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Tutorial

Cross-Linguistic and Multicultural Considerations in Evaluating Bilingual Adults With Aphasia

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ABSTRACT

Purpose: The current study delineated a clinical and theoretical framework that clinicians and researchers can use to guide the assessment of bilingual aphasia at morphosyntactic, lexical–semantic, and phonological levels of language processing.
Method: This tutorial outlines cross-linguistic and multicultural considerations that should be addressed in evaluating bilingual adults with aphasia (BWAs).
Results: At the morphosyntactic level, we presented three features that should be taken into account when evaluating linguistic symptoms in languages considering whether they are typologically similar or dissimilar: word order, pro(-noun)-drop, and morphological inflections of verbs. We suggest that clinicians need to conduct additional error analyses that reflect typological differences in syntactic templates, argument-deletion phenomena, and morphological inflections to better understand linguistic characteristics of impairments arising from the interactions of the two languages that may differ in many ways. At the lexical–semantic level, we addressed three cross-linguistic features that may impact naming performance in BWAs: cognates, lexical frequency, and semantic typicality. The presence of cognates between the two languages can lead to differential interpretations of naming performance. In addition, the same lexical items may exhibit varying lexical frequency and typicality across languages due to cultural and linguistic differences. We suggest that clinicians should thoroughly prepare the testing items considering the linguistic distance. Finally, we emphasized differences in segmental and suprasegmental features of phonology that could contribute to cross-linguistic phenomena during assessment of two or more languages.
Conclusions: This cross-linguistic assessment framework contributes to a better understanding of linguistic impairments and communication difficulties experienced by BWAs. This framework can be utilized in current clinical practice to facilitate culturally and linguistically appropriate assessment and treatment approaches for BWAs.

Aphasia, which is considered the most common speech and language disorder after stroke, is expected to increase among bilingual individuals in the coming years (Centeno, 2009). In the United States, this projected increase in bilingual aphasia will be supported by demographic trends such as rising multiculturalism coupled with an uptick in stroke incidence, especially among racial, ethnic, and linguistic minority populations (Peñaloza et al., 2021; Scimeca et al., 2022). In addition, although aphasia has been conventionally associated with elderly individuals given that the risk of poststroke complications increases with age, recent epidemiological evidence suggests that cardiovascular disease and other stroke risk factors may soon lead to more brain injuries among younger individuals (i.e., below the age of 55 years; Leasure et al., 2022). Together, these factors indicate that bilingual adults with aphasia (BWAs),

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some of whom will experience chronic, long-lasting speech and language disabilities for a greater portion of their lives than previously anticipated, will be one of the predominant clinical subgroups in the future.

Developing clinical services to meet the projected needs of BWAs requires careful evaluation of existing guidelines for both assessment and treatment (Lorenzen & Murray, 2008). From a practical standpoint, it is important to acknowledge that BWAs present to rehabilitation programs with various patterns of impairment in one or both languages that result in communication restrictions across sociolinguistic environments (Paradis, 2004). Developing assessment procedures that accurately capture the sheer diversity in (a) the bilingual experience prestroke and (b) profiles of impairment poststroke, which lead to these social limitations among individuals, remains a significant obstacle in aphasia rehabilitation. Although previous studies have pointed to culturally and linguistically appropriate assessment as a first step in moving beyond some of these difficulties, current approaches to bilingual language evaluation do not provide clinicians with sufficient detail to judge whether their procedures meet these criteria. In this study, we revisit current approaches to assessment in bilingual aphasia and discuss how an existing framework for evaluating cross-linguistic differences between two languages could aid speech-language pathologists in strengthening the quality of speech and language evaluations they provide for bilingual clients.

Overview of Assessment in Bilingual Aphasia

Traditionally, the aim of language assessment for BWAs has been to measure impaired and preserved communication abilities in both languages (Ansaldo et al., 2008). General procedures typically include the administration of bilingual language questionnaires to characterize prestroke language abilities and estimate language proficiency followed by specific language testing, which may include a combination of formal (i.e., published behavioral assessments) and informal (i.e., unstandardized) approaches (Goral & Norvik, 2021). Although it is impossible to truly know bilingual language abilities prestroke, the combination of self-reported measures of proficiency from language questionnaires and objective data from language testing provide valuable information for designing clinical interventions (Kiran & Roberts, 2012).

Gathering background information about language history and premorbid abilities is vital when working with BWAs to establish baseline language proficiency and assist with later interpretation of language performance on a variety of clinical assessments. Without a detailed language background, deviations from expected linguistic behavior could be erroneously attributed to brain injury when it might be the case that the skill under consideration was not particularly strong or well developed in adulthood. Alternatively, linguistic skills could appear weaker due to natural cross-linguistic influence in which abilities in one language are modulated by knowledge and use of a second language (L2) across the lifespan (Kartushina et al., 2016). Examples may include altered phonological production in one language due to cross-language interaction (Best & Tyler, 2007), a reduced vocabulary (Bialystok et al., 2008) especially for highly technical terms that are only needed (and learned) in one language, and shifted verb argument structure based on transfer from a nontarget language (Salamoura & Williams, 2007).

To establish a baseline picture of language proficiency, language use questionnaires (LUQs; see Kastenbaum et al., 2019; Marian et al., 2007) are often administered to individuals with aphasia that collect information about language acquisition, use, exposure, family background, educational attainment in both languages, and language-mixing or code-switching behaviors. Language questionnaires may be completed via self-report from BWAs or with the input of caregivers or other family members who could supply chronological information about language development and shifts in behavior. Ultimately, this information is important because previous evidence has shown that patterns of impairment and recovery after stroke in BWAs are affected by bilingualism-related factors such as the age of L2 acquisition, language proficiency, language use and exposure, and linguistic distance between languages (Kuzmina et al., 2019). Furthermore, bilingual background metrics are crucial to disentangling variability in language learning, cross-linguistic influence, and poststroke impairments that may all affect performance on clinical assessments.

Specific language testing is another vital component of assessment in bilingual aphasia, which must accompany the administration of LUQs to contextualize the relationship between prestroke language abilities and poststroke levels of impairment. Naturally, it is best practice to assess poststroke abilities in both languages, and where possible, instruments should be chosen that are linguistically equivalent or that measure aspects of each language in a similar manner (Lorenzen & Murray, 2008). In reality, achieving linguistic equivalence during testing is difficult, even when using clinical instruments such as the Bilingual Aphasia Test (BAT; Paradis & Libben, 2014) that were specifically designed to elicit comparable responses across languages (M. V. Ivanova & Hallowell, 2009; Muñoz & Marquardt, 2008). Difficulties arise because norm-referenced assessments in bilingual aphasia are typically unavailable or are only standardized with one language population in mind

(e.g., Castilian Spanish only and not American Spanish). In these cases, language elicitation tasks such as verbal fluency paradigms or narrative picture descriptions with culturally appropriate stimuli may serve as more accurate clinical assessment tools (Kiran & Roberts, 2012).

