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Passive Sentence Constructions by Hindi-English Bilingual Speakers with Broca's Aphasia

By

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This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

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ABSTRACT OF THE THESIS

PASSIVE SENTENCE CONSTRUCTIONS BY HINDI-ENGLISH BILINGUAL SPEAKERS WITH BROCA'S APHASIA

Background. It has been observed that speakers with Broca's aphasia often have difficulties producing complex sentences with movement-derived structures. An example of this are passive sentences. Production of passive sentences in Broca's aphasia is characterized by role reversals and syntactic errors in English. However, research on passive sentence constructions in languages which are syntactically different from English, such as Hindi, is scarce. Hence, more research is required to better understand language specific difficulties that patients with aphasia face while producing complex sentences and what can explain these deficits. Several language models try to explain the deficits in complex sentences in Broca's aphasia. *Representational models* such as the Trace Deletion Hypothesis (TDH) (Grodzinsky, 2000) claim that some syntactic representations are lost in certain structures involving movement. *Processing models* claim that the computational mechanisms required to process syntactic representations are limited. For example, the Competition Model (MacWhinney et al., 1991) proposes that speakers resort to language specific cues while producing sentences. Based on this assumption, speakers should resort to word order cues in English while inflection and case markers should have the highest cue validity in Hindi. A better understanding of which model applies and which cues are most salient to speakers is important to guide effective treatment of monolingual and bilingual people with aphasia.

Aim. The aim of the present study was to conduct a pilot investigation to determine what type of data would be required to investigate the performance of Hindi-English bilingual speakers in comprehension and production of passive sentences.

Methods. Since a vast majority of population is bilingual in India, the current study focused on bilingual speakers. Five adult Hindi-English bilingual speakers with Broca's aphasia participated in the study. Their language competence was assessed using the Cookie Theft picture description task from the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass et al., 2001). This was followed by the two main experimental tests which aimed to study passive sentence production and comprehension. Passive sentence

comprehension was assessed using a sentence-to-picture matching task from subtest 55 for passives in the Psycholinguistic Assessments of Language Processing in Aphasia (PALPA) (Kay et al., 1992). Passive sentence production was tested using a picture description task adapted from the PALPA.

Results. The results indicate that in the English passive sentence production task, the participants produced a higher number of syntactic errors than role reversals. The results for the passive production task in Hindi showed that the percentage of role reversals and syntactic errors was almost the same. The results do not support the Competition model since a higher number of role reversals were expected in English in comparison with Hindi. Other models cannot explain these types of differences in bilingual speakers with Broca's aphasia's language samples either.

Conclusion. The asymmetry between English and Hindi results suggests that the current participants did not always resort to language specific cues while producing sentences. The finding that the number of role reversals was higher in Hindi in comparison to English suggests the presence of cross-language effects, i.e., the patients might have made use of cues such as word order in Hindi while producing passives which could have been transferred from English. However, more data needs to be collected in future studies in order to confirm the findings of the current study.

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Introduction

The current study investigated passive sentence constructions by Hindi-English bilingual speakers with Broca's aphasia. The thesis is organised into four main chapters. An overview of each of these chapters is presented below.

The background in the "literature review" (chapter 1) following this introduction provides an overview of bilingualism and aphasia. The discussion about aphasia is followed by a section on bilingual aphasia which includes details about some recent studies on Hindi-English aphasia. The subsequent section discusses different types of aphasia and narrows down to the discussion on Broca's type of aphasia. This is followed by sections on the difficulties faced by speakers with Broca's aphasia while producing complex sentences and the reasons behind these problems. The chapter ends with outlining the rationale for the current study, its aim, objectives and the research question.

Chapter 2 provides details of the "methodology" used in the current study. The chapter begins with a discussion of the study design for the present research. This is followed by a description of the participants and the materials used for the study. The subsequent sections discuss the data collection procedures and how the data was analysed.

Chapter 3 presents the results of this study and covers the language profiles of each participant across all the experiments of the study. The chapter also makes group comparisons by focusing on the comparisons between comprehension vs production, actives vs passives and English vs Hindi.

The "discussion", chapter 4, brings together findings of the current study. The chapter begins with the results for the comparisons between different sentence types and modalities, i.e., comprehension vs production, and actives vs passives. The subsequent section discusses the difference between the performances of participants between the structured tasks and the spontaneous speech samples. This is followed by a discussion of the research question, i.e., the difference in the performance of the participants across

English and Hindi. The chapter concludes with a discussion about the limitations of the current study and implications for future research.

CHAPTER -1

Literature Review

This thesis is about passive sentences constructions by Hindi-English bilingual speakers with Broca's aphasia, and therefore the literature review will cover a discussion on bilingualism, Broca's aphasia and bilingual aphasia. The review of the literature will initially discuss bilingualism (section 1.1). This will be followed by a section on aphasia (section 1.2). The subsequent section will present a detailed description of bilingual aphasia (section 1.3). The next section will discuss various types of aphasia and Broca's aphasia in more detail (section 1.4) followed by a discussion of the issues faced by speakers with Broca's aphasia while producing and comprehending complex sentences (section 1.5). The next section will discuss language models that can be used to explain the deficits in complex sentence production and comprehension in Broca's aphasia (section 1.6). The literature review will conclude with a rationale discussing research gaps and the experimental questions for the proposed research.

1.1 Bilingualism

While monolingualism may be the norm in the Western world, a large population uses more than one language for communication (Endo & Reece-Miller, 2010; Jeffery & van Beuningen, 2020). Okal (2014) states that speakers who can communicate in more than one language are called 'bilinguals' or 'multilinguals'. Sometimes the term 'bilingualism' is used interchangeably with the term 'multilingualism' but there is a difference between the two (Okal, 2014). While bilingualism is the ability of a speaker to communicate effectively in two languages, multilingualism is the ability of a speaker to communicate effectively in two or more languages.

Those who have acquired two languages during childhood are called early bilinguals whereas those who acquire a second language in adulthood are late bilingual speakers (Kalia et al., 2011). Among early bilinguals, those who have acquired a language from birth are simultaneous bilinguals, those who have learned a second language during childhood are called early sequential bilingual speakers (Kohnert, 2013). Apart from the age of language acquisition, some researchers have also tried to classify bilinguals on the

basis of language proficiency. 'Balanced bilinguals' are the speakers who are equally competent in two languages from birth, whereas 'dominant bilinguals' are those bilingual speakers who are more proficient in one language than the other (Pavlenko, 2012). However, it has been questioned whether it is possible to achieve or maintain an absolutely equal degree of language competence across two languages. Many bilingual speakers can express themselves in certain situations better in one language than the other. Kohnert (2013) further argues that language proficiency is a fluid procedure rather than an end state. She discusses that language abilities of individuals continue to develop when enough resources are available; language abilities decline if resources are insufficient or become impaired. Resources are both internal and external to the speaker (Kohnert, 2013). Internal resources which have an effect on language maintenance include the integrity of the sensory, cognitive, neurobiological and motor systems. Resources external to the speaker comprise language opportunities and experiences available in an individual's educational, social, and vocational environment. Internal resources can be impaired in language disorders such as aphasia. In order to provide effective treatment, it is necessary to know which resources are affected. This is particularly true for bilingual speakers with aphasia to understand how this impacts their two languages.

The current study focuses on Hindi-English speakers with Broca's aphasia from India. Before discussing how aphasia affects the internal language resources available to these speakers, it is important to establish the external environment in which the language is used. The next section therefore discusses bilingualism and other language demographics of India in more detail.

1.1.1 Scope of Bilingualism in India

The Constitution of India (2021[1]) has recognized 22 languages as the official languages of the country. Some of the most commonly spoken languages in India include Hindi, Bengali, Marathi, Telugu, Tamil, Gujarati, Kannada, Malayalam, and Punjabi. According to the most recent census of India, the 2011 Census of India, Hindi is the most prevalent language in India with 57.1% speakers. The results of the census also show that Hindi is

[1] The Constitution of India was first enacted on 26 January 1950. Several amendments have been made to the Constitution every few years since 1950. The Constitution was last amended in 2021.

the most prevalent language in the northern states of India whereas Telugu and Tamil are the most popular languages in southern India. According to the 2001 census of India, approximately 25% of the total population of India are bilingual[2] speakers. This is higher than the statistics of the 1991 census of India which reported that only 19.44% of the total population of India is bilingual. The 2001 census also states that approximately 86 million Indians reported English as their second language and 39 million Indians reported English as their third language. Although this is a small percentage of the total population of India (1.03 billion), this makes English the second most prevalent language in India (Census of India, 2001). English continues to be an important language in India due to its continued use as an official language by the central government alongside Hindi (Constitution of India, 2021). English has developed new syntactic patterns and phonology since colonial times after heavy contact with Indian languages and a new variety of English has emerged in India (Sharma, 2005; Wiltshire & Harnsberger, 2006). Some phonological features of Indian English include the use of retroflex [ʈ] and [ɖ] in words such as *but* and *could*, clear [l] in word-endings where standard British English uses a dark [l] such as in words like *all* and *call* etc. (Sailaja, 2009; Schneider, 2011). Some morphosyntactic features of Indian English include overextension of *-ing* on verbs as in "*we are knowing each other*" instead of "*we know each other*", or omission of definite and indefinite articles etc. (Sailaja, 2009; Schneider, 2011; Sharma, 2005). The following section highlights some features of Hindi that are relevant for characterisation of syntax, lexicon, and morphology in comparison with English.

1.1.2 Comparison of Hindi and English Grammar

This study focuses on syntax and morphology, which are inter-related. For example, it has been observed that word order influences other linguistic features, such as the placement of determiners before or after nouns, the existence of prepositions or postpositions, the presence or absence of pro-drop and of dative subjects (Thompson, 2010). In addition, word order is linked to the amount of inflectional markers (Bose et al., 2021). For example, English is predominantly an analytic language, i.e., it is mainly made up of free lexical units and there is a small amount of inflection. Hindi is a highly inflected language with verbal conjugation according to tense, person, aspect, gender, number and

[2] They speak more than one of the official languages of India.

honorification; inflectional markers for number and gender on nouns and pronouns (Agnihotri, 2022; Montaut, 2005). The inflectional nature of words in a language is, therefore, associated with the flexibility of word order (Bose et al., 2021), e.g. due to the higher number of inflections, word order is flexible in Hindi whereas it is more fixed in English. Table 1 summarizes syntactic, lexical and morphological properties of Hindi and compares them with those of English.

Table 1 Summary of relevant linguistic features for Hindi and its contrast with English

Syntactic Properties	**Hindi**	**English**
Canonical word order	SOV	SVO
Flexibility of word order	Flexible	Rigid
Question constructions	Question words do not change the structure of the declarative sentence.	Question words change the structure of the declarative sentence.
Relative constructions	Flexible order of independent and dependent clauses.	Rigid order of relativized clauses.
Passive constructions	Case markings are used instead of the preposition '*by*' to indicate the agent.	The preposition '*by*' is used to indicate the agent.
Lexical categories		
Open-class words		
Nouns	Present	Present
Verbs	Present	Present
Compound verbs	Frequent	Infrequent
Adjectives	Present	Present
Adverbs	Present	Present
Closed-class words		
Pronouns	Pro-drop, similar inflectional system to nouns	Limited inflections
Prepositions	Absent	Present
Postpositions	Present	Absent

Auxiliaries	Present	Present
Reduplication	Common	Rare
Morphological Features		
Nominal morphology	Limited inflections	Limited inflections
Nouns are inflected for:		
Number	Marked with suffix	Marked with suffix
Gender	Marked with suffix	Not marked
Verbal morphology	High number of inflections	Limited inflections
Auxiliary verbs	Present	Present
Verbs are inflected for:		
Tense	Marked with auxiliary	Marked with suffix
Aspect	Marked with suffix or auxiliary	Marked with auxiliary
Person	Marked with suffix or auxiliary	Marked with suffix but limited
Gender	Marked with suffix or auxiliary	Not marked
Number	Marked with suffix or auxiliary	Limited to third person singular
Honorification	Marked with suffix or auxiliary	Not marked

Note. The table highlights some relevant linguistic features, i.e., syntactic, lexical and morphological, for Hindi (Agnihotri, 2022; Montaut, 2005; Singh & Sarma, 2011) and compares them with those of English (Bose et al., 2021).

Morphology in Hindi and English

As indicated in Table 1, Hindi verb morphology is extensive and complex. Verbs are inflected for tense, aspect, person, gender, number and honorification. Singh and Sarma (2011) discuss that inflection on verbs in Hindi might appear as suffixes or as auxiliaries. For example, in the sentence 'vəh (She) pi:-**t**i (drink-participle-sg-f) hɛ (be-3s-present[3])' (*She drinks*), the habitual aspect is marked on the main verb using a suffix. In the sentence 'vəh pi: (drink) **rəh**-i (progressive-sg-f) **hɛ**' (*She is drinking*), the progressive aspect is

[3] sg stands for singular, f for feminine, and 3s for third person singular.

marked using the auxiliary verb 'rəh'. Interestingly, the burden of tense is almost entirely carried by the auxiliary verb in Hindi (Agnihotri, 2022).

Syntax in Hindi and English

Generally, most sentences in Hindi conform to the SOV (Subject – Object – Verb) word order (Agnihotri, 2022; Montaut, 2005). This is in contrast to English which predominantly follows an SVO word order. However, this word order changes in complex sentence constructions in both languages. For example, in interrogatives, a question word is inserted at the beginning of the clause and the auxiliary and subject are inverted in English (Agnihotri, 2022). Since the word order in Hindi is not as rigid, the question word can be placed at the beginning or end of the constituent before the main verb (Agnihotri, 2022).

There are no differences between relative clauses in both languages apart from the flexibility in the placement of the relative clause in sentences. In English, it is not possible to invert the order of dependent and independent clauses in relativized sentences. For example, in the sentence 'This is the cake that Susie baked', the order of the independent clause 'This is the cake' and the dependent clause 'that Susie baked' cannot be changed. Agnihotri (2022) states that in Hindi, the order of clauses in relative sentences is more flexible.

This study focused on passive constructions. Although these constructions are not particularly frequent in either language, they lend themselves well to studying how speakers manipulate grammatical concepts, and specifically, how these may differ across languages, as outlined in the next section.

Passives in Hindi and English

In English, the passive type of an active sentence is formed by adding an appropriate form of the auxiliary verb 'to be' and the past participle of the main verb of the active sentence. The subject of the active sentence becomes the object of the passive sentence and is preceded by the preposition 'by' (Bruening, 2012). For example, the active sentence '*Mary chased the dog*' transforms into the passive sentence '*The dog was chased by*

Mary'. In this example, the form of the verb 'chase' has been changed to its perfective form in the passive sentence along with the addition of the past tense of the verb 'to be'. Also, the subject of the active sentence, '*Mary*', has become the object of the passive sentence and is preceded by the preposition 'by'.

Hindi also has active and passive voice, however, in contrast to English, several passive forms are available to speakers, as illustrated in example 1.1.2:

1.1.2 (a). ACTIVE - *Amit is frightening the cat.*

(Hindi) - əmit billi ko ɖərɒ rəhɒ hɛ
(Amit) (the cat) (ACC marker)(to frighten)(Pres.Cont.)(to be)

(Hindi light verb construction[4])
(Subject) (Object) (Verb)

1.1.2 (b). PASSIVE – *The cat is being frightened by Amit.*

(Hindi) - billi ko əmit kɛ dwɒrɒ ɖərɒjɒ dʒɒ rəhɒ hɛ
(NOM marker[5])(by) (frighten-Pfv.[6]) (be.Pres.[7])

(see footnotes)

OR

1.1.2 (c). billi əmit dwɒrɒ ɖərɒi dʒa rəhi hɛ

In the first type of passive (1.1.2 (b)), the verb phrase is formed by combining a perfective participle with an auxiliary verb, similar to English (Agnihotri, 2022; Montaut, 2005). In this example, 'ɖərɑjɑ dʒa' is the perfective participle form of the main verb 'ɖara' (*to frighten*) and 'rəha hɛ' is the present tense form of the auxiliary verb 'rəha hɛ' (*to be*). However, instead of the preposition 'by' in English, case markings are used in Hindi. The positions of the accusative and nominative case markers get interchanged. The word order of the passive sentence changes from SVO to OVS. The object of the passive can be realised by either the instrumental case marker –*se* or –(*ke*) *dwara* '-Gen through' (Bhatt,

[4] Light verbs refer to verbs that do not behave like standard verbal predicates as they have depleted semantic contribution to the event described by the light verb construction (Vaidya et al., 2016). Verb phrases in Hindi are mostly light verb constructions. For example, 'rəhɒ' in 1.1.2(a) is the present continuous (Pres.Cont.) marker.
[5] NOM stands for nominative case marker. ACC stands for accusative case marker.
[6] Perfective participle of the verb 'to frighten' in Hindi.
[7] Present tense of the auxiliary verb 'to be' in Hindi.

2003). However, with greater use of overt objects in passives (due to the influence of English on written Hindi), -(ke) dwara has become the most frequently used marker to mark the object and *–se* has been limited to inabilitative passives. Inabilitative passives are a type of passive construction that have widely been attested in the literature on passives, especially in South Asian language studies. These type of passives convey the inability of the agent to initiate the event denoted by the predicate, hence they are called inabilitative passives (Chandra & Srishti, 2014). However, these types of passives were not used in the study as the study focused on reversible passives where the agents were always animate.

As illustrated above (1.1.2 (c)), there is another possible type of passive sentence construction in Hindi, which is less frequent. This type of passive is different from the one in 1.1.2 (b) in terms of case marking and verb inflection. In 1.1.2 (b), the object of the sentence has been marked by a nominative case marker 'kɛ' and the subject has been marked by an accusative case marker 'ko' whereas in 1.1.2 (c), there is no case marking on either the subject or object of the sentence. Also, the main verb in 1.1.2 (b) has been inflected for the gender of the object whereas the main verb in 1.1.2 (c) has been inflected for the gender of the subject. Although the sentence in 1.1.2 (c) is a grammatical construction, it is rarely used in writing or in formal conversations and it seems to be limited to casual talks and the literature on non-reversible passives. There are no reports in the literature regarding the frequency of the two passive constructions to date.

Reversible versus Non-Reversible Passives

Syntactic and morphological complexity are not the only variables impacting on performance in the production and comprehension of passives. Conceptual complexity in terms of the plausibility of a particular sentence meaning is a further factor. Both language development and language impairment studies have observed that speakers tend to make less errors with thematic role assignment in non-reversible than reversible passives. Non-reversable include sentence pairs such as 'The boy is eating the apple' – 'The apple is eaten by the boy'. Speakers are less likely to confuse the agent and patient in this construction as 'The boy is eaten by the apple' is not a logical sentence. On the other hand, in reversible structures such as 'The boy pushes the girl', meaning does not guide

the interpretation of the grammatical structure as each noun is plausible as agent and patient, and thematic role errors are therefore more likely (Cho & Thompson, 2010). In order to ensure that investigations can pick up all potential error types without inadvertently cueing the participant, it is thus important to use reversible passives as elicitation material.

1.2 Aphasia

Every 6 seconds, an individual in the world has a stroke affecting his/her quality of life (Mackay & Mensah, 2004). Aphasia is a frequent sequelae of stroke, with up to 38% of stroke survivors being diagnosed with aphasia (Engelter et al., 2006). Although the most common cause of aphasia is stroke, it may also result from brain tumors, head injuries or other progressive neurological conditions. It is not thoughts that are affected for speakers with aphasia, but the ability to access these thoughts through language. Kohnert (2013) states that the severity and nature of aphasia can vary from a word-retrieval deficit (anomia) to a complete loss of speech. The severity of aphasia for most speakers falls in between these two extremes (Kohnert, 2013).

Whilst aphasia has been relatively well described for English and some other Germanic and Romanic languages such as Dutch, German, Italian and Spanish (e.g., Bastiaanse et al., 2003; Betancort et al., 2009; Faroqi-Shah & Thompson, 2003; Garraffa & Grillo, 2008; Neuhaus & Penke, 2008), investigations focusing on other world languages are a lot less common. For example, there are only a small number of papers published on Hindi speakers with aphasia, and reports on other Asian languages such as Chinese are similarly scarce (Kong et al., 2021). The lack of knowledge about specific manifestations of these languages presents a problem for effective management of patients with aphasia. This issue is further complicated by the fact that in many Asian countries, large parts of the population are bilingual (Chang, 2011). For this reason the current study focused specifically on bilingual speakers. Aphasia manifests differently in these groups than monolingual speakers, hence bilingual aphasia will be discussed in more detail in the next section.

1.3 Bilingual Aphasia

Since both languages of bilingual adults are processed in the same hemisphere of the brain in adjacent or overlapping areas, it can be anticipated that both languages will be affected to some extent in the vast majority of bilinguals with acquired aphasia (Fabbro, 2001; Kohnert, 2013; Paradis, 2004). That is, if a speaker has a mixed receptive-expressive aphasia in one language, production and comprehension will most probably be affected in her or his other language as well. When a multilingual speaker has aphasia, the languages spoken premorbidly may show comparable or differential patterns of impairment (Weekes, 2010). Kohnert (2013) claims that typological characteristics of different languages affect the most observable symptoms. For example, agrammatic productions might vary in a language like Hindi that requires grammatical markings for gender, case or tense as compared to languages such as English that rely on contextual or lexical cues to convey this information (Kohnert, 2013).

Recovery of languages may get affected by factors such as premorbid language proficiency, age of language acquisition, typological distance between languages, and the type of treatment strategies being used (Ansaldo et al., 2008; Faroqi-Shah et al., 2010; Goral et al., 2006; Paradis, 2004). A number of studies have reported cross-language transfer of therapy benefits where treatment in one language can result in improvement in another language which has not been treated (Ansaldo et al., 2008; Faroqi-Shah et al., 2010). In addition, Verreyt et al.'s (2013) study on cognate facilitation in lexical decision making experiments showed that the language which was not used was also active at the time of assessment and affected the lexical processing of the other.

