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EXPLORING THE COMPLEXITIES OF BILINGUAL APHASIA: IMPLICATIONS IN THE CONTEXT OF NEUROLINGUISTICS

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ABSTRACT

Aphasia, a complex communication disorder resulting from brain damage, causes difficulties in understanding and using language. The phenomenon of bilingual aphasia is challenging due to its complexity in understanding and rehabilitating language disorders. In the globalization era, the dual-speaking population's growth is increasing. However, our understanding of bilingual aphasia is still limited. Therefore, in-depth and systematic research is needed to guide bilingual aphasia's diagnosis, treatment, and rehabilitation. This study used a rigorous literature review method, with a thematic search and analysis of relevant studies on bilingual aphasia. Symptom profiles, risk factors, pathophysiology, and rehabilitation strategies were comprehensively reviewed. The thematic analysis of the literature revealed diverse symptom profiles in individuals with bilingual aphasia and associated risk factors and pathophysiological mechanisms. In addition, this study examined effective rehabilitation strategies appropriate to the characteristics of bilingual aphasia. This research has important implications in neurolinguistics and aphasiology, improving the accuracy of diagnosis, development of appropriate interventions, and effective rehabilitation planning. The results make valuable contributions to clinical practitioners, researchers, and educators in providing better care and support for individuals with bilingual aphasia. In addition, this study also enriches our understanding of the complexity of language and the brain-language connection at large.

Key Words: *bilingual aphasia, neurolinguistics, linguistics, language pathology.*

ABSTRAK

Afasia, gangguan komunikasi yang kompleks akibat kerusakan otak, menyebabkan kesulitan dalam memahami dan menggunakan bahasa. Fenomena afasia dwibahasa cukup menantang karena kompleksitasnya dalam memahami dan merehabilitasi gangguan bahasa. Di era globalisasi, pertumbuhan populasi yang menggunakan dua bahasa semakin meningkat. Namun, pemahaman kita tentang afasia bilingual masih terbatas. Oleh karena itu, penelitian yang mendalam dan sistematis diperlukan untuk memandu diagnosis, pengobatan, dan rehabilitasi afasia bilingual. Penelitian ini menggunakan metode tinjauan literatur yang ketat, dengan pencarian tematik dan analisis studi yang relevan tentang afasia bilingual. Profil gejala, faktor risiko, patofisiologi, dan strategi rehabilitasi ditinjau secara komprehensif. Analisis tematik dari literatur mengungkapkan profil gejala yang beragam pada individu dengan afasia bilingual dan faktor risiko serta mekanisme patofisiologi yang terkait. Selain itu, penelitian ini mengkaji strategi rehabilitasi yang efektif yang sesuai dengan karakteristik

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afasia bilingual. Penelitian ini memiliki implikasi penting dalam neurolinguistik dan afasiologi, meningkatkan keakuratan diagnosis, pengembangan intervensi yang tepat, dan perencanaan rehabilitasi yang efektif. Hasil penelitian ini memberikan kontribusi yang berharga bagi para praktisi klinis, peneliti, dan pendidik dalam memberikan perawatan dan dukungan yang lebih baik bagi individu dengan afasia bilingual. Selain itu, penelitian ini juga memperkaya pemahaman kita tentang kompleksitas bahasa dan hubungan otak-bahasa secara luas.

Kata Kunci: afasia bilingual, neurolinguistik, linguistik, patologi bahasa.

INTRODUCTION

Aphasia is a complex communication disorder that is generally caused by damage to the brain, particularly to the regions associated with language processing (Alduais et al., 2022; Nickels et al., 2019; Ramezani et al., 2020; Riley et al., 2021). This disorder can cause difficulty understanding and using language verbally or in writing. In some cases, individuals with aphasia also have dual language or bilingual abilities (Lerman et al., 2019; Nasrullah et al., 2019; Nickels et al., 2019; Ramezani et al., 2020; C. Sandberg et al., 2020). Bilingual aphasia is a unique phenomenon involving communication disorders in individuals who have successfully learned multiple languages (Nasrullah et al., 2021). Research in neurolinguistics and aphasiology has revealed the complexity of bilingual aphasia, and more and more studies are being conducted to understand its manifestations, mechanisms, and impact on language function (Alduais et al., 2022; Boye & Bastiaanse, 2019; Linden, 2018; Nadeau, 2019; Nedergaard et al., 2020).

