexical Items	Pictures		Lexical Items	Pictures
1.	Bottle / بوتل			Bus /بس	
3.	Button / بٹن			Captain /کپتان	
5.	Coat / کوٹ			Degree / ڈگری	
7.	Cup /کپ			Doctor /ڈاکٹر	
9.	Film /فلم			Hospital /ہسپتال	
11.	Hotel /ہوٹل			Nurse / نرس	

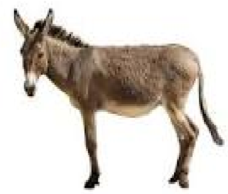
13.	Sofa / صوفہ			Phone /فون	
15.	Printer / پرنٹر			Tomato / ٹماٹر	
17.	School / سکول			Truck / ٹرک	
19.	Vote / ووٹ			Tyre / ٹائر	
21.	Wicket / وکٹ			Zip / زپ	

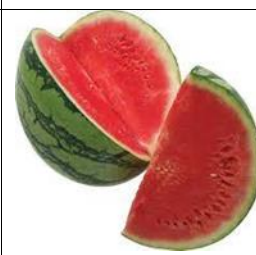
Appendix-5
List of Pictures (Double Cognates) Used for the Picture Naming Task

	Words	Pictures		Words	Pictures
1.	Box /ڈبہ			Cat /بلی	
3.	Chair کرسی/			Clouds / بادل	
5.	Cow / گائے			Dog /کتا	
7.	Duck / بطخ			Drum / ڈھول	
9.	Eye آنکھ/			Fan / پنکھا	
11.	Goat / بکری			Hand /ہاتھ	

13.	Horse گھوڑا/			Moon چاند/	
15.	Peach / آڑو			Potato / آلو	
17.	Road سڑک/			Scissors / قینچی	
19.	Socks / جراب			Star /ستارا	
21.	Table / میز			Water پانی/	

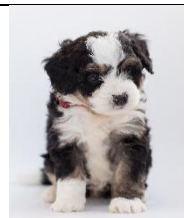
Appendix-6
List of Pictures (Unrelated Words) Used for the Picture Naming Task

	Lexical Items	Pictures		Lexical Items	Pictures
1.	Balloon / غباره / پغانہ			Buffalo / مج / بهینس	
3.	Bull / بیل / ڈھگا /			Donkey / گدھا / کھوتا	
5.	Door / بوا / دروازہ /			Feather / کھمب / پر	
7.	Garlic / تھوم / لہسن			Key / چابی / کنجی	
9.	Lock / / جندہ تالا			Hen / مرغی / ککڑی	

11.	Rain // مینہ بارش			Onion / پیاز / گنڈا	
13.	Shirt جھگا / قمیض / /			Train / ریل گڈی / گاڑی	
15.	Tree / درخت / رکھ			Wall / دیوار / کند	
17.	Stone / وٹہ / پتھر			Swing / جھولا پینگ/	
19.	Scale / فٹا / پیمانہ			Watermelon ہدوانہ /تربوز/	
21.	Wheat / گند م / کنک			Window،تاکی / باری / کھڑکی /	

Appendix-7
List of Pictures Excluded from the Picture-Naming Task

	Words	Pictures		Words	Pictures
1.	Calf			Car	
3.	Camp			Clock	
5.	Copy			Compass	
7.	Flour			Curtain	
9.	House			Finger	
11.	Lamp			Iron	
13.	Mint			Lamb	