While some studies have demonstrated the presence of cross-language influence, other studies found that these effects were unavailable when the languages spoken by a bilingual/ multilingual speaker are structurally different. Diéguez-Vide et al. (2012) have attributed non-parallel recovery patterns observed in Chinese-Spanish-Catalan trilingual speakers to the unavailability of cross-language transfer effects of therapy due to Chinese being typologically different from Spanish and Catalan. Another study found that therapy benefits in Russian (which was the native language of the speaker) were transferred to the second language of the speakers, Hebrew, in only reading, auditory comprehension and

elicited speech, but not in writing and naming (Gil & Goral, 2004). This difference was attributed to the orthographic and lexical difference between the two languages. The probability of different manifestations in two structurally different languages of bilingual adults such as English and Hindi following acquired aphasia has been a persistent topic of discussion in the literature on aphasia (e.g., Balasubramanian & Bose, 2016; Venkatesh et al., 2012). Some of these studies will be outlined in the next section beginning with the first studies on aphasia in Hindi monolingual speakers which laid a foundation for the later studies on bilingual aphasia in Hindi-English speakers.

1.3.1 Hindi-English Aphasia

Psycholinguistic investigations using aphasic data from Hindi, an Indo-European language, as well as from other Indian languages began in the late 20th century. The first published study on agrammatism in Hindi focused mainly on agrammatic disturbances in a Hindi monolingual speaker with aphasia (Bhatnagar and Whitaker, 1984). The researchers conducted two interviews with the speaker. The results showed that the performance of the patient in Hindi was characterized by all the typical symptoms of aphasia such as arduous, halting speech patterns, a decline in the closed class lexicon and to some extent the lack of structural and syntactic complexity. The syntactic errors observed in the study included deletion of inflectional morphemes and other grammatical forms such as conjunctions and auxiliaries. The clinical picture that the patient presented in the study cannot be considered a full portrayal of the language impairment since patterns seen after brain damage can differ depending on factors such as premorbid language proficiency, severity etc.. In order to make a stronger conclusion and test various hypotheses, one would need to study more patients displaying various degrees and types of grammatical breakdown.

In addition to studies on aphasia in Hindi monolingual speakers mentioned above, some researchers have studied aphasia in bilingual patients who speak English and Hindi (Balasubramanian & Bose, 2016; Venkatesh et al. 2012). One study aimed at identifying the features of narrative production of a Hindi-English bilingual speaker with aphasia with regard to distribution of various lexical categories (Balasubramanian and Bose, 2016). A narrative sample was elicited using the Frog story in Hindi and meaningful

words in the patient's speech data were counted in both English and Hindi. The authors concluded that the patient was able to overcome his agrammatic difficulties in English using Hindi and vice versa by code switching, thus resulting in a meaningful verbal output. Although this deduction holds true in case of Hindi for the patient, further assessment is required to learn more about the patient's language expression in English as the story was only elicited in Hindi. Therefore, agrammatic features in English were not assessed. Eliciting the story in English would contribute to the knowledge about code switching strategies used by the patient in Hindi and help make a comparison between the patterns observed in language expression across the two languages.

Another research by Venkatesh et al. (2012) studied production and comprehension of English and Hindi in aphasia by two multilingual individuals. The Bird Nest Story from the Bilingual Aphasia Test (BAT) and the Cookie Theft Picture Description task from the Boston Diagnostic Aphasia Examination (BDAE) were administered to obtain connected speech data. Thirty verbs and 30 nouns from An Object and Action Naming Battery were used for one word comprehension and one word naming. A comprehension task from the BAT was used to assess sentence comprehension in both languages. The results across all the tasks show that there was a uniform performance across the languages at the lexical level and an uneven performance across the languages at the syntactic level. Differences in syntax were observed across the pattern of errors in both languages. For example, there were a higher number of errors in verb inflections and obligatory argument omissions in English in comparison with Hindi. Venkatesh et al. (2012) concluded that since sentence production is an incremental process where parts of sentences are retrieved in fragments such that the lexical items retrieved first are placed first in the sentence, then the different word order of the two languages could have had an influence on 'differential verb production' in the two languages. However, there might have been an error in reporting this claim in the paper as differences were not observed at the lexical level but on a syntactic level, i.e., differences were observed in verb inflection across the languages instead of 'differential verb production'. Therefore, the SOV word order in Hindi might have given more time to select the inflectional marker as compared to English where the verb phrase has to be placed second in sentences which might have limited choices (the first noun chosen narrows the choice of verb). This is an interesting finding and it would

be worthwhile to study whether a larger group shows similar results across the two languages in future studies.

Whether presenting in monolingual or bilingual speakers, aphasia can take different forms and is typically classified on the basis of fluency of speech and comprehension abilities. The location and extent of the brain lesion typically dictates the particular linguistic aspects affected by the type of aphasia. The following sections will focus on the particular type investigated in this study, Broca's aphasia.

1.4 Broca's Aphasia

Aphasia can be classified into the two broad categories of fluent and non-fluent aphasia (Clough & Gordon, 2020). Barnett and Parmar (2018) state that there are more than eight particular types of aphasia. The major types are Broca's aphasia, Wernicke's aphasia, conduction aphasia, global aphasia, anomic aphasia, transcortical motor aphasia, transcortical sensory aphasia and mixed transcortical aphasia. Of these, Wernicke's aphasia, conduction aphasia, anomic aphasia and transcortical sensory aphasia are classified as fluent aphasia. Non-fluent aphasias include Broca's aphasia, global aphasia, transcortical motor aphasia, mixed transcortical aphasia. Broca's aphasia is a very common type of aphasia observed in clinical settings (Attard et al., 2013). It was named after the French neurologist Pierre Paul Broca who, in 1861, described the communication patterns of two patients with severe speech production difficulties, but whose comprehension was seemingly unimpaired (Dronkers et al., 2007). The brain of these patients showed large damage to the left frontal lobe. This area was later called Broca's area. It is well-known today that the brain area involved in Broca's aphasia is not limited to Broca's area (Fridriksson et al., 2015). Adjacent and deeper areas such as the posterior portion of Broca's area, the *pars opercularis*, and the left superior temporal gyrus also seem to be implicated (Papathanasiou & Coppens, 2017). The current research focuses on Broca's aphasia as agrammatism, a form of language expression, is often associated with Broca's aphasia in which some syntactic representations such as verb inflections seem to be inaccessible. In severe agrammatism, speech consists of only noun strings; in mild agrammatism, function words, e.g., auxiliaries, articles, and inflectional affixes are mainly substituted or omitted (O'Connor et al., 2005), with other sentence elements

largely preserved. Although Broca's aphasia is characterised by relatively intact comprehension, specific comprehension deficits regarding complex syntactic structures have been observed. For example, Pinango (2000) observed that speakers with aphasia face more difficulties with the comprehension of non-canonical sentences, such as passives, in comparison with linear ones. Some of the most common types of errors observed in the comprehension of complex sentences by speakers with Broca's aphasia include incorrect thematic role assignment and syntactic errors. Since the current study focuses on complex sentence structures, language expression by speakers with Broca's type of aphasia will be analysed in the study due to the presence of agrammatic features in their language expression. The next section outlines the way Broca's aphasia manifests in production and comprehension paradigms in more detail.

1.4.1 Production and Comprehension in Broca's Aphasia

According to Grodzinsky (2000), production and comprehension in Broca's aphasia might not be affected in parallel. Literature on first language acquisition has discussed the relationship between comprehension and production in children (e.g., Bock & Griffin, 2000; Fernald et al., 2006; Gershkoff-Stowe & Hahn, 2013; Marchman et al., 2010). The rate of acquisition in comprehension is usually higher than that of production in children, i.e., children understand more words than they can produce. Even the storage of incomplete forms of a word are enough to allow access to the meaning of the word in comprehension but the retrieval of all the phonological information is required in production which might not be required in a similar level of detail in word comprehension (Bock & Griffin, 2000). Similar patterns are also observed in the communication data obtained from speakers with Broca's aphasia, i.e., the performance of speakers with Broca's aphasia is generally better in comprehension tasks than in production tasks (e.g., Acharya & Wroten, 2020; Dronkers et al., 2007; Grodzinsky, 2000; Grossman & Irwin, 2018). However, a study comparing the production and comprehension of *wh*- questions in German (Neuhaus & Penke, 2008) shows that comprehension of *wh*- questions was found to be more impaired than *wh*- question production. This could have been due to differences in the complexity of each task. In the *wh*-question production task, a speech repetition and an elicitation test was conducted by the researchers. In the elicitation task, the participants were asked to transform a main clause presented to them on a card into a

wh-question. In the repetition task, the participants had to repeat different *wh*-questions (subject and object questions) as accurately as possible. In the experimental design of the comprehension task, some pictures depicting semantically reversible actions performed by two or three people were presented to the participants (e.g. a man is brushing a woman who in turn is brushing another man) before they were asked a *wh*-question about one of the persons in the picture (Neuhaus & Penke, 2008). To answer the questions, the participants had to point to the corresponding person in the picture. The picture pointing task for assessing comprehension of *wh*- questions might have been more challenging than the repetition and elicitation task for assessing production of *wh*- questions. Although the speakers had to read and parse the clauses presented to them in both the production and comprehension tasks, they also had to parse to which of the three persons in the pictures the sentence referred in the comprehension task unlike the production task where less than three actors were present. Hence, differences in task demands and processing load might account for the finding that the participants made more errors in the comprehension task in comparison with the production task. The next section discusses the issue of processing load in more detail and how sentences with a high level of processing load get affected in agrammatism.

1.5 Complex Sentences in Broca's Aphasia: What is the Problem?

1.5.1 Wh-questions and Relatives

Broca's aphasia is characterised by difficulties in language expression, but relatively intact comprehension. However, specific comprehension deficits regarding complex syntactic structures have also been observed. In the syntactic domain, production and comprehension of movement derived structures such as questions(1.5.1a) and relatives(1.5.1b) have been observed to be difficult in agrammatism (Avrutin, 2000; Grodzinsky, 2000). The reason behind why agrammatic speakers find comprehending and producing movement derived structures difficult has been explained further using example 1.5.1 below.

1.5.1 (a) Simple sentence: The girl t_i ate the cake.

Question: Who t_i ate the cake?

(b) Simple sentence: The girl t_i ate the cake.

Relative: This is the girl [who t_i ate the cake.]

The examples in 1.5.1(a) and 1.5.1(b) are all derived by movement of a noun from its canonical position to the other periphery, leaving a trace (t_i) in its place of origin. For example, 1.5.1(a), 'the girl' has left a trace in its original place in the sentence. People with aphasia find these constructions difficult to produce and comprehend as there are traces that need to be processed.

Studies have proved that the number of syntactic errors increase with a rise in syntactic complexity of sentence structures. For instance, studies on the comprehension of wh-questions have shown that speakers with aphasia comprehend subject questions better than object questions (e.g., Neuhaus & Penke, 2008; Salis & Edwards, 2005). For example, the object question 'What did Monica give you for your birthday t_i?' is more difficult than the subject question 'Who gave t_i you the gift?'. There is no trace with 'who' which replaces Monica as, unlike object questions, there is no overt movement in subject questions which reduces the processing load of subject questions. Overt movement is a type of syntactic movement that is phonologically visible in the syntactic derivation (Polinsky & Potsdam, 2013). Similarly, other studies on relatives in Italian (Garraffa & Grillo, 2008), Russian (Friedmann et al., 2010) and Spanish (Betancort et al., 2009) reported that object relatives are more affected than subject relatives. Interestingly, this claim about relatives is not true for some languages such as Basque (Gutierrez-Mangado & Ezeizabarrena, 2012) and Mandarin (Su et al., 2007) which are structurally different from Italian, Russian and Spanish. These studies reported higher error rates in the tasks for subject relatives than in object relatives. In languages with prenominal relatives such as Basque, object relatives are favoured because the first argument in these relative clauses (overtly marked by ergative case) is interpreted as the agent (Gutierrez-Mangado & Ezeizabarrena, 2012). On the other hand, the zero marked absolutive argument in subject relatives can be interpreted by speakers as either agent or patient (either subject or object). Hence, structural differences between languages might lead to differences in the way aphasia affects the syntax of each language.

Several other studies have examined the effects of syntactic deficits on sentence production and comprehension of complex structures in Broca's aphasia. For instance, Bastiaanse et al. (2003) proposes that the mechanism of syntactic movement is disrupted

in both production and comprehension. The study aimed to assess whether the production of sentences with moved objects was impaired in Broca's aphasia for speakers of Dutch. Eight participants were shown two pictures in which the same person was performing the same action with different persons or objects. A sentence was read out loud followed by an incomplete sentence. The speakers were asked to complete the second sentence in a similar way. There were two types of sentences in the study: one with the canonical word and another involving syntactic movement. The results showed that the sentences with a non-canonical word order, where the object had moved to the other side of the adverb, were more difficult to produce in comparison with the sentences with a canonical word order. A high number of word order and omission errors were observed in non-canonical sentences in the study. Broca's aphasia patients, therefore, avoided movement of arguments and adjuncts to functional domains in production. The study also discussed some parallels with sentence comprehension based on the findings of other studies (for e.g., Grodzinsky, 2000) where comprehension of reversible sentences (for e.g., the girl is chasing the boy) with argument movement were found to be difficult. Bastiaanse et al. (2003) concluded that there is no clear pattern of comprehension abilities with regard to movement in Broca's aphasia based on these studies. This type of movement can also be observed in the movement of noun phrases in passives in English. The next section discusses how passive sentences are affected in Broca's aphasia.

1.5.2 Passive Sentences

Passive sentence production is often impaired in Broca's aphasia. Researchers state that such agrammatic disturbances are a result of an underlying structural impairment, i.e., impaired thematic role assignment (e.g., Bazzini et al., 2012; Cho & Thompson, 2010) and a morphological deficit (e.g., Caplan & Hanna, 1998; Faroqi-Shah & Thompson, 2003; Weinrich et al., 2001).

Some studies argue that the inability to produce passive morphology underlies the deficit in passive sentence production. Caplan and Hanna (1998) studied the correlation between grammatical morphology and thematic roles using active and passive sentences in 14 speakers with Broca's aphasia. The study comprised of a picture description task in which participants heard verbs, saw pictures of a simple transitive event and described the

pictures with a single sentence. Respondents were asked to begin the sentence with one of the two event members, either the Agent or Patient, marked with a dot to obligate the production of either an active or passive sentence respectively. The research concluded that production of thematic roles was easier in actives in comparison with passives and grammatical morphemes associated with thematic role assignment (i.e., *by* and auxiliary verbs) were more impaired than the ones that were not related to thematic role assignment (for e.g., determiners, plural noun markers). The results showed that patients had difficulty producing both thematic roles and grammatical form, i.e., there was no significant difference between the frequency of the two types of errors produced in the experiment. Nonetheless, this study provided the participants with the first noun of a sentence to start with explicitly. Hence, the frequency of role reversals (RRs) might have been reduced because they were unlikely to be produced in this experimental paradigm as it facilitated passive sentence production.

Another study by Faroqi-Shah & Thompson (2003) also claimed that speakers with Broca's aphasia may find passive sentences difficult due to issues with retrieving correct grammatical morphemes. The study aimed to make comparisons between sentence production abilities of speakers with Broca's and Wernicke's aphasia in order to explore the degree to which impaired grammatical morpheme retrieval impedes sentence production. Picture cards with black and white line drawings depicting actions involving two elements were presented to the participants. In the uncued condition, the participants were asked to produce a sentence describing the action in the picture and start the sentence by the element to which the arrow pointed. In the cued condition, the participants were also provided lexical cues (the uninflected verb and the relevant nouns) while instructing them to describe the pictures. Errors were scored on the basis of the nature of deviation (Faroqi-Shah & Thompson, 2003). Error categories comprised of preposition errors (substitution, omission, and addition of prepositions), grammatical morpheme errors (substitution, omission or inappropriate insertion of auxiliaries and/ or verb inflection), unrelated sentences (did not describe the target action), RRs, and non-sentences (single words or a string of words that did not consist of any evidence of phrase structure). The results showed that speakers with both Broca's and Wernicke's aphasia were impaired in passive sentence production and these issues were not overcome even when lexical cues

were provided. Analysis of the error patterns suggested that agrammatic disturbances are a result of a morphological deficit for speakers with Broca's aphasia whereas speakers with Wernicke's aphasia may have not been able to automatically access the passive sentence structure (Faroqi-Shah & Thompson, 2003).

Another study suggests that thematic role assignment, irrespective of passive morphology, is impaired in English (Bastiaanse & Edwards, 2004). The study assessed the production of non-canonical sentences using a non-verbal task, a sentence anagram test, in which participants had to arrange word cards (e.g., *the child*/ *is washed by*/ *the mother*) in the order corresponding to a picture. The findings showed that the majority of errors for passive targets were RRs, suggesting that aphasic patients exhibited difficulty mapping thematic roles onto grammatical roles even when passive morphology did not play a role in building passive structures.

Another study by Cho and Thompson (2010) also claimed that the impairment in passive sentence production arises, at least in part, from a structural level deficit rather than just a morphological impairment. Nine participants listened to and viewed a prime sentence in either active or passive voice, and then repeated it aloud. Then, a picture appeared on the computer screen and participants were asked to describe it using the primed sentence structure. Participants' utterances were scored for phrase structure, thematic role assignment, and grammatical morphology. Incorrect responses were scored for the following error types: RRs, grammatical morphology errors (omission or substitution of a morphological indicator), incorrect lexical items, sentence type errors (actives for passives or passives for actives) and others (incomplete responses containing a noun and an auxiliary verb only). Cho and Thompson (2010) conclude that the results indicated that the highest number of errors were RRs and actives-for-passives. Hence, the study supports the claim about agrammatic disturbances in passives being a result of an underlying structural impairment.

The studies outlined in this section make some crucial contributions to the studies about passive sentence production impairment in agrammatism. Some of these studies show that difficulties in passive sentence production in agrammatic aphasia can result from

impaired passive morphology while others prove that aphasia is a result of impaired thematic role assignment due to the presence of RRs in the findings. The studies discussed in the sections above are only a small number of studies about the nature of the deficit. The next section discusses some language models which try to explain the reasons behind the language deficits observed in the movement-derived sentence structures discussed in the sections above.

1.6 Why are Complex Sentences Difficult in Broca's Aphasia?

A number of different models of agrammatism have been proposed to explain the observations described above, which can be divided into representational and processing models. *Representational models* claim that the syntax of agrammatic speakers is mostly preserved except for some syntactic representations which are lost and have an effect on certain structures involving movement (Munarriz et al., 2016). On the other hand, *processing models* claim that syntactic representations in agrammatism are intact but the computational mechanisms required to process them are limited (Munarriz et al., 2016). These two types of models are discussed below.

A representational model, the Trace Deletion Hypothesis, explains how impaired thematic role assignment can affect comprehension and production in aphasia. The arguments which a verb assigns to noun phrases (NPs) are called theta roles (thematic roles). In order to comprehend and produce sentences, the speakers need to know what theta roles should be assigned to each NP. For example, the entity that carries out the action of a verb is assigned the theta role of the 'agent' while the entity that directly receives the action of the verb is assigned the theta roles of the 'patient'. In movement-derived sentences, movement of phrases leave traces behind. Theta roles can be assigned to traces and then shifted to the moved phrase. For example, in the passive sentence *"The cake* t_{i2} *was eaten by* t_i *the girl"*, the thematic roles have moved with the respective noun phrases, leaving traces behind (t_i is the trace left behind for the patient, i.e., 'the cake' and t_{i2} is the trace that has been left behind for the agent, i.e., 'the girl'). The Trace Deletion Hypothesis (TDH) (Grodzinsky, 2000), states that traces are deleted from the syntactic representation of agrammatic speakers, and theta-role of NPs is assigned by default, following a strategy that assigns *agent* and *patient* roles to the first and final arguments

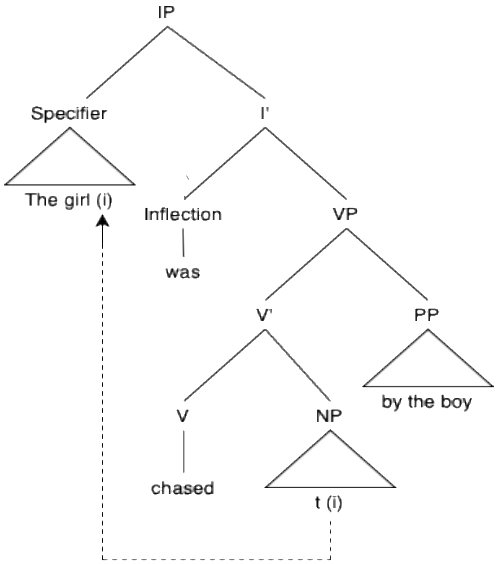
respectively in the sequence of NPs. Hence, in a passive sentence such as '*the horse was kicked by the boy*', a speaker with aphasia might assign '*the horse*' to be the agent of the sentence, as by default in English, the first noun in the sentence is 'usually' the agent. This competes with '*the boy*' being assigned the role of the agent of the sentence as well by the preposition '*by*' which might lead to confusion as '*the horse*' has been assigned the role of the agent too. Therefore, the confusion in assigning the same theta role to each NP might result in the speaker guessing the correct interpretation of the sentence. Hence, there is a 50% chance of obtaining correct responses from speakers. Even if the speaker forms a correct sentence, he or she might have processed the sentence incorrectly but guessed the correct interpretation at the time of giving a response to the listener. Therefore, this might explain variations observed in speakers' performances where they get a response correct sometimes but incorrect at other times.