The problem of bilingual aphasia is an interesting topic for researchers because this phenomenon combines the complexity of aphasia with the factor of bilingualism. In the current era of globalization, the growth of the dual-language population is increasing (Ramírez-Esparza et al., 2020). However, our understanding of bilingual aphasia is still limited and in-depth research is needed to uncover the characteristics and differences between bilingual aphasia and aphasia in one language.

Research and understanding of bilingual aphasia is essential in neurolinguistics and aphasiology. With increased mobility and cross-cultural interaction, bilingual aphasia could significantly impact the rehabilitation and treatment of language-impaired individuals (Muò et al., 2021). Recognizing differences in the

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manifestations and mechanisms of bilingual aphasia will enable health professionals to devise more effective therapeutic strategies that suit the needs of such individuals.

Research on bilingual aphasia has been one of the central studies in neurolinguistics and aphasiology. Already in early work, Albert and Obler (Albert & Obler, 1978) documented different patterns of recovery in proficiency in two languages—that is, one language recovers better than the other. This research highlighted that language recovery could vary based on factors such as pre-stroke proficiency levels and linguistic characteristics of the languages known. Such differences in the degree of agrammatism between Hebrew and English have further been supported by findings from Grodzinsky (Grodzinsky, 1984) and Goral (Goral, 2001). It has been identified that Hebrew displays tendencies for paragrammatism, while English for agrammatism, and this further confirms differences in the structure of the brain when processing the language.

Similar conclusions from Silverberg and Gordon (Silverberg & Gordon, 1979) are further evident that in bilingual aphasia, usually the language recovery is non-parallel. Indeed, they documented some cases demonstrating that one language can recover more completely and more quickly than the other. Indicating clearly that factors such as age of language acquisition and quality of language proficiency are very highly influential on patterns of recovery. This view is supported by two recent studies from Linden and Brady et al. (Brady et al., 2016, 2022), who introduced a new term into clinical nomenclature, differential aphasia, to describe "those patients who manifest one set of aphasia symptoms in one language but exhibit a different form of aphasia in the other". This indicates that recovery mechanisms in language have the potential to be highly variable and influenced by several contextual and neurophysiological factors.

Other studies, such as Peñaloza and Kiran (Peñaloza & Kiran, 2019) and Sandberg and Zacharewicz (C. Sandberg et al., 2020) have gone on to show what affects language recovery in bilinguals. They concluded that the pre-stroke proficiency levels and the linguistic distance between languages significantly affect recovery outcomes. Research has also shown that speech therapy in bilingual aphasia patients could potentially lead to a partial transfer from the treated language into the

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untreated one. Bahadoran-Baghbaderani et al. (Bahadoran-Baghbaderani et al., 2021) showed that treatments of the non-dominant language are associated with the co-activation of L1-L2 lexical representations and that there is evidence of cross-language therapeutic transfer.

At the same time, there is a need to synthesize the literature systematically and comprehensively, which can bring forward consistent findings and the areas with deficiencies in the knowledge on the subject. The present study helps fill that gap through a systematic review of available literature on the patterns of recovery of bilingual aphasia. By systematically analyzing and integrating the current research, this study intends to clearly bring out the unique features of the recovery process from the affliction of bilingual aphasia in such populations, thus identifying areas that need further research.

This study's primary purpose is to systematically analyze existing literature on bilingual aphasia. We can present a more comprehensive understanding of bilingual aphasia through rigorous literature review methods, including symptom profiles, risk factors, pathophysiology, and effective rehabilitation methods. By gaining a deeper understanding of bilingual aphasia, we can improve the diagnosis, and interventions provided to individuals with this dual language disorder.

The benefit of this study is that it provides valuable insights to clinical practitioners, researchers, and educators in neurolinguistics and aphasiology. The information gathered through this study will enrich our knowledge of bilingual aphasia, facilitate the development of more effective rehabilitation strategies, and provide guidance in supporting individuals with bilingual aphasia in overcoming their communication barriers.

This study embraced a systematic literature review methodology in collecting, analyzing, and synthesizing findings from relevant studies on bilingual aphasia. The selected systematic literature review approach enables the integration of existing knowledge while providing a detailed overview of the topic under investigation. The process is developed systematically, with replication; therefore, the review is comprehensive and unbiased.

