Original Research

Binding Processing in Turkish-German Bilingual Aphasia: a Multiple Case Study

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Abstract

Aim: The current multiple case study investigates whether Turkish-German bilinguals with aphasia extend to binding constructions and whether pronoun variables show selectivity in bilingual people with aphasia (PWA). These constructions involve referential dependencies, which are difficult for PWAs to compute.

Methods: Three Turkish-German bilingual people with aphasia participated in this study and received an offline Picture Verification Task. It is predicted that bilingual PWA would perform worse with pronouns than reflexives or show similar levels of impairment in both pronoun and reflexive conditions in the conditions that involved anaphoric elements with referential antecedents for both languages. On the other hand, it is predicted that they would perform much better in pronouns than in reflexives if the antecedent is quantificational, as they would tend to reject the bound interpretation of pronouns according to the quantificational asymmetry phenomenon.

Results: Each subject's performance was analyzed individually to see if there were any differences between the PWAs' bilingual profiles. The results align with the literature findings that there is a selectivity in PWAs regarding the binding of referential elements to their antecedents.

Conclusion: The onset of bilingualism and premorbid language imbalance influences the different impairment patterns observed in Turkish-speaking bilingual PWA.

Keywords: aphasia, bilingualism, bilingual aphasia, binding, syntax

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Introduction

The term "bilingual" refers to people who use two or more languages or dialects in their everyday lives (Grosjean, 1992; Grosjean & Miller, 1994). Aphasia studies in bilingual speakers show different patterns of impairment and recovery for the two languages (Ansaldo et al., 2008; Weekes, 2010). Bilingual people with aphasia (PWA) do not demonstrate the same language disruptions with the same degree of severity in both languages. Thus, it is not ethically acceptable to assess bilingual PWA in only one of their languages (Paradis, 1995). While most bilingual PWAs display a parallel total recovery rate, some show differential or selective recovery patterns. For instance, in one of the earliest studies, Fabbro (2001) examined 20 right-handed, bilingual Italian-Friulian speakers and indicated that approximately 65% of bilingual PWA exhibited parallel recovery, 20% had more significant impairment of the second language (L2), and 15% had greater impairment of the first language (L1). In a review study in which 132 cases were included, 61% of bilingual PWA exhibited parallel recovery, 18% differential recovery, 7% blended, and 5% selective (Paradis, 2001).

Regarding recovery conditions other than parallel recovery, it is known that the most critical factors related to the non-parallel recovery process are the competence level of L1 and L2 before aphasia syndrome, the age at which languages are acquired, and the extent of language exposure and use. Many factors have been proposed to influence recovery patterns, such as age, proficiency, age of acquisition, and type of bilingualism, but Paradis (1977) proposed that recovery patterns most likely result from a combination of these factors. To briefly describe these recovery patterns, in parallel recovery, both languages are recovered simultaneously; in selective recovery, only one language slowly comes back while the other is never recovered; in antagonistic recovery, one language is initially available, and as the other language recovers, the initially available language disappears; in successive recovery, one language improves before the other one; and lastly, in mixed recovery, languages are mixed in the recovery process (Paradis, 1977). Rare instances of unusual recovery have been documented. Even though one of the languages was never used for communicative purposes before aphasia, it was very well preserved, and the patient's primer language was completely lost (Paradis, 1983; Aglioti & Fabbro, 1993). Although unparalleled recovery in L1 and L2 is controversial in the literature, many different suggestions have been discussed. Ribot's law suggested that the most recently acquired (L2) language would be more susceptible to deterioration (L1 recovery). Pitres' law generally stated that the best-known language would be more prone to recovery because the neural elements specific to that language would be more

closely linked (Pearce, 2005). However, it is still debated whether the best-known language, the most frequently used language, or the mother tongue will be more prone to recovery.