Cross-Linguistic Framework in Assessment of Bilingual Aphasia

In assessing bilingual aphasia, it is critical to consider an overarching theoretical framework that helps us understand the nature of linguistic deficits arising from cross-linguistic differences and similarities between two languages. Cross-linguistic studies in aphasia have contributed to identifying both language-general and language-specific patterns of impairments across languages. These cross-linguistic features have been examined in both monolingual and bilingual individuals with aphasia, encompassing various linguistic domains such as syntax, lexical semantics, and phonology.

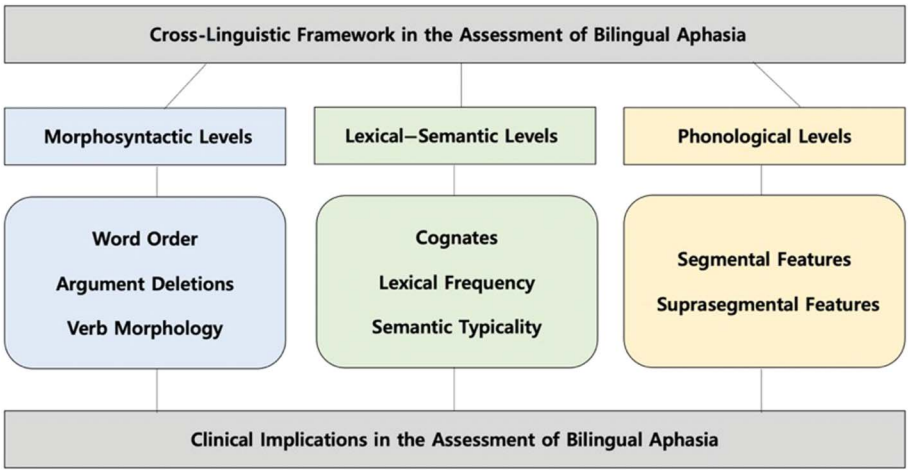
In the syntactic domain, the competition model has been employed to account for cross-linguistic differences and demands imposed on language processing (e.g., E. Bates et al., 1991; MacWhinney et al., 1984). The competition model is a psycholinguistic framework that posits different languages carry different weights for linguistic cues. For example, English speakers rely more on word order to parse a sentence, whereas speakers of languages like Korean utilize case marking cues. This feature was conceptualized as the notion of "cue validity" and "cue cost" within the competition model. Using the comparisons between English and Korean as an example, English has higher cue validity for word order due to its strong reliance on syntactic word-order principles. In contrast, languages with case marking systems, such as Korean, allow for greater flexibility in word order, resulting in relatively lower cue validity for word order than in English. Similarly, linguistic features with higher cue validity are associated with lower cue cost as these prominent linguistic cues can reduce cognitive processing demands. The principles of "cue validity" and "cue cost" within the competition model serve to delineate the varying demands of linguistic representations across languages and may be especially suited for considering morphosyntactic deficits in aphasia (E. Bates et al., 1991).

Whereas models addressing the syntactic domain in cross-linguistic studies have primarily focused on the structural differences among languages, several models in the lexical–semantic domain have highlighted linguistic similarities such as shared features of semantic concepts. One classical model, the revised hierarchical model (RHM; Kroll & Stewart, 1994), has posited a shared conceptual system between a bilingual individual's first language (L1) and L2. In addition, the connections between the conceptual system and separate lexical systems depend on an individual's proficiency in each language. The distributed feature model (DFM; De Groot, 1992) has emphasized the role of distributed semantic memory. According to the DFM, when an individual processes a word in one language, the corresponding word form is activated and hence spreads its activation through related semantic nodes, which in turn activate the word form in the other language. Similar to the RHM, the DFM assumes that the degree of activation at the semantic level depends on a bilingual's proficiency in both languages. Such cross-linguistic variations may arise from cultural differences—which are often overlooked in bilingual aphasia assessment—that present challenges when evaluating semantic processing poststroke.

Another component we must consider during the clinical assessment of BWAs concerns phonological similarities and differences at the sublexical levels of linguistic processing. Errors that emerge in either the language being tested or in another nontarget language might be attributed to vulnerabilities in phonological processing in one or both languages. These errors might not arise solely from deficits at higher levels of representation as can be seen in mixed semantic and phonological errors in confrontation naming. Recent research largely supports these clinical observations, indicating that bilingual individuals tend to activate both of their languages simultaneously during linguistic processing. This theory of nonselective language access (Costa, 2005; Costa et al., 2000; Kroll et al., 2006) carries significant implications for bilingual aphasia assessment. Given that both languages, even those that do not share the same script (e.g., Japanese and English; Hoshino & Kroll, 2008), may be active during linguistic processing, deficits in the phonological system of one language may lead to decreased performance (i.e., cross-linguistic errors or pathological switching errors) on tasks in the other language. The extent to which differential phonological processing skills are observed across languages in bilingual aphasia is further complicated by both cross-linguistic differences in phonological systems.

The current study will delineate how to use a cross-linguistic framework to guide the assessment of bilingual aphasia at morphosyntactic, lexical–semantic, and phonological levels of language processing (see Figure 1). At the morphosyntactic level, we focused on word order, pro(noun)-drop features (i.e., optional omission of pronouns in a language), and verb morphology to demonstrate how the proposed framework accounts for differences across languages. At the lexical–semantic level, we specifically focused on the effects of cognates, cross-linguistic lexical frequency differences, and semantic typicality on bilingual

Figure 1. Overall framework of the cross-linguistic considerations in the assessment of bilingual aphasia.



assessment. At the phonological level, we addressed both segmental and suprasegmental features, which are essential to consider during sublexical assessment. In all cases, we address how these factors may influence clinical diagnoses.

To illustrate aspects of this cross-linguistic framework, we employed four language exemplars, namely, English, Spanish, Chinese, and Korean, to demonstrate a diverse spectrum of linguistic typology at morphsyntactic, lexical–semantic, and phonological levels of language processing. From the morphosyntactic perspective, English and Spanish both belong to the same Indo-European language family, but they have evolved into distinct language subgroups. Spanish is categorized as a Romance language, whereas English belongs to the Germanic language group. They are both subject–verb–object (SVO) languages, but they differ in morphological inflections. As East Asian languages, Chinese and Korean exhibit contrasting linguistic features at the morphosyntactic level, partly because they belong to different language families. Chinese is part of the Sino-Tibetan language family, whereas Korean belongs to the Ural-Altaic group. Chinese typically follows a fixed SVO word order. The default word order in Korean is subject–object–verb (SOV); however, due to a rich case marking system, word order is relatively free in Korean. Furthermore, Chinese is known for its lack of inflectional morphology, whereas Korean has a high degree of verbal morphology. From the lexical–semantic perspective, languages such as Spanish and English may be more linguistically similar if they share a large number of cognates. Other lexical–semantic features such as lexical frequency and semantic typicality may be strongly affected by cultural backgrounds. At the phonological level, languages may be distinguished via segmental and/or suprasegmental phonology. For example, tones convey critical information about word meaning in Chinese but not in the other languages.