Another representational model affecting thematic role assignment in both comprehension and production is the Double Dependency Hypothesis (DDH) (Mauner et al., 1993). According to this hypothesis, the impairment in Broca's aphasia affects the processing of syntactic R(eferential)-dependencies since the speaker cannot mark coindexation. The term coindexation refers to two elements in a sentence with the same reference (the entity denoted by an expression). This means that when an element moves in a passive sentence, the moved element and the trace it leaves behind have the same index resulting in two thematic R-dependencies in passives (O'Grady & Lee, 2005). Hence, sentences with two thematic R-dependencies such as object relatives and passives have ambiguous representations and have a higher probability of being impaired compared with structures with only one R-dependency such as subject relatives and actives (O'Grady & Lee, 2005). Difficulties in object relatives and passives do not only arise due to the high number of R-dependencies but due to the fact that one of the R-dependencies is a trace which leads to a rise in the processing load.

The Tree Pruning Hypothesis (TPH) (Friedmann, 2002) is another representational language model which is different from the two models discussed above as it explains how a morphosyntactic deficit can affect loss of morphemes in production and comprehension. The TPH suggests that syntactic trees are pruned in Broca's aphasia. This

results in the loss of some morphemes in phrase-structures. Hence, according to TPH, the tense node that dominates the agreement node in movement-derived sentence structures, such as passives, is pruned. This means that every projection in the syntactic tree above the tense phrase is not present in agrammatic grammar. Therefore, in figure 1, every projection in the syntactic tree above the tense phrase 'was', is absent in agrammatism which leads to the loss of morphemes.

Figure 1 Syntactic Tree for a Passive Sentence Structure



Processing models such as the Slow Syntax approach (Burkhardt et al., 2008) claim that speakers with aphasia use semantic strategies (agent-first linear strategy) to compensate for the loss of the resources necessary to form and comprehend syntactic structures. Another processing theory trying to explain syntactic deficits in movement derived structures is the Argument Linking Hypothesis (Pinango, 2000). The model is based on the idea that there are two linking systems that ensure correspondence between grammatical functions (subject and object) and arguments (thematic roles): syntactic linking and semantic linking. Syntactic linking ensures correspondence between arguments and syntactic functions. Semantic linking establishes correspondence between thematic roles. In people without language disorders, syntactic linking is always deployed before semantic linking. The constraint linking syntactic and semantic relationship is not present in agrammatic comprehension, hence the two linking systems are in direct competition in agrammatic interpretation. Therefore, if the result of the two systems'

mechanisms is the same as in active sentences, speakers' interpretation is usually correct, whereas if the results of the mechanisms conflict as in passives, then the speakers usually guess the interpretation. Therefore, this indicates that as syntactic complexity increases, speakers with Broca's aphasia might face greater difficulties in sentence comprehension. Avrutin (2000) also proposed that comprehension is more difficult for speakers with Broca's aphasia when syntactic and discourse-related operations have to be integrated; hence, deviation from a canonical word order pattern and the parsing of discourse-linked noun phrases, i.e. noun phrases specific to a conversation or a story, independently lead to increased processing load.

Another processing model, the Competition Model (MacWhinney et al., 1991), focuses on cue validity. This model focuses on the different linguistic cues used by speakers to process sentences. This concept refers to the information value of a syntactic (word order), semantic (animacy), and/or morphological (case markings or subject-verb agreement) cue to sentence meaning, the strength of which is different across different languages (MacWhinney et al., 1991). The weaker the strength of a cue in a language, the more sensitive it is to language impairment. This means that an English speaker will resort to word-order and subject-verb agreement cues while processing sentences. On the other hand, a Hindi speaker might resort to case marking and morphological cues while processing a sentence.

While both representational models such as the Trace Deletion Hypothesis and processing models such as the Slow Syntax approach have been adopted by a large number of studies, researchers have claimed that these models cannot explain all the results of their studies. For example, Neuhaus and Penke (2008) discuss that the results of their study do not support the claim that certain morphemes are lost in agrammatic Broca's aphasia (Tree Pruning Hypothesis). They further state that the scalar performance pattern observed in the comprehension task of their study cannot be explained by the Trace Deletion Hypothesis which predicts simple two-way dichotomy between preserved and impaired sentence types. Also, these hypotheses cannot account for the impairment pattern observed in simple syntactic structures such as active sentences. Moreover, Love et al. (2008) argue that the slow syntax hypothesis does not consider the possibility that the

slowness in processing can occur even before the syntactic level of processing is involved. Hence, it is possible that slowness could occur before the lexical level or during the time it interacts with processing at phonological, morphological or even motor levels of information processing.

Although many studies, such as the ones mentioned in this section, have discussed how representational and processing models use different approaches to explain grammatical errors in complex sentences in Broca's aphasia, it is beyond the scope of the current study to make comparisons between the two types of models. Rather the current study aims to collect piloting material to study the differences between agrammatism in Hindi and English by adopting a model that fits best in a bilingual experimental setting. In the absence of a model that can truly account for the full range of error patterns observed in speakers with Broca's aphasia, the current study has adopted the Competition Model to investigate bilingual speakers, as it fits best in a cross-linguistic context in which two typologically different languages are being studied where speakers are likely to rely on different cues while constructing sentences. According to this model, the cue validity of word order should be the highest in English as the language is governed by word order. This should lead to a below-chance performance in passives as the first argument in all types of sentences should be interpreted as the agent. In Hindi, on the other hand, the cue validity of case markings and inflection should be the highest which should lead to an above-chance performance in passives compared to active sentences.

1.7 Summary and Rationale

As outlined above, people with Broca's aphasia often have difficulty comprehending and producing sentences with a syntactically complex, movement-derived structure. For example, English speakers with agrammatic aphasia often have difficulty comprehending and producing sentences with non-canonical word orders such as passives, in which the linear word order of NPs within a sentence does not match their semantic prominence, i.e., the patient precedes the agent (Cho & Thompson, 2010; Faroqi-Shah & Thompson, 2003). The purpose of the current research was to study passive sentence comprehension and production by bilingual speakers who speak two structurally different languages, English and Hindi. Out of the various models discussed in section 1.6 above, the

Competition Model has been adopted for the current study. According to this model, the cue validity of word order should be the highest in English as the language is governed by word order. This should result in the first argument in both active and passive sentences being interpreted as the agent. In Hindi, on the other hand, case markings and inflection should be the cues with the highest cue validity which should lead participants to produce lesser role reversal errors in comparison with English. This will help determine whether differences in grammatical structure lead to differences in the way language impairment manifests in both languages. It is essential to learn more about the Competition Model and how this can inform clinical practice, e.g. features of the same importance might transfer across languages, whereas those only important for one language might not. This could thus aid in clinical decision-making while evaluating the prognosis of language recovery and in developing rehabilitation strategies for bilingual speakers with aphasia who speak languages with different typological features as the ones assessed in the current study. A study surveying aphasia rehabilitation by speech-language therapists (SLTs) in India highlighted that one of the main 'clinician-related' issues in India was the general inefficiency of therapy techniques used for Indian languages apart from other 'client-related' problems (Tiwari & Krishnan, 2011). The researchers discussed that despite more than 40 years of the inception of the occupation of SLTs in India, clinicians still experience lack of sufficient and effective rehabilitation strategies. These issues arise due to the lack of research on aphasia in Indian languages (Tiwari & Krishnan, 2011). Therefore, the current study will provide a much-needed description of language difficulties in Hindi speakers with Broca's aphasia. The information about error patterns in Hindi agrammatism will be beneficial when devising rehabilitation strategies for this speaker group.

1.8 Plan of Study and Experimental Questions

The aim of the present study was to collect pilot data to investigate methods that can be used to study the performance of Hindi-English bilingual speakers with aphasia in comprehension and production of passive sentences. The study therefore provides information on the performance of bilingual aphasic speakers in a scarcely studied language, i.e., Hindi. The objective of the current study was to observe the grammatical error patterns of bilingual speakers with Broca's aphasia in active and passive sentence

comprehension and production in English and Hindi. The study analysed whether the Competition Model can explain language differences across Hindi and English as predicted in section 1.6 or whether another model is more appropriate to explain passive sentence production in Hindi-English agrammatism. The study further collected wider information on language performance, i.e., spontaneous speech samples (especially in Hindi), to characterise the linguistic levels of the bilingual speakers and situate their performance within the existing literature in the field.

The research question for the current study is as follows:
Are there differences across English and Hindi in error patterns for passive structures as predicted by the Competition Model?
Hypothesis: There will be differences in the error patterns as word order has the highest cue validity in English, while inflection and case markers have the highest cue validity in Hindi (cf. section 1.6).

CHAPTER - 2

Methodology

The purpose of this chapter is to discuss the research methodology for this study focusing on passive sentence constructions by Hindi-English bilingual speakers with aphasia. The chapter begins with a discussion on the study design of the research (section 2.1). This is followed by a section on the participant selection criteria for the current study (section 2.2). The subsequent sections discuss the materials (section 2.3) and procedure used (section 2.4), and how data was collected (section 2.5) and analysed (section 2.6). The final section discusses the ethical considerations for the present study.

2.1 Study Design

The aim of the current study was to collect piloting data to investigate methods that explain the performance of Hindi-English speakers in comprehension and production of passive sentences.

The study adopted a single-case experimental design. The design is usually effective in rehabilitation clinical research while assessing effects of novel interventions or when resources are limited (Lobo et al., 2017). In clinical settings, language specific issues can be highly idiosyncratic in nature and speakers have unique language acquisition patterns. Therefore, in order to target these issues, individually tailored interventions would be necessary to target specific individual aphasia patterns (Tanious & Onghena, 2019).

The experimental data collected in the current study was analysed using quantitative approaches like percentages and paired t-test. Quantitative analysis helps identify patterns across the participants' performance which might be difficult to study in non-numerical data (Ahmad et al., 2019). Quantitative methods allow the researcher to systematically measure different variables and test hypotheses by studying patterns observed in the numerical data. Therefore, the current study adopted quantitative methods for data analysis and testing the research hypothesis.

2.2 Participants

There were five adult participants in this research who were Hindi-English bilingual speakers with Broca's aphasia from New Delhi. The participants were recruited through clinicians in New Delhi using the following inclusion and exclusion criteria:

- The participants' language expression and comprehension showed characteristics of Broca's aphasia. This was established through the information about the medical history of the participants provided by the clinicians.
- The participants were required to be similarly proficient in English and Hindi pre-morbidly and at the time of assessment. This was established through the information about the linguistic history of the participants provided by the clinicians.
- Their language competence was further assessed using the Cookie Theft Picture Description task from the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass et al., 2001).
- The participants had normal or corrected to normal hearing and vision to be able to hear the utterances produced by the researcher and to be able to see the picture stimuli clearly. This information was also collected from informal testing and their medical history.
- The medical history of the participants also provided other important information such as the underlying neuropathology and the time post onset.
- The clinicians ruled out other associated neurogenic communication disorders such as dysarthria through tests as the scope of this research was to study sentence construction by speakers with only aphasia and no other communication disorders.
- Patients for whom language mixing was pathological, were excluded from the experimental tests. The profiles of the participants have been presented in table 2 below.

Patients, who matched the selection criteria discussed above, were asked by the clinicians whether they were interested to take part in the study. If they agreed, the clinicians gave them the Participant Information Sheets, which included the investigator's contact details (see Appendices A and B). The patients could, then, contact the student directly or through the clinicians.

The aim of the current research was to collect piloting data to find methods that can be used to establish the error types prevalent in passive sentence structures in Hindi-English bilingual aphasia patients' production and comprehension of speech. Hence, a control group was not necessary for the tests for passives as the current study did not aim to make any comparisons between the patients and a control group.

The present research comprised of four assessments – one eligibility test and three experimental tests. The eligibility test required the researcher to hold a free conversation with the participants individually (see Appendix C). This task helped determine whether the participants would have been able to conduct the rest of the experimental tasks. The Aphasia Severity Rating Scale from BDAE was used to select participants (Goodglass et al., 2001). The scale had a rating from 0 to 5. A rating of 0 means there is no usable speech or auditory comprehension. 1 on the rating scale suggests that all communication is through fragmentary expression; there is great need for inference, questioning and guessing by the listener. A rating of 2 suggests that conversation about familiar subjects is possible by the patient with help from the listener. The rating of 3 on this scale suggests that the participant can discuss almost all everyday problems with little or no assistance. A rating of 4 means there is some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression. A rating of 5 means there is minimal discernible language impairment and the patient may have subjective difficulties that are not obvious to the listener. Participants whose communicative ability was at a rating of 3 or 4 in both languages were invited to participate in the experimental tasks. This criterion was chosen for the study as the participants whose communicative ability was at lower levels of comprehension and production were likely to find it difficult to follow the instructions or show the syntactic patterns that were to be elicited through the experimental tasks and participants whose communicative ability was at a higher rating might not have had any language difficulties that were obvious to the listener.

Although detailed bilingualism profiling could not be performed in the current study due to time and resource constraints, the information necessary to address the research

question was collected efficiently. Participants' language profiling included information about their linguistic history that was collected by the researcher from the clinicians. The clinicians confirmed that the participants' linguistic history indicated that they were simultaneous bilingual speakers of Hindi and English. This was necessary to establish that the participants were similarly proficient in both languages. Participants' language proficiency in each language post onset was further analysed using the Cookie Theft Picture Description task from the BDAE (Goodglass et al., 2001). The purpose of the test was to establish that the participants were similarly competent in the two languages and that the other experiments can produce valid results. The data collection procedure for the test is discussed in section 2.4.1. Hence, the experimental task further helped in determining the language proficiency of participants to supplement the linguistic background information gathered during the participant recruitment stage. The linguistic data collected in the experiment is presented for each participant separately as their linguistic profiles in the results chapter.

Table 2 Participant Information for PwA

Participants	Gender	Age (in years)	Time post-onset (in months)	Lesion Location	Aphasia Severity Rating (BDAE scale: 0 to 5)
AZ	Male	50	40	LH lesion involving posterior inferior frontal gyrus with posterior extension	3
BY	Female	48	12	bilateral MCA territory infarct	3
CX	Female	40	12	L MCA infarct	3
DW	Female	36	35	L MCA infarct	3
EV	Male	33	36	LH lesion involving inferior frontal gyrus	4

Note. The table lists some important information about each participant provided by the clinicians and participants.

2.3 Materials

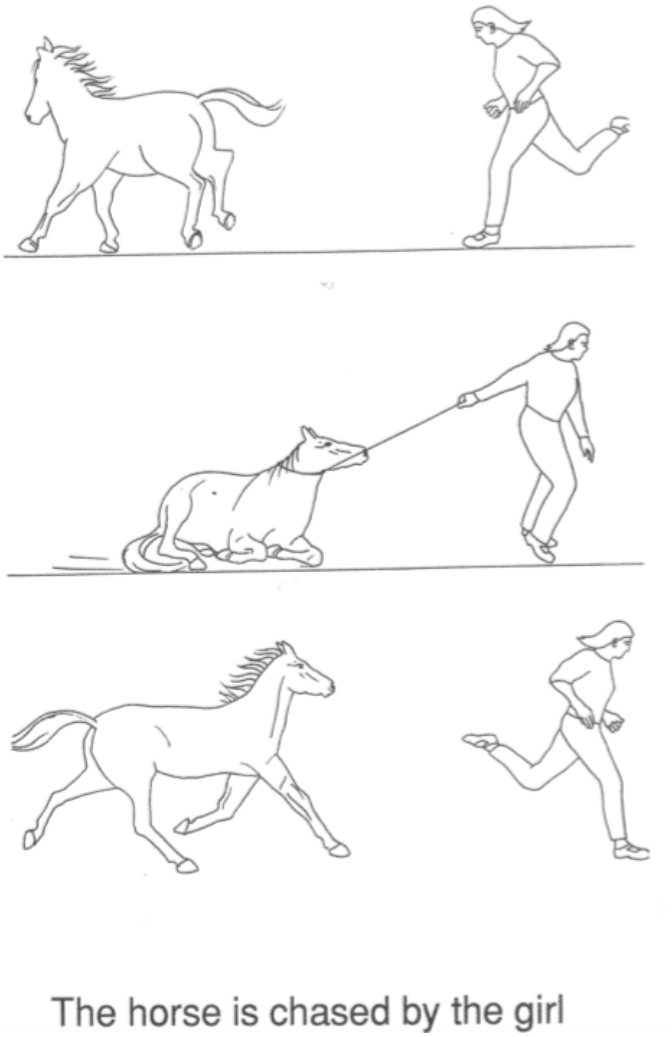
2.3.1 Experimental Materials

The Cookie Theft picture from the BDAE (Goodglass et al., 2001) was used for the first experimental test to assess the language competence of the participants across the two languages. Lehmann (2007) states that linguistic competence is the knowledge or the competence of a speaker in a language. Cummings (2019) discuss that the Cookie Theft picture has dominated clinical setting assessments in aphasia, dementia and Alzheimer's disease. The fact that the task is widely used with such a diversity of clients proves the capacity of the picture to reveal a speaker's linguistic skills. Impairment of phonology, syntax and semantics can be clearly observed in picture description tests, and efficient information transmission about the picture by the speaker to the hearer gets hindered in such tests (Cummings, 2019). Apart from word-finding difficulties, limited syntax in a speaker might find certain grammatical constructions produced with errors or avoided altogether. Therefore, the Cookie Theft picture was used to assess the linguistic competence of participants in the current study.

The stimuli for the passive comprehension task consisted of picture cards from subtest 55 of the Psycholinguistics Assessments of Language Processing in Aphasia (PALPA) (Kay et al., 1992). Similar sentence-to-picture matching tests have been effective in comprehension tests of complex sentences in recent studies such as Neuhaus and Penke (2008) (cf. section 1.4.1). Eight active and eight passive sentences were used for these two tests (see Appendix D). The current study only included reversible passives, i.e., passive constructions where the subject can be exchanged with the object and still form a logical construction (cf. section 1.1.2). The stimuli consisted of sixteen picture cards with three pictures each, one target and the other two semantically-related distractors. The distractor pictures varied in terms of the sentence construction, they consisted of distractors in which the subject and object were reversed and/or lexical distractors for the subject, object or verb had replaced the target ones. For example, in Figure 2, the picture on the top is the correct target picture for the sentence "the horse is chased by the girl". The picture in the middle is a distractor picture that depicts a sentence construction in which a lexical distractor for the verb (pulled) has replaced the target one (chased). The picture at the bottom is the second distractor picture where the subject and object are reversed. The sentences from the PALPA were translated into Hindi from English by the researcher. The translated sentences were checked by a high school Hindi teacher.

The same picture cards were also used for the assessment of the passive sentence production task in both the languages. Studies on passive sentence production by English speakers with Broca's aphasia such as Cho and Thompson (2010) and Faroqi-Shah and Thompson (2000) used picture description tasks to elicit passive sentences effectively (cf. section 1.5.2). Hence, a similar picture description task was chosen for the current study to elicit reversible passive sentences in Hindi and English.

Figure 2 Picture from the PALPA used for the sentence-to-picture matching task



Note. The figure is from subtest 55 in the PALPA (Kay et al., 1992). It is an example of the type of picture cards that were used for the comprehension task with one target and two distractor pictures on each card.

The error coding schemes used for the passives test in the current study were also motivated by those used in previous studies such as Cho and Thompson (2010) and Farogi-Shah and Thompson (2000). The types of errors observed in these studies mainly comprised of syntactic errors such as morpheme errors, and semantic errors such as incorrect thematic role assignment.

2.3.2 Preliminary Study

In order to determine which passive construction should be elicited in Hindi, a preliminary study was conducted involving five Hindi speakers without language disorders. The speakers were 24 to 63 years old. Three of the participants were females and two of them were male Hindi speakers. The speakers were given one active sentence in Hindi. The participants were asked to reframe the sentence as a passive sentence and the type of passive construction they preferred. All five speakers said that they preferred the type of sentence construction used in example 1.1.2 (b) (cf. section 1.1.2). One speaker concluded that the type of sentence construction in 1.1.2 (c) was acceptable to her as well but she would prefer the type of construction in 1.1.2 (b). Hence, only the type of sentence construction in 1.1.2 (b) were used in the stimuli for the main experiment.

2.4 Procedure

The participants were tested individually and the tests were carried out in each language separately across two sessions. In accordance with the wishes and fatigue levels of the participants, the sessions were either conducted on the same day or different days. Three participants got fatigued after the first session, and decided to return the next day for the second session. Two participants decided to start the second session the same day after relaxing for an hour. The sessions took place in hospitals. Participants were audio-recorded and the recordings were saved on a laptop for the purpose of transcription. There were two separate sessions for English and Hindi to ensure that the participants were in a monolingual mode of communication with minimal code switching.

Although code switching is a natural phenomenon for bilingual speakers, it was not the research focus of this study. Code switching was acceptable for the current research as long as it did not change the overall syntactic structures of the sentences of the target language. For example, an uninflected noun form in a language could be replaced with the translated uninflected noun form. However, if Hindi light verb constructions, for example, were replaced with English verb constructions, the produced utterance would no longer allow to address the research aims. None of the utterances had to be excluded on that basis. Two participants only code switched uninflected noun forms in Hindi and replaced them with English uninflected noun forms. For example, in the Hindi sentence

“Horse (The horse) ko (ACC marker) ɒ:dmi (the man) kɛ (NOM marker) dwɒrɒ (by) hilɒjɒ dʒɒ rəhɒ hɛ (is being moved)” (*The horse is being moved by the man*), the noun ‘horse’ has not been translated from English to Hindi but this instance of code switching does not affect the grammatical structure of the sentence. Therefore, these kinds of utterances with code switching were allowed and the participants were not motivated to produce the correct noun forms while collecting data.

English was tested in the first session for all the participants and they were explicitly asked to use only English during the entire session. As English was their second language which is also mostly used for official purposes in India, conducting the test in English first was likely to create a more professional environment, thereby reducing the chances of code switching. Further, it was expected that the participants might have gained a better understanding about the aims of the study by the second session, hence there should have been minimal chances of code switching by then. The participants were informed that the researcher was a Hindi-English bilingual as well and that the participants would be examined in both languages. However, providing the participants with this information could have increased the probability of code switching which could cause a hindrance in obtaining sentence structures that were purely in one language. In order to minimise this risk, the researcher explained the aim of the study to the participants and why it was important for them to stick to the usage of only one language during one session. In addition, some other strategies to avoid code switching were also used such as providing the participants with the target language, letting the participants pre-plan and monitoring closely which is a widely used strategy (Özdemir, 2015). Nevertheless, if the participants still code switched, then the researcher provided them with prompts in the target language. The researcher spoke to all the participants for some time before the recording in order to build a comfortable atmosphere for the participants. If the individuals with aphasia wore prescription glasses or hearing aids, the researcher made sure the glasses and aids were worn during testing. The collected data will be stored in a locked facility within the university for ten years after which it shall be destroyed.