The study of bilingual PWA with parallel impairment of both languages seems to confirm the hypothesis that grammatical disorders in aphasia depend on the language structure, and grammatical errors will be different only at the junctures where the two languages differ (Fabbro, 2001). The present multiple case study seeks to investigate whether Turkish-German bilinguals with aphasia extend to binding constructions. These constructions involve referential dependencies, which are difficult for PWAs to compute (Edwards & Varlokosta, 2007; Grodzinsky et al., 1993; Love et al., 1998; Rigalleau & Caplan, 2004). Binding constructions involve a co-referential relation between an antecedent NP and reflexives or pronouns. Reflexives, such as Monkey$_i$ is touching himself$_i$, require a c-commanded antecedent, that is, they must be bound in their local domain, whereas pronouns, such as Monkey$_i$ is touching him$_j$ do not because the antecedent is not in the same domain. In the latter case, an extrasentential link, that is, 'discourse linking', should be made to interpret the pronoun 'him', which is harder to understand for PWAs (Choy & Thompson, 2010).

Comprehension of Binding Constructions in Aphasia

Although pronouns are one of the most widely studied syntactic phenomena in aphasia (Arslan et al., 2021), comprehension of binding constructions has not been studied widely in aphasia in the literature (Edwards & Varlokosta, 2007; Grodzinsky et al., 1993; Love et al., 1998; Rigalleau & Caplan, 2004; Choy & Thompson, 2010). However, to the best of our knowledge, there has been no study regarding the binding constructions in bilingual PWA. While the fact that aphasia adversely impacts pronoun processing is consistent among the authors, the question of what causes this is still controversial. Some studies examined pronouns and reflexives (i.e., she/herself, he/himself) and demonstrated mixed results, as some studies found that non-fluent PWA performs better with reflexives than direct object pronouns (Blumstein et al., 1983; Edwards & Varlokosta, 2007; Grodzinsky et al., 1993; Love et al., 1998; Rigalleau & Caplan, 2004), while others have demonstrated opposite results (Thompson & Choy, 2009); still others have shown similar levels of impairment in both pronoun and reflexive conditions (Choy & Thompson, 2010), or no impairment at all in personal pronouns and reflexives (Bos et al., 2014).

Many accounts have been proposed to explain the nature of pronoun processing difficulty in aphasia. According to the slower-than-normal syntax model (Burkhardt et al., 2008; Burkhardt et al., 2003), sentence interpretation deficits in aphasia are mainly the result

of slowed syntactic computation, suggesting that reflexive anaphors are better preserved or unimpaired than object pronouns. Still, they can only process them more slowly. In contrast, the resource reduction model proposes potential pronoun interpretation deficits in aphasia with reduced cognitive resources, resulting in failures in interpretation processes either due to impaired lexical processes or reduced working memory capacity (Caplan et al., 2013a, 2013b, 2015). This is based on evidence from individual self-listening studies with picture validation tasks examining object pronouns and reflexives (among many other syntactic constructs), where pronoun impairment is associated with poor performance on working memory tasks (i.e., digit span). In another account, delayed lexical integration predicts that sentence comprehension difficulties in bilingual PWA aphasia result from a delay in the integration of lexical information into sentence interpretation (Thompson & Choy, 2009; Choy & Thompson, 2010; Hanne et al., 2011). This hypothesis is based on the eye-movement studies that observed equally poor performance on both pronoun and reflexive conditions; however, no differences were observed for PWA when compared to healthy controls. According to another account based on the eye-movement studies, an increased interference model predicts that strong activation of non-target interpretation interferes with the intended interpretation in PWA and causes a sentence interpretation difficulty (Dickey et al., 2007; Dickey & Thompson, 2009; Hanne et al., 2011). According to eye-movement studies (Hanne et al., 2011), PWA's eye-fixations during sentence listening focused on non-target visuals depicting a non-target interpretation of a given sentence. The discourse-linking impairment model predicts that pronouns referring to previous discourse are proposed to be rather more impaired for PWA than, for instance, reflexives, as reflexive anaphors refer to local referents in the same sentence. Lastly, the grammatical vs. lexical account predicts that grammatical pronouns are predicted to be rather more impacted in PWA based on the ProGram theory defined within a usage-based framework of grammatical status (Ishkhanyan et al., 2017; Martinez-Ferreiro et al., 2020; Martinez-Ferreiro et al., 2017). According to Boye and Harder (2012), pronouns can be classified as lexical or grammatical depending on their inherent discourse prominence and dependency, whereas lexical items can be discursively primary and have the potential to convey meaning in isolation (e.g., Help!), grammatical items are discursively secondary and depend on a (discursively primary) host. According to these perspectives, grammatical pronouns are more cognitively demanding than lexical pronouns because they require a combination and can be more easily reduced for communicative purposes. This means that grammatical pronouns are expected to be more severely impacted in aphasia compared to lexical pronouns. In a recent