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The sources of literature have been selected in consideration of quality and relevance with good thoroughness and system. The process of collecting data involved the following steps.

This was achieved through multiple academic sources including PubMed, Scopus, Web of Science, and Google Scholar. The search was limited to peer-reviewed journal articles, conference papers, books, and dissertations related to neurolinguistics, aphasiology, and bilingualism.

A variety of keywords and search terms were clearly defined to maximize the effective retrieval of relevant literature. Such included "bilingual aphasia," "bilingualism," "language disorder," "neurolinguistic aphasia," "aphasia recovery," "language impairment," and "rehabilitation methods." Boolean operators (AND, OR) were utilized to tailor or extend the search. The following inclusion and exclusion criteria were identified to be appropriate in the selection of literature: published in English, based on the study of bilingual aphasia, type of publications—research articles, reviews, case studies, or clinical trials—and published within the last 20 years to extract current and relevant information. The exclusion criteria would be those studies not related to bilingual aphasia, non-peer-reviewed articles, and publications written in languages other than English.

The retrieved search results were screened through the titles and abstracts to identify studies that met the eligibility criteria. Retrieved full texts of selected studies were again reassessed for relevance and quality. Disagreements between researchers at the selection stage were resolved through discussion.

A standardized form was used to extract data systematically from the selected studies. Data were extracted regarding the aims, methods, characteristics of the sample, major findings, and conclusions of the study. Data on definitions and characteristics of bilingual aphasia, risk factors, pathophysiology, clinical symptoms, and methods of rehabilitation were also noted.

Data analysis took a systematic approach to identifying crucial findings from the selected studies to synthesize the results. In this regard, the following steps were pursued.

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Thematic analysis was used to determine recurring themes and patterns in the extracted data. This process involved coding of the extracted data and arranging them into categories based on topics of interest: manifestations of bilingual aphasia, mechanisms of language impairment, and effective rehabilitation methods.

Comparative analysis was performed across different studies. This step included comparing similar and contrasting different results, taking into account study designs, population characteristics, and methodological approaches.

The findings were synthesized in a way that would develop a flowing and logical story for the full display of accumulated knowledge concerning bilingual aphasia. In the synthesis, we tried to indicate points of convergence, divergences, and gaps in the literature.

The quality of research was based on predefined criteria used for the studies' appraisal. Criteria involved in this assessment include study design, sample size, and data collection methods; bias was also a key criterion. To enhance the validity and credibility of the information, only peer-reviewed publications have been cited.

DISCUSSION

The manifestation of linguistic deficits in bilingual individuals before specific neurological events has been a crucial font of knowledge for formulating conjectures regarding the cognitive functioning arrangement within the cerebral realm (Gilmore et al., 2019; Kambanaros et al., 2017; Patra et al., 2020; Peñaloza et al., 2021). Investigations about language impairment in bilingual individuals have additionally contributed to an enhanced comprehension of how language is encoded and processed within the neurophysiological substrates of individuals who exhibit typical communicative abilities. Moreover, certain research discoveries have given clinicians and speech therapists valuable insights into devising more efficacious therapeutic methodologies.

Patterns of Language Competence Recovery in Bilingual Aphasia Patients

Following a stroke or traumatic neurological accident, bilingual individuals are expected to recover and restore their language skills in all of their languages at the

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same level (Bahadoran-Baghbaderani et al., 2021; Lerman et al., 2019; Paplikar et al., 2019). Suppose they were more fluent in one of the languages before a particular neurological accident. In that case, this dissimilarity will manifest through variations in the degree of impairment observed within each language, as evidenced by heightened scores in the language previously established as exhibiting greater proficiency (Conner et al., 2018; Fyndanis et al., 2017). Some patients show a pattern of parallel recovery (Nasrullah et al., 2019; Peñaloza & Kiran, 2019; C. W. Sandberg et al., 2021; Van der Linden et al., 2018), where speaking ability in the impaired language goes hand in hand with previous knowledge in the two languages mastered before onset. However, there are also exceptional cases where language recovery does not run in parallel. This pattern is known as differential recovery (Khamis Dakwar et al., 2018; Peñaloza et al., 2020; van Zyl et al., 2019), where the recovery of one of the languages is much better than the other. Either the previously more fluent language recovers well or does not even recover at the expected rate.