15.	Plate			Melon	
17.	Puppy			Pillow	
19.	Room			Plum	
21.	Statue			Rice	
23.	Strainer			Sweater	

Appendix-8
List of Lexical Items Used for the Picture Naming Task

	Triple Cognates	Double Cognate	Unrelated words
1	Bottle / بوتل	Box / صندوق	Balloon / غبارہ / پغانہ
2	Bus /بس	Cat / بلی	Buffalo / بھینس / مج
3	Button / بٹن	Chair / کرسی	Bull / بیل / ڈھگا
4	Captain /کپتان	Clouds / بادل	Donkey / گدھا / کھوتا
5	Coat / کوٹ	Cow / گائے	Door / دروازہ /بوا
6	Degree / ڈگری	Dog / کتا	Feather / پر / کھمب
7	Cup /کپ	Duck / بطخ	Garlic / لہسن / تھوم
8	Doctor /ڈاکٹر	Drum / ڈھول	Key / چابی / کنجی
9	Film /فلم	Eye / آنکھ	Lock / تالا / جندرا
10	Hospital / ہسپتال	Fan / پنکھا	Hen / مرغی / ککڑی
11	Hotel /ہوتل	Goat / بکری	Rain /بارش / مینہ
12	Nurse / نرس	Hand / ہاتھ	Onion / پیاز / گنڈا
13	Sofa / صوفہ	Horse / گھوڑا	Shirt / قمیض / جھگا
14	Phone / فون	Moon / چاند	Train / ریل گاڑی / گڈی
15	Printer / پرنٹر	Peach / آڑو	Tree / درخت / رکھ
16	Tomato / ٹماٹر	Potato / آلو	Wall / دیوار / کند
17	School / سکول	Road / سڑک	Stone / پتھر / وٹہ
18	Truck /ٹرک	Scissors / قینچی	Swing / جھولا/ پینگ
19	Vote / ووٹ	Socks / جراب	Scale / پیمانہ / فٹا
20	Tyre / ٹائر	Star / ستارا	Watermelon /تربوز/ ہدوانہ
21	Wicket / وکٹ	Table / میز	Wheat / گندم / کنک
22	Zip / زپ	Water / پانی	Window / کھڑکی / تاکی، باری

Appendix-9
List of Sentences Used for the Translation-Elicitation Task

English Sentences
The students brought **notebooks** to take notes.
The child was punished for drawing **lines** on the wall.

Sentences with Triple Cognates
1. The water flows along a **pipe** to our houses.
2. The thief raised his **pistol** and aimed.
3. The inspector connected the microphone to the **laptop**.
4. The new university hired experienced **professors.**
5. The gas leak from the **heater** has become common.
6. The tourist captured beautiful scenes in his **camera.**
7. The former player decided to become a **referee.**
8. He walked to the polling station to cast **vote**.
9. The manager gave the customer his visiting **card**.
10. Azam was the best player of his **team**.

Sentences with Double Cognates
1. The skier made an extraordinary **jump** during the Olympics.
2. The painter gave a **picture** to his personal manager.
3. The judges awarded a special **prize** to the best performance.
4. My children asked many **questions** from the librarian.
5. The man stopped the **clock** at the end.
6. The CEO made a list of **problems** to be discussed.
7. The girl did not want to cut her long **hair**.
8. The doctor prescribed medicine for the **patient**.
9. Cows were domesticated to provide us with **milk**.
10. The gardener began to heap up the fallen **leaves**.

Sentences with Unrelated words
1. The new employee was the **friend** of former manager.
2. The plumber repaired the **hole** under the sink.
3. The cook served coffee prepared for **guests**.
4. The robber went up the **ladder** onto the roof.
5. The executive donated the money to **blind** to help them
6. The gardener watered the **plants** regularly.
7. The purpose of learning and education is mental **growth.**
8. The prize money was divided among the competing **boys**.
9. Tomorrow's weather will be **dry** with sunny periods.
10. They have raised two wonderful **sons**.

Appendix-10
List of Sentences Used for the Translation-Elicitation Task

Urdu Sentences

1-اس نے کتابیں **بیگ** میں رکھیں
2- میں اکثر اپنے **بچپن** کی یادیں میں کھو جاتا ہوں

Sentences with Triple Cognates

1. ظفر کے ابا جان ایک سرکاری دفتر میں بڑے **افسر** ہیں
2. کچھ عرصہ پہلے ایک استاد صاحب ہمارے **سکول** آئے تھے
3. وہ رحم دل خاتون ایک کالج کی **پرنسپل** تھیں
4. کیا سفر کے دوران **ڈرائیور** سے بات کر سکتے ہیں؟
5. ملزمان کو **پولیس** نے جلد گرفتار کر لی
6. امن جنگی مشقوں میں **ٹینک** بھی شامل تھے
7. ملک کے بیترین ڈاکٹرآج **کیمپ** کا آغاز کریں گے
8. آج کل ہر قسم کی اطلاع **ٹیلی فون** سے دی جاتی ہے
9. اس کی ملازمت **کمپنی** کے ساتھ ہی ختم ہو گئ۔
10-وہ دس سال تک **پرائمری** سکول میں پڑھاتا رہا ہے

