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Syntactic Frequency and Sentence Processing in Standard Indonesian

Data from agrammatic aphasia and ERP

Bernard Amadeus Jaya Jap

university of groningen

The work reported in this thesis has been carried out under the auspices of the Erasmus Mundus Joint International Doctorate for Experimental Approaches to Language and Brain (IDEALAB) of the Universities of Groningen (NL), Newcastle (UK), Potsdam (DE), Trento (IT) and Macquarie University, Sydney (AU), under Framework Partnership Agreement 2012-0025 – specific grant agreement number 2014-0685/001-001-EMII EMJD by the European Commission.

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Data from agrammatic aphasia and ERP

PhD thesis

to obtain the joint degree of PhD at the
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on the authority of the
Rector Magnificus of the University of Groningen Prof. C. Wijmenga, President of the University of Potsdam, Prof. O. Günther, the Rector of the University of Trento, Prof. P. Collini, the Vice Chancellor of Macquarie University, Prof. S. Dowton, and the Vice Chancellor of Newcastle University, Prof. C. Day
and in accordance with
the decision by the College of Deans.

This thesis will be defended in public on

Thursday 12 November 2020 at 09.00 hours

by

Bernard Amadeus Jaya Jap

born on 21 March 1991
in Jakarta, Indonesia

Supervisors
Prof. Y.R.M. Bastiaanse
Prof. I. Wartenburger

Co-supervisor
Dr. S. Popov

Assessment Committee
Prof. D. Howard
Prof. B.A.M. Maassen
Prof. S. Stavrakaki
Prof. A. Szmalec

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CHAPTER 1

General Introduction

1.1 Introduction

The current study is a psycholinguistic research based on three sets of experimental data. It focuses on the processing of language at the sentence level by individuals with aphasia, as well as healthy adults. Apart from focusing on sentence processing in aphasia (Chapter 2 and 3), the research presents, to our knowledge, the first series of studies that utilize ERP (Chapter 4) to study sentence processing in Standard Indonesian (SI).

The major theories discussed involve aphasic sentence processing: the Trace Deletion Hypothesis (TDH; Grodzinsky, 1990) and the Derived Order Problem Hypothesis (DOPH; Bastiaanse & Van Zonneveld, 2005) were originally formulated in the framework provided by Government and Binding theory (Chomsky, 1981). While the TDH departs from the assumption that traces are lost in aphasia, the DOPH assumes that for each language there is a default order of constituents in language comprehension and production, and deviations from this order will increase processing load, thereby making particular structures, such as the passive, more difficult to process. The main aim of Chapters 2 and 3 is to find out whether particular sentence structures that are impaired in other languages are also impaired in Standard Indonesian (SI) speaking individuals with aphasia. Additionally, we also seek to find out how these structures are processed in other samples in an online environment in Chapter 4.

For the first two experiments on aphasia, a set of tasks were used to assess the participants. First of all, the Token Test has been adapted to SI to rate aphasia severity among participants, and to create norms for stroke patients (with and without aphasia) and non-brain damaged participants. Furthermore, a sentence comprehension test adapted from the VAST has been used to detect comprehension deficits at the sentence level. Finally, the second experiment (Chapter 3) used a sentence production task which utilized pictures for elicitation.

SI was the language of interest due to previous studies, namely, a case study (Postman, 2004) and a spontaneous speech analysis (Anjarningsih, Haryadi-Soebadi, Gofir, & Bastiaanse, 2012) that indicate, contrary to findings in several other languages, agrammatic speakers of Indonesian can comprehend passive sentences and produce them at a rate that is proportionate to healthy speakers of comparable age. However, there were a limited number of studies on sentence processing in SI aphasic speakers. One notable difference between passive sentences in SI and other languages such as English is the frequency in which they occur (Sneddon, 1996). Passives in SI are used frequently. As such, this study aims to present an additional factor to be considered when examining the processing of the passive as a structure with derived word order: the role of frequency.

1.2 Sentence processing in aphasia

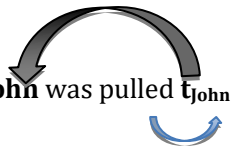
One of the defining points of aphasia is that in almost all its types, patients show, in one form or another, some deficit in comprehension (Caramazza & Zurif, 1978). There are several dimensions involved in understanding a sentence accurately.

Knowledge on sentence processing in aphasia has increased in recent years hand-in-hand with theoretical as well as experimental advances. Many of the more recent online studies are based on previous offline findings on testing sentence processing in non-fluent aphasia. One conclusion is that aphasic individuals face problems in processing certain sentence types (non-canonical) significantly more compared to other sentence types (Burchert, Hanne, & Vasishth, 2013). Previous studies show that, there is a regular pattern of sentence comprehension with certain word orders being systematically more challenging to process for agrammatic aphasic individuals (Caramazza & Zurif, 1976; Grodzinsky, 2000; Burchert, De Bleser, & Sonntag, 2003; Bastiaanse & Edwards, 2004, among others).

There are numerous theories in aphasic sentence processing that provide a delineation on the patterns previously found in crosslinguistic research data. Theories which are relevant to the dissertation are discussed in the following subchapters.

1.2.1 The role of Government and Binding (GB) Theory in aphasia

Three theories are contrasted by Grodzinsky (1990): Lexical Functional Grammar (Bresnan, 1982), Generalized Phase Structure Grammar (Gazdar et al., 1985), and Government and Binding Theory (Chomsky, 1981). Grodzinsky (1990) found that only the Government and Binding Theory is compatible with the pattern of comprehension of passive sentences in the data of individuals with Broca's aphasia (from now on 'agrammatic aphasia') because this theory distinguishes between the adjectival passives (e.g. "John was interested in Claire") which is unimpaired relative to healthy speakers and the verbal passives (e.g. "John was pulled by Claire") which agrammatic aphasic speakers struggle with. The movement of a constituent from one position to another, regardless of the type of movement, will generate a trace in the original position. Traces are placeholders crucial to the assignment of thematic roles. Additionally, they are essential components within the process of parsing a complete syntactic representation.



(1) John was pulled $\mathbf{t_{John}}$ by Claire.

Theme

In the example (1), the passive sentence shows the verb *pull* which provides thematic role information to object NP, and the NP moves to the front position. The moved NP still possesses the thematic role as a theme from its interaction with the trace. In studies on agrammatic aphasia, this idea is further propelled by the proponents of the Trace Deletion Hypothesis (TDH). The TDH proposes that the NP 'John' does not receive trace information because the trace does not exist or is 'deleted'.

1.2.2 The Trace Deletion Hypothesis (TDH)

Based on the GB theory, the Trace Deletion Hypothesis (TDH; Grodzinsky, 1995, 2000), states that in agrammatic Broca's aphasia, the traces which are crucial for accurate syntactic representation are lost. Moreover, Grodzinsky adds that for comprehension, agrammatic aphasic speakers have a certain pattern that is predictable in that active sentences are comprehended at above chance level while passive structures are comprehended at chance level (i.e. the aphasic speaker guesses the answer). The proposed cause is the fact that

all structures that contain argument movement (and therefore traces) result in an impaired assignment of thematic roles for the individual.