study that used the same methodology as the present study, it has been proposed that Turkish PWA are prone to quantifier spreading errors; however, such quantificational scope errors seem independent of pronominal or anaphoric resolution (Arslan et al., 2023).

Present Study

The interpretation of reflexives and pronouns is known to be restricted by structural constraints. The Binding Theory structurally regulates the relations between anaphoric elements and their antecedents (Chomsky, 1993). Principle A defines syntactic conditions on the interpretation of reflexives, which are constrained to being referentially dependent on a c-commanding antecedent within a local domain. In contrast, Principle B prohibits a pronoun from taking a c-commanding antecedent within the local domain (see 1). This study aims to examine whether these pronoun variables show selectivity in bilingual PWA's impairment (a) in the conditions that involve anaphoric elements with referential antecedents (see 1) and (b) in the conditions that involve anaphoric elements with quantificational antecedents (see 2).

(1)　a.　Tavşan$_i$　kendi-ni$_i$ /o-nu$_j$ göster-iyor

　　　　rabbit　　self-/him-ACC　show-PRES.3SG

　　b.　Der Hase$_i$　　　　　zeigt　　sich$_i$/ihn$_j$

　　　　the rabbit show-PRES.3SG self/him.ACC

　　　　'The rabbit$_i$ is showing himself$_i$/him$_j$'

(2)　a.　Her tavşan$_i$ kendi-ni$_i$ /o-nu$_j$ göster-iyor

　　　　every rabbit　　　　　　　self-/him-ACC　show-PRES.3SG

　　b.　Jede Hase$_i$ zeigt　　　　sich$_i$/ihn$_j$

　　　　every rabbit　　　　　　　show-PRES.3SG　　　self/him.ACC

　　　　'Every rabbit$_i$ is showing himself$_i$/him$_j$'

We predict that bilingual PWA would perform worse with pronouns than reflexives, in line with (Grodzinsky et al.,1993; Love et al., 1998) or show similar levels of impairment in both pronoun and reflexive conditions in the conditions that involved anaphoric elements with referential antecedents for both languages (Edwards & Varlokosta, 2007). On the other hand, we predict that they would perform much better in pronoun than in reflexive if the antecedent is quantificational since, in this case, they tend to reject the bound interpretation of pronouns, which is a phenomenon that Elbourne (2005) has called a quantificational asymmetry.

Method

Participants

The present study included three Turkish-German bilingual PWA (two females and one male) born in Turkey but moved to Germany as children due to labor migration. The first language of all three participants is Turkish, and the second language is German. Table 1 shows the demographic characteristics of the bilingual PWAs who participated in this study. All three participants were assessed and diagnosed with mild-to-moderate non-fluent aphasia using the Turkish Aphasia Assessment Test (Toğram & Maviş, 2012) in Turkish and the Bogenhausener Semantik-Untersuchung (BOSU) (Glindemann, 2002) and the naming part of the LeMo test (De Bleser et al., 1997), which is a computer-assisted system in German. All participants reported being fluent in both languages in their daily lives before the stroke.

Our first case, TT, is a 41-year-old right-handed housewife with 12 years of education. She suffered a stroke 18 years ago, before the onset of this study. Her auditory comprehension was relatively spared.

The second case, TY, is a 40-year-old charwoman, right-handed with 12 years of education. She suffered a stroke about 1.5 years ago, prior to the onset of this study. Her auditory comprehension was relatively spared.

The third case, BD, is a 36-year-old engineer, a right-handed man with 16 years of education. He suffered a stroke 16 years ago, prior to the onset of this study. His auditory comprehension appeared intact. BD was still receiving speech therapy for both languages for six months at the time of testing, whereas TT and TY had received speech therapy for a few years in the past. All three participants signed an informed consent form.