Sentences with Double Cognates

1. اسے تحفے میں ایک قیمتی گھڑی ملی
2. گیند کو **دائرے** سے باہر پھینکنے والا آؤٹ ہو جائے گا
3. میں اور میرا بھائی شام کو باغ کے پودوں کو **پانی** دیتے ہیں
4. چوری سے متعلق سپریم کورٹ کا **فیصلہ** خوش آئند ہے
5.اندر جانے سے پہلے **جوتے** اتار لو
6. سردی ختم ہوتے ہی **بہار** کا موسم شروع ہوجاتا ہے
7. تالاب اور باغیچے **شہر** کی خوبصورتی میں اضافہ کرتے ہیں
8. سردی سے بچنے کے لے اس نے **جرسی** پہن رکھی تھی
9- پائلٹ نے **ہوائ جہاز** کو قریبی ائرپورٹ پر اتار دیا
10- تیراکی کرنے والے اپنا **تولیا** ساتھ لاتے ہیں

Sentences with Unrelated words

1. خریداری کے دوران موبائل **جیب** سے گر گیا
2. کمرۃ امتحان میں سینکڑوں **طالب علم** وجود تھے
3. سارا دن صدا ئیں لگانے کے بعد **بھکاری** تھک گیا
4. یوم آزادی کے موقع پر **غیر ملکی** سفیر بھی مدعو تھے
5. ماہی گیروں کی **کشتی** سمندر میں الٹ گئی
6. مہمانوں کے آرام کے لئے **تکیے** لگےتھے
7- کئی روز کے سفر کے بعد وہ اپنے **گاؤں** پہنچ گیا
8. ماں باپ کے جانے کے بعد **بچہ** کھیلنے لگا
9- اولاد کے لیےجو بھی گھر لاؤ سب سے پہلے **بیٹی** کو دو
10- کسان صبح سویرے **کھیت** کو روانہ ہو جاتے ہیں

Appendix-11
Frequency of Lexical Items for the Picture-Naming Task

Word	SUBTLEX-US FREQcount	SUBTLEX-US CDcount	SUBTLEX-US FREQlow	SUBTLEX-US Cdlow	SUBTLEX-US SUBTLWF
balloon	442	261	422	257	8.67
bottle	2588	1561	2510	1537	50.75
box	4577	2353	4355	2296	89.75
Buffalo	607	253	237	137	11.9
bull	1403	665	917	497	27.51
bus	3783	1546	3607	1504	74.18
button	1441	900	1322	851	28.25
camp	2612	1094	2309	1016	51.22
Captain	10622	1785	2630	953	208.27
car	24636	5154	23946	5106	483.06
cat	3383	1386	2855	1241	66.33
chair	2511	1553	2442	1525	49.24
clock	2990	1639	2893	1608	58.63
clouds	511	382	482	361	10.02
coat	2146	1272	2108	1258	42.08
compass	207	124	196	117	4.06
copy	2666	1441	1960	1248	52.27
cow	1301	728	1202	696	25.51
cup	2634	1566	2373	1494	51.65
curtain	525	331	376	252	10.29
degree	759	585	745	579	14.88
doctor	13461	3703	9101	3267	263.94
dog	9835	3049	8851	2935	192.84
donkey	273	162	211	141	5.35
door	14895	5286	14339	5228	292.06
drum	432	270	370	241	8.47
duck	1263	703	938	562	24.76
eye	5701	3216	5464	3157	111.78
fan	1792	1097	1562	1037	35.14
feather	338	231	303	220	6.63
film	3328	1013	3210	974	65.25
finger	1870	1287	1820	1269	36.67
flour	161	110	149	106	3.16
garlic	306	192	262	175	6
goat	537	338	480	315	10.53
hand	14262	5562	13466	5431	279.65
hen	163	107	132	93	3.2
horse	4737	1577	4472	1488	92.88
hospital	6334	2611	5727	2472	124.2
hotel	5264	2021	4201	1797	103.22