Grodzinsky, Pinango, Zurif, & Drai (1999) observed that in group studies, the results are statistically consistent when analysed together. Due to the deletion of traces, the comprehension of sentences that contain syntactic movement is impaired. The reversible passive, as a non-canonical sentence structure, was predicted to be comprehended poorly. The comprehension accuracy is compared to a "chance level" or coin toss, where they proposed the accuracy should be binomially distributed around the mean at 50%.

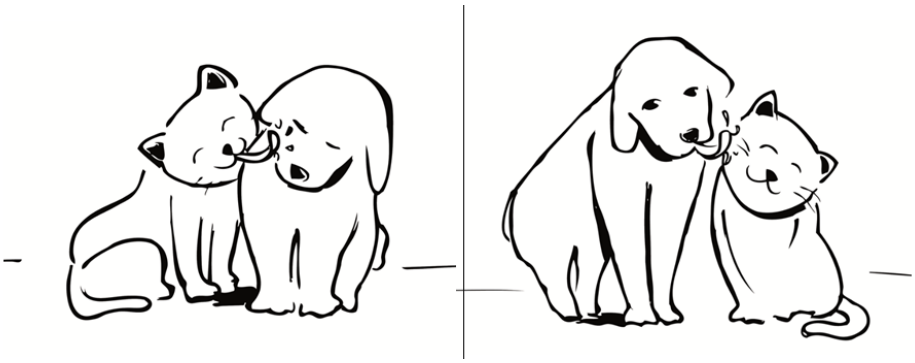


Figure 1.1 Example of a two-choice sentence-picture matching task (taken from Jap, Martinez-Ferreiro, & Bastiaanse, 2016)

Individuals with agrammatic Broca's aphasia have difficulties in accurately assigning the thematic role in a reversible sentence that contains argument movement because the syntactic representations do not contain traces. As such, when Figure 1.1 is presented as an item, and a sentence such as "the cat is licked by the dog" is read out, individuals with agrammatic aphasia cannot parse who is doing what to whom, because the trace of the theme (the cat) is lost. Now a heuristic strategy is used (in English): the NP1, 'the cat', has no thematic role and gets assigned the role that is most common to the NP1 in the sentence, i.e., the agent role. Now the aphasic individual faces a problem: there is a representation with two agent roles. One assigned by the passive morphology to 'the dog' and one assigned by the heuristic strategy, 'the cat' and the patient has to guess. Hence, a guessing strategy is employed and therefore showing a chance-level performance. As a representational account of agrammatic sentence processing, this impairment suggests that individuals

with agrammatic aphasia are not, in any way, able to process non-canonical structures such as passives reliably and because of that, they employ a 'strategy' that involves guessing.

1.2.3 The Derived Order Problem Hypothesis (DOP-H)

Bastiaanse & Van Zonneveld (2005) with the Derived Order Problem Hypothesis (DOP-H) proposed that impairment associated with grammatical processing is the main cause of problems in the processing of reversible structures with derived word orders. It is based on data from a number of typologically distinct languages (Swahili: Abuom, Shah, & Bastiaanse, 2013;, Dutch and English: Bastiaanse, Edwards, Maas, & Rispens, 2003; Bastiaanse & Thompson, 2003; Bastiaanse & Van Zonneveld, 2006; Turkish: Yarbay Duman, Ozgirgin, Altinok, & Bastiaanse, 2011) and accounts for both production and comprehension. The DOP-H argues that all languages have a base word order, where constituents are placed in the 'default' or in the most common order. Any changes from this order increase the linguistic operations needed and, therefore, increase the cognitive effort required to process it and decrease accuracy. One notable aspect of the DOP-H, unlike the previously discussed TDH, is that the DOP-H does not employ a representational account of sentence processing. In other words, it does not predict that agrammatic individuals will *consistently* fail in parsing all non-canonical sentences involving movement. Hence, the DOP-H does not precisely predict 'chance-level' performance, but rather that performance on non-canonical sentences will be less accurately processed than on canonical sentences. One example of the distinction between DOPH's prediction compared to the TDH can be seen below in Table 1.1 (Bastiaanse & van Zonneveld, 2006:141); the chance-level descriptions are displayed on the DOPH column for ease of comparison.

Table 1.1 A comparison of the TDH, the DOPH, and Dutch data

	TDH	DOP-H	performance
Het meisje wordt door de jongen gekust The girl is by the boy kissed	Above chance	At chance	At chance
Het meisje wordt gekust door de jongen The girl is kissed by the boy	Above chance	At chance	At chance
De jongen kust het meisje The boy kisses the girl	At chance	Above chance	Above chance

The DOP-H is also able to account for the pattern of performance observed with aspects other than syntactic movement such as embeddings, which were predicted to add additional processing costs during parsing (Abuom, Shah, & Bastiaanse, 2013). As such, the expectations for the multiple sentence types tested in the present study starts from the least linguistically demanding which would be the active structure (-embedded, +canonical), followed by subject-cleft (+embedded, -canonical), the passive (-embedded, -canonical), and finally object-cleft (+embedded, -canonical). The clefts are only incorporated in the second chapter on comprehension. We also included an additional factor of animacy and reversibility, which will be described in detail in Chapter 4.

1.3 Structural frequency in sentence processing

Two aspects that have been taken into account in present models of language processing such as the constraint-based (Trueswell & Tanenhaus, 1994) and the competition model (MacWhinney, 1987) are sensitivity towards statistical and probabilistic aspects of language and the frequency information of lexical items used. The notion stems from previous findings on the fact that processing decisions in NBDs were affected by the lexical frequency of a word (MacDonald et al., 1994) and its occurrence in different syntactic constructions (Juliano & Tanenhaus, 1994).

According to MacDonald, Pearlmutter, & Seidenberg (1998), the frequency of constructions in which verbs occur affects parsing decisions at the sentence level. It suggests that "exposure-based strategies" are indeed prevalent in sentence processing (Mitchell, 1994). Furthermore, Mitchell, Cuetos, Corley, & Brysbaert (1995) presented evidence against models that rely on exclusive "fine-grained" lexical information based on the argument that lexical constraints can be weak, and a more viable account of language processing requires frequency details on statistical regularities beyond the word level.

Compared to actives (both in terms of accuracy and time required to parse), both reversible and non-reversible passives are more difficult to process. One methodology that has been taken into account is eye movement patterns in the processing of unambiguous sentences in English (Ferreira, 2003). Difficulty in the atypical assignment of thematic roles is not attributed to frequency. However, actives, which are frequent, and subject-clefts, which

are not frequent, are considered equally "easy". To illustrate, if one were to predict processing difficulty solely based on frequency, (2a) would be the easiest followed by the three structures, (2b), (2c), and (2d) in no particular order since all three are relatively infrequent in English. However, in aphasia, it is known that the comprehension of subject-cleft (2c) is also fairly unimpaired in comparison to non-canonical structures. This causes a frequency-based account to not be viable at least if it is used as the sole factor.

(2a) The horse bites the cow.

(2b) The cow is bitten by the horse.

(2c) It is the horse that bites the cow.

(2d) It is the cow that the horse bites.