Given that English-, Spanish-, Korean-, and Chinese-speaking BWAs may have significantly different linguistic and cultural backgrounds, it is plausible to assume that linguistic processing varies across these four languages. Therefore, by utilizing these four languages, we can identify cross-linguistic features that should be considered when evaluating BWAs who use two languages that are either typologically similar or dissimilar. Although this study specifically mentions four languages, the results can provide a foundation or framework for understanding aspects of bilingual aphasia in other languages as well.

Clinical Implementations of Cross-Linguistic Framework

Morphosyntactic Features

The term "morphosyntactic" impairments in aphasiology often refers to deficits in using morphological components and/or manipulating the syntactic features that govern hierarchical structure and the sequence of linguistic constituents (E. A. Bates et al., 1988). The degree of morphological and syntactic impairments in bilingual aphasia may differ as a function of linguistic characteristics between the two languages of BWAs. Morphosyntactic deficits in bilingual aphasia depend upon the structure of each language and may differ according to specific aspects of the grammatical processing system (Paradis, 1988). However, few studies have directly investigated the impact of cross-linguistic differences on morphosyntactic

deficits in BWAs. Furthermore, cross-linguistic considerations that reflect linguistic typology—based on structural similarities and differences—are not clearly defined or tracked during the evaluation of BWAs (Kuzmina et al., 2019; Rothman, 2015). In the current study, we specifically focused on three morphosyntactic domains, given that these linguistic features are among the critical symptoms reported in describing linguistic impairments of aphasia (Grodzinsky, 2000; M. Kim & Thompson, 2000): (a) word order, (b) pro-drop features, and (c) morphological inflections of verbs. Across our four language samples, we illustrated some morphosyntactic features and challenges for cross-linguistic assessment of BWAs (see Figure 2).

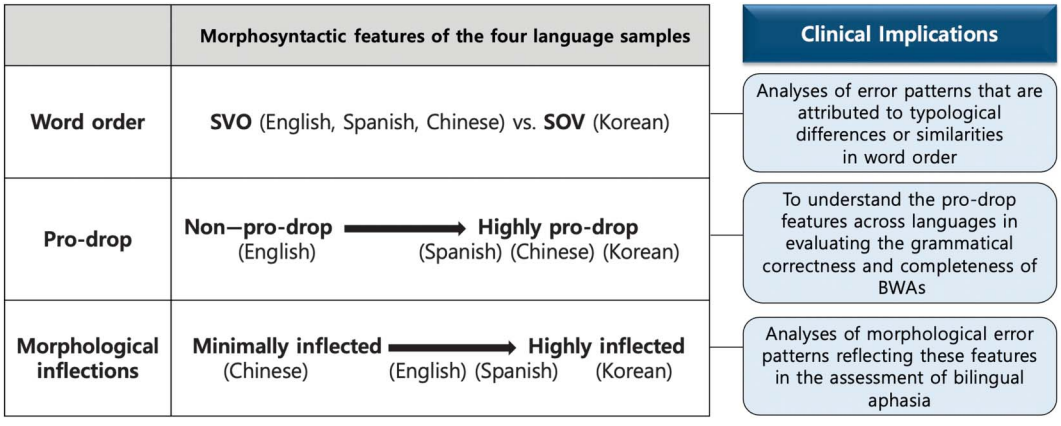
Word Order

The ability and efficiency to formulate sentences may be heavily influenced by the degree of similarity of syntactic templates between the two languages that are simultaneously activated in the bilingual brain. According to the competition model (E. Bates et al., 1991), English has higher cue validity in word order with heavy reliance on syntactic word-order principles following its SVO structure compared to other languages with relatively greater freedom of word order such as Korean. As a verb-final language, Korean follows a canonical word order of SOV, but word order variations such as object–verb–subject (OSV) are allowed due to higher cue validity in case-inflected morphemes that denote "who did what to whom" instead of word order. Therefore, BWAs may present with different patterns of grammatical breakdown given that their combinations of L1 and L2 may carry different cue validity for morphosyntactic features.

BWAs who share the same word order template in their L1 and L2 (e.g., English–Spanish) are likely to require fewer cognitive resources with respect to the arrangement of word order in sentence production. By contrast, greater resources may need to be allocated for those who must keep two—or sometimes more than two—word order templates activated by switching between structures such as Korean–English bilinguals who may produce SOV, OSV, or SVO structures based on verb-final sentence properties in Korean. Multiple activations that require greater switching costs can lead to more errors in word order selection for Korean–English BWAs compared to those who use shared word order structures.

Although there are limited studies that have directly examined the effects of differences in word order for BWAs using the language pairs that we exemplified above, some studies have explored the effects on those who use two languages with different word orders. Munarriz et al. (2016) examined performance on the comprehension of movement structures in a Spanish–Basque BWA. Spanish and Basque are typologically dissimilar languages in syntactic word order (SVO for Spanish and SOV for Basque). Furthermore, Basque has greater flexibility in word order and richer grammatical morpheme inflections than Spanish. Results demonstrated preserved syntactic representations in Spanish but selective morphosyntactic deficits in Basque under the condition at which morphology and word order generated competing cues. However, the participants' comprehension abilities were not impaired in Basque when both cues converged. The asymmetric impairments at the morphosyntactic level suggest that morphosyntactic cues are not equally available in both languages and the language-specific cues are not transferred from one language to the other due to the typological distance between them. The authors suggested that cross-linguistic effects are not prominent when language pairs are typologically dissimilar.

Figure 2. Clinical implications of morphosyntactic features among English, Spanish, Korean, and Chinese. SVO = subject–verb–object; SOV = subject–object–verb; BWAs = bilingual adults with aphasia.



Although limited, several studies have reported how word order differences affect performance on sentence production (Faroqi-Shah & Waked, 2010; Venkatesh et al., 2012) and comprehension (Munarriz et al., 2016) in BWAs. Clinicians need to critically analyze the error patterns of sentence processing to understand the extent to which linguistic symptoms may be attributed to typological differences or similarities in bilingual aphasia. More studies are needed to further investigate word order effects on sentence-level impairments in bilingual aphasia and develop relevant assessment tools reflecting these cross-linguistic differences.

Pro-Drop Features

The extent to which languages employ other grammatical features such as pronoun omission (pro-drop) may also vary. Pro-drop languages allow for complete omission of pronouns, whereas partially pro-drop languages only allow for the omission of subject pronouns. By contrast, many Northern European languages such as English are categorized as non–pro-drop languages (Bussmann, 2006) because pronoun usage is obligatory to avoid ambiguity in sentence processing. For highly pro-drop languages such as Korean, there exist no dummy subjects (e.g., "it") at all, and pronouns may be omitted as far as relevant information can be retrieved from context. In addition to Korean, Chinese and Spanish exhibit frequent pro-drop features.