Table 1. Demographic and Clinical Information of Bilingual PWA Participants

|	Age	Gender	Etiology	Post-onset	Education	L2 Acq.	Diagnosis
TT	41	F	Left CVA	18	High School	10-12	ADD, LEMO, BOSU
TY	41	F	Left CVA	1,5	High School	10-12	ADD, LEMO, BOSU
BD	36	M	Left CVA	16	University	10-12	ADD, LEMO, BOSU

Acq: Acquisition; ADD: Turkish Aphasia Assessment Test; BOSU: Bogenhausener Semantik-Untersuchung; CVA: cerebral vascular accident; LEMO: Lexicon and morphology. F: Female; M: Male.

Materials

Çiyiltepe & Aydın's Picture Verification Tasks were used for the experimental task (Çiyiltepe & Aydın, 2007). This test was the Turkish version of Chien and Wexler's Picture Verification Tasks (Chien & Wexler, 1990). In the test, there are four sentences from each construct in (3) (a total of 32) with true and false matches, and four control structures (16 in total) from each construct in (4) where there were true and false matches (a total of 48 sentences). All of the action verbs used in sentences, e.g., *yıkamak* (to wash), *kurulamak* (to dry), *göstermek* (to show), and *dokunmak* (to touch), are semantically reversible actions. These verbs were chosen because, among them, *yıkamak* (to wash) and *kurulamak* (to dry) are verbs that can also be lexically reflexive (reflexivisatible) in Turkish. However, verbs such as *göstermek* (to show) and dokunmak (to touch) are used only with reflexive pronouns (self), which do not allow reflexive morphology. In the experimental test, the verbs *yıkamak* 'to wash' and *kurulamak* (to dry) are presented with reflexive pronouns but not in reflexive forms. For each sentence, using colored pictures (see Figure 1), environments with true and false matches were created, and the subjects were asked to answer "yes" or "no".

(3)   a. DP-anaphor   *Tavşan kendini gösteriyor 'The rabbit is showing himself'*

        b. DP-pronoun   *Tavşan onu gösteriyor 'The rabbit is showing him'*

        c. QP-anaphor   *Her tavşan kendini gösteriyor 'Every rabbit is showing himself'*

        d. QP-pronoun   *Her tavşan onu gösteriyor 'Every rabbit is showing him'*

(4)   a. DP-DP   *Tavşan maymunu gösteriyor 'The rabbit is showing the monkey*

        b. QP-DP   *Her tavşan maymunu gösteriyor 'Every rabbit is showing the monkey'*

Figure 1. A Sample of Visual Picture Panels
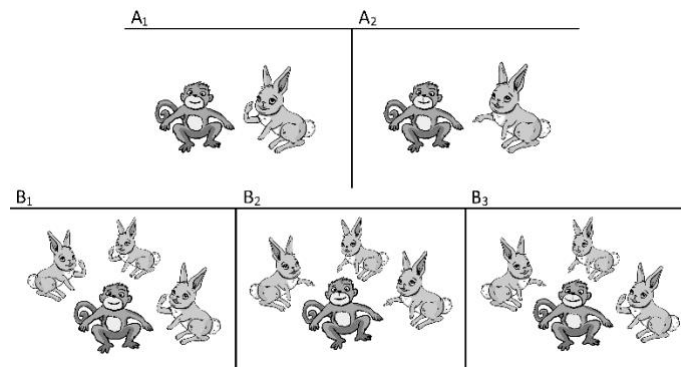
For A1, the visual reflexive condition, the auditory stimulus (3a) is a matching condition, and (3b) is a mismatching condition; for A2, the auditory stimulus (3b) is a matching condition, and (3a) is a mismatching condition. The auditory stimulus (4a) is a matching condition for B1, (4b) is a matching condition for B2, and B3 is used for mismatching conditions.