house	26214	6040	24470	5849	514
iron	915	622	834	580	17.94
key	4430	2165	4165	2099	86.86
lamb	542	322	426	280	10.63
lamp	657	384	640	375	12.88
lemon	613	344	376	277	12.02
lock	2885	1866	2267	1548	56.57
melon	218	99	121	90	4.27
mint	277	204	201	159	5.43
moon	2548	1167	2123	1028	49.96
nurse	2294	1099	1589	906	44.98
onion	216	152	200	141	4.24
peach	324	212	246	185	6.35
phone	13756	4502	13087	4436	269.73
pillow	581	453	553	443	11.39
plate	1308	925	1280	905	25.65
plum	174	112	125	92	3.41
potato	576	385	498	347	11.29
printer	107	73	104	71	2.1
puppy	584	383	542	361	11.45
rain	2494	1446	2243	1335	48.9
rice	769	447	583	355	15.08
road	5709	2766	5043	2567	111.94
room	22415	6251	21385	6167	439.51
scale	485	391	469	383	9.51
school	16989	4531	15967	4447	333.12
scissors	341	207	271	173	6.69
shirt	2365	1400	2330	1383	46.37
socks	932	546	864	529	18.27
sofa	299	226	287	220	5.86
star	4149	1821	3118	1543	81.35
statue	540	317	434	251	10.59
stone	2072	938	1158	737	40.63
strainer	14	11	12	11	0.27
sweater	704	466	690	460	13.8
swing	1325	857	1064	755	25.98
table	5387	2889	5136	2826	105.63
tomato	301	203	248	178	5.9
train	4848	1760	4618	1700	95.06
tree	3315	1622	3093	1551	65
truck	3716	1555	3571	1537	72.86
tyre	124	54	119	52	2.43
vote	1751	733	1630	715	34.33
wall	3605	2105	3219	1953	70.69
water	11478	4127	10619	3999	225.06

watermelon	112	68	92	64	2.2
wheat	293	203	224	167	5.75
wicket	7	7	6	6	0.14
window	4386	2442	4287	2410	86
zip	389	279	231	200	7.63

Appendix-12
Frequency of English Lexical Items Used in the Translation-Elicitation Task

Lexical Item	SUBTLEX-US FREQ. count	SUBTLEX-US CD count	SUBTLEX-US FREQ.low	SUBTLEX-US Cdlow	SUBTLEX-US SUBTLWF
airplane	557	354	507	332	10.92
beggar	126	87	114	81	2.47
blind	2337	1353	2174	1313	45.82
boat	4885	1457	4750	1426	95.78
boys	11432	3747	10241	3581	224.16
camera	2907	1387	2663	1324	57
camp	2612	1094	2309	1016	51.22
card	4357	2107	4236	2076	85.43
child	8040	3067	7673	2995	157.65
circle	1097	689	898	596	21.51
City	8624	3321	5760	2637	169.1
clock	2990	1639	2893	1608	58.63
company	7507	3283	6473	3073	147.2
daughter	8739	2993	8576	2957	171.35
decision	2808	1810	2797	1807	55.06
driver	2416	1398	2153	1286	47.37
dry	2184	1537	2003	1450	42.82
field	3580	1919	3172	1803	70.2
foreigner	150	102	132	93	2.94
friend	21384	6178	20982	6147	419.29
growth	329	243	320	238	6.45
guests	1311	884	1256	865	25.71
hair	7831	3632	7535	3582	153.55
heater	139	103	134	101	2.73
hole	2969	1755	2846	1711	58.22
jump	3561	1973	2806	1744	69.82
ladder	472	313	430	304	9.25
laptop	177	133	173	131	3.47
leaves	2316	1719	2236	1679	45.41
milk	2169	1262	1935	1175	42.53
officer	5265	2026	3313	1580	103.24
patient	3246	1460	3129	1438	63.65
picture	7061	3178	6868	3119	138.45
pillow	581	453	553	443	11.39
pipe	989	643	853	558	19.39