Contrasting theories in aphasia have proposed that a variety of factors make particular syntactic structures more complicated to comprehend and/or produce than others. Sentences with more noun phrases and/or verbs, according to St John & Gernsbacher (1998), are more difficult than ones with fewer numbers of noun phrases and/or verbs and the non-canonical word order is more difficult than the "preferred" one. Notwithstanding the fact that frequency is essential in human memory, language acquisition, and language processing, frequency in the context of sentences has not been incorporated into theories that explain aphasic comprehension of different syntactic structures. However, one criticism towards this study is that since it only focuses on actives and passives, it would be inadequate to draw a conclusion on the basis of frequency when the latter is both more complex syntactically and less frequent. An exploration on the corpora shows that an absolute frequency-based account is again insufficient to clarify aphasic sentence processing. To demonstrate, note that both subject and object-clefts are extremely rare, found in less than 1 per 1000 sentences in English. Passives are more frequent with 2.4-3.2 per 1000 sentences in spoken corpora and 7.7-10.5 in written corpora (Roland et al., 2007). Despite the fact that passives are more frequent, they are more difficult for agrammatic individuals than subject-clefts and subject relatives in both production and comprehension (Abuom, Shah, & Bastiaanse, 2013). Additionally, a study on speakers with agrammatic aphasia in Dutch, Bastiaanse, Bouma, & Post (2009) found that unlike linguistic complexity, frequency of grammatical structures cannot

account for the performance of agrammatic speakers on production tasks. Bastiaanse et al. (2009) found that passives, object clefts and object relatives are not only poorly understood, but also have low frequency, whereas subject clefts have equally low frequency, but are well understood .

To recap, the role of frequency has been established in some aspects of normal language processing. Nevertheless, the role of frequency in processing certain derived structures by agrammatic individuals is not yet evidenced.

1.4 Standard Indonesian

Indonesian is a member of the Austronesian language family under the Western Malayo-Polynesian subdivision which has 23 million native speakers and over 140 million L2 speakers (Lewis et al., 2013). The variety used in education, governmental activities, and other formal settings is called Standard Indonesian (SI). SI is a zero-marking language (Nichols & Bickel, 2013) without case or gender markings. Verbs are usually only inflected for voice; there is no verb inflection for tense, aspect, or agreement. Most people acquire Standard Indonesian through formal education with regional dialects spoken as L1. Consequently, monolingual SI speakers are relatively low in number.

1.4.1 Verbs in Standard Indonesian

According to Sneddon (1996), single-word verbs are categorized into two groups according to their affixation types. Primary verbs can either be transitive or intransitive. Secondary verb forms involve the deletion of primary affixations, for instance, the primary verb *men*-base *"memukul"* 'to hit' to the secondary verb base-*men*-base "*pukul memukul"* 'to hit repeatedly or to hit one another'. In this section we will focus on primary verbs, the forms included in our task designs.

Among the primary verbs, there are simple intransitive verbs like *tidur* 'to sleep', *ber*- intransitive verbs like *berenang* 'to swim' (where the *ber*- prefix generally does not have an assigned meaning other than the well-formedness of the verbal form), and intransitive verbs with *men-,* which form the majority of intransitives in the test. Intransitive verbs with *men*- which are of interest to us may either have a verbal base such as *menikah* 'to marry' from *nikah* 'to marry' (colloquial) or noun bases such as *mendarat* 'to land' from *darat* 'land'.

Although some verbs have interchangeable prefixes such as *menyanyi* 'to sing' and *bernyanyi* 'to sing' from *nyanyi* 'to sing' (colloquial), most are not interchangeable: simple verbs cannot be prefixed at all, and others require prefixes. These differences have no known function other than the fact that they are used only with certain bases, which Sneddon describes "occur unpredictably," (1996: 66).

One difference between transitive and intransitive verbs in the context of SI is that the transitives carry voice inflection. In the following chapters, verbs in the materials are actives are always inflected with *men-*. There are cases in which these affixes are omitted, such as imperative structures '*tendang bolanya!*' (kick the ball!) where only the base of the verb 'tendang' is used. Another case where the affix is commonly omitted, especially in oral form, is highly frequent transitive verbs such as *minum* 'to drink' and *makan* 'to eat', though formally the prefixed forms should still be used. Simple transitive verbs contain roots which are not affixed apart from the voice inflection. Most transitive verbs used in the experiments are in this category such as *membaca* 'to read', *menulis* 'to write'.

1.4.2 Sentence structure and word order in Standard Indonesian

There are two obligatory components for the basic clause of SI: the subject and the predicate. The subject of a clause indicates, in general, what is being discussed. It is usually produced in the form of a noun or a pronoun phrase (though nominal clauses can also appear in subject position). Clauses are either verbal, with a verb as the predicate centre (3a), or non-verbal (3b).

3a. *Andi*	*memasak*	*nasi.*
Andi	cook(s)	rice.
3b. *Andi*	*di*	*rumah.*
Andi	(is) at	home.

The clause type is decided by the predicate. We do not discuss non-verbal clauses in greater detail as the experiments utilize verbal-clauses exclusively.

Despite indications that the limited SI morphology implies a more rigid word order, SI is quite flexible in constituent ordering (Stack, 2005). The

subject followed by the predicate is the 'base' word order in an SI clause. The object follows the predicate in transitive verbal clauses. The examples below summarize most variations of word order in SI declaratives:

(5) "She bakes a cookie."

a. Dia	*memanggang*	*biskuit.*
He/she	ACT-bake	cookie.
b. Biskuit	*dipanggang*	*dia.*
Cookie	PAS-bake	he/she.
c. Biskuit	*dia*	*panggang.*
Cookie	he/she	bake.

Item 5a shows the basic word order with an active voice marking (*men-*) on the verb. The passive is indicated by the *di-* prefix on the verb at 5b, and the "cookie" is the theme. Noting the fact that the examples are semantically non-reversible, the *di-* prefix on the verb will assign NP1 as theme. The third construction (5c) is the least frequent of the three, and uses an unmarked verb at the sentence-final position. There has been debates on whether the third construction is a passive with some scholars calling it a "bare" passive / passive type-two (Nomoto, 2010; Sneddon, 1996) and others referring to it as an object-preposed construction (Postman, 2004). In short, SI has a relatively free word order for wh-questions (also yes/no questions) as well as, in a more restricted context, declaratives. Although there are several types of passives, this study focuses on the most common "type-one" passive which is shown on example 5b.

1.4.3 Passives in Indonesian

Of the several passive forms in SI, the structure relevant to the set of experiments conducted is composed of a theme, followed by a verb, an optional preposition (by), and an agent. This structure is comparable to the English passive, though the by- preposition is not often used and the verb inflection paradigm are different in SI as described previously.

The passive structure is more prominent in SI than in other languages, like English. It is acquired early around the age of 2;0 (Gil, 2006). This seems to be early compared to English-speaking children who do not use the passive voice until the age of 4 or 5. Additionally, regarding the input frequency (recorded adult speech in the presence of language-acquiring-children) of

passive structures, Gil (2006) estimated to be approximately 28-35% in SI, compared to 4-5% in English. The passive in English is a predominantly written structure, as a corpus study (Roland, Dick, & Elman, 2007) found that passives appear 4 to 5 times more often in written compared to spoken corpora. In its written form, 30 to 40% of the verbs in SI have the passive *di-* prefix (Kaswanti Purwo, 1991). This can be seen in comparison to English whereby approximately 9% of English verbs display passive morphology (Givon, 1979). The highly frequent passive phenomenon is not exclusive to SI, as it is also common in Malay, the language from which SI is derived (Suwarso, 1994). To follow-up on this notion, the passive in Indonesian has a functional property, that is, to make clauses more polite. Randriamasimanana (1999) observed that the number of verbs in passive form increases as it is utilized as a politeness strategy (i.e. communicating with people of higher status).