Procedure

The picture verification task was conducted at the Berliner Werkstaten Betriebe and Logopadie in Wedding Speech Therapy Clinics in Berlin, Germany, and was accompanied by an expert speech therapist. Tests were carried out in two sessions. Participants' responses were noted on a score form for later analysis during the test. Turkish and German *Picture Verification Task*s were administered to the participants on different days. The tests were administered to the participants in accordance with the following instructions: "*Now, I'm going to show you one picture on each page. I'm going to ask you to look carefully at these. Then, I will say some sentences about the picture. If the sentence I said matches the picture, I will ask you to evaluate it as 'yes', 'no' or 'undecided'. Try to focus well on whether the picture and the sentence I'm saying match up*".

Results

Table 2 and Figure 2 present the scores of three bilingual PWAs in Turkish and German tasks. Since the task is quite easy for neurologically typical individuals, in cases where the bilingual control group performed at ceiling level, although TT performed at ceiling level in Turkish tasks (see Table 2 and Figure 2), she performed worse than the bilingual control group in German tasks. BD and TY also performed worse than the bilingual control group.

Table 2. For Each BWA, the Proportional Accuracy Score for Different Tasks (Turkish and German)

Patient		Antecedent: DP		Antecedent: QP	
		Turkish	**German**	**Turkish**	**German**
TT	DP	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)	87.5 (0.35)
	Anaphor	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)	75.0 (0.46)
	Pronoun	100.0 (0.00)	87.5 (0.35)	100.0 (0.00)	87.5 (0.35)
TY	DP	100.0 (0.00)	100.0 (0.00)	75.0 (0.46)	87.5 (0.35)
	Anaphor	75.0 (0.46)	87.5 (0.35)	87.5 (0.35)	100.0 (0.00)
	Pronoun	100.0 (0.00)	87.5 (0.35)	100.0 (0.00)	100.0 (0.00)
BD	DP	100.0 (0.00)	100.0 (0.00)	100.0 (0.00)	87.5 (0.35)
	Anaphor	87.5 (0.35)	100.0 (0.00)	62.5 (0.52)	75.0 (0.46)
	Pronoun	62.5 (0.52)	100.0 (0.00)	75.0 (0.46)	100.0 (0.00)

Numbers in parenthesis indicate the standard deviation, DP: Determiner Phrase; QP: Quantifier Phrase.

Figure 2. Proportion Accuracy Score for Different Tasks (Turkish and German) for Each PWAs
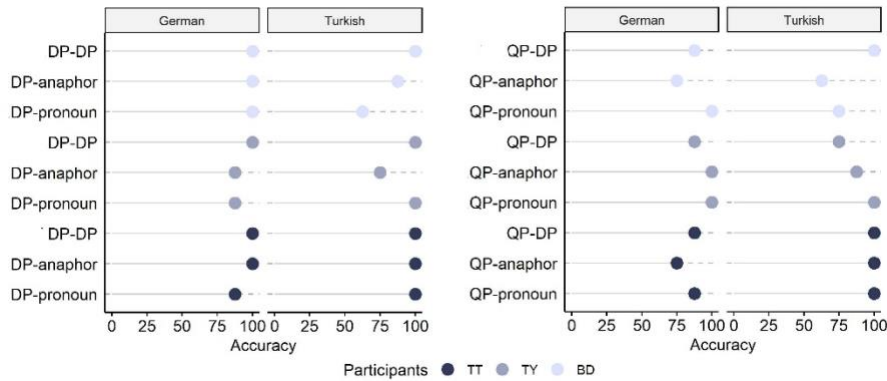
DP: Determiner Phrase; QP: Quantifier Phrase.

A chi-square test of independence was performed to assess the relationship between conditions and matching. There was not a significant relationship between the two variables in the case of the DP antecedent ($\chi2$ [17] = 19.10, p=.32), while there was in the case of the QP antecedent ($\chi2$ [17] = 69.8, p<.001).

A chi-square test of independence was performed to examine the relationship between participants and the conditions when the antecedent is DP. The relation between these variables was significant in Turkish ($\chi2$ [4, 24] = 10.12, p<.01) but not in German ($\chi2$ [4, 24] = 1.14, p = .89). Similarly, there is a significant relationship between participants and the conditions when the antecedent is QP in Turkish ($\chi2$ [4, 24] = 11.12, p<.05), but not in German ($\chi2$ [4, 24] = 3.27, p=.51).