In the assessment of BWAs, it is critical to be aware of these morphosyntactic features when evaluating agrammatic symptoms given that the criteria for the grammatical completeness of sentences differ across languages. Furthermore, BWAs who use two languages with different pro-drop features may demonstrate cross-language transfer in sentence production due to the differences in cue validity as evidenced by pro-drop errors when they speak non–pro-drop languages.

Although the evidence is not from BWAs, J. E. Sung et al. (2016) analyzed cross-linguistic differences in the number of verbs per utterance and noun-to-verb ratio in a picture description task by comparing two groups of English and Korean speakers with aphasia. As mentioned previously, pronoun deletion is permitted as far as information and meaning can be inferred from context in Korean. These features make Korean a verb-salient language, suggesting that Korean sentences often consist of only predicates by deleting subjects and objects when they are shared in context. Reflecting pro-drop features in Korean, the authors assumed that Korean speakers with aphasia would be more resilient to verb retrieval impairments than English speakers with aphasia, given that Korean verbs have greater cue validity with lower cue cost assigned to verb production. As predicted, results suggested that Korean speakers with aphasia produced significantly more verbs per utterance and lower noun-to-verb ratios than English-speaking individuals with aphasia when the two language groups were matched for age, education, aphasia severity, and types of aphasia. The authors argued that language-specific features need to be considered in evaluating aphasia symptoms to better understand differential characteristics of linguistic deficits in their own language.

Although none of the previous studies have directly examined pro-drop features in bilinguals speaking Korean, Chinese, English, and Spanish, studies in other language combinations have suggested that pro-drop features may affect linguistic impairments in sentence production of BWAs. Fabbro and Frau (2001) reported morphosyntactic errors of pronoun deletions in Friulian–Italian BWAs. Italian, as a partially pro-drop language, only allows the omission of subject pronouns, whereas subject pronouns are obligatory in Friulian. BWAs produced substantially more omission errors in obligatory pronouns (38.25%) in Friulian than in Italian (1.25%). The results imply that the pro-drop features in Italian are likely to affect the error patterns of subject deletion in Friulian, suggesting that morphosyntactic features of one language can be transferred to another language.

To evaluate the grammatical correctness and completeness of BWAs, it is important for clinicians to understand pro-drop features across languages and employ differential scoring guidelines to reflect these cross-linguistic features. Clinicians also need to cautiously monitor whether the pro-drop features of one language could affect the omission of pronouns in another language, especially for individuals who use typologically dissimilar languages (e.g., pro-drop vs. non–pro-drop language).

Morphological Inflections for Verbs

Morphological inflections for verbs refer to the process of modifying word forms to denote grammatical functions such as tense, case, voice, person, number, and gender. Across our four language exemplars, English, Spanish, and Chinese share a syntactic template of SVO word structure, but the degree of inflectional morphology is different among them. Both English and Spanish verbs are often inflected for person, number, tense, and aspect, although Spanish has grammatical gender and more extensive morphological inflectional systems than English. In contrast, Chinese verbs exhibit minimal overt inflections or no inflection at all. As for agglutinative languages such as Korean, almost all word classes can be inflected according to their roles in a sentence. Given the cross-linguistic variation in inflectional characteristics of verbs, it is important to evaluate the impact of these distinct features on linguistic symptoms in bilingual aphasia.

Although limited, a few studies have reported differential morphological deficits in trilingual or bilingual aphasia cases, depending on whether the language combinations are typologically similar or dissimilar. Diéguez-Vide et al. (2012) reported a rare case of a Chinese (L1)–Spanish (L2)–Catalan (L3) trilingual with aphasia who demonstrated differential patterns of linguistic deficits among their three languages. Chinese, as an isolating language, is typologically dissimilar to Spanish and Catalan, which are, on the other hand, structurally close given that they belong to the same language family with highly inflected morphological systems. Chinese was relatively preserved in the case of trilingual aphasia, whereas agrammatism was mild in L2 and more severe in L3. The morphological tasks were administered in Chinese and Catalan from the BAT, but performance on the morphological tasks was not evaluated in Spanish. The patient demonstrated 100% and 40% of accuracy in the tasks on the derivative morphology in Chinese and Catalan, respectively. However, as the authors claimed, it was not possible to directly compare the abilities of morphological inflections from Catalan to Chinese, given that morphological derivational systems are different. Altogether, the results indicate that Chinese (L1) is most preserved, followed by Spanish (L2) and Catalan (L3). The authors argued that deficits in L3 were likely attributed to L2 impairments as L2 and L3 were typologically similar. However, patterns of recovery in L1 were different due to its structural dissimilarities to both Romance languages.

In another study, de Diego Balaguer et al. (2004) reported two cases of morphological errors in Spanish–Catalan BWAs. The authors examined morphological errors in past-tense inflections of verbs as a function of regularity. Spanish and Catalan are typologically similar languages regarding morphological inflections with complex conjugations, although some cognate verbs that have regular inflections in Catalan have irregular inflections in Spanish. Not surprisingly, these participants demonstrated similar patterns of impairment in both languages, that is, greater difficulties in irregular than regular verbs. Although the above studies have attempted to examine morphological error patterns across languages in bilingual aphasia, systematic investigations are still limited from cross-linguistic perspectives with diverse language combinations.

Lexical–Semantic Features

Whereas the cross-linguistic framework for morphosyntactic features mostly focused on linguistic differences between languages in bilingual aphasia, models concerning lexical–semantic features for BWAs propose a shared conceptual–semantic system within the bilingual brain, as previously mentioned. The assumption of the shared semantic representation of a concept across languages often allows for the inclusion of direct translation equivalents when assessing lexical retrieval abilities in BWAs. However, one main issue of using direct translations is that the semantic representation of the target items may vary by language due to various lexical–semantic and sociocultural factors, leading to differences in lexical access. The extent to which translation equivalents are included in naming assessments varies across languages. For example, all items on the Spanish and Chinese versions of the Boston Naming Test (BNT; Cheung et al., 2004; K. J. Kohnert et al., 1998) are direct translation equivalents. In comparison, 51 out of the total 60 items in the Korean BNT (H. Kim & Na, 1999) are culturally adapted for Korean speakers. In this section, we address three key factors that may cause cross-linguistic differences in naming: cognates, lexical frequency, and semantic typicality (see Figure 3).

Figure 3. Clinical implications of lexical–semantic differences among English, Spanish, Korean, and Chinese. BNT = Boston Naming Test.