In differential recovery, an initial phase ensues wherein only one language demonstrates recuperative progress, followed by a gradual resurgence of the second language (Nikitha et al., 2020). However, this resurgence is accompanied by a proportional regression in the recovery of the first language, eventually leading to its ultimate loss. When this pattern recurs cyclically, characterized by alternating availability and unavailability of languages over a span ranging from hours to months, it is denoted as "alternating antagonism" (Raghibdoust & Hajiloo, 2019; Sajid et al., 2020). Conversely, cases of mixed recovery manifest wherein patients unconsciously blend elements from their two languages and cannot speak one language at a time. This phenomenon, termed "mixed recovery" (Chen, 2018; Nasrullah et al., 2019), involves amalgamating vocabulary and grammatical structures from both languages while circumventing the confusion that may arise in mixed aphasia or "mixed polyglot aphasia" (Aboh, 2020; Nadeau, 2019).

No monolithic dimension can be used to classify all the patterns. The designations that characterize these patterns are mere descriptors of the patient's subjective experiences, lacking a robust theoretical foundation. Moreover, these patterns are not constrained to specific contexts or temporal occurrences. They can

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change over time, such as an initially antagonistic recovery that eventually becomes parallel after some time (KK Nair et al., 2021; Nikitha et al., 2020; Wauters et al., 2020). In addition, bilingual aphasia patients with different language combinations may also show different patterns.

The recovery patterns of language competence observed in bilingual aphasia patients include differential, selective, parallel, antagonistic, and mixed recovery. The notion can be conceived as positions spanning a continuum of varying severity. Selective aphasia entails impairment in only one language while the other remains unaffected (Van der Linden et al., 2018). In cases of differential recovery, both languages are impaired, but one language exhibits a more pronounced impairment. Selective recovery involves impairment in both languages, with one language experiencing severe deficits (Chen, 2018; Raghibdoust & Hajiloo, 2019; Sajid et al., 2020). Parallel recovery manifests with equal interference levels observed in both languages (Nasrullah et al., 2019; Raghibdoust & Hajiloo, 2019). Antagonistic recovery is characterized by alternating periods of interference in both languages (Raghibdoust & Hajiloo, 2019). Mixed recovery denotes impairment in both languages due to the absence of discerning inhibitory control (Lahiri et al., 2021; Raghibdoust & Hajiloo, 2019). Scholars have documented diverse manifestations of these patterns, ranging from five, six, seven, or even more, depending on whether they are perceived as discrete entities or constituent elements within a comprehensive framework. Nevertheless, despite ongoing development, the descriptive labels employed lack a clear theoretical classification scheme. For instance, Linden (2018) and Brady et al. (2022) introduced the concept of differential aphasia to describe patients exhibiting specific aphasia symptoms in one language and different aphasia types in another.

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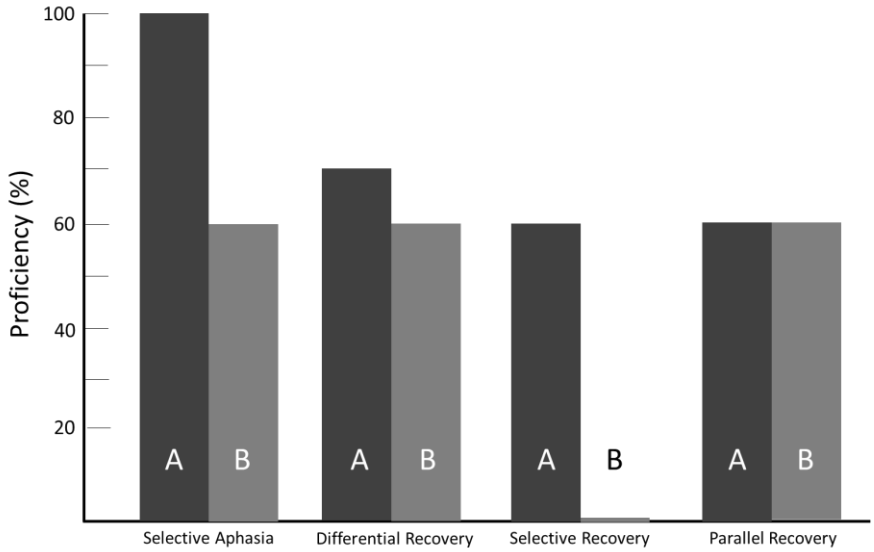