2.5 Data Collection

2.5.1 Test I – Linguistic Competence: Cookie Theft Picture Description

The first experimental test was a spontaneous speech task. The spontaneous speech sample was used to make comparisons with the test for active sentence production and assess whether the pattern of errors was similar across the two tasks. The sample was also used to assess the level of linguistic competence of the participants across the two languages. It will be worthwhile to do an analysis of spontaneous speech as different linguistic levels (word finding, phonology, morphosyntax) only intersect in spontaneous speech (Prins & Bastiaanse, 2004). The Cookie Theft Picture from the BDAE was used for this assessment (Goodglass et al., 2001). The Cookie Theft picture card was presented to the participants and they were asked to describe the picture. The instruction given to them was: "Tell me everything you see going on in this picture." The researcher pointed to the features of the picture that were not covered by the patients and asked for elaboration if the patient's answer was incomplete or shorter than what he/she was capable of producing (Goodglass et al., 2001).

2.5.2 Test II – Test for Passives: Comprehension Task

After test I, each participant was assessed on the comprehension task. The same material was used for both the comprehension and the production tasks for both languages. For Test II (the Comprehension Task), a sentence-to-picture matching task was used. The stimuli consisted of all picture stimuli for reversible sentences from subtest 55 for passives from PALPA (Kay et al., 1992). The test used pictures to assess comprehension of sentences presented in auditory form (cf. section 2.3). One picture card at a time was placed in front of the participants. The target sentence was spoken aloud by the researcher and the participants were asked to point to the picture that best matched the sentence. The instruction provided to the subjects by the researcher was: "Listen to the sentence spoken by me, then point to the right picture" (Kay et al., 1992). The participants heard the target sentences only once.

2.5.3 Test III – Test for Passives: Production Task

For Task III (the Production task), the participants were given cues to produce the same target constructions that were used for the comprehension task to describe the action

depicted in the pictures with the aim of eliciting the target structures. First, a picture card from the comprehension task was presented to the participants in each language session. The researcher described the picture on the card to the participants using an active sentence. Then, the researcher presented eight picture cards used in the comprehension task to the participants one by one. The following instruction was given to the participants: "Describe the pictures. You have to use sentences similar to the one I used for the first picture I showed you." Similarly, eight pictures were presented randomly to the participants to elicit passive sentences from them for each language session by using the same procedure. The instruction given to the participants was: "Describe the pictures. You have to use sentences similar to the one I used for the picture I showed you last."

The participants were given a maximum of two minutes to produce the target sentence. However, all were able to produce a sentence in less than a minute. After that period they moved on to the next stimulus. Struggle behaviour of the participants was also observed while testing and gestural and verbal prompts were provided in this case. Struggle behaviour included visible tension in the participants' voice/pitch and face, changing words for the fear of producing incorrect ones and/or facial grimaces. However, only the first utterances produced by the participants without any help from the investigator were included for analysis. It was decided that testing would be discontinued if a participant would not be able to produce five consecutive sentences irrespective of structure. However, none of the participants faced this difficulty.

2.6 Data Analysis

2.6.1 Test I – Linguistic Competence: Cookie Theft Picture Description

The utterances produced by the participants in the test were transcribed orthographically. An utterance is defined as any communicative act (written, spoken or gestured) that is both an initiation and a response (Linell et al., 1988). Utterances are phrases written, spoken or gestured starting and ending with a clear pause. An example of an utterance produced by a speaker with aphasia from the current research is "This is a kitchen" which is a spoken phrase with clear pauses in the beginning and end. Two variables were measured for the spontaneous speech task. The first was Mean Length of Utterance (MLU) which was calculated for both languages for each participant. The percentage of

the Correct Information Units (CIUs) was also calculated (based on the rules for scoring CIUs in Nicholas & Brookshire, 1993). A concept analysis was also undertaken for each participant (based on Mackenzie et al., 2007). Seven concepts (woman doing dishes, sink overflowing, boy on stool, children stealing cookies, girl reaching for cookie, stool falling, woman not noticing) were assessed for their accuracy, presence and completeness (accurate and complete, accurate but incomplete, inaccurate or absent). The analysis scheme for the concept analysis is presented in table 3 with some illustrative examples.

During data analysis, a control group of five Hindi-English bilingual participants (FU, GT, HS, IR and JQ) also performed the Cookie Theft Picture Description Task from BDAE (Goodglass et al., 2001). This task helped determine whether the difference in both languages' MLU for the performance of people with aphasia (PwA) was within a typical range as determined by the MLU differences between both languages for each of the control group participants. It was necessary to conduct the test as no norms are available for the Cookie Theft Picture Description task in Hindi. The findings have been presented in the results chapter in section 3.2 that discusses linguistic proficiency of all speakers.

Table 3 Examples for the Concept Analysis for PwA

Concept	Illustrative Examples for accuracy, presence and completeness		
	English		
	Accurate and Complete	Accurate but incomplete	Inaccurate
Woman doing dishes	DW: Mother wash plate.	AZ: The mother is standing… at sink. *(No mention of washing the dishes by AZ)*	The woman is washing shirts.
Sink overflowing	CX: Water is falling in the sink.	DW: fall water. *(No mention of sink)*	The bucket is overflowing.
Boy on stool	AZ: The boy is on a stool.	EV: Boy is…	The girl is standing on a chair.
	Hindi		
	Accurate and Complete	Accurate but incomplete	Inaccurate
Children stealing cookies	EV: bət͡ʃɛ (The children) biskut (biscuit) lɛ rəhɛ (taking)	CX: ləɖki (The girl) biskut (biscuit) liɛ (took)	ləɖki (The girl) nɛ (NOM marker) biskut (biscuit) bənaɛ (made)
Girl reaching for cookie	AZ: ləɖki biskut lɛti hɛ (The girl) (biscuit) (taking) (is)	ləɖki kut͡ʃ lɛ rəhi hɛ (The girl) (something) (taking) (is)	bət͡ʃɛ bəsta lɛ rəhɛ (The children) (bag) (taking)

Stool falling	DW: stul (The stool) gir rəha (falling) hɛ (is)	ek (One stool) stul hɛ (is)	kursi (A chair) rəxi (kept) hɛ (is)

Note. The table presents the analysis scheme for the concept analysis with some examples.

Since the task required the production of spontaneous speech, it was also used to make comparisons with the test for active sentence production, i.e., a structured speech production task. In order to make comparisons with the test for active sentence production, all types of errors were counted. Types of errors comprised of syntactic errors, lexical item errors, incomplete sentences, unrelated sentences and non-sentences. The analysis scheme for the spontaneous speech sample has been presented in table 4 with some examples.

Table 4 Examples of Spontaneous Speech Error Types for PwA

Error Types	Sub-categories	English Examples	Hindi Examples
Syntactic	Morpheme	AZ: Two ladies and… one boy is work in the kitchen. (*Morpheme error on the main verb)*	BY: ləɖki (The girl) biskut (biscuit) lɛna (take) hɛ (is) (*Morpheme error on the main verb "take". The correct verb form would be "taking".*)
	Auxiliary	AZ: Two ladies and… one boy is work in the kitchen. (*Incorrect auxiliary verb)*	DW: ləɖka (The boy) dəbːɛ (the box) pər (on) biskut (biscuit) lɛ rəha (taking) (*Omission of the auxiliary verb)*
	Preposition	CX: Utensils are… uh… the kitchen slab. (*Omission of the preposition 'on')*	DW: ləɖka (The boy) dəbːɛ (the box) pər (on) biskut (biscuit) lɛ rəha (taking) *(Incorrect preposition 'pər')*
Lexical		BY: There is boy at the door. (*Semantically different lexical item: door, There was no door in the picture*)	DW: səb xuʃ hɛ (everyone happy is) (*Semantically different lexical item: happy*)
Incomplete Sentence		EV: Boy is…	EV: bət͡ʃɛ… (children…)
Unrelated Sentence		BY: Cup is at the shelf. (*There are no cups at the shelves)*	DW: bəs xədi hɛ (bus standing is) (*There are no buses in the picture)*

Non-sentence		DW: looking garden behind curtain	dəbːɛ… ləɖka… (box… boy…)

Note. The table shows some examples for each types of errors observed in the spontaneous speech samples.

2.6.2 Test II – Test for Passives: Comprehension Task

The cards used in this task comprised of three pictures, one target and the other two semantically related distractors. Accuracy scores were calculated for each participant for both languages along with the number of each error type made by the participants. There were two error categories in this task: role reversals and lexical distractor errors. The responses were scored as correct, lexical distractor error or role reversal. These scores were then converted to percentages and group mean values were calculated for analysis.

2.6.3 Test III – Test for Passives: Production Task

For each trial, all responses produced to describe target pictures including fillers (e.g. *uh, mm, um*) and self-corrections were transcribed and recorded. All the participants were presented with identical material, presented in random order to ensure that they did not memorize the pattern of sentence structures. If the participants produced more than one utterance or self-corrections, only the utterances made by the patients without the help of the researcher were considered for analysis. If they produced two utterances without the help of the researcher, only the first one was considered for analysis. The responses were scored as *actives* if the sentence structure followed an NP V NP order and the sentence was in active voice in English. Responses were scored as passives if the structures followed an NP V PP word order along with all the specific English passive morphology (i.e. passive auxiliary "to be" and an *-en*/ *–ed* verbal inflection on the main verb and the preposition *by*). Similarly, responses were scored as *actives* and *passives* in Hindi according to the morphology of these sentence types (cf. section 2.3.2). Phonemic paraphasias were allowed when half or more phonemes of the target word were produced. For example, *ban* for *man* was acceptable. Also, certain lexical errors were accepted. These included: a correct target noun with any determiner (*a girl* and *the girl*), omission of the determiner (*girl*), a semantically similar noun (*boy* for *man*), a noun with an additional modifier (*a tall man*) and a semantically similar verb (*follow* for *chase*). These errors were disregarded for analysis as these do not affect the sentence type (i.e. whether

the sentence is in active or passive voice). The total number of correct active and passive sentences was noted for each participant. The transcriptions were checked by both the supervisors three times.

Incorrect responses were scored for the types of errors to determine and analyse the nature of deviations in both languages (see Appendix E). These included incorrect sentence type, role reversals, incorrect lexical item, syntactic errors, incomplete sentences, unrelated sentences and non-sentences. *Sentence type errors* included utterances where the participants produced an active for a passive sentence or a passive for an active sentence. For example, *the man's following the dog* in place of *the dog is followed by the man* (example from a participant). Responses were scored as role reversals when the target agent was exchanged with the target patient in the sentence. For example, *the horse's pulled by the man* in place of *the man is pulled by the horse* (example from a participant). Responses were scored as *incorrect lexical items* when they contained words that were not related to the target word. These included semantically different nouns and verbs. *Syntactic*[8] *errors* included sentences where thematic roles were appropriately assigned but the responses omitted, substituted or inserted grammatical elements (such as preposition errors). For example, *the girl is watch-- from the chicken* in place of *the girl is watched by the chicken*. There were three types of syntactic errors: morpheme, auxiliary and preposition errors. Responses were scored as *incomplete sentences* if they contained a subject (or an object) and the auxiliary verb only. Responses were scored as *unrelated sentences* if they did not describe the target action. *Non-sentences* were single word utterances or a string of words that did not contain any evidence of phrase or clause structure. All the data was converted into percentages and group means were calculated. Paired t-test was used to determine whether the differences between the two sentence types (actives and passives) and the two modalities (production and comprehension) was significant. The analysis scheme for the production tasks has been presented in table 5 with some illustrative examples.

[8] Syntax has been interpreted in the more general sense in this thesis and morphology has been included in it.

Table 5 Examples of the Error Types Observed in the Production Tests for PwA

Error Types	Sub-Categories	English Examples	Hindi Examples
Sentence Type		AZ: The chicken is watching… the girl. (*Target: The girl is watched by the chicken.)*	BY: ɒ:dmi (The man) ɣoɖɛ (the horse) ko (ACC marker) hilɒ (move) rəhɒ (present continuous marker) hɛ (is) *English:* BY: The man is moving the horse. *Target:* The horse is being moved by the man.
Role Reversal		BY: Horse is pull by man. (*Target: The man is pulled by the horse.)*	AZ: ɒ:dmi (The man) ko (ACC marker) kut:ɛ (the dog) kɛ (NOM marker) dwɒrɒ (by) pəkɖɒ (follow) dʒɒ rəhɒ (present continuous marker) hɛ (is) *English:* AZ: The man is being followed by the dog. *Target:* The dog is being followed by the man.
Syntactic	Morpheme	DW: Boy push the horse. (*Morpheme error on the main verb*	DW: kut:ɛ (The dog) ko (ACC marker) ləɖki (the girl) kɛ (NOM marker)

		"push". The target verb is "pushing".)	dwɒrɒ (by) dərɒ (frighten) dʒɒ rəhɒ (present continuous marker) hɛ (is) *English:* DW: The dog is being frighten by the girl. *Target:* The dog is being frightened by the girl.
	Auxiliary	DW: Boy push the horse. (*Omission of auxiliary verb)*	DW: ləɖki (The girl) ko (ACC marker) ʧu:zɛ (the chicken) kɛ (NOM marker) dwɒrɒ (by) dɛxɒ (watch) dʒɒ rəhɒ (present continuous marker) *English:* DW: The girl being watched by the chicken. *Target*: The girl is being watched by the chicken.
	Preposition	CX: Man… is pulled horse. (*Omission of the preposition 'by' after the main verb*)	CX: ɒ:dmi (The man) ko (ACC marker) ɣoɖɛ (the horse) kɛ (NOM marker) xi:nʧɒ (pull) dʒɒ rəhɒ (present continuous marker) hɛ (is)

			English: CX: The man is being pulled the horse. *Target:* The man is being pulled by the horse.
Lexical		BY: Horse… pulled by… boy. (*Target: The man is kicked by the horse. 'pulled' is a semantically different verb.*)	DW: ɒ:dmi (The man) ko (ACC marker) kut:ɛ (the dog) kɛ (NOM marker) dwɒrɒ (by) pəkɖɒ (approach) dʒɒ rəhɒ (present continuous marker) hɛ (is) *English:* DW: The man is being approached by the dog. *Target:* The girl is being approached by the dog.
Incomplete Sentence		CX: Horse… is… being moved (*Target: The horse is being moved by the man.*)	DW: ɒ:dmi ko ɣoɖɛ… (The man) (ACC marker) (the horse)…
Unrelated Sentence		DW: The girl looked at the dog and dog looked the girl. (*Target: The girl is approached by the dog*)	DW: ləɖki (The girl) kuʃ (something) dɛx (watch) rəhi (present continuous marker) hɛ (is)
Non-		DW: Chicken… the	ɒ:dmi… ɣoɖɛ…

sentence		girl…	(Man)… (horses)…

Note. The table presents some examples for each type of errors observed in the active/ passive sentences. In Hindi sentences that consist of only one or two words with errors, the words that contain errors have been highlighted in blue.

2.6.4 Statistical Analysis

Descriptive statistical methods were used to summarise the characteristics of the data. Descriptive statistics included calculation of MLU in the test for linguistic competence, and percentages and mean for error types and accuracy across all the tasks. An inferential statistical test suitable for the small sample size of the research, the paired t test, was used to assess whether the difference between the results for the comprehension and production tasks was statistically significant. The paired t test was also used to study the significance level of the differences between the tests for actives and passives.

2.7 Ethical Considerations

The Ethics Committee of the Medical Council of India (MCI) guided the student investigator to follow the instructions in the handbook of the Indian Council for Medical Research (ICMR) for the year 2018 for conducting research in India. The handbook of the ICMR stated that ethics approval from the ethics committee of a recognised institution was required to conduct research in India and it stated some ethical guidelines which must be followed while conducting research in the country. Therefore, the guidelines and principles stated in the handbook were followed during the fieldwork and ethical approval to conduct the study was sought and granted by University of Strathclyde's Ethics Committee before the commencement of fieldwork.

In order to make sure that ethical considerations were followed during the current research, the following steps were taken:

i. The participants took part in the study on the basis of informed consent. The participants had significant language impairment of a nature and extent that might have affected their ability to give informed voluntary consent. Hence, the investigator provided the participants with two simplified Participant Information Sheets and Consent Forms containing short sentences and pictures in order to explain the objectives and methodology of the research clearly to the participants.

ii. Voluntary participation of the participants in the study was crucial, with, participants having the right to withdraw from the research at any stage of the research if they wished to do so.

iii. Any information was treated confidentially and Personal information data concerning the participants collected during the assessments was not shared with anyone else during and after the investigation. All names and other information indicating the identity of the participants was removed from the assessment transcripts.

CHAPTER - 3

Results

The aim of the present study was to conduct a pilot study to investigate the performance of bilingual speakers of English and Hindi in comprehension and production of passive sentences.

The research question was:
Are there differences across English and Hindi in error patterns for passive structures as predicted by the Competition Model?
Hypothesis: There will be differences in the error patterns as word order has the highest cue validity in English while inflection and case markers have the highest cue validity in Hindi (cf. section 1.6), i.e. participants were expected to produce more role reversal errors in English and syntactic errors in Hindi.

Participants completed three experimental tests, i.e., a picture description task to establish linguistic competency in either language, followed by a test for active and passive comprehension and then one for active and passive production ability.

Five Hindi-English bilingual speakers with aphasia participated in the research. Their results will be presented as single case reports initially, followed by group summaries to identify whether any performance patterns can be identified across participants.

3.1 Case Studies

This section discusses the language profile of each participant across the three tasks. The section presents the individual results of each participant across the three experimental tasks in order to set a foundation for later sections of the results chapter that make group comparisons. Individual and group results will then help provide an answer to the research question by indicating how participants performed as a group and the similarities and variations observed in individual case studies. The results are presented in three main sections: test for linguistic competence, tests for actives and tests for passives. English results are discussed first, followed by Hindi.

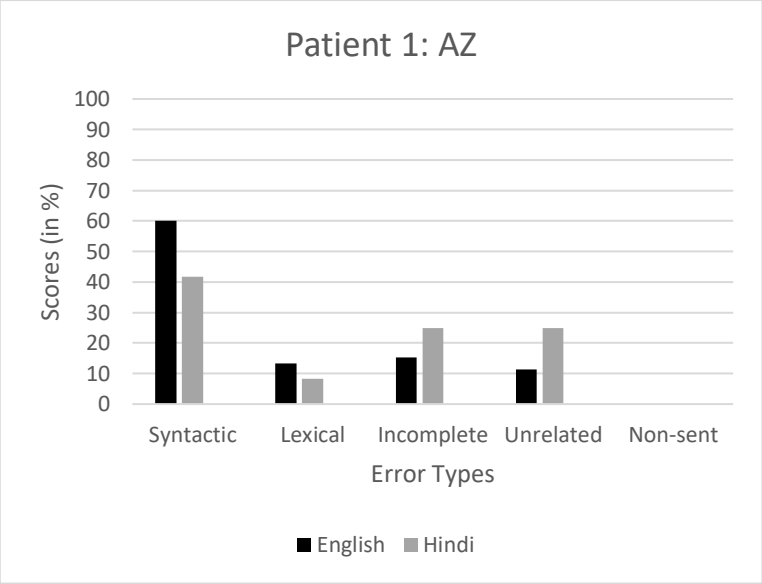
3.1.1 Case Study 1: AZ

Test for Linguistic Competence

The measures applied to the test for linguistic competence include MLU, CIU%, concept and error analysis. The speaker produced an MLU of 4.65 (SD = 2.22) for the English narrative sample. The CIU% for AZ's results in the English session was 77 and six out of seven concepts were "accurate and complete". The results for Hindi showed similar results with an MLU of 4.54 (SD = 2.32) a high percentage of correct CIUs (89%) and six out of seven accurate and complete concepts.

Figure 3 shows the percentage distribution of error types across the two languages. The highest number of errors observed in English were syntactic errors. The participant produced three types of syntactic errors, morpheme (incorrect verb and noun inflections), auxiliary and preposition errors, which were distributed evenly. The participant also produced some lexical item errors, as well as incomplete and unrelated sentence errors. AZ produced similar types of errors in Hindi although the distribution varied slightly.

Figure 3 Distribution of Error Types for AZ: Test for Linguistic Competence



Note. The bars show the percentage of each error type produced by AZ during the Cookie Theft picture description task in each language.

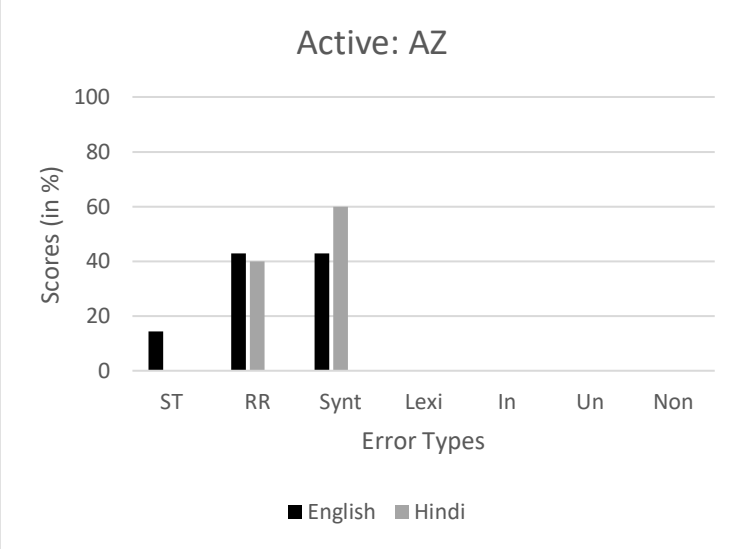
The data thus suggest similar levels of competence across the two languages in terms of quantity and quality of output, with some small variations in terms of error type.