	Lexical–semantic features of the four language samples	Clinical Implications
Cognate effect	More cognates in Spanish–English vs. Korean–English or Chinese–English	• Check cognates • Include noncognates if needed
Frequency effect	Higher correlations between Spanish and English on the BNT items	• Use stimuli with comparable frequency • Extract frequencies from online databases
Typicality effect	Some items are more typical in one language than the other (e.g., "scallion" is a typical vegetable in Korean but atypical in English)	• Subjective ratings of typicality for each testing item • Cultural and language background via a questionnaire

Effect of Cognates

One factor that may determine bilingual language performance is linguistic distance (Kuzmina et al., 2019). It is well identified in the literature that languages with more typological similarities are linguistically closer to each other. Cognates are words with commonalities in phonological and/or orthographic form and meanings, for example, "telephone" (English) – "*teléfono*" (Spanish). A large number of words in Spanish and English are cognates, making them typologically more similar to each other than other language pairs that do not share any cognates, such as either Korean–English or Chinese–English. When evaluating lexical–semantic deficits in BWAs, it is important to note which language pairs may share cognates given that cognates may influence performance on language testing.

Healthy Spanish–English bilinguals have demonstrated better performance (i.e., faster linguistic processing) for cognates than noncognates across language tasks as evidenced by more production in verbal fluency tasks (Blumenfeld et al., 2016) and higher accuracy in picture naming (Costa et al., 2005). Similar patterns have been reported in Spanish–English BWAs (K. Kohnert, 2004). This evidence points to a cognate facilitation effect in bilinguals, which can be explained by three accounts: conceptual–semantic, lexical–morphological, and phonological–sublexical (Costa et al., 2005). From a conceptual–semantic perspective, since cognates have a larger conceptual overlap than noncognates (van Hell & De Groot, 1998), lexical retrieval of cognates is faster. From a morphological standpoint, cognates share morphological representations to some extent, making them more likely to be clustered together in the bilingual lexicon (Lalor & Kirsner, 2001). Hence, cognates may show a facilitative effect in bilingual speakers due to such lexical clustering. Finally, cognates have higher phonological neighborhood density (i.e., the number of phonological similar words that can be formed by changing one phoneme in the target word) relative to noncognates, so activating the phonological form of the target word would strengthen the form of its neighbors (Costa et al., 2005).

Despite strong evidence for a cognate facilitation effect during linguistic processing for both healthy bilinguals and BWAs, a second body of research suggests that cognates may induce interference effects depending on language dominance patterns. For example, Broersma et al. (2016) examined cognate and noncognate naming in Welsh–English healthy bilinguals, who were divided into a Welsh-dominant group and an English-dominant group. Their findings revealed lower naming accuracy for cognates in the English-dominant group when naming in Welsh, suggesting a cognate inhibition effect in the less proficient language. In BWAs, although studies have reported a facilitative effect in naming therapy targeting cognates (K. Kohnert, 2004), an inhibitory effect has also been found in individuals with lesions in the basal ganglia (Kurland & Falcon, 2011), a component of the language control network (Abutalebi & Green, 2007).

Given the above evidence for cognate effects in bilingual lexical retrieval, clinicians should pay close attention to cognates versus noncognates when assessing naming in different bilingual populations. It is important to scrutinize whether the assessment stimuli include any cognates and, if so, how they may be distributed in the lexicons of both languages. As a result, bilinguals speaking typologically similar languages (e.g., Spanish–English BWAs) may perform differently when naming specific items that are cognates than might be expected compared to bilinguals speaking typologically dissimilar languages (e.g., Chinese–English). Depending on the task, clinicians can make decisions on whether additional noncognate items should be included to thoroughly characterize an individual's naming ability.

Effect of Cross-Linguistic Lexical Frequency

The effect of lexical frequency in lexical processing has been well documented in previous studies. That is, words with higher frequency are easier to access than words with lower frequency (Almeida et al., 2007). Lexical frequency also impacts lexical access in individuals with aphasia. Previous research has found a relationship between word frequency and both phonological and semantic errors, suggesting that frequency plays a role at both the semantic and phonological levels in lexical access (Bastiaanse et al., 2016).

Lexical access is slower in bilinguals than monolinguals as bilinguals use words from each language less frequently, leading to weaker lexical connections (Gollan et al., 2005). Previous studies have corroborated this assumption and found a larger frequency effect in bilinguals than monolinguals during lexical retrieval tasks (I. Ivanova & Costa, 2008). There is also evidence indicating a relationship between the frequency effect and language proficiency. Bilinguals may demonstrate less accuracy or longer reaction times for low-frequency items, particularly in their weak or less dominant language (Duyck et al., 2008; R. Li et al., 2019), indicating that the weaker or less dominant language is more affected by lexical frequency.

The same lexical item may have different lexical frequency values across languages due to cultural and linguistic differences. As previously mentioned, direct translations in the Spanish and Chinese BNTs may not capture bilingual naming performance accurately due to this cross-linguistic difference in lexical frequency. Specifically, across shared items on the English, Korean, Spanish, and Chinese BNTs, lexical frequency is highly correlated

between English and Spanish BNTs (r = .815) but not between English and Chinese BNTs (r = .369) based on unpublished data in our lab. Higher correlations between the English and Spanish BNTs are likely due to shared linguistic features between the two languages such as cognates (Marte et al., 2023). Conversely, the adapted Korean BNT has only 10 items that overlap with those of the English BNT, and the correlation of these items' lexical frequency is relatively low (r = .194). This is likely because some items are highly frequent in both languages, for example, "camel" and "cactus," whereas other items are highly frequent in one language but less frequent in the other, for example, "globe." The differences in lexical frequency of the same BNT items suggest that although many items overlap on the standardized language test across languages, the lexical frequency values for these items vary and hence may affect language performance in BWAs.

Given the above evidence suggesting cross-linguistic differences in lexical frequency on naming task items, it is crucial for clinicians to use stimuli with comparable lexical frequency across languages to assess naming ability in BWAs. Specifically, item frequency can be checked using online databases (e.g., SUBTLEX English/Spanish/Chinese and the Sejong Corpus in Korean). These resources provide information about whether an item varies in frequency between two languages and may guide the interpretation of naming performance in both L1 and L2.

Effect of Cross-Linguistic Semantic Typicality

Another factor that highly impacts bilingual lexical processing is semantic typicality (Rosch et al., 1976). Conceptually, items that share more semantic features (e.g., "sparrow") with the prototype of a semantic category (e.g., "birds") are more typical than those that share fewer semantic features (e.g., "penguin"). However, the internal category structure may vary by language users with different language backgrounds and cultures. For example, "dates" are considered a prototypical fruit in some North African countries but not in the United States or the United Kingdom (Croft & Cruse, 2004). Therefore, we cannot assume that the effect of semantic typicality on language processing is similar across languages.