Figure 1 The Dynamic Spectrum of Bilingual Aphasia Recovery Patterns

Figure 1 shows the continuum encompassing selective aphasia, disparate patterns of recovery, and distinct instances of targeted recuperation. Language ability in languages A and B can be expressed independently using a scale from 0 to 100. For example, A 100 / B 60 indicates the presence of selective aphasia where language ability in language A is 100 while in language B is 60. A 70 / B 50 indicates differential recovery where both languages are affected, with language ability in language A at 70 and in language B at 50. A 60 / B 0 indicates a selective recovery where both languages are affected, but language proficiency in language B is 0, while in language A, it is 60. A 60 / B 60 indicates a parallel recovery where both languages are affected equally, i.e., language proficiency in languages A and B are at 60. The percentages used are only for random illustration and may vary between 99 and 0 for each language.

Albert and Obler (1975) conducted a study wherein they recorded the manifestation of symptoms associated with Broca's aphasia in the English language and symptoms indicative of Wernicke's aphasia in Hebrew, all observed within a single patient who possessed multilingual abilities (Nadeau, 2019). Notably, the patient exhibited superior comprehension abilities and reduced fluency in English compared to Hebrew. Additionally, the patient demonstrated a propensity for frequent word substitution errors, specifically in the context of Hebrew. It should be

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noted that healthy polyglot individuals usually do not have similar proficiency and comprehension in multiple languages. Therefore, it is not surprising that after experiencing certain events, there are differences in comprehension, accuracy, and fluency in language, reflecting abnormal conditions.

In this particular instance, two factors potentially contributed to the emergence of the patient exhibiting symptoms characteristic of Wernicke's aphasia in the Hebrew language. Firstly, the quality of Hebrew acquisition after age 19 may have played a role. Secondly, the erroneous substitution of inflectional morphemes, mistakenly perceived as inappropriate indicators within the sentence, likely influenced the manifestation of symptoms. Interestingly, the patient's initially severe auditory comprehension disorder exhibited a swifter English recovery than Hebrew. From their observations, Albert and Obler (Lerman et al., 2020, 2022; Nadeau, 2019) deduced that distinct patterns of brain organization for each language might underlie the symptoms experienced by the patient. However, in this specific case, the recovery pattern observed aligns with differential recovery, wherein discrepancies in recovery rates between languages are observed rather than the presence of distinct aphasia types. Notably, in both languages, the patient demonstrated symptoms that were suggestive of Broca's aphasia.

According to Grodzinsky (1984) and Goral (2001), the manifestation of agrammatism symptoms in Hebrew differs from its counterpart in English. Specifically, in Hebrew, the symptoms are distinguished by the replacement of inflectional morphemes, which aligns with the occurrence of paragrammatism in the English language and corresponds to the classification of Wernicke-type aphasia. In contrast, the omission of inflectional morphemes, associated with agrammatism in English and classified as Broca-type aphasia, is not a prominent feature in Hebrew. The patient cases reported by Silverberg and Gordon (1979) also influenced interpretation by clinicians and speech therapists. The first patient had non-fluent aphasia in Spanish and fluent aphasia (Wernicke's aphasia) in Hebrew, with more rapid and complete recovery in Hebrew than in Spanish. Aphasia diagnosis highly depends on the classification criteria used in the different tests. Hebrew was also seen to have symptoms of Wernicke's aphasia in a second case involving a Russian

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doctor who had only been learning Hebrew for one year. Hebrew was still not fully recovered after six months, while Russian was much better. This shows the progression from selective recovery to differential recovery over time.

The patient commonly referred to as Bychowski (1919) (Vaid, 1983) is often regarded as an advanced instance of differential aphasia. Bychowski exhibited symptoms of transcortical motor aphasia in German, a milder form of aphasia in Polish, and aphasia symptoms resembling amnestic aphasia in Russian. Nonetheless, the meticulous delineation of transcortical motor aphasia and amnestic aphasia remains somewhat elusive, indicating a certain degree of interrelation between the two. This discrepancy may indicate varying progression of recuperation over temporal intervals shaped by the characteristics of verbal stimuli encountered in the patient's surroundings. Another case documented by Wald (1958, 1961) involved a patient who presented with conduction aphasia in Russian and motor aphasia in Yiddish, English, and German. Notably, Yiddish, English, and German exhibited more pronounced impairments than Russian (Parr et al., 2018; Roberts, 2005). The patient retained the ability to spontaneously produce utterances in Russian, whereas the other languages were rendered unusable and suffered even more severe impairment.