1.5 The study

The main research questions are formulated as follows;

1. How do SI-speaking agrammatic individuals with Broca's aphasia comprehend sentences with non-canonical word orders (and their canonical counterparts)? (Chapter 2)
2. How do SI-speaking agrammatic individuals with Broca's aphasia produce sentences with non-canonical word orders? (Chapter 3)
3. How are derived word orders processed in healthy adult SI speakers? Are there neural correlates / processing costs associated with passives? (Chapter 4)

The hypothesis, based on the evidence presented by previous studies on SI aphasia, is that syntactic frequency has an effect on the processing of non-canonical structures. It is predicted that comprehension and production of both active and passive structures will be intact, comprehension of the subject-clefts, which have canonical word order but are embedded structures, is expected to be better preserved than comprehension of object-clefts, which are the least frequent non-canonical condition. The base vs derived word order performance dichotomy will be observed for clefts, structures that have low frequencies in SI. Additionally, as the ERP study on typical (non-violation) sentence processing is exploratory, our hypothesis will only go so far as to state that the expected "processing costs" of derived word orders should be

considerably less noticeable due to smaller frequency difference between the active and passive structures.

1.5.1 Structure of the thesis

The experimental parts of this thesis start with Chapter 2, which is on the sentence comprehension of SI agrammatic speakers. Then, a different set of stimuli were designed for Chapter 3, which discusses sentence production in SI agrammatic speakers. Chapter 4 presents ERP data on SI sentence processing: an experiment which we conducted on healthy adults. Chapter 5 rounds up the results from the experimental chapters and connects them to the clinical context and future research.

CHAPTER 2

The Effect of Syntactic Frequency on Sentence Comprehension in Standard Indonesian Broca's Aphasia[1]

Abstract

Comprehension of reversible sentences that have derived word-order has often been reported as impaired in agrammatic aphasia. Most accounts of this phenomenon refer to the syntactic differences between derived and base word-order of the arguments. However, it has been demonstrated that in agrammatic spontaneous-speech in Standard Indonesian (SI) passives are produced at a rate that is proportional to that of healthy speakers. The main difference between SI and other languages is the frequency with which passives are used: passives in SI are highly frequent. The main reason is that passive should be used to address someone who is higher in hierarchy. The purpose of the current study is to investigate comprehension of the passive as a derived structure in SI and the influence of frequency. A sentence-to-picture matching task was developed to test four reversible sentence types (active, passive, subject cleft, and object cleft). There are three variables that are of interest, that is, word order, embedding, and relative frequency of structures. Eleven agrammatic speakers classified as suffering from Broca's aphasia were tested. The passive sentences were comprehended equally well as the active sentences. Embedding had limited effects: subject-clefts were understood as well as actives and passives. Object clefts, however, were understood poorly and significantly worse than the three other sentence types. The sentence comprehension deficit pattern shown in SI individuals with Broca's aphasia introduces frequency of a syntactic structure as an additional factor to consider. Whether frequency or pragmatic constraints protects against erosion of the passive in Broca's aphasia in SI remains an open question.

Keywords: Broca's aphasia, sentence comprehension, word order, passives, syntactic frequency, Standard Indonesian

[1] The study reported in the current chapter has been published in an adapted format as: Jap, B. A., Martinez-Ferreiro, S., & Bastiaanse, R. (2016). The effect of syntactic frequency on sentence comprehension in standard Indonesian Broca's aphasia. *Aphasiology*, 30(11), 1325–1340.

2.1 Introduction

One of the defining characteristics of aphasia is that in almost all its types, patients show deficits in sentence comprehension (Goodglass, Kaplan and Barresi, 2001). For agrammatic Broca's aphasia[2] in particular, there is substantial evidence to indicate that reversible sentences with derived word-order are more vulnerable to breakdown (Bastiaanse and Edwards, 2004; Burchert, De Bleser, and Sonntag, 2003; Caramazza and Zurif, 1976; Grodzinsky, 2000 among others). Although different theories have been formulated to account for these findings (Bastiaanse & Van Zonneveld, 2005, 2006; Caplan & Futter, 1986; Grodzinsky, 1995, 2000; Schwartz, Linebarger, Saffran & Pate, 1987), overall these studies suggest that the order of the arguments influences performance on sentence comprehension tasks in Broca's aphasia. The Derived Order Problem Hypothesis (DOP-H; Bastiaanse & Van Zonneveld, 2005; 2006) assumes that every language has a base order (e.g., SVO for English, SOV for Dutch). All other orders are derived by linguistic operations. Sentences with derived order are harder to produce than sentences with base word-order for individuals with Broca's aphasia.

For comprehension, this implies that all sentences with derived order require more processing capacity (see Bastiaanse & Van Zonneveld 2006). This is hard to measure with offline tasks for most constructions, but for semantically-reversible sentences, the order of the arguments is crucial: when the agent and theme are in base order (i.e. agent precedes the theme) sentences are relatively easy; when the agent and theme are in derived order (i.e. theme precedes the agent, such as in the passive and object relative sentences in English), comprehension will be impaired. Notice that the DOP-H is a processing account: it assumes that derived order is more difficult than base order, but not that derived order is impossible, such as representational accounts like the Trace Deletion Hypothesis (e.g. Grodzinsky, 2000) suggests. The DOP-H focuses on word order in particular and is based on empirical findings across languages (for a review of the hypothesis, Abuom, Shah, & Bastiaanse, 2013).

[2] We do not go into the discussion on the differences and / or similarities between agrammatism and Broca's aphasia. Here we follow Goodglass et al.'s (2002) definition of Broca's aphasia: agrammatic speech and relatively good (word) comprehension. Since in the literature on sentence comprehension the term 'Broca's aphasia' is most common, this is the term we use throughout the chapter.

Data on Standard Indonesian (SI) aphasia are relatively scarce compared to those of Indo-European languages. The available data suggest that SI speakers with Broca's aphasia do not only comprehend passive sentences correctly, but also produce them at a rate that is proportionate to healthy speakers (Anjarningsih, Haryadi-Soebadi, Gofir, & Bastiaanse, 2012; Postman, 2004). A marked difference between passive structures in SI and other languages is the frequency in which these structures are used (Sneddon, 1996). The current study aims to present an additional factor to be considered when examining comprehension performance: the role of relative frequency of structures. We examine comprehension patterns in SI speaking individuals with Broca's aphasia speakers, focusing on three variables, that is, word order, embedding, and relative frequency of structures. We start by providing the relevant background on SI word order and passive structures, which is followed by an overview of theories in Broca's aphasia that aim at describing sentence comprehension deficits. Then, previous studies in agrammatic Broca's aphasia in SI will be reviewed. We conclude the introductory section by stating the predictions of the current study.