pistol	513	324	481	316	10.06
plants	488	320	469	312	9.57
pocket	1821	1282	1769	1260	35.71
police	12044	3369	9934	3146	236.16
primary	444	324	401	301	8.71
principle	395	316	383	309	7.75
prize	1142	735	977	634	22.39
problems	3931	2427	3857	2395	77.08
question	10116	4587	9854	4528	198.35
referee	183	106	146	91	3.59
school	16989	4531	15967	4447	333.12
shoes	3782	2019	3611	1982	74.16
sons	921	615	803	557	18.06
spring	1597	1027	1345	910	31.31
student	2195	1140	2082	1111	43.04
sweater	704	466	690	460	13.8
tank	1306	674	1122	643	25.61
team	7528	2623	6765	2473	147.61
telephone	1651	984	1437	892	32.37
towel	722	525	687	508	14.16
village	1712	774	1459	636	33.57
vote	1751	733	1630	715	34.33
watch	16831	5882	11063	4994	330.02
water	11478	4127	10619	3999	225.06

Appendix-13
Frequency of Urdu Lexical Items Used in the Translation-Elicitation Task

Word	BlogFreq	BlogFreqPm	BlogCD	TwitterFreq	TwitterCD
شہر	1225	375.3967	884	56	53
فیصلہ	1174	359.7679	795	52	51
پانی	1132	346.8972	776	19	19
پولیس	673	206.2383	424	65	63
میدان	433	132.6912	387	37	31
بچہ	333	102.0466	261	5	4
بیٹی	315	96.5306	259	2	2
بہار	285	87.3372	242	10	10
گاؤں	278	85.1921	212	5	4
کمپنی	262	80.2889	177	13	13
جہاز	249	76.3051	157	14	12
سکول	247	75.6922	169	8	8
افسر	152	46.5798	119	6	6
دائرہ	149	45.6605	126	3	3
جیب	130	39.838	114	20	19
ڈرائیور	101	30.9511	72	2	2
کشتی	94	28.8059	75	44	40
جوتے	82	25.1286	60	2	2
لہسن	58	17.7739	51	1	1
پرنسپل	47	14.403	41	0	0
پرائمری	44	13.4836	35	2	2
طالبعلم	42	12.8707	30	0	0
ٹینک	37	11.3385	32	0	0
بھکاری	27	8.274	23	0	0
ٹیلیفون	26	7.9676	22	0	0
غیرملکی	24	7.3547	23	6	6
تولیہ	12	3.6774	6	0	0
تکیے	9	2.758	8	0	0
صوفہ	4	1.2258	4	0	0
جرسی	0	0	0	0	0

Appendix-14

List of Items for the Pilot Study

Lexical Items			
airplane	door	Leaves	Rice
balloon	driver	Lemon	Road
bank	drum	Lines	Room
beggar	dry	lock	Scale
bicycle	duck	Medal	School
blind	eye	Melon	Scissors
boat	fan	Milk	Sheet
bottle	feather	Mint	shirt
box	field	mobile	Shoe
boys	Film	Moon	Socks
brush	finger	neighbour	Sofa
buffalo	flour	notebook	Sons
bulb	flower	Nurse	Spring
bull	foot	Office	Star
bus	foreigner	Onion	Statue
button	friend	patient	Stone
camera	garlic	Peach	Strainer
camp	glass	Permit	Student
captain	goat	Phone	Sweater
car	grass	picture	Swing
card	growth	Pillow	Table
cat	guests	Pipe	Tank
chair	hair	Pistol	Teacher
child	hand	Plants	Telephone
circle	heater	Plastic	ticket
city	hen	Plate	tomato
clock	hole	Plum	towel
coat	horse	Pocket	train
company	hospital	Police	tree
compass	hotel	Potato	truck
copy	house	primary	tyre
cow	ink	principal	village
cup	jail	Printer	vote
curtain	jump	Prize	wall
daughter	key	problems	water
decision	kitten	professor	watermelon
degree	ladder	Puppy	wheat
doctor	lamb	questions	wicket
dog	lamp	Rain	window
donkey	laptop	referee	zip