Cross-linguistic differences in semantic typicality have been identified across individuals with different cultural backgrounds. For example, Schwanenflugel and Rey (1986) have examined typicality ratings by Spanish- and English-speaking monolingual adults in the United States. They found different ratings between these two groups on items such as "raspberry" (rating was 5.38 in English vs. 3.74 in Spanish), suggesting that semantic typicality may be attributed to individual variations in language or cultural background. Another bilingual study investigated typicality ratings in Dutch–French bilingual adults and compared them with Dutch- and English-speaking monolinguals (Ameel et al., 2009). Their findings showed more similar ratings between languages in bilingual participants than between bilingual and monolingual participants. The same items in English and Korean also vary by typicality rating (Kiran & Thompson, 2003; J. Sung & Kim, 2011). For instance, the word "celery" is a typical item in English but an atypical item in Korean. In contrast, items such as "scallion" and "garlic" under the semantic category of "vegetable" are rated as typical in Korean but as atypical in English. This is likely because "scallion" and "garlic" are key ingredients in kimchi, which is one of the most famous side dishes served at almost every meal in Korea. This evidence suggests that semantic typicality is one of the psycholinguistic variables that is heavily influenced by cultural backgrounds. Altogether, these previous examples describe how cultural differences affect typicality ratings in a semantic category. Hence, clinicians need to consider any cross-linguistic differences in semantic typicality and incorporate them into bilingual naming assessment.

One approach that clinicians can adopt is to ask for subjective ratings of each tested item. For example, clinicians can ask clients to rate their familiarity with an item or its typicality on a Likert scale in each assessed language. These ratings can directly reflect clients' familiarity of the tested items, which plays a significant role in their bilingual naming performance. An alternative approach is to collect their cultural and linguistic background via a questionnaire. Questions can shed light on the source of vocabulary acquisition in each language (i.e., learned in school vs. studying abroad), which can facilitate clinical understanding of whether certain tested items may be less typical in one language than the other.

Phonological Features

Thus far, we have detailed aspects of morphosyntactic and lexical–semantic processing that should be monitored and assessed carefully when working with poststroke BWAs. Our discussion of clinical assessment would be incomplete, however, without examining the capacity for similar cross-linguistic phenomena at sublexical levels of linguistic processing given that speech production underlies both morphosyntactic and lexical–semantic skills as we have presented them in this study. Indeed, errors produced in the language being tested or in the other, nontarget language could result from vulnerabilities in phonological processing in one or both languages rather than solely from deficits at higher levels of representation (i.e., consider mixed semantic and phonological errors in confrontation naming).

These clinical possibilities are supported by the large amount of contemporary research that suggests bilingual

individuals activate both of their languages in parallel during linguistic processing. This theory of nonselective language access (Costa, 2005; Costa et al., 2000; Kroll et al., 2006) has implications for assessment in bilingual aphasia. Given that both languages may be active during linguistic processing, deficits in the phonological system of one language may lead to altered speech sound production in the other language. The extent to which differential phonological processing skills are observed across languages in bilingual aphasia is further complicated by cross-linguistic differences in speech sound systems (e.g., tone in Chinese vs. absence of tone in English, Spanish, and Korean). In the sections below, we organize phonological features into segmental and suprasegmental subtopics and then present differences in language dialects to provide a brief survey of speech sound systems and detail how processing may be influenced by cross-linguistic differences (see Figure 4).

Segmental Features

Segmental features in phonology refer to the smallest units that represent meaning in a given language. Naturally, the extent to which a sound system can be divided into discrete units on the basis of sublexical features that distinguish units from one another varies across the languages of the world, as does the degree of phonological overlap between any two languages. Among the four language exemplars discussed throughout this work, there is significant variation in phonology even for English and Spanish, which overlap in many other linguistic features as members of the same language family.

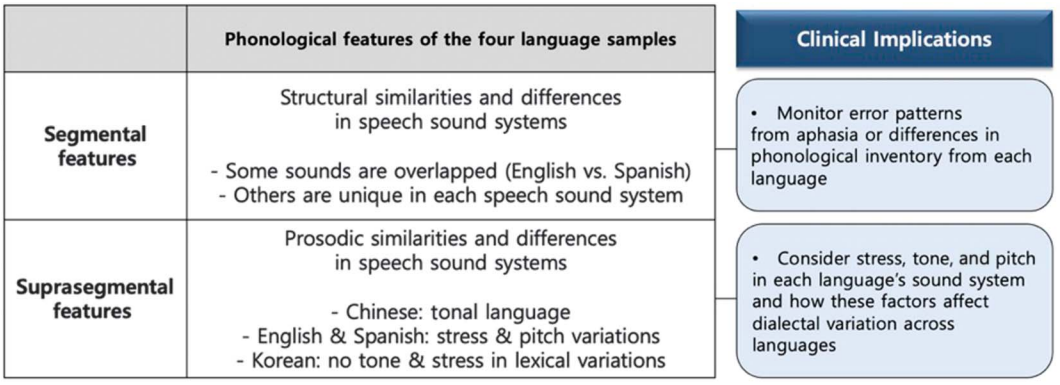
For example, American English possesses an expanded set of vowels in comparison to the other languages, including 11–12 monophthongs and five major diphthongs. Chinese has a series of retroflex consonants that do not exist in the other three languages, namely, /tʂ/, /tʂʰ/, and /ʐ/; furthermore, it lacks consonant clusters present in other languages as words begin with a single consonant. Most varieties of Spanish realize voiced plosives (i.e., /b/, /d/, /g/) as voiced fricatives ([β], [ð], [ɣ]) in intervocalic positions (Anderson & Centeno, 2007). Finally, Korean has a three-way contrast (tense–lax–aspirate) for plosives and some affricates (e.g., /p*/, /p/, /pʰ/) and no contrast between /ɹ/ and /l/ that set it apart from English, Spanish, and Chinese (Ha et al., 2009). These unique phonological aspects are meant to illustrate some basic differences in speech sound systems between languages given that a formal analysis of speech sound inventories is beyond the scope of this work. In a clinical environment, knowledge of the sound systems of the client's language(s) is crucial to understanding whether a given error may arise from speech sound vulnerabilities in one language poststroke or from structural differences between languages that may be mediated by pre- or poststroke proficiency.

For example, let us consider a Korean–English bilingual who is completing an English confrontation naming test. The client produces [ɹɑk] for the target picture [lɑk] ("lock"), and this response could be interpreted in two ways. First, this could be interpreted as an error in speech production that would be explained by vulnerabilities in English phonological processing poststroke leading to misselection of /ɹ/ instead of /l/ and subsequent misarticulation of the final target. However, given that the individual is bilingual, a second explanation could be that parallel activation of the English and Korean sound systems was responsible for the unexpected response. Under this view, it would be vital to know that there is no phonological contrast for /ɹ/ and /l/ in Korean and, therefore, the response [ɹɑk] could have resulted from the cross-linguistic influence of Korean on English.