Overall, TT showed the highest performance among the three participants in both tasks (94.8% SD = 0.22). She performed at ceiling level in the Turkish task, while she made 87.5% correct responses in the DP-pronoun condition and 100% in the DP-anaphora and DP-DP conditions in the German task, but a chi-square goodness of fit test revealed that the proportions did not differ by condition ($\chi2$ [2, 24] = 1.09, p =.58). Similarly, in the case of the QP antecedent, she performed at ceiling level in the Turkish task, and in the German task, the proportion of her performance on QP-pronoun (87.5%), QP-anaphor (75.0%), and QP-DP (87.5%) conditions did not differ ($\chi2$ [2, 24] = 1.25, p =.54).

Participant TY, with a score of 91.67% (SD = 028), showed an almost similar pattern to TT in the German task, with the performance of the DP-pronoun condition (87.5%), and similarly, the proportion of performance in the German task did not significantly differ by conditions ($\chi2$ [2, 24] = 1.14, p=.56). She performed similarly well in those conditions in the

Turkish task ($\chi2$ [2, 24] = 4.55, p =.10). In QP antecedent conditions, she made approximately the equivalent number of errors on the three conditions in the German task (QP-pronoun, 100%, QP-anaphor, 100%, and QP-DP, 87.5%) ($\chi2$ [2, 24] = 1.09, p =.58). In the Turkish task, on the other hand, she showed a higher number of errors in the QP-DP condition (25%) than in the QP-anaphor (%12.5) and QP-pronoun (no errors), but the differences were not significant ($\chi2$ [2, 24] = 3.57, p =.16).

These results show that BD performed with 87.5% (SD = 0.33) accuracy in all conditions in both the Turkish and German tasks. Chi-square goodness of fit test revealed that the proportions differed by three conditions ($\chi2$ [2, 24] = 8.75, p<.05). His performance on the DP-pronoun condition (62.5%) was worse than on the DP-anaphor condition (87.5%) in the Turkish task ($\chi2$ [1, 24] = 4.16, p<.05). He also showed a higher number of errors in the DP-pronoun condition than in the DP-DP condition (100%), ($\chi2$ [1, 24] = 8.65, p<.01), but the proportions did not differ between the DP-anaphor and DP-DP conditions ($\chi2$ [1, 24] = 0.83, p=.36). In the case of the DP antecedent, he performed at the top of his ability in the German task. A chi-square goodness of fit test revealed that the proportions in the Turkish task differed by three conditions ($\chi2$ [2, 24] = 9.21, p<.01). His performance on the QP-anaphor condition (62.5%) was worse than on the QP-DP condition (100%), but there were no differences between QP-anaphor and QP-pronoun (75%), ($\chi2$ [2, 24] = 1.14, p=.28) or between QP-DP and QP-pronoun ($\chi2$ [2, 24] = 3.57, p=.58). By contrast, there are no significant differences between conditions (i.e., QP-pronoun, QP-anaphor, and QP-DP) in the Turkish task ($\chi2$ [2, 24] = 3.57, p =.16). Interestingly, his performance on the QP-DP condition (87.5%) was worse than on the QP-pronoun condition (100%).

Discussion and Conclusion

This multiple case study aimed to investigate whether Turkish-German bilinguals with aphasia extend to binding constructions. A general summary of the findings is presented in Table 3.

Table 3. Summary of the Individual Analysis

	Antecedent: DP		Antecedent: QP	
Patient	**Turkish**	**German**	**Turkish**	**German**
TT	*ceiling level*	*pronoun=anaphor= DP*	*ceiling level*	*anaphor=pronoun=D P*
TY	*pronoun=anaphor =DP*	*pronoun=anaphor= DP*	*anaphor=pronoun=D P*	*anaphor=pronoun=D P*
BD	*pronoun>anaphor =DP*	*ceiling level*	*anaphor=(pronoun)> DP*	*anaphor=pronoun=D P*

DP: Determiner Phrase. QP: Ouantifier Phrase.

TT and TY exhibit a more or less similar pattern in their performance, with no hierarchy found regarding the binding of pronouns, anaphors, and DP binders to DP or QP antecedents in either participant (see Table 3). These findings deviate from the literature, which indicates selectivity in PWAs regarding the binding of these elements to their antecedents (Grodzinsky et al., 1993; Love et al., 1998).