Comprehension and Production of Actives

AZ performed better in the comprehension task than for production in both languages (English: 88% correct for comprehension, 50% for production; Hindi: 75% correct for comprehension, 60% for production).

In terms of error type, the comprehension task only contained role reversals in English, but interestingly, an equal number of role reversal and lexical distractor errors in Hindi. For production (Figure 4), there was an even distribution of syntactic and role reversal errors in English, with only one sentence type error. A similar pattern is evident for Hindi, although syntactic errors were slightly more frequent than role reversals. AZ frequently made more than one error in a sentence, for example, role reversal and syntactic errors as in '*the horse is move the man*' instead of '*the man is moving the horse*' where the roles have been reversed and the main verb has not been inflected.

Figure 4 Error Distribution for Active Production Paradigms for AZ



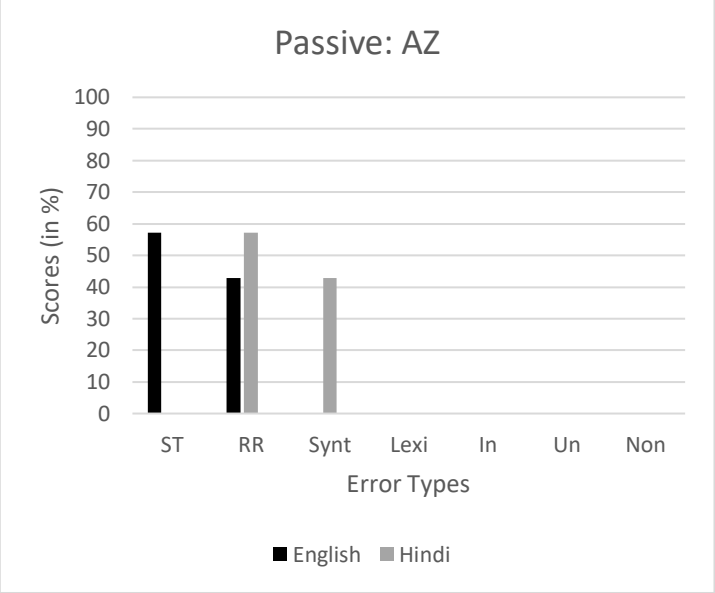
Note. The bars show the percentage of each error type produced by AZ during the active sentence production tasks in each language. "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Comprehension and Production of Passives

Similar to the active sentence task, AZ again performed better in the comprehension than the production tests across both languages (English: 63% correct for comprehension, 25% for production; Hindi: 50% correct for comprehension, 38% for production). Overall, performance was less accurate than for actives.

In terms of error type, AZ produced both role reversals and lexical errors in both languages for comprehension. In the production task (figure 5) sentence type errors, e.g. '*the chicken is watching the girl*' in place of '*the girl is watched by the chicken*'. were the most frequent errors followed by role reversals in English. On the other hand, AZ showed a different error profile for Hindi. Whilst the data suggests similar number of role reversals, he produced no sentence type errors at all and instead introduced a number of syntactic errors.

Figure 5 Error Distribution for Passive Production Paradigms for AZ



Note. The bars show the percentage of each error type produced by AZ during the passive sentence production tasks in each language. "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

In summary, AZ showed a relatively consistent performance across English and Hindi tasks in terms of quantity and quality of output for the picture description task as well as

percentages correct and error type for the active sentence task. Similar errors were also evident in the passive comprehension task, however, the production of passives showed a clear difference in relation to the presence of sentence type and syntactic errors which only occurred in one of the two languages.

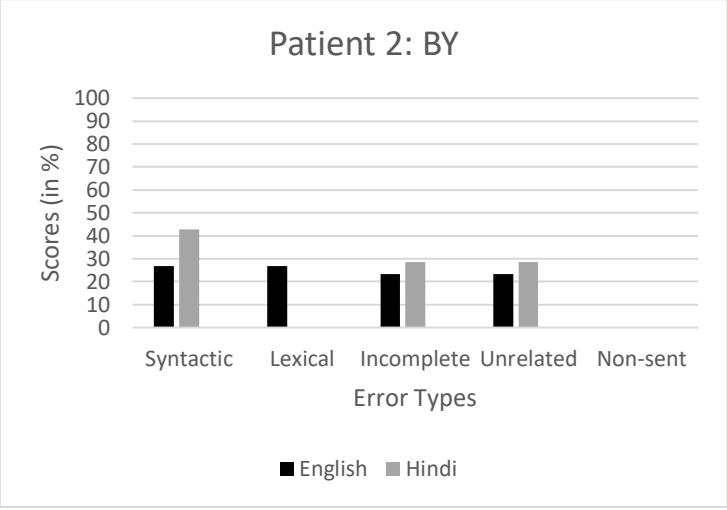
3.1.2 Case Study 2: BY

Test for Linguistic Competence

The MLU for BY was 3.45 (SD = 1.79) in English. The CIU% was 84 and the participant covered five out of seven concepts which were marked as "accurate and complete". The results for Hindi were similar to that of English with an MLU of 2.83 (SD = 1.36), CIU% of 87 and six out of seven concepts "accurate and complete".

Figure 6 depicts error distribution across Hindi and English. The highest number of errors in English were syntactic (morpheme and auxiliary) and lexical errors. The participant produced similar types of errors in Hindi except for the absence of lexical errors.

Figure 6 Distribution of Error Types for BY: Test for Linguistic Competence



Note. The bars show the percentage of each error type produced by BY during the Cookie Theft picture description task in each language.

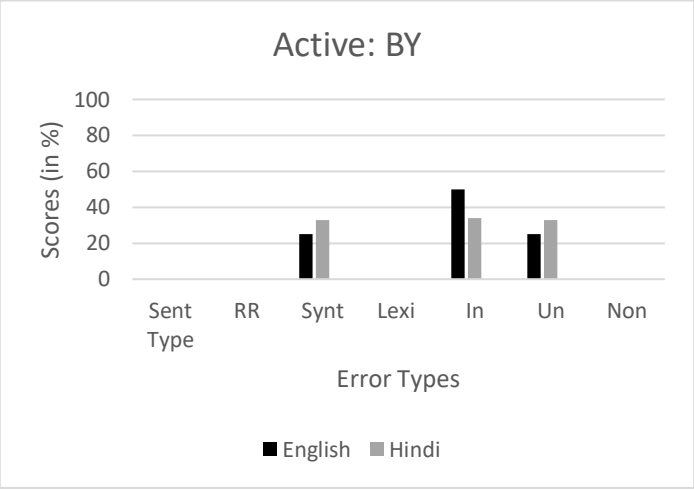
Therefore, the data suggests similar levels of linguistic competence across Hindi and English in terms of quantity and quality of input, with slight variations in terms of the distribution of errors.

Comprehension and Production of Actives

The participant performed better in the comprehension task compared to the production task across the two languages (English: 75% correct for the comprehension task, 63% correct for the production task; Hindi: 63% correct for the comprehension task, 50% correct for the production task).

BY produced an equal number of role reversal and lexical errors in the English comprehension test. Figure 7 shows the distribution of error types elicited in both the languages while testing for active sentence structures for BY. The highest number of errors in English were those of incomplete sentence type. For example, '*boy is kicking…*'. Unlike English, in the Hindi comprehension test, BY produced more role reversals than lexical distractor errors. In the Hindi production test BY produced the same number of syntactic, incomplete and unrelated sentence errors which varied from the English production test result.

Figure 7 Error Distribution for Active Production Paradigms for BY



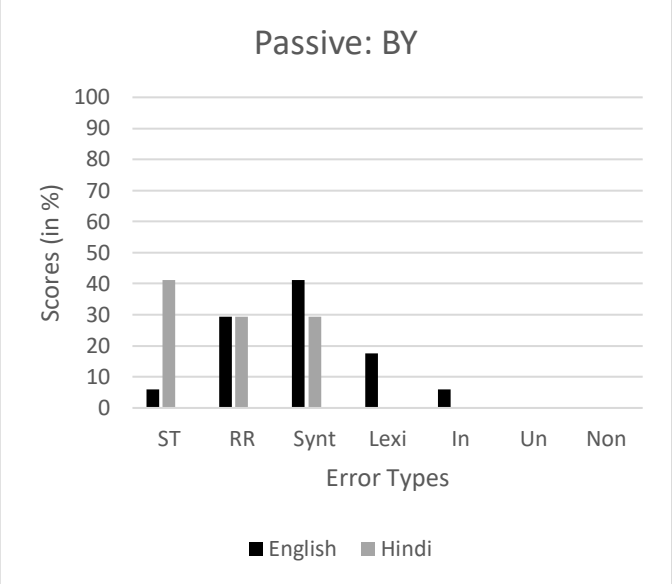
Note. The bars show the percentage of each error type produced by BY during the active sentence production tasks in each language. "Sent Type" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Comprehension and Production of Passives

Similar to the performance for active sentences, BY's performance was better in the comprehension task compared to the production task for passives (English: 63% correct for the comprehension test, 13% correct for the production test; Hindi: 63% correct for the comprehension test, no responses correct for the production test).

In the comprehension tests, 67% errors were role reversals and 33% errors were lexical distractor errors for both languages. Figure 8 shows the error distribution profile for the passives tests. The highest number of errors in English were syntactic in nature which mostly comprised of morpheme errors. For example, the main verb in '*horse is pull by man'* has not been inflected. The number of role reversals was also high. Unlike English, the results for the Hindi production test shows that sentence type, role reversals and syntactic errors were around a similar range.

Figure 8 Error Distribution for Passive Production Paradigms for BY



Note. The bars show the percentage of each error type produced by BY during the passive sentence production tasks in each language. . "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

To summarize, BY's results show a consistent performance across the two languages in terms of quality and quantity of output for the Cookie Theft picture description task as

well as percentages correct and error type for the active sentence tasks. Similar errors were also evident in the passive comprehension task, however, the production of passives showed a clear difference in relation to the presence of sentence type errors which were only present in one of the two languages.

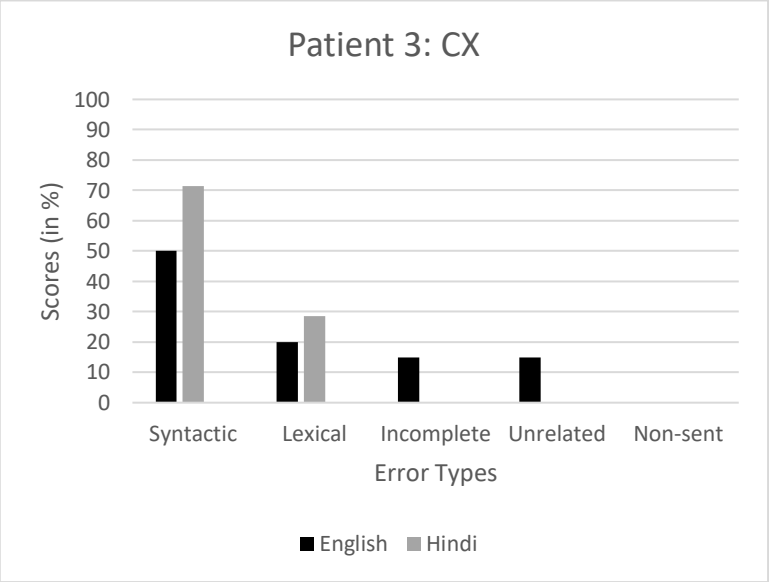
3.1.3 Case Study 3: CX

Test for Linguistic Competence

CX's MLU was 4.87 (SD = 1.65) for English. The CIU% for the participant's English scores was 71 and five concepts were "accurate and complete". Similarly, for Hindi, the MLU was 4.37 (SD = 2.33), the CIU% was 87 and five concepts were "accurate and complete".

Figure 9 illustrates that the highest number of errors in both languages were syntactic errors. These included morpheme and preposition errors in both languages. An example of preposition errors in CX's results include '*a boy is falling… on stool'* where an incorrect preposition has been used.

Figure 9 Distribution of Error Types for CX: Test for Linguistic Competence



Note. The bars show the percentage of each error type produced by CX during the Cookie Theft picture description task in each language.

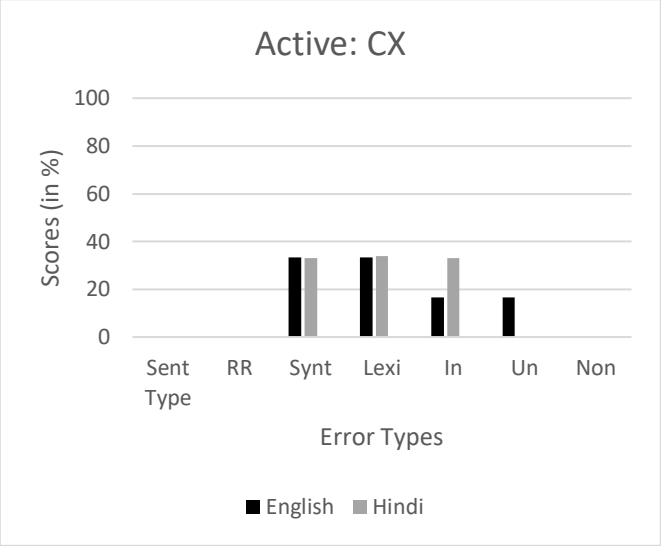
The data, hence, suggests, similar levels of language competence across the two languages in terms of quantity and quality of output, with a negligible amount of variation across the types of errors produced.

Comprehension and Production of Actives

CX produced a higher number of correct responses in the comprehension task compared to the production task for both languages in the test for actives (English: 88% correct for the comprehension task, 50% correct for the production task; Hindi: 75% correct for the comprehension task, 38% correct for the production task).

Out of the two error types in the comprehension task, all errors made by CX were lexical errors for both languages. Figure 10 shows that out of the total number of errors in the English production task for CX, the highest number of errors were syntactic and lexical errors. An example of lexical item errors include the use of semantically different verbs such as '*beating*' in place of '*kicking*'. Figure 10 shows that in the Hindi active sentence production test, syntactic, lexical and incomplete sentence errors were spread uniformly.

Figure 10 Error Distribution for Active Production Paradigms for CX



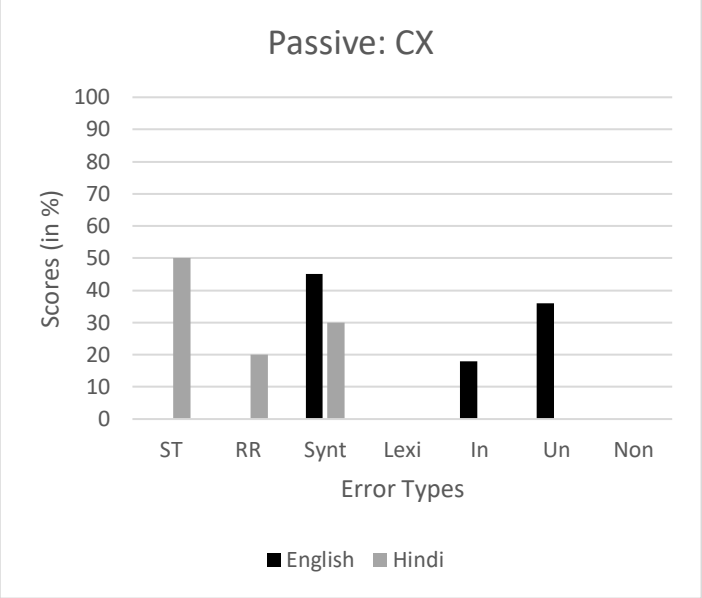
Note. The bars show the percentage of each error type produced by CX during the active sentence production tasks in each language. "Sent Type" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Comprehension and Production of Passives

CX produced the same number of correct responses for both languages across the comprehension and production tasks for passives (38% correct for the comprehension tasks for both languages, no correct responses in the production task for both languages).

In the comprehension tasks for both languages, 60% errors made by CX were role reversals and 40% errors were lexical distractor errors. Figure 11 shows that the results for the passive production task varied considerably across the two languages.

Figure 11 Error Distribution for Passive Production Paradigms for CX



Note. The bars show the percentage of each error type produced by CX during the passive sentence production tasks in each language. . "Sent Type" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

In summary, CX's performance showed a relatively consistent pattern across English and Hindi tests in terms of quantity and quality of output for the Cookie Theft picture description task as well as percentages correct and types of errors for the active sentence task. Similar errors were also observed in the passive comprehension task, however, the production of passives showed a clear difference in relation to the presence of sentence type and role reversal errors which only occurred in Hindi.

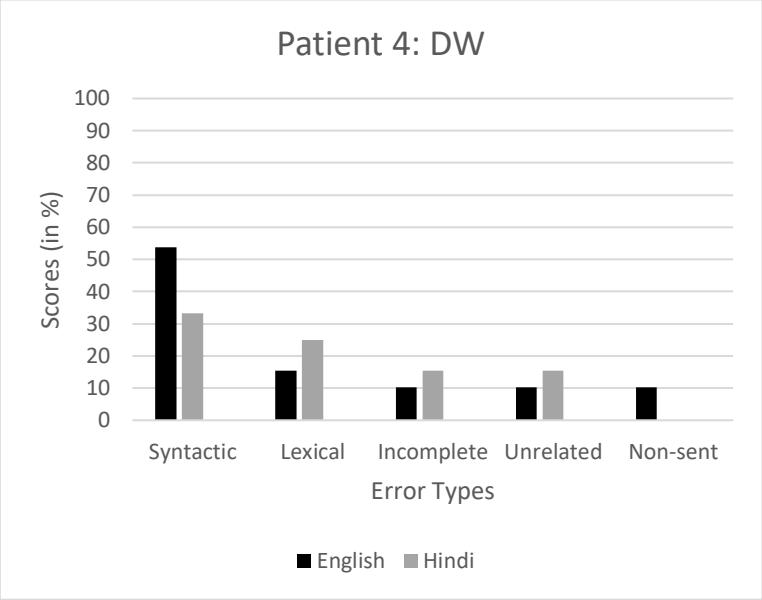
3.1.4 Case Study 4: DW

Test for Linguistic Competence

Results for DW show that the MLU for her in English was 3.25 (SD = 1.59). The CIU% in the English session was 67 and only four out of seven concepts were "accurate and complete". The MLU of Hindi, similar to the English results, was 3.97 (SD = 1.89), the CIU% was 58 and five out of seven concepts were "accurate and complete".

Figure 12 shows that the results for the types of errors produced by DW in the test for linguistic competence was similarly spread across the two languages.

Figure 12 Distribution of Error Types for DW: Test for Linguistic Competence



Note. The bars show the percentage of each error type produced by DW during the Cookie Theft picture description task in each language.

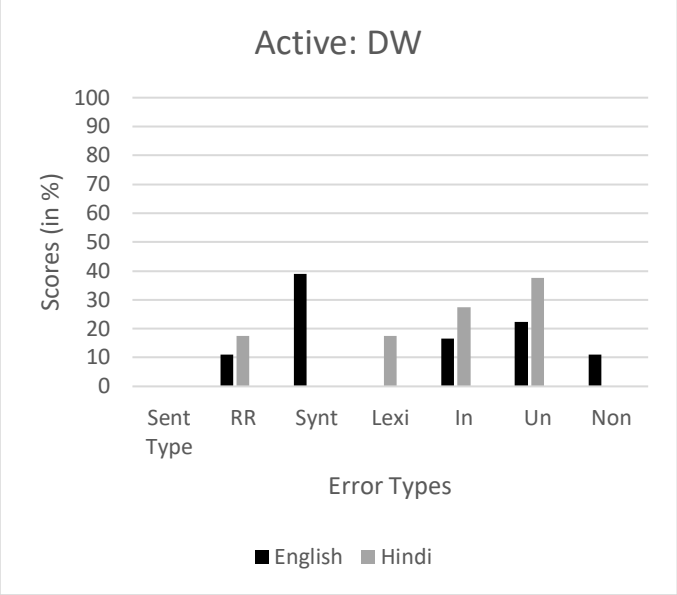
Thus, the data suggests similar levels of competence across the two languages in terms of quantity and quality of output, with minimal variation in terms of error types.

Comprehension and Production of Actives

DW performed better in the comprehension task than the production task for actives (English: 50% correct for the comprehension task, no correct responses for the production task; Hindi: 75% correct for the comprehension task, 25% correct in the production task).

In the English comprehension test, 25% errors were role reversals and 75% errors were lexical distractor errors. DW produced an equal number of role reversal and lexical errors in the Hindi comprehension task. Figure 13 shows that there was considerable variation in the distribution of errors in the production task for actives.

Figure 13 Error Distribution for Active Production Paradigms for DW



Note. The bars show the percentage of each error type produced by DW during the active sentence production tasks in each language. "Sent Type" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

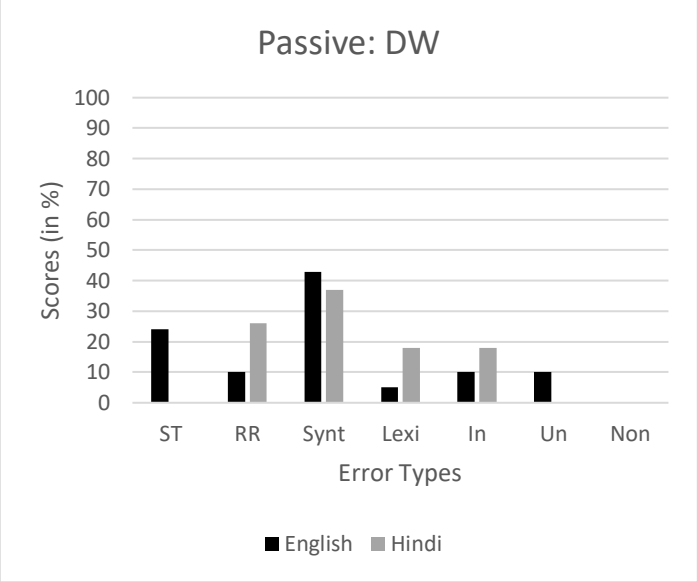
Comprehension and Production of Passives

Similar to the tests for actives, DW's performance was better in the comprehension task for passives than the production task for passives (English: 38% correct for the comprehension task, no correct responses for the production task; Hindi: 75% correct for the comprehension task, 13% correct for the production task).