2.1.1 Word order and passives in Standard Indonesian

SI is a member of the Austronesian language family under the Western Malayo-Polynesian subdivision. It has 23 million native speakers and over 140 million L2 speakers (Lewis, Simons & Fennig, 2013). SI is the language used in education, governmental activities, and other formal settings. Though initially SI is acquired as a second language with regional dialects spoken as L1, native speakers of SI continue to grow in number (Postman, 2011).

SI is a zero marking language (Nichols & Bickel, 2013). Zero marking is defined as the absence of overt morphological markers that are usually present in the core arguments of a predicate (Sinnemäki, 2010); in this context, SI has neither case nor gender markings. (Transitive) verbs are usually only inflected for voice (active or passive). With the exception of particular reduplicated verb constructions that signify an iterative aspect (Mistica, Andrews, Arka, & Baldwin, 2009), typical use of SI usually involves no verb inflection for tense, aspect, or agreement. For example, the verb *memasak* in (1b) provides a lexical entry as well as information regarding voice, which is active and indicates transitivity. The base clause of SI has two obligatory components: the subject and the predicate. The subject of a clause is, in general, what is being discussed (the topic). It is usually produced in the

form of a noun or a pronoun phrase (though nominal clauses can also appear in subject position). Clauses are either non-verbal (1a) or verbal, with a verb as the predicate centre (1b),

(1a) Andi di rumah
Andi at home
'Andi is at home'

(1b) Andi **me**masak nasi
Andi **ACT-**cook nasi
'Andi is cooking rice'

SI morphology (or its lack thereof) suggests a rigid word order, though in certain constructions such as WH-questions (Stack, 2005) and predicate nominalization (McCune, 1979), the ordering of constituents can be flexible. The base word order in an SI clause is subject - predicate. An object follows the verb in transitive verbal clauses indicating that SI has an SVO base word order. The examples below (2a-b) clarify the types of sentences that will be discussed in the present study.

(2a) Base order, simple active (agent-theme)

Perempuan itu **me**manggil laki-laki itu
girl the **ACT**-call boy the
'the girl is calling the boy'

(2b) Derived order, simple passive (theme-agent)

Laki-laki itu **di**panggil (oleh) perempuan itu
boy the **PAS**-call (by) girl the
'the boy is called by the girl'

The base word order with an active voice marking (*meN-* reduced to 'me' due to assimilation) on the verb is shown in (2a). The examples above, as with the materials we used for testing, are semantically reversible. The passive[3] is expressed by the *di-* prefix on the verb in (2b) where 'the boy' is the theme. As

[3] The use of the term 'passive' to refer to all un-affixed and *di-* verb clauses has been widely debated. Several researchers (Rafferty, 1982; Hopper, 1983) claim that some of the traditionally considered passive constructions are passives, while others should be classified as ergative. However, a review on passive constructions being ergative concluded that none of the arguments successfully demonstrated that Indonesian/Malay is an ergative language (Cumming and Wouk, 1987).

in English, the by-phrase in the passive (2b) is optional. Additionally, the preposition *oleh:* 'by' may be omitted in both spoken and written form when nothing is placed in between the passivized verb and the agent phrase. The NP – V – NP structure of the passive when the agentive preposition is omitted appears to be the mirror image of the active structure.

The passive construction plays a more vital role in SI than in other languages documented so far. It is acquired appropriately at a very early age, sometimes under 2 years old (Gil, 2006). In comparison, Gil (2006) mentions that English-speaking children do not use the passive voice until age 4 or 5. Moreover, the input frequency of passive structures is estimated to be between 28-35% in SI, compared to 4-5% in English. Among adults, SI passives become increasingly more frequent as they age, in both spoken and written context. Another contrast with English is shown by a corpus study (Roland, Dick, & Elman, 2007). Passives appear 4 to 5 times more often in written corpora compared to spoken ones in English, demonstrating it is primarily a written structure in this language. In SI, however, Kaswanti Purwo (1991) found that 30 to 40% of the verbs in written SI have the passive *di-* prefix, compared to approximately 9% of English verbs displaying passive morphology (Givón, 1979). The highly frequent SI passive is also found in other Malay languages such as classic Malay, a language from which SI is derived (Suwarso, 1994). The saliency of the passive in SI is attributed to the unambiguous voice morphology that provides a straightforward schema of the *meN-* prefix for active and the di-prefix for passive. This salience can also be observed in the fact that, unlike the *di-* prefix, the active prefix *meN-* contains a schwa and is often reduced in spoken Indonesian to stem-initial assimilation (e.g. *menyapu* -> *nyapu* ; to sweep).

The passive in Indonesian has a functional use: it makes sentences more polite. Randriamasimanana (1999) observed the usage of verbs in passive form in letters sent by native SI speakers (parents) to their sons and daughters studying in the United States in the late 1970s. In an example, one of the individuals was reported to write three letters, one to a civil servant, one to the individual's elder son, and another to the individual's younger son. The letter directed to the civil servant had a large proportion of passive verbs (57.1%; 32 out of 56), compared to that of the elder son (at 29.5%; 18 out of 61) and that of the younger son (16.3%; 8 out of 49). This example illustrates that passives are considered to be more polite, and thus deemed more appropriate in certain contexts. The frequent use of passives in SI can also be

motivated by specific discourse functions that are distinct from those of active verb forms. Using a discourse analysis, Kaswanti-Purwo (1988) described the *di-* verbs' functions as foregrounding, describing punctual and/or factual events, as well as introducing actions that come in sequences. On the other hand, *men-* verbs function as beginning of discourse (background), describing habitual and/or nonfactual events, providing parenthetical information, and also breaking or closing narrative flows. Verhaar (1978) also noted some contexts where the *di-* passives are more "compatible", for instance when the verb form is not reduplicated or when a sentence does not provide information on duration.

Subject and object clefts (3a-b) are relatively infrequent compared to actives and passives. In other languages such as English, the use of cleft constructions are highly restricted and rarely used in both spoken and written English occurring at a rate of 0.8 cleft construction per 2000 words in the British component of the International Corpus of English (Nelson, 1997). While there were no formal corpora analyses comparing clefts with other structures in SI, using a corpus of colloquial spoken data, Englebretson (2008) found 83 occurrences of cleft constructions within 8,744 Intonation Units (IU) and 24,074 words by tagging the word *yang* (who/that), an obligatory relativizer. Another study of colloquial Jakarta Indonesian (Ewing & Cumming, 1998) reported that the corpus, consisting of 1360 IUs, had 74 relative clauses of which 25 of them were identified as "clefts", and they added that clefts in their observed corpus were restricted by transitivity; only about 20% of intransitive relative clauses were classified as clefts. The sentence referred here as object cleft has also been called a "bare" passive or passive type-two (Nomoto, 2010; Sneddon, 1996) while others refer to it as an object-preposed construction (Postman, 2004). The structure (3b) shows the embedded, derived order condition. In this sentence type, the verb occurs in bare form, as the restriction on extracting objects of verbs prefixed with *meN-* can be explained by seeing the active voice marker as lacking an Extended Projection Principle feature (Cole & Hermon, 2008). However, Postman (2002) remarked that the SI grammar may evolve to a point where object extraction with *meN-* active verbs is allowed. While instances of these are relatively uncommon and still generally regarded as ungrammatical, they are recorded to have occurred in formal registers of Indonesian (Hassal, 2005).