Limited collective investigations have contributed to the corpus of data concerning aphasia recovery. Most existing publications predominantly comprise individual case studies, with an estimated count of approximately 300 published cases thus far. From these studies, parallel recovery is the more common pattern, followed by differential, mixed, selective, and antagonistic recovery. However, cases of parallel recovery are rarely reported as they do not show prominent phenomena. The results from this cohort study are roughly consistent with findings in the literature regarding the frequency of nonparallel recovery.

Occurrences of selective aphasia can potentially go undetected if patients are exclusively evaluated in the language employed by medical staff. Several studies conducted in Paris revealed occurrences of selective aphasia specific to the Gujarati language, which would have remained undiagnosed had the patient solely undergone testing in French (Singleton, 2018, 2019; Weekes, 2020). Three main questions about

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recovery patterns must be asked to understand this phenomenon. The first question concerns the brain mechanisms that allow different recovery patterns. After getting an answer to this question, the second question is what factors influence the type of recovery experienced by a particular patient. Once these two questions are answered, the third inquiry pertains to the rationale behind preserving one language and losing another in instances of selective recovery.

Doctors have been looking for potential factors that could provide insights into addressing the third inquiry. Experts such as Ribot, Pitres, and Minkowski have given their views. Ribot stated that the mother tongue usually recovers first or better based on the cardinal principle that the oldest memories are most resistant to damage (Pearce, 2005). Pitres found that the mother tongue is usually also the language the patient is most familiar with. If not, the patient would recover better in a language other than their mother tongue (Pearce, 2005). According to Minkowski, robust language recovery is more likely to transpire in languages that maintain significant emotional connections with the patient (Zhou et al., 2022). Different viewpoints propose that the language most extensively employed within the patient's immediate surroundings or the language last encountered or spoken before the onset of the disorder will exhibit favorable recovery outcomes (Cargnelutti et al., 2019; Herath et al., 2022).

Nevertheless, these factors failed to fully account for the observed recovery patterns in over half of the cases investigated. Pitres also endeavors to elucidate the mechanisms behind differential and selective recovery. He posits that selective recovery is unlikely to stem from distinct neural localities for each language but rather arises from physiological inhibitory mechanisms that impact one of the languages, either transiently or enduringly (Pearce, 2005).

In contemporary scholarship, Green has proposed a theoretical framework to elucidate the phenomenon of language inhibition within the confines of limited cognitive resources. According to the Activation Threshold Hypothesis, language inhibition is contingent upon cognitive resources rather than being an all-or-nothing phenomenon (Lerman et al., 2023; Raghibdoust & Hajiloo, 2019). This hypothesis elucidates the varied patterns of recuperation witnessed in individuals, including

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enduring inhibition (selective recovery), temporary inhibition (sequential recovery), alternating inhibition (antagonistic recovery), heightened inhibition in one language (differential recovery), and the absence of inhibition (mixed recovery). Although many researchers have largely disregarded the notion of discrete neural localization for each language, certain facets of this concept have reemerged, suggesting that selective or differential recovery may be attributed to less centralized or overlapping language representations within the brain.

Heterogeneity of bilingual speakers

Differences in the age and method of language acquisition, level of mastery, and usage patterns of each language can affect the relativity of each language in bilingual speakers. The development of linguistic competence in both languages can occur unconsciously, depending on when and how they became bilingual. In this context, the brain substrates involved may differ so that the languages may have different levels of susceptibility to injury to language-related brain areas. Hence, it is imperative to comprehend the context surrounding the acquisition and utilization patterns of individual languages in patients. Code-switching in conversation, even mid-sentence, is common in some speech communities and is not necessarily pathological. However, certain cases indicate code-switching as a pathology, both in sociolinguistic and syntactic aspects (Chen, 2018). Code-switching sociolinguistically reflects a lack of awareness of the contradiction of language use with speakers who do not master the language. Code-switching in the grammatical aspect is characterized by violations of grammatical and psycholinguistic rules, such as incorporating words from different languages or using linguistic elements from one language in sentences of another language.