Suprasegmental Features

Individuals with aphasia may also present with poststroke deficits affecting suprasegmental aspects of phonology (Cappa et al., 1997) or features such as stress, tone,

Figure 4. Clinical implications of phonological differences and similarities among English, Spanish, Korean, and Chinese.



and pitch that may be layered over segments to change the quality of speech production. Suprasegmental features such as lexical stress may serve to differentiate a set of words that are otherwise phonologically identical (e.g., **per**mit and per**mit** in American English); this aspect of speech production alone makes it important for clinicians to carefully monitor speech production above and beyond just sounds (segments) themselves. Similar to segmental features, suprasegmental aspects of phonology vary across English, Spanish, Chinese, and Korean, and in the clinic, it will be important for clinicians to be aware of these differences to determine if unexpected patterns of tone or stress in one language could be due to poststroke deficits or cross-language influence from another language.

For example, as a tonal language, Chinese phonology differs from the other three languages in its unique lexical tone, which uses pitch variation to indicate differences in word meaning. Chinese has four contrastive tones (Duanmu, 1990): level (Tone 1), rising (Tone 2), fall/rise (Tone 3), and falling (Tone 4). For example, a Chinese syllable /ma/ can represent four different meanings when carrying different tones: 妈 /ma1/ (mom), 麻 /ma2/ (hemp), 马 /ma3/ (horse), and 骂 /ma4/ (curse).

Deficits in tone perception and production have been identified in Chinese-speaking individuals with aphasia (Q. Li et al., 2021). These individuals may demonstrate impaired tone perception in listening identification and/or incorrect tone production in word repetition as compared to healthy controls. Therefore, potential tone deficits make it important for clinicians to consider language-specific phonological features when assessing Chinese-speaking individuals with aphasia. For example, during naming assessment, clinicians should be aware of other possible word meanings with tone variations. Hence, if a client produces a target name accurately except for the tone (e.g., target is 飞 /fei1/ [fly], but response is 肥 /fei2/ [fat]), a phonological error should be scored accordingly.

Unlike Chinese phonology, English and Spanish do not have a tonal system for representing differences in word meaning according to pitch variation. However, these two languages do employ lexical stress to differentiate words in their lexicons (e.g., **con**vert and con**vert** in English, ***ha**blo* ["I speak"] and *ha**bló*** ["he/she/it spoke"]). In both English and Spanish, the default position for lexical stress falls on the penultimate syllable; however, there are words across the languages that do not adhere to this rule, and in Spanish, a system of rules exists to determine the position of written stress in a word based on its visual word form, which is not possible in English. Nevertheless, the similar nature of stress patterns is important given that previous evidence has suggested that individuals with aphasia produce more phonological errors for words with weak–strong (i.e., the first syllable in a bisyllabic word is unstressed) patterns of stress (Nickels & Howard, 1999). Although this evidence is based on observations from English-speaking individuals with aphasia, similar patterns of phonological errors may be expected cross-linguistically in Spanish given the similar structures of the languages.

By contrast, Korean does not use tone or lexical stress to differentiate lexical items from one another. Therefore, when working with Korean BWAs, it is especially important to examine suprasegmental features during language production tasks as any errors in stress or tone in a language other than Korean could be due to cross-language differences (i.e., the absence of these features in Korean) rather than poststroke linguistic deficits.

Nevertheless, suprasegmental features other than stress do distinguish dialects of Korean from one another. In comparison to Mandarin Chinese, Chinese dialects vary in terms of tone, consonants, and vowels (Chen, 2000). For instance, many Chinese dialects have complex tone sandhi patterns, in which the realization of a tone varies depending on the context of the syllable (i.e., a third tone changes to a second tone when followed by another third tone). In addition, some dialects such as Shanghainese lack the retroflex consonants found in Mandarin (i.e., /ʈʂ/, /ʈʂʰ/, and /ɻ/). Other dialects in northern and central China have retroflex vowels, which are syllabic fricatives derived from high vowels (i.e., /i/, /u/, /y/) following sibilant initials (Chang & Shih, 2015). Finally, American English and Spanish dialects mostly differ within language based on segmental differences. For example, some Peninsular dialects of Spanish retain the fricative /q/, which is absent from Latin American dialects (Mackenzie, 2001). In Southern American English, patterns of vowel merging can be seen in which a vowel such as /ɪ/ represents both /ɪ/ and /ɛ/ in intervocalic positions (e.g., "pin" and "pen" are both realized as [pɪn]).

Ultimately, it is important to recognize differences both within language in terms of dialects and also across languages so that clinicians may expect interactions between the language under evaluation and the other languages a client may know. In this case, it is vital to note each response a participant produces and to verify the accuracy or appropriateness of responses after, by either checking in with the family or caregivers or consulting high-quality linguistic resources in the given language.

Overall Clinical Recommendations

Thus far, we have made the case for adopting cross-linguistic approaches to language assessment in bilingual aphasia. In our view, a cross-linguistic assessment framework

that includes morphosyntactic, lexical–semantic, and phonological elements will ultimately yield a better understanding of language impairment and other communication difficulties for each bilingual adult. The utility of this framework may be applied to current clinical practice to advance our assessment procedures in various ways. In the sections below, we discuss aspects of the framework in relation to clinical practice and present examples to guide implementation.

Obtain Language Background Information

As mentioned previously, it is important to obtain information about bilingual language history to estimate prestroke language abilities before any language testing is administered. A number of bilingual questionnaires may be adapted for use in aphasia to gather this information such as the Language Experience and Proficiency Questionnaire (Marian et al., 2007) or the LUQ (Kastenbaum et al., 2019), and it may be useful to enlist the support of a caregiver or family member during a clinical interview with the participant. More importantly, language background information may change from pre- to poststroke, so it may be beneficial to inquire about information from these two epochs separately. Establishing patterns of use and proficiency is also essential to determining the degree of cross-linguistic interaction and the capacity for skills in one language to have influenced the other pre- and poststroke.

Contextualize the Presence and Frequency of Language Mixing

Clinically speaking, collecting language background information is crucial not only to estimate premorbid abilities and postmorbid changes but also to describe patterns of language mixing and switching. Given that code-switching and other language-mixing behaviors are governed by sociolinguistic rules and context such as relationships between interlocutors, it is important to establish the typical conditions for using both languages so that this information can be used to contextualize impairment. Furthermore, different language combinations may be associated with more frequent language mixing. For example, Spanish–English bilinguals routinely engage in code-switching, which is undoubtedly facilitated by the structural similarities between the two languages, even when fluency in one language may be low (Lipski, 2014), Therefore, it is likely that responses or utterances produced in a language other than the one being tested may be more indicative of typical behavior rather than cross-linguistic errors for Spanish–English BWAs. For other language combinations, however, unexpected language-switching behavior may point to cross-linguistic errors as a result of language deficits.