(3a) Base order, subject cleft (agent-theme)

Perempuan itulah	yang	**me**manggil	laki-laki	itu
girl that is	who	**ACT**-call	boy	the

'that is the girl who is calling the boy'

(3b) Derived order, object cleft (theme-agent)

Laki-laki itulah	yang	perempuan	itu	panggil.
boy that is	who	girl	the	0-call.

'that is the boy who the girl is calling'

2.1.2 Derived order problem hypothesis: agrammatic sentence comprehension

Individuals with Broca's aphasia have problems assigning the correct thematic roles in a reversible sentence that has derived word order. When a sentence such as *the cat is scratched by the dog* is read aloud and the participants have to select the correct picture, they may have problems identifying who does the action (the agent) and who undergoes it (the patient/theme). Consequently, they may fail to identify the matching picture in a sentence-to-picture matching task. Representational accounts of the comprehension impairment suggest that individuals with Broca's aphasia cannot understand derived structures such as passives and object-clefts, and thus resort to a guessing strategy. An example of a representational account is the Trace Deletion Hypothesis (Grodzinsky, 2000). From the point of view of minimalist linguistic theory, sentences with base and derived word-order have the same underlying structure, but for derived word-order an extra operation is needed. Consider the following example. In a simple active sentence (in English), the base word-order is Agent – Verb – Theme. In a passive sentence, word order is derived, that is, the order is Theme – Verb – Agent. In order to get this derived structure, a linguistic operation is need (we refrain from a discussion whether this happens through movement, merge or any other operation; the idea is that the word order is not the base order). It has been shown repeatedly and in many languages that comprehension of sentence with Theme – Agent order is difficult for agrammatic speakers. This has been shown for both production and comprehension in several structures in different languages: passives in English (e.g., Grodzinsky, 1995); object clefts in Swahili (Abuom, Shah & Bastiaanse, 2013); sentences with scrambled objects in Turkish (Yarbay

Duman, Ozgirgin, Altinok & Bastiaanse, 2011). The DOP-H captures these word-order problems and also accounts for the pattern of performance observed with embeddings: embedding requires and extra operation and thus adds up to the problems with derived order (Abuom, Shah, & Bastiaanse, 2013).

2.1.3 Sentence comprehension in SI aphasia

As previously mentioned, data on aphasia in SI speakers are very scarce compared to those of Indo-European languages. There are, however, two studies on complex constructions in SI aphasia, one by Anjarningsih et al. (2012) and one by Postman (2004).

Anjarningsih et al. (2012) analyzed the agrammatic spontaneous-speech of SI individuals with Broca's aphasia and found that, in addition to characteristics of agrammatism also present in other languages (such as reduced use of functional elements, lower speech rate, and lower mean length of utterances), there are two phenomena that seem to be unique to SI: normal verb production, and normal production rate of non-canonical structures such as passives. The occurrence of passive sentences was found to be proportionate to normal speakers.

Postman (2004) conducted a case study on a non-fluent SI aphasic speaker using puppets in an acting-out task. He successfully comprehended all single-clause sentences; therefore, a condition including complex sentences (two verbal clauses) was added to the design (4). The results of the study show that he comprehended and enacted the first clause of all trials including verbs with passive markers perfectly, but interpreted sentences inaccurately when the first clause was either a passive (Theme-Verb-Agent) or an object-topicalized structure (Theme-Agent-Verb).

(4)

Susan	**di**cium	Nando	dan	**di**peluk	Allen
Susan	**PASS**-kiss	Nando	and	**PASS**-hug	Allen

'Susan is kissed by Nando and hugged by Allen'

While he comprehended that 'Nando kissed Susan', he incorrectly interpreted *Nando* (instead of *Susan*) as the theme of the second action. This outcome draws further questions to whether aphasic SI speakers can

consistently and accurately parse sentences with derived order, and whether word order interacts with the increasing complexity of the sentence. In Postman's (2004) study, complexity is defined in terms of number of clauses and total length of the sentence, where in the current study, the focus is shifted to word order and embedding as sentence complexity factors.

2.1.4 Structural frequency in sentence processing

Models of language processing, for example the constraint-based model (Trueswell & Tanenhaus, 1994) and the competition model (MacWhinney, 1987), have considered sensitivity towards statistical and probabilistic aspects of language such as the frequency details of lexical items used and how it affects processing of sentences. It has been shown that the lexical frequency of a word (MacDonald, Pearlmutter, & Seidenberg, 1994) and its occurrence in different syntactic constructions (Juliano & Tanenhaus, 1994) affect processing decisions in non-brain-damaged speakers (NBDs).

MacDonald et al. (1994) proposed that, at the sentence level, the relative frequency of constructions affect parsing decisions. This is more clearly seen in sentences containing syntactic ambiguities. The fact that information from linguistic regularity is conveyed in the initial interpretation of sentences suggests that "exposure-based strategies" are indeed prevalent in sentence processing (Mitchell, 1994). Moreover, Mitchell, Cuetos, Corley, and Brysbaert (1995) presented evidence against models that rely exclusively on "fine-grained" lexical details. They argued that lexical constraints can be weak, and a more viable account of language processing requires frequency records on statistical regularities beyond the word level.

Eye movement patterns while processing unambiguous English sentences have been taken as evidence that passives (both reversible and irreversible) are more complex to process than actives - both in terms of accuracy and time required to respond to the comprehension question in NBDs (Ferreira, 2003). Difficulty in the atypical assignment of thematic roles is not attributed to frequency, however: actives, which are frequent, and subject-clefts, which are not frequent, are comprehended equally well. To illustrate, if one were to predict processing difficulty solely based on frequency, (5a) would be best comprehended followed by the three structures, (5b-d) in no particular order since all three are infrequent in English. However, we know that in Broca's aphasia, the comprehension of subject-clefts (5c) is

relatively unimpaired in comparison to other derived structures (Grodzinsky, 2000; Abuom, Shah & Bastiaanse, 2003). This makes a frequency-based account not valid, at least when it is used as a sole factor.

(5a) The horse bites the cow. (active)

(5b) The cow is bitten by the horse. (passive)

(5c) It is the horse that bites the cow. (subject cleft)

(5d) It is the cow that the horse bites. (object cleft)

In aphasia, competing theories have suggested that various factors make certain syntactic structures more difficult to comprehend and/or produce than others. According to St John and Gernsbacher (1998), sentences with more noun phrases and/or verbs are more difficult than the ones with fewer noun phrases and/or verbs. This adds up to the fact that derived word order is more difficult than the canonical word order. Despite the fact that lexical frequency has been traditionally taken to be important in the fields of human memory, language acquisition, and language processing, frequency of grammatical constructions has not been incorporated into theories that explain aphasic comprehension of different syntactic structures. Gibson, Sandberg, Fedorenko, Bergen and Kiran (this issue) found that individuals with aphasia rely more on plausibility than on syntax in interpreting sentences.