In the English comprehension test, 60% errors were role reversals and 40% errors were lexical distractor errors. Figure 14 shows that syntactic errors (morpheme and auxiliary errors) were the most frequent errors for the English production test. For example, in '*boy push the horse',* the main verb has not been inflected and the auxiliary has been omitted.

Also, DW could assign the thematic roles correctly in English but faced difficulties in constructing the target sentence type. All errors produced by DW were role reversals in the Hindi comprehension test. Figure 14 shows DW's performance for Hindi in the passive production paradigm. Similar to English, syntactic errors were the most frequently observed errors in Hindi.

Figure 14 Error Distribution for the Two Passives Production Tests for DW



Note. The bars show the percentage of each error type produced by DW during the passive sentence production tasks in each language. "Sent Type" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

In summary, DW showed consistent results across English and Hindi tasks in terms of quality and quantity of output for the picture description task as well as percentages correct and error type for the active sentence task. Similar errors were also evident in the passive comprehension task, however, the production of passives showed a clear difference in relation to the presence of sentence type errors which only occurred in English.

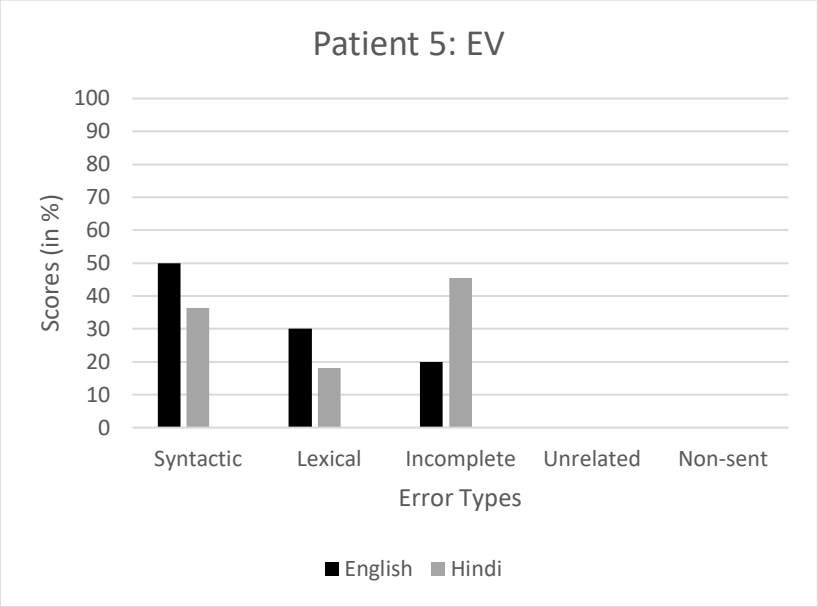
3.1.5 Case Study 5: EV

Test for Linguistic Competence

The MLU for EV's results in English was 4.15 (SD = 2.69). The CIU% was 62 and four concepts were present in English. Similar to English, in Hindi, the MLU was 4.83 (SD = 2.32), the CIU% was 60 and three concepts were present in Hindi. However, two of these concepts were "incomplete".

Figure 15 shows that errors produced by EV across the two languages varied slightly across the two languages.

Figure 15 Distribution of Error Types for EV: Test for Linguistic Competence



Note. The bars show the percentage of each error type produced by EV during the Cookie Theft picture description task in each language.

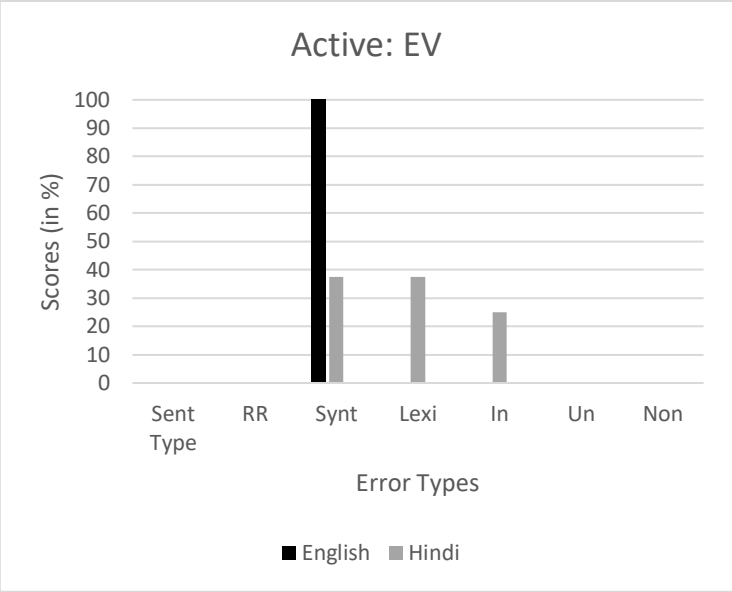
The data, therefore, suggests similar levels of competence across the two languages in terms of quantity and quality of output, with some small variations in terms of error types.

Comprehension and Production of Actives

EV performed better in the comprehension task compared to the production task for actives (English: 75% correct for the comprehension task, 38% correct for the production task; Hindi: 88% correct for the comprehension task, 25% correct for the production task).

EV produced an equal number of role reversal and lexical distractor errors in the English comprehension task, whereas all errors in Hindi were lexical distractor types. Figure 16 shows that EV produced only syntactic errors in English whereas in Hindi errors were spread almost evenly across three error types (syntactic, lexical and incomplete sentences).

Figure 16 Error Distribution for the Active Production Paradigms for EV



Note. The bars show the percentage of each error type produced by EV during the active sentence production tasks in each language. "Sent Type" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

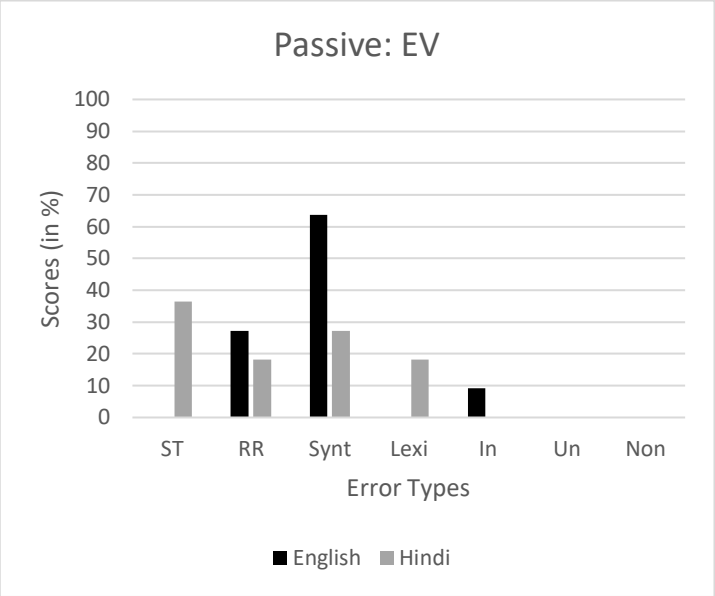
Comprehension and Production of Passives

Similar to the tests for active, EV's performance was better in the comprehension task than the production task for passives (English: 75% correct for the comprehension task, 13% responses correct for the production task; Hindi: 50% correct for the comprehension task, 13% correct for the production task).

EV produced only role reversal errors in the English comprehension task. Figure 17 shows that for the English passive production condition, EV had the most difficulty in syntactic constructions which mainly comprised of morpheme errors. For example, the

main verb in '*the dog is follow… by the man*' has not been inflected. EV made an equal number of role reversal and lexical distractor errors in the Hindi comprehension test. Figure 17 shows that for the Hindi passive production condition, the highest number of errors observed were sentence type errors.

Figure 17 Error Distribution for the Two Passives Production Tests for EV



Note. The bars show the percentage of each error type produced by EV during the passive sentence production tasks in each language. . "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

To conclude, the individual case reports highlight some commonalities and differences in the error patterns observed in the data for each participant. In order to be able to consider these more effectively to allow identification of data trends, the data for the various tasks will be presented across all participants in the subsequent sections.

3.2 Language Proficiency

The results of the Cookie Theft picture description task have been summarised in table 2 for PwA. The individual data showed that some participants had a slightly higher MLU in English, and others in Hindi, although none of the differences were greater than 1. To ensure that this was typical and language skills were indeed comparable across Hindi and English, further data was collected from five Hindi-English bilingual speakers without

language disorders (FU, GT, HS, IR and JQ) in the absence of any published normative data for Hindi (cf. section 2.6.1). Their results for this task have been outlined in table 6. The table shows that the results for the PwA were comparable to those of the control group, i.e., their MLU also differed less than 1 across the two languages. Similarly, the difference between the CIU% for the two languages for each group is <=15%. Hence, group comparisons in the following sections can be made on the basis of the language profiles presented in section 3.1 as the results confirm that the participants with aphasia were similarly proficient in both languages.

Table 6 Summary of the Results for the Language Competence Task

	PwA					Control Participants				
Participants	AZ	BY	CX	DW	EV	FU	GT	HS	IR	JQ
MLU - English	4.65 (SD = 2.22)	3.45 (SD = 1.79)	4.87 (SD = 1.65)	3.25 (SD = 1.59)	4.15 (SD = 2.69)	7.52 (SD = 2.33)	10.38 (SD = 2.95)	9.25 (SD = 2.44)	8.63 (SD = 1.93)	8.15 (SD = 2.69)
MLU - Hindi	4.54 (SD = 2.32)	2.83 (SD = 1.36)	4.37 (SD = 2.33)	3.97 (SD = 1.89)	4.83 (SD = 2.32)	6.88 (SD = 2.47)	9.67 (SD = 1.83)	10.14 (SD = 2.80)	9.5 (SD = 2.55)	8.83 (SD = 2.32)
CIU% - English	76.92	84.42	71.21	67.12	62.16	93.57	97.69	89.48	80	100
CIU% - Hindi	88.63	86.52	86.52	57.97	60	80	100	96.76	92.67	99.5

Note. The table shows the MLU and CIU% for the control group's performance data from the Cookie Theft Picture Description task.

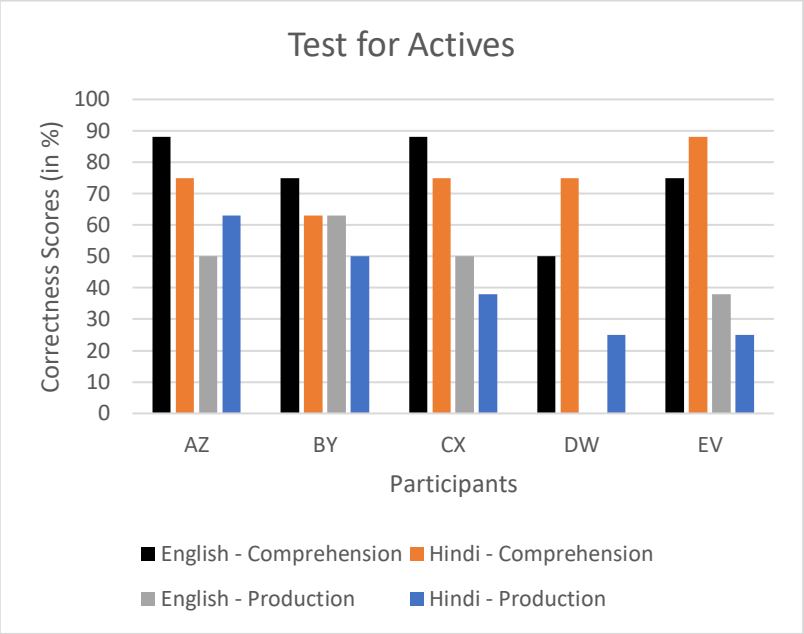
3.3 Comparison of Comprehension and Production

3.3.1 Actives

Sections 3.3.1 and 3.3.2 discuss the similarities and differences between the results of the comprehension and production tasks. Figure 18 presents the accuracy scores that the participants achieved in the active comprehension and production tests. A comparison of

the accuracy scores for the comprehension and production tasks shows that the difference between the two tests is very statistically significant (paired *t* test: $p = 0.0077$, $t = 4.9560$). That is, all the participants achieved significantly higher accuracy scores for the comprehension test compared to the production test in both languages.

Figure 18 Comparison of Active Comprehension and Production

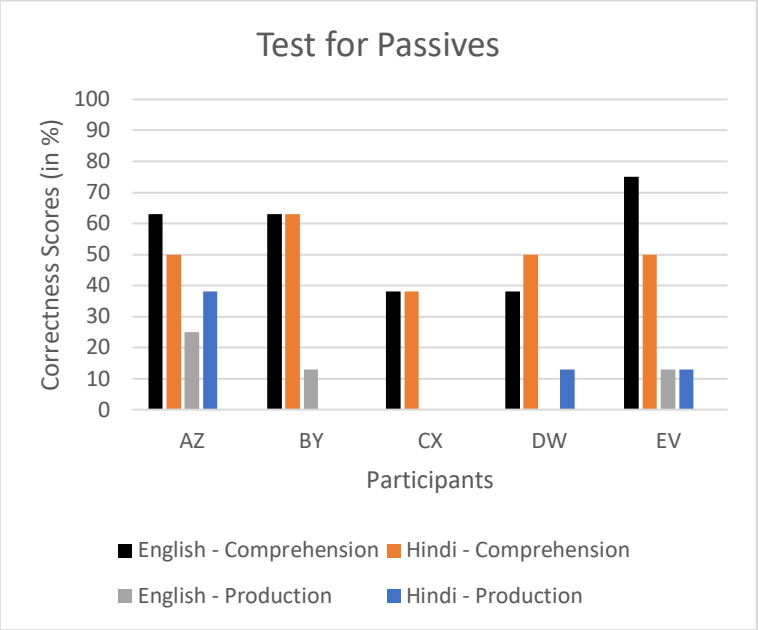


Note. The graph shows the percentage of correct responses for each participant's performance in the test for actives.

3.3.2 Passives

Figure 19 presents the accuracy scores that the participants achieved in the passive comprehension and production tests. A comparison of the accuracy scores for the tasks shows that the difference between the two tests is very statistically significant (paired *t* test: $p = 0.0021$, $t = 7.0527$). That is, as for actives, all the participants achieved higher accuracy scores for the comprehension test compared to the production test in both languages. Also, the differences between the performance of speakers in production and comprehension tasks were more prominent in the passive tests in comparison with the tests for actives across both languages. For example, the difference between BY's scores for the production and comprehension tasks in the test for actives is much smaller compared to the scores of the passive production and comprehension tests.

Figure 19 Comparison of Passive Comprehension and Production



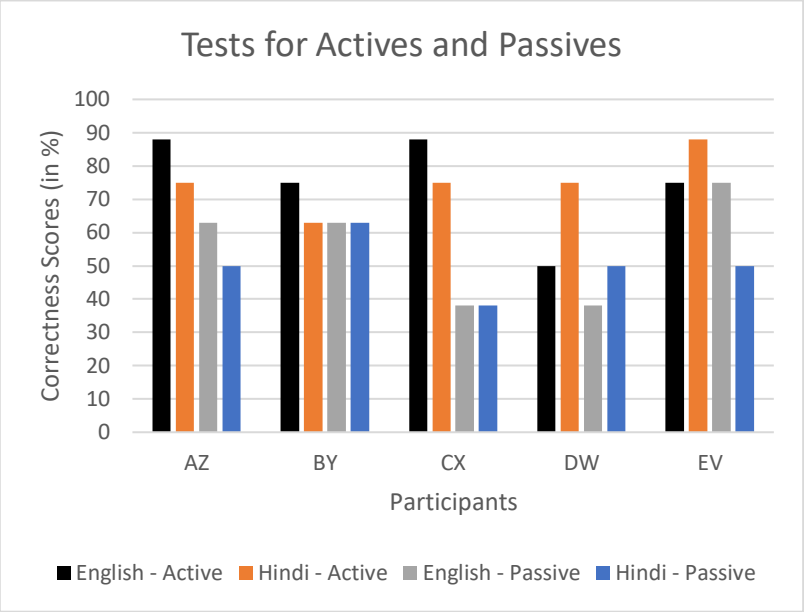
Note. The graph shows the percentage of correct responses for each participant's performance in the test for passives.

3.4 Comparison of Actives and Passives

3.4.1 Comprehension Task

Sections 3.4.1 and 3.4.2 discuss the similarities and differences between the findings of the actives and passives assessments. Figure 20 shows the percentage of correct responses for the active and passive paradigm of the comprehension task. In the active condition, the group mean was 15 for each of the two languages which was higher than the group mean for passives. A comparison of the accuracy scores for the comprehension tasks for actives and passives shows that the difference between the two tests is statistically significant (paired *t* test: $p = 0.0215$, $t = 3.6635$). All the participants made more errors in the passive condition but there were some variations. EV had no difference between active and passive in English. Similar results were observed for BY in Hindi. Therefore, out of the five participants, the results for EV and BY did not follow the common pattern.

Figure 20 Correctness scores for the active and passive paradigm



Note. The graph shows the percentage of correct responses obtained in the comprehension task for each participant.

Table 7 shows how the errors are distributed across the two error types for each of the participants in the active and passive paradigms. The results show similar patterns for CX, DW and EV across the two languages in both the paradigms. The number of role reversal errors increased for their responses in the passive paradigm while the number of lexical distractor errors reduced in both languages.

Table 7 Error Distribution in the Comprehension Test for PwA (in %)

	Types of Distractor Pictures							
Participants	Role Reversal				Lexical Distractors			
	Eng - Act	Hin - Act	Eng - Pas	Hin - Pas	Eng - Act	Hin - Act	Eng - Pas	Hin - Pas
AZ	100	50	33	50	-	50	67	50
BY	50	67	67	67	50	33	33	33
CX	-	-	60	60	100	100	40	40
DW	25	50	60	100	75	50	40	-
EV	50	-	100	50	50	100	-	50
x̄	45	33	63	63	55	67	37	37

Note. "Eng" denotes *English*, "Hin" stands for *Hindi*, "Act" means *Active* and "Pas" stands for *Passive*. The first column on the left lists the names (pseudonyms) of the participants.

3.4.2 Production Task

The mean for the group in the active test was 7.7. The mean reduced to 2.4 in the passive test.

Tables 8 and 9 show the distribution of errors across the active and passive paradigms. A comparison of the accuracy scores for the production tasks for the actives and passives paradigm shows that the difference between the two tests is statistically significant (paired *t* test: $p = 0.0234$, $t = 3.5703$). Syntactic errors were the most frequently observed errors across the two paradigms. These mainly comprised of morpheme errors. The percentage of role reversals and sentence type errors increased in the passive condition while the percentages of other error types decreased for the group. However, there were slight variations in individual error patterns. For example, while sentence type errors and role reversals increased for CX in the passive paradigm, unrelated sentences also increased in the passive test.

Table 8 Distribution of Error Types across all PwA for the test for actives (in %)

	ENGLISH							HINDI						
Parti	ST	RR	Sy	Le	In	Un	Non	ST	RR	Sy	Le	In	Un	Non
AZ	14	43	43	-	-	-	-	-	40	60	-	-	-	-
BY	-	-	25	-	50	25	-	-	-	33	-	34	33	-
CX	-	-	33	33	17	17	-	-	-	33	34	33	-	-
DW	-	11	39	-	17	22	11	-	18	-	18	28	38	-
EV	-	-	100	-	-	-	-	-	-	38	38	25	-	-
x̄	3	11	48	7	17	13	2	-	12	33	18	24	14	-

Note. "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Sy" means *syntactic errors*, "Le" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Table 9 Distribution of Error Types across all PwA for the test for passives (in %)

	ENGLISH							HINDI						
Parti	S T	RR	Sy	Le	In	Un	N	S T	RR	Sy	Le	In	Un	N
AZ	57	43	-	-	-	-	-	-	57	43	-	-	-	-
BY	6	29	41	18	6	-	-	41	29	29	-	-	-	-
CX	-	-	45	-	18	36	-	50	20	30	-	-	-	-
DW	24	10	43	5	10	10	-	-	26	37	18	18	-	-
EV	-	27	64	-	9	-	-	36	18	27	18	-	-	-
x̄	17	22	39	5	9	9	-	25	30	33	7	4	-	-

Note. "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Sy" means *syntactic errors*, "Le" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "n" for *non-sentences*.

3.5 Comparison of Tests for Linguistic Competence and Active Sentence Production

Tables 10 and 11 show the difference between the common error types elicited from the participants in the spontaneous speech sample and test for active sentence production respectively. The test for language competence only comprised of syntactic errors, lexical errors, incomplete sentences, unrelated sentences and non-sentences but no sentence type errors and role reversals. The results show similar error patterns across the two tasks where the highest number of errors produced by the group is syntactic. Individual results for AZ, CX and EV indicate error patterns similar to the one observed in the group results.