Test Vulnerabilities in Both Languages

After language background information has been gathered, a testing battery may be constructed to examine specific language deficits. Testing batteries will undoubtedly be guided by the goals of the assessment and the interests of the client, but clinicians will need to consider the materials available to them in each language. For example, some language combinations such as Spanish and English may have more published instruments available for assessment, but these materials are also more likely to be direct translations. Deciding which assessments to use will require careful consideration of whether equivalent instruments are available in both languages or whether informal language tasks such as discourse samples could be used to probe for deficits in a culturally appropriate manner (i.e., a Chinese-speaking clinician asks a Chinese–English bilingual to retell a famous and well-known story or myth), as bilingual language performance can vary by cultural background (Paradis & Libben, 2014).

For one specific example, we could consider a picture description task in which a Korean–English BWA is asked to provide responses only in Korean during one session and then responses only in English in a separate session. During the Korean testing session, pro-drop behavior was observed in descriptive utterances given that this is a well-established grammatical rule in Korean. However, these same pro-drop features were also observed during English testing. After scoring both description tasks, the clinician concludes that the client has greater morphosyntactic impairment in English compared to Korean given that pronoun omission is ungrammatical in English. On the surface, these clinical findings appear straightforward; however, there are at least three possible explanations for these patterns of pro-drop features. First, if the client reported that Korean was their more proficient and frequently used language prestroke, pro-drop behavior in English could be evidence of cross-linguistic influence driven by the transfer effects of dominant linguistic features from Korean to English (i.e., this pattern is a natural consequence of healthy bilingualism before brain injury). Alternatively, this ungrammatical behavior could be attributed to selective morphosyntactic impairment in English that may be indistinguishable from cross-linguistic influence from Korean on English and for which the client may not be consciously aware (i.e., pronoun omission is grammatical in at least one language). Finally, this behavior could be attributed to cross-linguistic influence from Korean on the English pronominal system that appears after the stroke mediated by increased usage of Korean as the more spared language poststroke and a commensurate decrease in English usage and proficiency due to greater overall impairment (i.e., English undergoes language

attrition). Determining whether these pro-drop errors may be attributed to prestroke cross-linguistic influence, poststroke language attrition, or impairment in aphasia is vital to ensure that clinicians select targets for therapy that will reflect language rehabilitation rather than language (re)learning.

It may also be beneficial to ask clients to estimate their performance on an assessment prestroke to guide the interpretation of results. In the previous example, we might ask our Korean–English client if they were able to produce English pronouns in discourse before their injury, especially if performance on the picture description task was poor. During other testing such as confrontation naming, clinicians may ask clients to provide a rating of how likely they were to know the name of a picture in a given language before their stroke; low familiarity ratings may suggest certain words were never learned prestroke, and therefore, any incorrect responses to those items may reflect individual differences in bilingual language learning rather than true language impairment.

Consider Additional or Alternative Scoring Procedures

Finally, clinicians need to make decisions about how they will approach scoring when clients produce responses that are correct in context but differ from an expected response. Some of these decisions may be determined by the type of the assessment and the goals for the session. For example, during confrontation naming testing in Spanish, a Spanish–English client may produce "house" for the expected target, "*casa*"—a correct nontarget response that is the English translation of the expected Spanish target. If the goal of the assessment is to examine semantic abilities, accepting correct responses in the nontarget language may provide a more accurate understanding of poststroke semantic abilities in a conceptual scoring framework. By contrast, during a morphosyntactic assessment in which responses in both languages are produced but the grammatical structures are language specific, the nontarget language responses may be scored as incorrect.

To accurately score responses in a dialect other than the mainstream ones often reflected on clinical assessments, clinicians may need to modify scoring guidelines. For example, when administering an English sentence production task to an African American English (AAE)-speaking adult with aphasia, responses should be scored correctly if they include the zero copula and show variable use of (a) overt marking of the simple past tense and (b) the third-person singular present-tense morpheme *–s*, as these features are grammatical in AAE (Hendricks & Adlof, 2017) but not in mainstream American English dialects.

Similar modifications should be considered across lexical semantics and phonology during confrontation naming testing. Given that many confrontation naming assessments do not allow any phonological deviations, administration and scoring in a language like Spanish—which has several mutually intelligible dialects that differ in phonology—may require additional clinical insight. For example, alternative correct responses for "*máscara*" [ˈmaskaɾa] (*mask*) include [ˈmahkaɾa] or [ˈmakaɾa] based on Caribbean Spanish dialect variations (Hammond, 1989). In addition, on the same confrontation naming test, a Spanish-speaking individual could produce "*serrucho*" or "*sierra*" (for English "saw"); both are correct responses whose frequency differs according to dialect. Overall, clinicians are encouraged to consult dictionaries, other high-quality resources in a given language, and/or the client's caregivers to resolve ambiguity surrounding whether aspects of morphology, lexical semantics, or phonology would be correct within an established dialect.

In addition, item-level analyses may provide useful information about the nature of underlying impairment. During morphosyntactic assessment, special attention should be paid to differences in inflectional morphology between language combinations. For example, Korean verbs require more inflectional morphology than do Chinese verbs across tense and aspect; the facility with which a client may employ verb forms in both languages will inform the degree of impairment and relative abilities between the two. For lexical–semantic assessment, greater difficulties in naming for objects that are atypical or less frequent in one language may also contextualize deficits in organization of the shared lexicon between languages.

Conclusions

The current study delineated a combined clinical and theoretical framework that clinicians and researchers could use to evaluate BWAs who have diverse language backgrounds. We provided an overview of linguistic features that clinicians should consider at morphosyntactic, lexical–semantic, and phonological levels of assessment. At the morphosyntactic level, we presented three linguistic features that should be taken into account during assessment: word order, pro-drop features, and morphological inflections of verbs. We suggest that clinicians conduct additional analyses that capture typological differences in syntactic templates, argument-deletion phenomena, and morphological inflections to better understand language impairment arising from the interactions of two languages. At the lexical–semantic level, we addressed three cross-linguistic features that may impact naming performance in BWAs: cognate status, lexical frequency, and semantic

typicality. The presence of cognates between the two languages can lead to differential interpretations of naming performance, and the same lexical items may exhibit varying lexical frequency and typicality across languages due to cultural and linguistic differences. Finally, we emphasized differences in segmental and suprasegmental features of phonology that could contribute to cross-linguistic phenomena during assessment of two or more languages. Although this study highlights four specific languages, its findings can lay the groundwork for understanding aspects of bilingual aphasia in additional language combinations. In summary, this cross-linguistic assessment framework contributes to a better understanding of linguistic impairment and communication difficulties after stroke and can be utilized to facilitate culturally and linguistically appropriate assessment approaches for BWAs.

Author Contributions

Jee Eun Sung: Conceptualization, Supervision, Writing – original draft. **Michael Scimeca:** Writing – original draft. **Ran Li:** Writing – original draft. **Swathi Kiran:** Conceptualization, Supervision, Writing – review & editing.

Data Availability Statement

Data are available on request from the authors.

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