Implementing appropriate preventive measures to differentiate between normal bilingual language use and pathological linguistic patterns. The psychological impact of the surrounding environment holds significant relevance in this regard. Environments devoid of bilingualism tend to promote monolingual discourse, whereas bilingual settings foster code-switching strategies, particularly in communities where language alternation is commonplace. Hence, when conducting

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assessments, it is crucial to engage native speakers proficient in the relevant languages to facilitate bilingualism in the patient. Additionally, careful observation of the patient's nonverbal cues can provide valuable insights, as individuals readily recognize the availability of an alternative language and refrain from seeking a word in one language if it is accessible in another.

The utilization of the Bilingual Aphasia Test (BAT) has revealed the efficacy of employing grammatical evaluations of sentences incorporating reversible contrasting morphosyntactic features to ascertain language dominance during assessments (Fallahi, 2017; Paradis, 2011). To ensure an accurate interpretation of results, it is crucial to gather comprehensive information regarding the acquisition and usage history of each language, considering the premorbid circumstances of the patient. The BAT is also employed in languages beyond bilingual or aphasic populations. For instance, in Italy, the BAT is routinely administered to evaluate cognitive impairment in individuals with conditions such as multiple sclerosis, Parkinson's disease, motor neuron disease, cortical-basal ganglionic degeneration, olivopontocerebellar atrophy, and cerebellar vermis lesions, who may not be bilingual or experiencing aphasia (Conner et al., 2018). Furthermore, BAT has been utilized to assess the effects of typical aging.

Bilingual aphasia research contributions

A single case cannot comprehensively understand brain function in bilingual speakers. However, it does provide insight into the possibilities. When multiple cases show similar symptoms, we can infer how the system works and identify a possible malfunction in the human brain system. Ultimately, cases showing different symptoms provide information about different patterns of system damage and give an initial idea of the structure of the brain system. The models generated from this information can then be tested experimentally by designing studies focusing on one aspect of the brain system that is suspected to be affected. We can also check whether the model fits the observed behavioral phenomena.

Conceptual frameworks developed to elucidate bilingual aphasia have substantially contributed to our comprehension of language processing in the broader

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context of the brain. The diverse recovery patterns observed have bolstered the concept of neurofunctional modularity. The existence of diverse sociolinguistic registers among individuals who are not native speakers is perceived as neurofunctional components reminiscent of the concurrent presence of two languages within the cognitive domain of bilingual individuals. Research on bilingual aphasia has also shed light on activation thresholds for diverse representations within the non-bilingual language subsystem. Explorations into the amplified engagement of the right hemisphere in language representation among bilingual individuals have ignited investigations into the function of pragmatics in verbal communication. Specifically, researchers have explored the potential of Pragmatics as a compensatory mechanism to alleviate linguistic proficiency constraints among second language speakers, bilingual aphasia patients, and young children during their initial language acquisition process. The segregation between linguistic competence and metalinguistic knowledge in individuals learning a second language has contributed to a more profound comprehension of the intricate relationship between procedural and declarative memory in language acquisition and utilization. Furthermore, disparities in emotional system engagement between first and second languages have highlighted the involvement of the amygdala and dopaminergic systems in individuals with non-linguistic backgrounds. These findings hold significant implications for comprehending the neural representation and cognitive processing of language in the human brain and diagnosing and rehabilitating neurogenic communication disorders.

Implications for speech therapy

Before proceeding with the research on speech therapy in bilingual aphasia patients, it is necessary to identify some questions that still need to be explored. These questions are varied and have not all been addressed. For example, should therapy be given simultaneously in both languages or sequentially? If only one language is used, which language should be chosen? Other questions relate to the transfer of therapeutic benefits between languages and what factors influence this. Are translation strategies an effective tool, or should they be avoided? Does the

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effectiveness of therapeutic techniques vary depending on language structure? These questions remain unanswered, and multiple interacting factors influence the complexity of bilingual aphasia. In older patients, indirect linguistic abilities are usually difficult to recover fully, and compensatory strategies are often the only effective means. These factors create a complicated and elusive picture of language loss and recovery in bilingual aphasia patients.

Although there have been speech therapy studies in bilingual aphasia patients for many years, it is still unclear whether therapy in one language affects the language that does not receive therapy, how large the proportion is, and what conditions influence it. Most authors have agreed that therapy in two languages simultaneously can hinder the recovery of general language competence and slow the recovery of all previous languages. Therefore, therapy should be provided in one language in the early stages, with the mother tongue being the main focus or the language that shows stronger spontaneous recovery. In the case of a patient residing within a bilingual environment, other individuals should communicate with the patient to utilize the language in which the patient demonstrates higher levels of recovery. When the patient's language preference deviates from that of the speech therapist, proactive measures should be taken to involve family members or friends in therapy sessions, employing the patient's preferred language.