Table 10 Distribution of Errors for PwA's Spontaneous Speech Samples (in %)

	ENGLISH					HINDI				
Parti	Synt	Lexi	In	Un	Non	Synt	Lexi	In	Un	Non
AZ	60	13	15	11	-	42	8	25	25	-
BY	27	27	23	23	-	43	-	29	29	-
CX	50	20	15	15	-	71	29	-	-	-
DW	54	15	10	10	10	33	25	15	15	-
EV	50	30	20	-	-	36	18	45	-	-
x̄	48	21	17	12	2	45	16	23	14	-

Note. "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Table 11 Distribution of Error Types for the Active Paradigm for PwA (in %)

	ENGLISH					HINDI				
Parti	Synt	Lexi	In	Un	Non	Synt	Lexi	In	Un	Non
AZ	43	-	-	-	-	60	-	-	-	-
BY	25	-	50	25	-	33	-	43	33	-
CX	33	33	17	17	-	33	34	33	-	-
DW	39	-	17	22	11	-	18	28	38	-
EV	100	-	-	-	-	38	38	25	-	-
$\bar{x}$	48	7	17	13	2	33	18	24	14	-

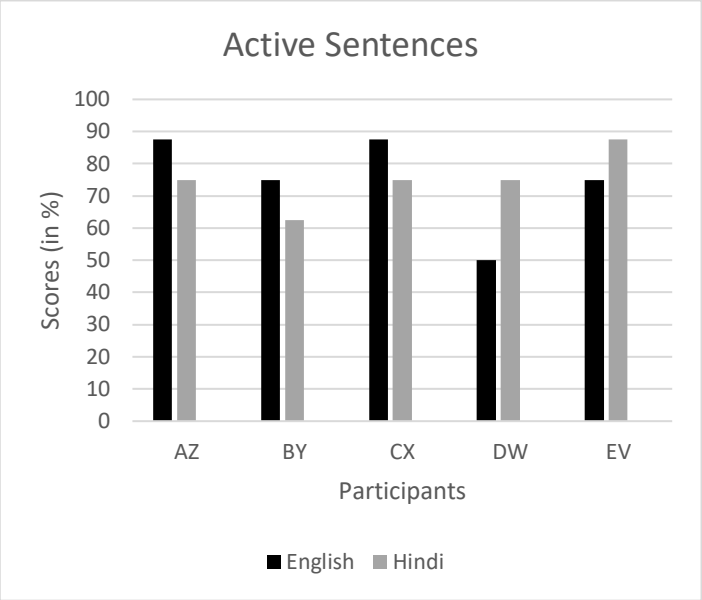
Note. "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

3.6 Comparison of Passives in Hindi and English

3.6.1 Comprehension Task

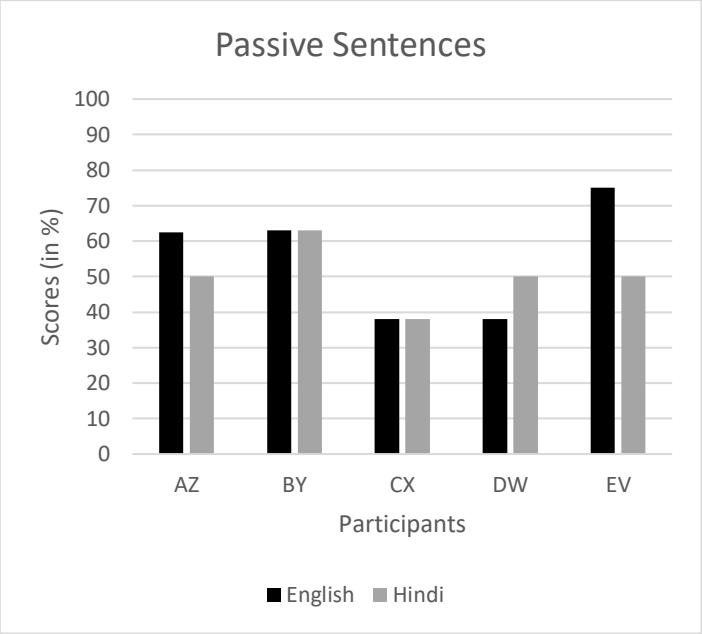
Whilst the previous sections confirmed that the participants are comparable to each other, the final two sections, 3.6.1 and 3.6.2, will make a comparison between the findings of the two language tasks for passives in order to answer the research question. Figure 21 shows that for the active condition, the percentage of correct responses were the same for each language. Figure 22 shows that the percentage of correct responses did not differ to a great extent in the passive paradigm either for both languages for the group (55% for English and 50% for Hindi). In the passive condition, while AZ and EV produced a higher number of correct responses in English, the results for DW showed a reverse pattern where the percentage of correct responses were higher in Hindi.

Figure 21 Correctness scores for the comprehension of actives



Note. The graph depicts the percentage of correct responses for each participant in the comprehension test for active sentences.

Figure 22 Correctness scores for the comprehension of passives



Note. The graph depicts the percentage of correct responses for each participant in the comprehension test for passives sentences.

Tables 12 and 13 show the error distribution for the active and passive sentences across the two languages for the group of participants respectively. In the test for actives, AZ

and BY produced a high number of role reversals in both languages. CX, DW and EV produced a high number of lexical errors in both languages. In the passive paradigm, only BY and CX made the same number of role reversal and lexical errors in both languages. AZ's scores did not differ much across the two error types for both languages. DW and EV's responses show a considerable difference in terms of error distribution across the two languages. DW produced 40% more role reversal errors in Hindi in comparison with English while EV produced 50% more role reversal errors in English in comparison with his Hindi scores. The participants chose a high number of role reversal distractor pictures in the passive comprehension task for both languages instead of lexical distractors.

Table 12 Error Distribution for PwA: Active Sentences (in %)

	Types of Distractor Pictures			
Participants	Role Reversal		Lexical Distractors	
	English	Hindi	English	Hindi
AZ	100	50	-	50
BY	50	67	50	33
CX	-	-	100	100
DW	25	50	75	50
EV	50	-	50	100
$\bar{x}$	45	33	55	67

Note. The table shows the percentage of the two types of errors made by the participants in the comprehension task for actives.

Table 13 Error Distribution for PwA: Passive Sentences (in %)

	Types of Distractor Pictures			
Participants	Role Reversal		Lexical Distractors	
	English	Hindi	English	Hindi
AZ	33.33	50	66.67	50
BY	66.67	66.67	33.33	33.33
CX	60	60	40	40
DW	60	100	40	0
EV	100	50	0	50
$\bar{x}$	63.33	63.33	36.67	36.67

Note. The table shows the percentage of the two types of errors made by the participants in the comprehension task for passives.

3.6.2 Production Task

Table 14 summarizes the distribution of the types of errors across all participants for the active condition. The major difficulty lied in the syntax of the two languages for all participants except for BY. The least number of errors for both the language conditions was the sentence type errors. Role reversals, lexical, incomplete and unrelated sentence errors were slightly higher in Hindi than in English.

Table 14 Distribution of Error Types across all PwA: Actives (in %)

	ENGLISH							HINDI						
Parti	ST	RR	Sy	Le	In	Un	Non	ST	RR	Sy	Le	In	Un	Non
AZ	14	43	43	-	-	-	-	-	40	60	-	-	-	-
BY	-	-	25	-	50	25	-	-	-	33	-	34	33	-
CX	-	-	33	33	17	17	-	-	-	33	34	33	-	-
DW	-	11	39	-	17	22	11	-	18	-	18	28	38	-
EV	-	-	100	-	-	-	-	-	-	38	38	25	-	-
x̄	3	11	48	7	17	13	2	-	12	33	18	24	14	-

Note. "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Sy" means *syntactic errors*, "Le" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Table 15 Distribution of Error Types across all PwA: Passives (in %)

	ENGLISH							HINDI						
Parti	S T	RR	Sy	Le	In	Un	N	S T	RR	Sy	Le	In	Un	N
AZ	57	43	-	-	-	-	-	-	57	43	-	-	-	-
BY	6	29	41	18	6	-	-	41	29	29	-	-	-	-
CX	-	-	45	-	18	36	-	50	20	30	-	-	-	-
DW	24	10	43	5	10	10	-	-	26	37	18	18	-	-
EV	-	27	64	-	9	-	-	36	18	27	18	-	-	-
x̄	17	22	39	5	9	9	-	25	30	33	7	4	-	-

Note. "ST" stands for *sentence type* errors, "RR" denotes *role reversals*, "Synt" means *syntactic errors*, "Lexi" stands for *lexical errors*, "in" for *incomplete sentences*, "un" for *unrelated sentences* and "non" for *non-sentences*.

Table 15 depicts the distribution of the types of errors across all participants in the passive paradigm. Role reversals and syntactic errors were the two most common types of errors across both languages. Role reversals were higher in Hindi in comparison with English. Syntactic errors were the highest type of errors observed in English.

Table 16 shows the distribution of syntactic errors across all participants in the passives production task. These mainly comprised of morpheme errors for the majority of the participants in both languages. Morpheme errors mostly consisted of omission of inflection on verbs but also the substitution of morphemes in rare cases. For example, in English, a participant omitted the inflection on the verb 'moving' in the sentence 'The horse is move the man'. In Hindi verbs, morpheme errors also included substitution of number and gender markers. Auxiliary errors comprised of only omission of auxiliary verbs but preposition errors also consisted of substitution of prepositions in both languages (postpositions in Hindi).

Morpheme errors were higher in Hindi. These were also among the highest error types observed in Hindi for all participants. In English, the distribution of syntactic errors varied to a great extent across the participants and no pattern could be identified.

While the error profiles show a similar pattern across the two languages, there are some differences in the performance of CX. While she produced mostly preposition errors in English, she produced a high number of morpheme errors in Hindi along with preposition errors.

Table 16 Distribution of Syntactic Errors across all PwA: Passives Test (in %)

	ENGLISH			HINDI		
Participants	Aux	Morph	Prep	Aux	Morph	Prep
AZ	0	100	0	0	100	0
BY	33.33	33.33	33.33	28.57	42.86	28.57
CX	20	20	60	14.29	42.86	42.86
DW	50	40	10	44.44	44.44	11.11
EV	0	83.33	16.66	0	80	20

Note. "Aux" stands for *auxiliary* errors, "morph" means *morpheme errors* and "prep" stands for *preposition errors*.

3.7 Summary of the Results

To conclude, the various types of linguistic differences captured in sections 3.3 to 3.6 provide data to address the research question of the current study. The participants' language skills were comparable, and the structured tasks were reflective of the spontaneous data. Section 3.3 showed that the participants produced a higher number of errors in production than comprehension across both actives and passives. This difference was statistically significant. Participants also produced a higher number of errors in the passives test in comparison with the actives test across both languages for comprehension and production. This difference was again statistically significant. The results also show that the number of role reversal errors increased in the test for passives. Section 3.5 showed that there were not many differences between the spontaneous speech samples and the controlled tasks. The final section aimed to address the main research question about the differences between the two language tasks. The section showed that while there were not many notable differences in error type across results of the comprehension tasks for both languages, some differences were observed across the production tasks for the two languages. While the highest number of errors in English were syntactic for the passives test, both role reversals and syntactic errors were the two most frequently observed types of errors in Hindi.

CHAPTER – 4

Discussion

The purpose of this research was to investigate methods that can explain the performance of Hindi-English bilingual speakers in comprehension and production of passive sentence structures. This chapter includes a discussion of major findings with a view to addressing the research question of the present study. The chapter concludes with a discussion of the limitations of the study and areas for future research.

For convenience, the research question has been stated again below:
Are there differences across English and Hindi in error patterns for passive structures as predicted by the Competition Model?
Hypothesis: There will be differences in the error patterns as word order has the highest cue validity in English while case markers and inflection have the highest cue validity in Hindi.

The information in sections 4.1 (comparison of comprehension and production), 4.2 (comparison of actives and passives) and 4.3 (comparison of tests for linguistic competence and active sentence production) will be discussed before addressing the research question. The information in the three sections mentioned above allow judgement on how well the performance of the current group compares with the literature. In section 4.4, the research question about the differences between passive constructions by PwA in English and Hindi will be discussed in light of the observations made on the differences between the test for passives across the two language samples discussed in results section 3.6.

4.1 Comparison of Comprehension and Production

The section discusses the difference in performance of the participants between the comprehension and production tasks in order to establish whether the performance of the participants shows similar patterns reported in the literature on Broca's aphasia in bilingual speakers.

The phenomenon of language expression and comprehension in children (cf. section 1.4.1) is mirrored in language expression and comprehension by speakers with Broca's aphasia. Comprehension is more accessible in comparison to production for patients with Broca's aphasia (Acharya & Wroten, 2020; Grossman & Irwin, 2018; Grodzinsky, 2000). Therefore, the performance of speakers was expected to be better in the comprehension tasks in comparison with the production task.

The results showed that the accuracy scores for comprehension were higher in comparison with production for both languages. This pattern was observed across the results for all participants. The results therefore support the claim that the performance of speakers is better in comprehension tasks than in production tasks (Acharya & Wroten, 2020; Grossman & Irwin, 2018; Grodzinsky, 2000). The differences were not as pronounced in the test for actives in comparison with the test for passives. The next section discusses this finding in detail.

4.2 Comparison of Actives and Passives

This section discusses whether difficulties faced by participants in sentence comprehension and production increased with an increase in syntactic complexity. Similar to the analysis in section 4.1, this analysis was also done to establish whether the participants' performance aligned with the literature on Broca's aphasia. In order to address this question, a comparison was made between active and passive sentences data across both languages. In spite of the observation that production and comprehension of passives was differently affected for the group, i.e., more errors were observed in the production tasks in comparison with the comprehension tasks (cf. section 4.1), a similarity was observed: passive sentences were more difficult to comprehend and produce than active sentences for the group (cf. section 3.4). The finding that the participants faced more difficulties with passive sentence production supports similar claims made by other researchers who studied active and passive sentence constructions by speakers with aphasia (e.g. Bazzini et al., 2012; Cho & Thompson, 2010; Faroqi-Shah & Thompson, 2003; Weinrich et al., 2001).

According to the Argument Linking Hypothesis (Pinango, 2000), the constraint linking syntactic and semantic relationship is not present in agrammatic comprehension, hence the two linking systems compete whenever thematic roles get reversed in sentences (cf. section 1.6). Such effects of canonicity, i.e., deviation from the canonical word order leading to a rise in the processing load, were observed in this study as the results show that the participants faced a higher number of difficulties with the comprehension of non-canonical sentences (passives) in comparison with linear ones (actives). Deviation from the canonical word order led to difficulties in thematic role assignment because the number of role reversal errors increased in the tests for passives for both languages. These errors were lesser than the only other type of error, lexical distractor errors, in the comprehension tests for actives. Similar results were also observed in the production task. Hence, deflection from the canonical word order leads to an increase in the processing load. This parsing effect, i.e., rise in the processing load due to the deviation from the canonical word order, results in canonical active sentences being retained well and non-canonical passive sentences being comparatively more impaired. Although the Argument Linking Hypothesis explains the English results well, it cannot be used to explain the same observation in Hindi which is not governed by a canonical word order. A possible explanation for the Hindi results could be cross-language effects. This will be discussed in more detail in section 4.4 where a comparison between the English and Hindi results will be made.

4.3 Comparison of Tests for Linguistic Competence and Active Sentence Production

The disturbances observed in spontaneous speech are one of the clearest evidences of the manifestation of aphasia as different language levels (morphosyntax, phonology, word finding) only intersect in spontaneous speech. Analysis of the spontaneous speech sample is worthwhile as difficulties in language production are most prominent during spontaneous speech production (Prins & Bastiaanse, 2004). Hence, in the current study, the spontaneous speech analysis has been more informative about the types of syntactic errors that speakers face while producing sentences compared to the test for active sentence production. Therefore, its analysis is crucial in aphasia studies as it provides a good reflection of linguistic abilities. The findings of the spontaneous speech sample of this study show that syntax was the most affected for all participants (cf. section 3.5).

Similar results were observed in the test for actives. Syntactic errors mostly comprised of morpheme errors in both tasks but also a few auxiliary and preposition errors across both languages. In the test for active sentence production, these errors were limited to omission of inflection on verbs. In the spontaneous speech task, these were more varied, especially in the Hindi data. In English, morpheme errors comprised of incorrect inflection of verbs and substitution of plural noun markers with single noun markers. In Hindi, morpheme errors included the substitution of gender markers on verbs and adjectives, substitution of derivational morphemes with inflectional morphemes on nouns and adjectives, substitution of plural noun markers with singular noun markers. Hence, the performance of the participants in the spontaneous speech sample and the controlled task (test for active sentence production) is similar to that discussed in the literature (for e.g., in Prins & Bastiaanse, 2004). Therefore, the active sentences produced by the participants in the current study are a true reflection of the participants' level of aphasia and error types as observed in the spontaneous speech sample.

Sections 4.1, 4.2 and 4.3 prove that the performance of the current group of participants compares well with the literature on Broca's aphasia. Therefore, comparison between English and Hindi can be made in the next section.

4.4 Comparison of Passive Constructions in Hindi and English

The final experimental question discusses whether Broca's aphasia manifested differently in English and Hindi for the participants based on evidence from the test for passives as predicted by the Competition Model. Although the results indicate the same impairment pattern for the results of the comprehension task, i.e., the highest number of errors were role reversals in both languages, differences were observed during the production task in the way the language impairment manifested in each of the two languages of the participants.

The errors produced by the speakers in this task comprised of sentence type (active for passive), syntactic errors, role reversals, lexical errors, incomplete sentence, unrelated sentence and non-sentence errors. Syntactic errors comprised of morpheme, auxiliary and preposition errors. The most frequently observed errors in the English production test

were syntactic errors, i.e. the speakers were able to produce passive sentences with comparatively preserved thematic role assignment, while the results for Hindi showed that the percentage of role reversals and syntactic errors was almost the same (cf. section 3.6.2). Syntactic errors mainly comprised of morpheme errors in both languages but these were more varied in Hindi as morpheme errors in English only included omission of tense markers on verbs but also included substitution of number and gender markers on verbs with incorrect markers in Hindi.

The English results are consistent with previous findings for passive constructions in English by speakers with Broca's aphasia which state that impairments in passive structures result from an impairment in passive morphology (Caplan & Hanna, 1998; Faroqi-Shah & Thompson, 2003). The results of the current study suggest that an impairment in grammatical morphology, that conveys thematic roles, instead of thematic role assignment, resulted in inaccurate passive sentence production in English. This impairment in the syntax mainly comprised of impaired verb inflection. For example, a participant omitted the inflection on the verb '*followed*' in the sentence '*The dog is follow by the man*'. Most of the morpheme errors in English were omissions such as the one in the example presented above.

As discussed earlier, according to the Competition Model (MacWhinney et al., 1991), cue validity is essential to sentence processing. Therefore, it was predicted that if word order had a higher cue validity in English, the speakers would have comprehended the first argument to be the agent and the second to be the patient in both active and passive sentences. Hence, the participants of the current study were expected to produce a high number of role reversal errors in English due to difficulties in thematic role assignment as predicted by the Competition Model. Interestingly, the results indicate that the participants did not produce many errors in thematic role assignment. On the other hand, if case markers and inflection had a higher cue validity in Hindi, the first argument in passive sentences would have been interpreted as the patient. Therefore, it was predicted that speakers would produce a smaller number of role reversal errors in the Hindi task in comparison with the English one due to the high cue validity of case markers and morphology in Hindi. However, the results indicate that a high number of errors in Hindi

were that of role reversals, i.e., errors in thematic role assignment. While the results for most participants showed this pattern, the results for EV showed some variation. EV produced a higher number of role reversals in English in comparison to Hindi. Hence, only the findings for EV can be explained using the Competition Model.

A possible alternative explanation of this phenomenon for the pattern observed for the other four participants could be cross-language effects (Ansaldo et al., 2008; Faroqi-Shah et al., 2010; Goral et al., 2006). A study by Verreyt et al. (2013) reports that cognate facilitation observed in lexical decision making tests showed that the language which was not used was also active and affected the lexical processing of the other (cf. section 1.3). Cross-language effects have also been observed in Indian English. Sharma (2005) states that bilingual speakers without language disorders omit or use articles in the wrong place in English sentences as Hindi determiners do not include any articles (cf. section 1.1.1). Effects from English have also changed passive sentence production in Hindi over the years (cf. section 1.1.2). Therefore, the language which was not being used by the participants in this study was likely still active and affected the processing of sentences in the other language that was in use. This can also explain the lower number of role reversals in English which seem to have been positively affected by Hindi as the participants seemed to have relied on morphological cues along with word order during the English task. However, EV's results for the tests for passives do not show any evidence for the presence of cross-language effects. This is also true for his results in other tasks where a greater degree of cross-language differences were observed when compared to the performance of other participants.

The results also show a high number of sentence type errors (active for passive) for the Hindi sample such as in the case of BY, CX and EV. Since Hindi does not have a rigid word order (although SOV is mostly used, other orders such as OSV are also considered grammatical), difficulties in the target sentence type production might have emerged. This is also in contrast with the English findings where the participants did not face many difficulties with the production of the target sentence type, i.e., the number of sentence type errors (active for passive) in English were comparatively lower (only AZ produced a high number of sentence type errors in English).

The results are also suggestive of a slowdown in syntactic processing and production of sentences. According to the Slow Syntax model (cf. section 1.6), processing routines are not always available due to deficiencies in parsing operations. Another model, the Tree Pruning hypothesis (cf. section 1.6), can explain the loss of morphemes in passive constructions in the current study. According to the model, every projection above the tense phrase is deemed to be absent from an agrammatic speaker's grammar. Although the Slow Syntax and Tree Pruning models can explain the high number of syntactic errors observed across the two language tasks for passives, these cannot explain the differences in the error patterns observed in the two languages of bilingual speakers. For example, why certain participants (AZ and EY) produced a high number of morpheme errors in only one language but no such syntactic errors in the other.

As discussed earlier in the section, error analysis showed that the highest percentage of errors produced by participants were syntactic in nature for English, while the highest number of errors in Hindi comprised of both syntactic errors and role reversal errors. While the syntactic errors in English mostly comprised of omission of inflectional markers on verbs, the syntactic errors in Hindi also included substitution of gender and number markers on verbs with incorrect markers. Hence, the omission of the passive morphology markers on verbs suggests that the verb phrase structure resembled the phrasal structure of active sentences. Therefore, the active sentence morphological structure in both languages and role reversals in Hindi suggests that there is a possibility of patients retrieving the incorrect verb lemma. As discussed in another study (Faroqi-Shah and Thompson, 2003), more frequent verb forms have lower activation thresholds. Since the activation of verb forms directs thematic role assignment to the nouns in the sentence, the difficulty in the retrieval of verb forms at higher thresholds could lead to impaired thematic role assignment in Hindi. Due to differences in verb phrase structures of the two languages (e.g., light verb constructions and a more varied verb inflection system in Hindi compared to English), specific language treatment strategies might be required for the retrieval of these verb phrases.