A comparison to a computational model based on frequency and a collection of aphasic comprehension data showed a matching performance for the frequent active and less frequent passive structures (St John and Gernsbacher, 1998). However, one criticism of this study is that it only investigates actives and passives, and this is insufficient to draw a conclusion on the basis of frequency, when the latter is both more complex from a syntactic and morphological point of view and less frequent. Though more frequent, passives are more difficult for individuals with Broca's aphasia than subject-clefts and subject relatives, in both production and comprehension (Abuom, Shah, & Bastiaanse, 2013). Also, linguistic complexity (i.e., derived word order) rather than frequency of the grammatical construction has been shown to be the predictive factor for agrammatic sentence production in Dutch (Bastiaanse, Bouma & Post, 2009).

A review of usage-based effects at the sentence level (Gahl & Menn, this issue) suggests that the influence of frequency extends to other syntactic contrasts (such as sentences with unaccusative verbs and sentences with other types of verbs as well as subject and object relatives). Additionally, Gahl & Menn (this issue) argued that frequency at the sentence level interacts with other factors such as the frequency in which a certain verb is used in certain constructions. Gahl et al. (2003) found that there is a modulation effect of lexical bias where, for example, passive sentences with passive-bias verbs are comprehended better than passive sentences with active-bias verbs.

To recap, frequency of sentence structure plays a role in normal-language processing and has an effect on sentence processing in aphasia. However, the nature of the relationship between relative syntactic frequency and word order in aphasic sentence comprehension has yet to be established.

If the frequency of the passive construction with its derived order does indeed play a role in SI sentence comprehension of individuals with Broca's aphasia, as expected on the basis of the data of Postman (2004) and Anjarningsih et al. (2012), relatively good comprehension of this sentence type is to be expected, even though the SI passive has derived word-order, the frequency and pragmatic constraints thus overruling the DOP-H. However, this can only be concluded when influence of derived word-order is shown by poor comprehension of SI object cleft sentences, noting that the object cleft in SI are both infrequent and use a derived order of agent and theme, this structure is predicted to be impaired.

2.2 Methods

2.2.1 Participants

Twenty-three participants were included in the sentence comprehension study: 11 individuals with aphasia (IWAs) who were classified as having Broca's Aphasia on the TADIR/SI Aphasia battery and spoke agrammatically, and 12 non-brain-damaged (NBDs) Standard Indonesian speakers. Aphasic participants were recruited from six nursing homes in several cities of Central Java, Indonesia (Surakarta, Brebes, Semarang, Ungaran, Bantul, and Sleman). Their demographic profiles were acquired from the caretaker of the nursing home and individual interviews. The NBD group was comprised of healthy individuals from two nursing homes in Surakarta and Brebes. While the

participants' first languages were not SI, the experimenter as well as nursing staff and interns (for the nurse profession) communicated to the participants using SI. Since these were state-owned nursing homes, many of the civil servants and interns working in the nursing homes come from other areas of Java, where they may speak a different dialect of Javanese or perhaps an entirely different language (Sundanese from West Java, for example). While we did not possess data on their pre-morbid SI proficiency, measures were made to ensure the proficiency of SI of the participants. First, all participants had to have completed compulsory education (mean=12.1 years), which was conducted exclusively in SI, to be included in the group. Secondly, practice runs were conducted prior to testing to ensure understanding of the instructions which was in SI.

Due to the lack of aphasia diagnosis in nursing homes, first a screening test was administered to all stroke victims who had problems communicating or suffered from a right hemiparesis. An SI translation of the Token Test from the Dutch *Aachener Aphasie Test* (AAT: Graetz, de Bleser, & Willmes, 1992) was used. An error rate of more than 15 on the Token Test indicates a high probability of aphasia when hearing and vision are intact. Those participants who had over 15/50 errors were then tested with the *Tes Afasia untuk Diagnosis, Informasi, dan Rehabilitasi* (TADIR: Indonesian Aphasia Test for Diagnosis, Information, and Rehabilitation; Dharmaperwira-Prins, 1996). A total of 24 post-stroke individuals were interviewed and tested with the Token Test, and 11 were tested with TADIR and participated in the sentence-comprehension study. These eleven aphasic individuals produced agrammatic speech and had relatively good comprehension and were classified as suffering from Broca's aphasia[4]. Table 2.1 provides an overview of the NBD participants and individuals with aphasia involved. Detailed individual information on aphasic participants can be found in Appendix 2.1.

[4] Two agrammatic speakers were classified as suffering from transcortical motor aphasia (TMA), because their repetition was relatively good. However, since they spoke in prototypical telegraphic speech, we included them in the Broca group.

Table 2.1 Demographics of the participants. Mean numbers are given with (sd). TPO=time post onset.

n	Type	Education (years)	Age (sd)	Gender	Handedness	TPO (years)	Token Test
12	NBD	11.5 (1.1)	66.9 (5.3)	Male=2	Right	-	49.2 (0.9)*
11	Broca	12.1 (1.5)	68.7 (8.3)	Male=5	Right	5.9 (4.3)	31.5 (3.8)

* The Token Test norm is from a non-age-matched group (n=26, mean age= 28.3)

Individual characteristics (such as related motor disorders and corrected hearing and vision) were noted. A written informed consent form for the interview and testing was either signed or finger-stamped after being read to every participant.

2.2.2 Materials and procedure

The sentence comprehension test was adapted from the subtask for sentence comprehension of the Verb and Sentence Test (VAST; Bastiaanse, Edwards, Maas, & Rispens, 2003). It contains 40 semantically reversible sentences distributed equally over four conditions representing 4 sentence types (10 actives, 10 passives, 10 subject clefts, and 10 object clefts). In addition, a set of practice items is used to introduce the four conditions. Each item was presented as a set of four pictures: one target and three distractors (see Figure 2.1.).

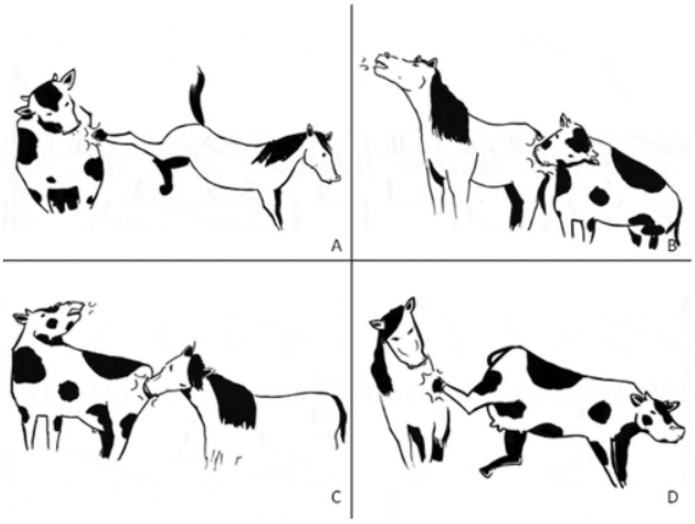


Figure 2.1. An example of an item set from the sentence comprehension test

In Figure 2.1, for the target sentence *Sapi ditendang kuda:* 'The cow is kicked by the horse', the target action is (A). This picture is contrasted with a distractor that has reversed assignment of thematic roles labeled as 'reversed role distractor' (D). In (C), a semantically related verb with the same order of thematic roles as the target is used to form a sentence, referred to as 'lexical distractor'. Finally, the lexical distractor is presented with these roles reversed, forming the 'reversed role lexical distractor' (B). The position of the target and distractor pictures was balanced.