Empirical evidence on the therapeutic transfer of bilingual aphasia is very limited. Several studies have documented partial language transfer from treated to untreated language in individuals with bilingual aphasia. There are intertwined factors, such as the patient's initial language preference and structural differences between languages. The efficacy of therapy appears to be commensurate with the degree of resemblance between certain attributes of the two languages. However, the therapy transfer is limited to certain aspects, and no transfer occurs in written form. Therapy in one language can improve comprehension in both languages, but there is no transfer in writing. Furthermore, certain investigations have revealed that therapy interventions exclusively influence the language abilities of one patient, with no discernible impact observed in the other language. Selective responses to therapy in

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one of the languages have been documented in several instances involving bilingual patients.

Therapy in a second language has positively affected both the mother tongue and the non-therapy language. Some studies report significant improvements in the non-therapy language when therapy is conducted in a second language. For example, intensive Romanian therapy also positively impacted the patient's other language, albeit with a lower level of improvement. Some studies have also shown that therapy in a second language has a greater effect on the untreated mother tongue. Speech therapy in a second language also positively impacts both the mother tongue and the untreated second language. Therapy in a deliberately used second language improves the patient's mother tongue, including foreign or extinct languages, such as Latin. In addition, in aphasia patients with the same severity and type of aphasia in both languages, therapy with picture naming resulted in greater improvement in the mother tongue. Scholars have hypothesized that the therapeutic gains observed in one language could extend to the unaddressed language due to shared neurophysiological or linguistic structural attributes. While therapy in one language might effectively influence the semantic structure across all languages, its impact may not extend to syntax, morphology, or phonology domains.

Previous research has shown barriers to transferring skills from treated to untreated language. Sometimes, therapy in the second language only benefits the untreated mother tongue. A bilingual simulation approach may be effective for restoring language skills in bilingual aphasia. Translation can be an appropriate strategy for restoring the patient's second language competence. However, there are reports of a lack of transfer to the untreated language and therapy in both languages, improving only one language. Therefore, therapy may be effective only in one language of the patient and not in the other. The lack of success in therapy for one language does not preclude the possibility of attempting it in another language.

In the process of speech therapy for aphasia patients, several strategies can be used. Firstly, metalinguistic knowledge can be used when declarative memory is not affected. Secondly, pragmatic substitution can be done when syntactic and lexical access is inhibited. Thirdly, translation can be used at different levels of linguistic

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structure. In the previous era, speech therapists often used exercises focused on metalinguistic knowledge to retrain lost or inhibited language functions. Structural approaches and grammar exercises were similar to second language learning. While these techniques do not restore the implicit component and the ability to use language automatically, they help improve the effectiveness of the patient's communication. Another strategy is to avoid syntactic interference by replacing it with pragmatic means of communication that are still well preserved in bilingual aphasic individuals. Some methods aim to improve the patient's social interaction ability without linguistic changes. Translation can also be used when words are not available in one language. Some bilingual aphasia patients can translate or use signs when a word is not accessible in both languages.

CONCLUSION

The concurrent and equitable recovery of language abilities among individuals afflicted with aphasia in multiple languages is not universally observed. The relationship between enhanced recovery in a specific language and biological or ecological factors remains elusive. The second language can sometimes exhibit more substantial recuperation than the native language due to patients' reliance on metalinguistic knowledge in their second language.

To comprehensively assess the linguistic capabilities of individuals with aphasia, it is imperative to employ equivalent assessment tools rather than simply translating standardized tests from unrelated languages. The lack of efficacy of therapeutic intervention in one language should not be misconstrued as evidence of its ineffectiveness in another language.

When individuals lack access to implicit linguistic competence, compensatory strategies such as metalinguistic knowledge and pragmatic proficiency can be utilized as alternative means. Translation can be a viable option when individuals encounter difficulties accessing lexical items.

Bilingual individuals who acquire a second language (L2) later in life without fully established linguistic competence tend to compensate for this deficiency by

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emphasizing pragmatic elements during oral communication and employing mechanisms grounded in right-brain functions.

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