To conclude, the results do not support the hypothesis about the Competition Model that was formed for the current study. An additional explanation specific to bilinguals, i.e.,

cross language effects, had to be considered. A clear statement cannot be made on whether the typological differences across the languages resulted in different impairment patterns because of cross language effects. Since the study was a pilot investigation to find methods to study the differences between language samples of participants' performance in tests for passives in Hindi and English, the method used in the current investigation did produce new and valid data on Hindi agrammatism in passives. However, further research is required to investigate whether a different model should be formed and/ or adopted instead of the Competition Model that can better explain the reasons behind language differences observed in bilingual agrammatism.

4.5 Limitations and Future Research Suggestions

4.5.1 Limitations of the Study

Although this study generated some interesting, although unexpected results, it had a number of limitations as follows:

Due to the time constraint and the exploratory nature of the study, it was not possible to recruit a higher number of participants. Stronger claims can be made in future studies if a larger group of participants will perform the experiments. However, the performance of the group of participants was similar to other reports in the literature. Hence, the results give some indication of what might happen in a larger sample.

The passive sentence production test can be designed in a different way in a language like Hindi, where the word order is not rigid. This should be done to avoid misinterpretation of the objectives of the experiment by the participants as observed in this study where a lot of actives for passives were produced.

Since the same picture stimuli was used for both languages, some participants could have memorised the target structures unintentionally. Although code switching was minimal in the present study, future research can randomize the stimuli more in order to reduce familiarisation effects on results.

The aim of the current research was to collect piloting data to establish the information about the error types prevalent in passive sentence structures in Hindi-English bilingual patients' speech samples. Therefore, a control group was not necessary as the study did not aim to make any comparisons between the language data of the patients and a control group. However, a control group might have produced more valid data with stronger claims. Future studies with a small sample size can make use of various statistical analysis such as the one used by Crawford and Garthwaite (2002). The researchers introduced a computer program (singlims.exe) that performs a significance test and provides a *p* value and 95% confidence limits on the abnormality of the patient's score. Although the test can be used to test for a deficit in the current study by using the data collected in the test for linguistic competence, it was not necessary as the fact that the participants had a deficit was established by the clinicians and further confirmed by the eligibility test used in the current study. Some other methods that make comparisons between the scores of two patients have also been developed by some researchers (Crawford, Garthwaite & Wood, 2010). The methods use a computer program to provide a significance test, point and interval estimates of the effect size for the difference, and point and interval estimates of the percentage of two control participants to quantify the abnormality of the difference. These methods, however, make comparisons of the two patients' scores to that of the control sample. Therefore, these could not be used for the test for passives in the current study to make comparisons in the current study as the current study did not recruit a control group for the passives test. The study, however, used a parametric test, paired t-test, to make several comparisons which produced results similar to other studies on passives.

In spite of the limitations of the current research, the study has been able to produce some valid data and preliminary answers to the research questions which have highlighted areas that would benefit from further investigation. Since no such investigation about passive sentence constructions by Hindi-English bilingual speakers with aphasia has taken place before, the current research has contributed to the field by laying a foundation for future studies on the topic.

4.5.2 Implications and Future Research Suggestions

The current research could have implications for clinical practice but it is too early to make any recommendations based on the results of the research. Therefore, more research is needed for future studies:

The overlapping representation and processing observed in this study suggest that cross-language effects need to be investigated further. Future research should include monolingual speakers as the current research cannot make strong claims about whether the typological differences in the two languages resulted in different impairment patterns in the two languages due to the presence of cross-language influence. Cross-language facilitation should be studied in more detail once the performance of monolinguals has been assessed. In addition, the impact of English grammar patterns on Hindi constructions needs to be investigated further in non-impaired bilingual speakers.

Future research could study other complex constructions such as relatives which have a similar frequency rate in both languages. This can help determine whether impaired thematic role assignment in Hindi in the current study was due to the low frequency rate of passives in Hindi or whether the results show a similar impairment pattern in future studies targeting other complex sentences such as relative constructions.

Given the variation in error patterns and the fact that the models that have been put forward could not explain every error pattern that has been reported means that more data is required to study how passive structures are processed. This can also be done by introducing a new model for bilingual aphasia.

4.6 Conclusion

To summarise, in spite of the limitations of the study, the overlapping processing and representation of passive structures observed in the study are suggestive of the presence of cross-language effects. Hence, the structural distance between the languages did not always affect the results due to the presence of these cross-language effects.

The results showed the same pattern in the comprehension task for passives but the patterns observed in the production task were different across the two languages. The patterns in the production task were also different from what was expected before the commencement of the study. It was predicted, according to the Competition Model, that since word order has the highest cue validity in English, speakers would produce a high number of role reversal errors in the English assessment while case markers and morphology is the strongest cue in Hindi, speakers were less likely to produce role reversal errors in Hindi. Nevertheless, the results did not show this pattern as syntactic errors were the most frequently observed errors in English while Hindi showed a comparable number of role reversal errors to English.

The symmetry found between the languages in terms of cue validity (morphological cues over word order) further suggest the presence of cross-language effects in spite of the structural distance between the two languages. This shows that speakers might not always resort to language specific cues and cross-language effects still occur in spite of the languages being structurally different.

Hence, Broca's aphasia seems to have manifested in different ways across the two languages, i.e., while syntax was the most affected in English, both syntax and thematic role assignment were affected in Hindi for the participants. The overlapping of processing strategies shows how the activation of one language of the bilingual speaker can have an effect on the results of the other. However, since this was an exploratory study on passives in Hindi-English bilingual aphasia, more research needs to be done in order to learn more about the way aphasia manifests in the two languages used by bilingual speakers.

In conclusion, the current research was a pilot study to find methods to study the differences between language samples of speakers' performance in tests for passives in Hindi and English. The method used in the current study did produce new data on aphasia in Hindi, and specifically on passive sentence constructions in Hindi by PwA.

Although the results of some participants support the study hypothesis, the results of the group do not support the study hypothesis, i.e., the group did not show exceedingly

different error patterns in passives across the languages. Instead, it looked like there were cross language effects that influenced performance. More information is required on how these manifest in more speakers without language disorders and with aphasia, and which language models can explain the variations observed in the results of the bilingual speakers of the current study. This is a potential area to exploit in therapy. Therefore, it is worthwhile to conduct further investigation on the topic.

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Appendix A

Participant Information Sheet for speakers with aphasia – Form 1 (Detailed Version)

[FOR USE WITH STANDARD PRIVACY NOTICE FOR RESEARCH PARTICIPANTS]

Name of department: Speech and Language Therapy

Title of the study: How Hindi-English Speakers with Communication Problems Produce Sentences

Introduction
Aphasia is an impairment of language. It affects the production of speech. It also affects the comprehension of speech.
I am Manali Sharma. I am a postgraduate student at University of Strathclyde in the U.K. I am doing a study to learn more about how Hindi-English bilingual speakers with aphasia make sentences.

What is the purpose of this research?
People with communication problems do not produce many difficult sentences. By finding out more about the difficulties bilinguals with communication problems have across two different languages, we hope to find better ways of helping them recover in future.

Do you have to take part?
It is upto you if you want to take part. If you agree, you will be asked to sign a consent form. You can decide to withdraw from the study at any time without giving a reason.

What will you do in the project?
If you would like to take part, then you and I would meet 2 times for 1 hour each. We will do all the activities in English in the first meeting for 1 hour. We shall do the same activities in Hindi in the next meeting for 1 hour. We would meet in the hospital that you go to regularly. First, we will have a short chat about you, your hobbies and your family. Then, we will look at a picture together and you will have to describe it for me. Next, you will have to match a sentence to some pictures. In the final activity, you will have to make a sentence about some pictures. We can stop anytime for a break. I will record us talking in all the activities so that I can listen to it again on my laptop.

Why have you been invited to take part?
You have been invited to take part because you are a speaker with aphasia.

What are the potential risks to you in taking part?
You may feel tired while we are doing the activities. However, you can ask me to stop anytime.

What information is being collected in the project?
We will ask your SLT to share your medical history to find out more about your aphasia and ask some personal questions, e.g. about your age and education. We will also audiorecord you doing the language tests and look at the errors you make.

Who will have access to the information?
Only my supervisors and I will have access to your information. No one else will know what you have said. Your name and personal details will be removed from everything.

Where will the information be stored and how long will it be kept for?
Information will be stored in a locked facility within my university. We will keep this for 10 years. Then, we shall destroy it.
Thank you for reading this information – please ask any questions if you are unsure about what is written here.
Please also read our Privacy Notice for Research Participants

What happens next?
If you have any questions or if would like to take part, please contact Manali Sharma.
If you do not wish to take part, then we thank you for your attention.
You will get feedback after the study is over. I will share a summary of the findings with you.

Researcher contact details:
Name: Manali Sharma
University e-mail address: manali.sharma@strath.ac.uk
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Chief Investigator details:
The Chief Investigator for this study is:
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This research was granted ethical approval by the University of Strathclyde Ethics Committee.
A Privacy Notice for participants has been attached at the end of this form.
If you have any questions/concerns, during or after the research, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:
Secretary to the University Ethics Committee
Research & Knowledge Exchange Services
University of Strathclyde
Graham Hills Building
50 George Street
Glasgow
G1 1QE
Telephone: 0141 548 3707
Email: ethics@strath.ac.uk

Consent Form for speakers with aphasia – Form 1 (Detailed Version)

Name of department: Speech and Language Therapy
Title of the study: How Hindi-English Speakers with Communication Problems Produce Sentences

☐ I confirm that I have read and understood the Participant Information Sheet. The researcher has answered any queries to my satisfaction.

☐ I confirm that I understand how my personal information will be used. I understand how it will be stored and for how long.

☐ I understand that I can decide whether to participate. I know that I am free to withdraw from the project at any time. I do not have to give a reason.

☐ I understand that data that do not identify me personally cannot be withdrawn once they have been included in the study.

☐ I understand that any information recorded in the research will remain confidential. No information that identifies me will be made publicly available.

☐ I agree to being a participant in the project.

☐ I agree to being audio recorded as part of the project.

(PRINT NAME)	
Signature of Participant:	Date:

Appendix B

Participant Information Sheet for speakers with aphasia – Form 2 (Simplified Version)

Name of department: Speech and Language Therapy

Title of the study: How Hindi-English Speakers with Communication Problems Produce Sentences

Introduction

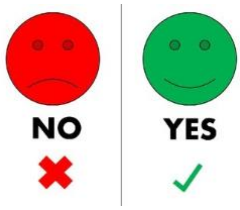
My name is Manali Sharma. I am a postgraduate student at University of Strathclyde in the U.K. I study linguistics.

What is the purpose of this research?

To study how Hindi-English speakers with communication problems make sentences in the two languages.

Do you have to take part?

You can decide if you would like to take part. You can say 'yes' or 'no'.



If 'yes', then, you will be required to sign a consent form.

What will you do in the project?

3 activities -

1. Describe a picture
2. Match a sentence to some pictures
3. Make a sentence about some pictures

All the activities will be done in English first for 1 hour.

Then, the activities will be done in Hindi for 1 hour.

You can do the activities on the same day or another day.

A machine will record you talking during these tasks.

Why have you been invited to take part?

We are looking for people who speak Hindi and English.

And who have communication problems that cause them difficulties forming sentences.

What are the potential risks to you in taking part?

- Risk: You may get tired.

  Solution: you can ask us to 'stop'.

What information is being collected in the project?

- Your medical history.
- Your responses to the 3 tasks.

Who will have access to the information?

ONLY my supervisors and I. NO other person will get your information. Your name will not be used in the test transcripts.

Where will the information be stored and how long will it be kept for?

Information will be stored in a locked facility within my university.

We will keep your data for 10 years. Then, we will destroy it.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

What happens next?

If you would like to know more or if you would like to take part, please contact: Manali Sharma.

If you do not wish to take part, then thank you for your attention.

You will get feedback after the study is complete. You will get a summary of the findings.

Researcher contact details:

Name: Manali Sharma
Telephone: +91 9971484012
University e-mail address: manali.sharma@strath.ac.uk

Chief Investigator details:

The Chief Investigator for this study is:
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This research was granted ethical approval by the University of Strathclyde Ethics Committee.
If you have any questions/concerns, during or after the research, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

Secretary to the University Ethics Committee
Research & Knowledge Exchange Services
University of Strathclyde
Graham Hills Building
50 George Street
Glasgow
G1 1QE
Telephone: 0141 548 3707
Email: ethics@strath.ac.uk

Consent Form for speakers with aphasia – Form 2 (Simplified Version)

Name of department: Speech and Language Therapy

Title of the study: How Hindi-English Speakers with Communication Problems Produce Sentences

YES NO I read and understood the Participant Information Sheet.

YES NO Manali has answered my queries.

YES NO I know how my personal information will be used. I know what will happen to it (i.e. how it will be stored and for how long).

YES NO I know that I don't have to take part in the study. I know that I am free to stop at any time.

YES NO I know that any information recorded in the research will remain confidential. I know that no information that identifies me will be shared.

YES NO I agree to take part in the project.

YES NO I agree to being audio recorded as part of the project.

(PRINT NAME)	
Signature of Participant:	Date:

Appendix C

Eligibility Test Material

- In order to elicit as much conversation as possible, the examiner should start with a familiar topic, such as "WHAT KIND OF WORK WERE YOU DOING BEFORE YOU BECAME ILL?" or "TELL ME WHAT HAPPENED TO BRING YOU HERE."
- Encourage at least three minutes of conversation, if possible.
- Avoid questions that would elicit "Yes" or "No" responses.

(Goodglass et al. (2001))

Rating Scale for Eligibility Test

No usable speech or auditory comprehension

1. All communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. The range of information that can be exchanged is limited, and the listener carries the burden of communication.
2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but the patient shares the burden of communication.
3. The patient can discuss almost all everyday problems with little or no assistance. Reduction of speech and/or comprehension, however, makes conversation about certain material difficult or impossible.
4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.
5. Minimal discernible speech handicap; the patient may have subjective difficulties that are not obvious to the listener.

(Goodglass et al. (2001))

Appendix D

Experimental Test II Material

- Instructions to Subject: Listen to the sentence spoken by the investigator, then point to the right picture.
- Marking Instructions: Circle choice in the appropriate column (corresponding with **T**op, **M**iddle or **B**ottom picture). Key to errors: **r** = reverse; **l** = lexical; **v** = verb.

	Active Sentences - English
1	The dog is approaching the girl.
2	The girl is frightening the dog.
3	The horse is kicking the man.
4	The man is following the dog.
5	The chicken is watching the girl.
6	The horse is pulling the man.
7	The man is moving the horse.
8	The girl is chasing the horse.

	Passive Sentences - English
1	The horse is being moved by the man.
2	The girl is watched by the chicken.
3	The man is pulled by the horse.
4	The horse is chased by the girl.
5	The man is kicked by the horse.
6	The girl is approached by the dog.
7	The dog is frightened by the girl.
8	The dog is followed by the man.

	Active Sentences - Hindi
1	kut:ɒ ləɖki ko pəkəɖ rəhɒ hɛ *(The dog is approaching the girl.)*
2	ləɖki kut:ɛ ko dərɒ rəhi hɛ *(The girl is frightening the dog.)*
3	ɣoɖɒ ɒ:dmi ko lɒt mɒr rəhɒ hɛ *(The horse is kicking the man.)*
4	ɒ:dmi kut:ɛ kɒ pi:tʃʰɒ kər rəhɒ hɛ *(The man is following the dog.)*
5	ʧu:zɒ ləɖki ko dɛx rəhɒ hɛ *(The chicken is watching the girl.)*
6	ɣoɖɒ ɒ:dmi ko xi:ntʃ rəhɒ hɛ *(The horse is pulling the man.)*
7	ɒ:dmi ɣoɖɛ ko hilɒ rəhɒ hɛ *(The man is moving the horse.)*
8	ləɖki ɣoɖɛ ko pəkəɖ rəhi hɛ *(The girl is chasing the horse.)*

	Passive Sentences - Hindi
1	ɣoɖɛ ko ɒ:dmi kɛ dwɒrɒ hilɒjɒ dʒɒ rəhɒ hɛ *(The horse is being moved by the man.)*
2	ləɖki ko ʧu:zɛ kɛ dwɒrɒ dɛxɒ dʒɒ rəhɒ hɛ *(The girl is watched by the chicken.)*
3	ɒ:dmi ko ɣoɖɛ kɛ dwɒrɒ xi:ntʃɒ dʒɒ rəhɒ hɛ *(The man is pulled by the horse.)*
4	ɣoɖɛ ko ləɖki kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ *(The horse is chased by the girl.)*
5	ɒ:dmi ko ɣoɖɛ kɛ dwɒrɒ lɒt mɒri dʒɒ rəhi hɛ *(The man is kicked by the horse.)*

6	ləɖki ko kut:ɛ kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ *(The girl is approached by the dog.)*
7	kut:ɛ ko ləɖki kɛ dwɒrɒ dərɒjɒ dʒɒ rəhɒ hɛ *(The dog is frightened by the girl.)*
8	kut:ɛ ko ɒ:dmi kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ *(The dog is followed by the man.)*

Appendix E

Examples of Each Error Type in English and Hindi in the Production Task

1. Sentence Type Errors (Active for Passive)

English

AZ: The chicken is watching… the girl. (active)

Target: The girl is watched by the chicken. (passive)

Hindi

BY: ɒ:dmi ɣoɖɛ ko hilɒ rəhɒ hɛ

(The man) (the horse) (ACC marker) (move) (present continuous marker) (is)

The man is moving the horse.

Target: ɣoɖɛ ko ɒ:dmi kɛ dwɒrɒ hilɒjɒ dʒɒ rəhɒ hɛ

(The horse) (ACC marker) (the man) (NOM marker) (by) (is being moved)

The horse is being moved by the man.

2. Role Reversal Errors

English

BY: Girl is… frightened by dog.

Target: The dog is frightened by the girl.

Hindi

AZ: ɒ:dmi ko kut:ɛ kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ

(The man) (ACC marker) (the dog) (NOM marker) (by) (is followed)

The man is followed by the dog.

Target: kut:ɛ ko ɒ:dmi kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ

(The dog) (ACC marker) (the man) (NOM marker) (by) (is followed)

The dog is followed by the man.

3. Syntactic Errors

3.1 Morpheme Errors

English

EV: The man is kick by the horse.

Target: The man is kicked by the horse.

Hindi

DW: kut:ɛ ko ləɖki kɛ dwɒrɒ dərɒ dʒɒ rəhɒ hɛ

(The dog) (ACC marker) (the girl) (NOM marker) (by) (is frighten)

The dog is frighten by the girl.

Target: kut:ɛ ko ləɖki kɛ dwɒrɒ dərɒjɒ dʒɒ rəhɒ hɛ

(The dog) (ACC marker) (the girl) (NOM marker) (by) (is frightened)

The dog is frightened by the girl.

3.2 Auxiliary Errors

English

CX: Horse… chasing… girl.

Target: The horse is chased by the girl.

(The incorrect sentence also contains other syntactic errors such as a morpheme error and a preposition error.)

Hindi

DW: ləɖki ko ʧu:zɛ kɛ dwɒrɒ dɛxɒ dʒɒ rəhɒ

(The girl) (ACC marker) (the chicken) (NOM marker) (by) (watched)

The girl watched by the chicken.

Target: ləɖki ko ʧu:zɛ kɛ dwɒrɒ dɛxɒ dʒɒ rəhɒ hɛ

(The girl) (ACC marker) (the chicken) (NOM marker) (by) (is watched)

The girl is watched by the chicken.

3.3 Preposition Errors

English

CX: Man… is pulled horse.

Target: The man is pulled by the horse.

Hindi

CX: ɒ:dmi ko ɣoɖɛ kɛ xi:nʧɒ dʒɒ rəhɒ hɛ

(The man) (ACC marker) (the horse) (NOM marker) (is pulled)

The man is pulled the horse.

Target: ɒ:dmi ko ɣoɖɛ kɛ dwɒrɒ xi:nʧɒ dʒɒ rəhɒ hɛ

(The man) (ACC marker) (the horse) (NOM marker) (by) (is pulled)

The man is pulled by the horse.

4. Lexical Errors

English

DW: Boy pushed the horse.

Target: The man is pulled by the horse.

(The incorrect sentence also contains sentence type errors and role reversal errors.)

Hindi

DW: ɒːdmi ko kutːɛ kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ

(The man) (ACC marker) (the dog) (NOM marker) (by) (is approached)

The man is approached by the dog.

Target: ləɖki ko kutːɛ kɛ dwɒrɒ pəkɖɒ dʒɒ rəhɒ hɛ

(The girl) (ACC marker) (the dog) (NOM marker) (by) (is approached)

The girl is approached by the dog.

5. **Incomplete Sentence Errors**

English

BY: The dog is…

Target: The dog is followed by the man.

Hindi

DW: ɒːdmi ko ɣoɖɛ…

(The man) (ACC marker) (the horse)

Target: The man is kicked by the horse.

6. **Unrelated Sentence Errors**

English

CX: Girl is walking.

Target: The girl is watched by the chicken.

Hindi

DW: ləɖki kuʧ dɛx rəhi hɛ

(The girl) (something) (is watching)

The girl is watching something.

Target: kut:ɒ ləɖki ko pəkɖ rəhɒ hɛ

(The dog) (the girl) (ACC marker) (is approaching)

The dog is approaching the girl.

7. Non-Sentence Errors

English

DW: The girl's standing and look dog and dog… look… the girl.

Target: The dog is approaching the girl.

Hindi

None of the participants produced any non-sentences in Hindi.