In contrast to TY, TT shows performance at the ceiling level in the Turkish task, indicating that TT is at the same level as neurologically typical individuals in Turkish and does not have a disruption in terms of binding principles. However, TT exhibits disruption in her L2, German, compared to her L1. This difference persists despite TT having received language treatment mostly in German since her post-onset. Although greater impairments in a bilingual PWA's L2 are not uncommon, TT presents a greater disruption in her L2 compared to her L1. Interestingly, TY's performance indicates that both her L1 and L2 are still impaired equally.

The findings of BD, who scored the lowest, are in line with the literature suggesting selectivity in PWAs regarding the binding of referential elements to their antecedents (Grodzinsky et al., 1993; Love et al., 1998). BD performed better with reflexives than direct object pronouns in Turkish. Although this finding was not observed in TT and TY, it is predicted that the reason for its occurrence in BD may be related to the different post-onset times. While the post-onset times of TT and TY are 16 and 17 years, respectively, BD's post-onset period is only 1.5 years. Additionally, BD's performance in German shows no hierarchy regarding binding constructions, and he performs at the ceiling level in German, suggesting no disruption in BD's L2.

These different patterns of impairment observed in bilingual PWAs may be influenced by premorbid language imbalance, as suggested by previous research (Sebastian et al., 2012; Paradis, 2004).

In line with Edwards and Varlokosta's study (Edwards&Varlokosta, 2007), we observed that the participants made more mistakes when the antecedents were QP. In addition, in cases where antecedents were QP, it has been observed that they had more difficulty with anaphors. TT and TY scored very low on those conditions that involved quantificational antecedents, particularly in sentences with reflexives, in just the same way as Edwards and Varlokosta (Edwards&Varlokosta, 2007). Taken together, it is clear that our bilingual PWA made more mistakes when the antecedents were QP. In addition, in line with Elbourne, when the antecedents were QP, our participants had more difficulty with anaphors (Elbourne, 2005). This observation was statistically significant in the findings of BD in Turkish. The present study has several limitations. One potential confound is the different post-onset times between the subjects. We aimed to analyze each subject's performance individually and avoided proposing any further generalizations.

In conclusion, this multiple case study delved into the investigation of binding constructions among Turkish-German bilinguals with aphasia. The examination of TT and TY revealed a notable consistency in their patterns, with no discernible hierarchy observed in the binding of pronouns, anaphors, and DP binders to DP or QP antecedents. Contrary to the anticipated selectivity in PWAs regarding binding principles, both participants exhibited comparable performances across linguistic elements. While TT showcased proficiency at the ceiling level in Turkish, her performance in German indicated disruption, highlighting the impact of language treatment primarily administered in the latter language. Conversely, TY displayed impairments in both L1 and L2, underscoring the complexity of language disruptions in bilingual PWAs. The case of BD, with the lowest score, aligned with existing literature highlighting selectivity in PWAs concerning referential elements. The differences in impairment patterns, particularly BD's performance with reflexives and direct object pronouns in Turkish, were attributed to varying post-onset times. Interestingly, BD exhibited no disruption in his L2 (German), challenging expectations of greater impairments in a bilingual PWA's L2. The observed patterns in bilingual PWAs' impairments were influenced by premorbid language imbalance, consistent with previous research. Additionally, participants demonstrated increased difficulty when antecedents were quantificational phrases, aligning with previous studies by Edwards, Varlokosta, and Elbourne (Edwards & Varlokosta, 2007; Elbourne, 2005). Despite acknowledging limitations, such as disparate post-onset times among subjects, this study sheds light on the intricate nature of language disruptions in bilingual PWAs and emphasizes the need for tailored therapeutic interventions based on individual linguistic

profiles. Ultimately, the insights gained from this study have the potential to guide speech-language therapists in crafting interventions that consider the intricate interplay of linguistic factors in bilingual individuals with aphasia, thereby enhancing language outcomes in this specific population.

Conflict of Interest

The authors declare that they have no conflict of interest.

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