The procedure was as follows: while looking at the practice item, the participant was asked whether he/she could see each picture clearly, and whether he/she could see all four pictures. For the practice items prior to starting the task, the participant heard all four-sentence types, one by one. When a practice item was answered incorrectly, the participant was corrected. After the practice items no feedback was given. The auditory stimulus was repeated one time on request. If the participant asked for a second repetition, this was given, but the answer was counted as incorrect. Self-corrections were counted as correct.

2.2.3 Scoring

Quantitative and qualitative error analyses were performed. One point was given for each correct response In the event of an incorrect response, the error was noted and classified per type.

2.3 Results

Average scores of the two groups can be found in Table 2.2. Scores for each aphasic individual can be found in Appendix 2.2.

Table 2.2. Mean numbers correct and standard deviations (sd) on the sentence comprehension test; NBD= non-brain-damaged participants.

n	type	mean (sd)	active	subject-cleft	passive	object-cleft
12	NBD	38.5 (1.0)	10 (0)	9.8 (0.4)	9.9 (0.3)	8.8 (1.0)
11	Broca	24.2 (3.9)	6.8 (1.8)	6.9 (2.1)	6.7 (1.4)	3.7 (1.1)
	Max.	40	10	10	10	10

The control group of 12 NBDs performed close to ceiling level (mean= 0.97, range=38-40 out of 40). The NBD group scored significantly higher in comparison to the IWAs (Mann-Whitney U Test: U=0, p=.001). We use a logistic generalized linear model with correctness as the dependent variable while including the maximum random-effect structure shown by the data. The random effects in this model include: participants, items and position of the target picture (whether the target picture is on the right, to exclude possible visual field deficits).

In our model, the main effect of condition (sentence type) remained significant when all random effects are included. A multiple comparisons test (Tukey Contrasts) was conducted to reveal significant difference between the conditions. The scores for object clefts were significantly lower than those for actives ($Z=-3.44$, $SE=0.36$, $p<0.01$), passives ($Z=3.45$, $SE=0.36$, $p<0.01$), and subject clefts ($Z=3.65$, $SE=0.36$, $p<0.01$). Actives did not differ significantly from passives ($Z=0.02$, $SE=0.36$, $p=1$). Finally, subject clefts did not differ from actives ($Z=0.13$, $SE=0.37$, $p=0.99$) and passives ($Z=0.12$, $SE=0.37$, $p=0.99$).

Mismatches were classified into three categories according to the three distractor-types: reversed role distractors (RR), lexical distractors (LD), and reversed role lexical distractors (RRLD). Table 2.3 shows mean numbers for the different type of errors. The individual error rates by type can be found in Appendix 2.3.

Table 2.3. Mean number of sentence comprehension errors (sd) of the individuals with Broca's aphasia. Maximum number of errors is 40. RR=reversed role distractor; LD=lexical distractor; RRLD=reversed role lexical distractors.

n	**mean (sd)**	**RR**	**LD**	**RRLD**
11	15.7 (4.0)	11.7 (2.8)	3.1 (2.1)	0.9 (1.2)

Role reversal errors were made significantly more often than both the lexical errors ($t(1)=10.9$; $p<0.001$) and the lexical errors with role reversals ($t(10)=10.32$, $p<0.001$).

2.4 Discussion

The current study investigated the comprehension of sentences with base and derived word-order and with and without clefting in individuals with Broca's aphasia and NBDs. The NBD group scored at ceiling and significantly higher than the aphasia group. For the whole group with Broca's aphasia there was no difference between comprehending active and passive sentences. However, this group had lower scores on object-clefts than on any other structure, including subject-clefts. Thus, the effect of word order is only apparent in the cleft conditions. With regard to embedding, there is no significant difference between actives and subject-clefts. While passives are comprehended better than object-clefts, it can be argued that the cause of this cannot be embedding, or at least the increased complexity entailed by embedding alone (since the subject clefts are relatively intact). This implies that the influence of embedding (via the use of subject and object relatives) that was reported for sentence comprehension of individuals with Broca's aphasia in English and Swahili (Abuom et al., 2013) is not found in SI.

The DOP-H predicts passives and object clefts to be comprehended less well than actives and subject clefts, respectively. Thus, the data on the SI passive do not support the DOP-H. In line with previous studies in SI, the current data show that the frequent passive constructions in SI are relatively well spared in individuals with Broca's aphasia.

2.4.1 Relative syntactic frequency in sentence comprehension

As previously mentioned, the four conditions tested in the sentence comprehension task differ not only in word order and embedding, but also in frequency. Gil (2006) has shown that the frequency of passives in both adult and child speech is much higher in SI than it is in other languages such as English. For that reason, the passive and the active are both marked as 'frequent'. Though no formal spoken corpora were used for the exact figures, Gil (2006) used a corpus of child and adult speech to confirm that the frequency of passive structures is higher in SI than in English and that the passive construction is acquired earlier in SI. Additionally, with the optional omission of the preposition *oleh* or 'by', passive structures in SI have an NP – V – NP structure similar to actives. However, the reason that the passive construction is relatively spared may also be related to its pragmatic and discourse functions: (1) using an active construction when addressing someone who is higher in hierarchy is very impolite (Randriamasimanana, 1999); (2) the SI (*di-*) passives are associated with foregrounding, stating punctuality and/or factuality, as well as expressing sequential events (Kaswanti-Purwo, 1988). These functions explain the high frequency of the passive in SI. It would be interesting to disentangle the effect of word order and frequency-related effects spurred by topicalization and pragmatic constraints. The data on the passive construction in SI so far show that frequency and / or pragmatic constraints protects the passives from being affected in SI Broca's aphasia, both in comprehension and in production (Anjarningsih et al., 2012; Postman, 2004; current study). Thus, the data also support the idea of Gahl and Menn (current issue) that the conditions under which grammatical constructions are used influences aphasic performance.

The present results open a new door for future studies: comprehension (and production; Anjarningsih et al., 2012) of sentence structures in aphasia should no longer be defined solely in terms of syntactic structure. Frequency of construction (current study) and of lexical items used in particular constructions (Gahl & Menn, this issue) should also be considered as a factor.

CHAPTER 3

Sentence Production in Standard Indonesian Agrammatism

Abstract

For individuals with agrammatic aphasia, producing sentences with non-canonical word orders is a challenging feat. Studies on different languages report deficits in this area of sentence production: some citing problems related to retrieval of verb morphology while others pursue a more holistic approach by attributing the root of the deficit towards the process of thematic role assignment. It has previously been shown that agrammatic speakers of Standard Indonesian are relatively unimpaired in the use (in spontaneous speech) and comprehension of passive constructions. These previous studies suggest that the high frequency of the passive structure in Standard Indonesian may play a role in its retrieval and processing. For the current study, we tested sentence production in agrammatic speakers of Standard Indonesian. The purpose of the present study is to assess the effects of syntactic frequency and word order on sentence production in agrammatic speakers of Standard Indonesian**.** Twelve agrammatic speakers were tested with a picture elicitation task. The participants had to produce active and passive, reversible and non-reversible sentences. Data for comprehension of active and passive sentences were collected as well. As for the results, there was no main effect of sentence type: reversible and irreversible active and passive sentences were produced with comparable accuracy. Despite this observation, the majority of errors produced are associated with role-reversals and verb inflection. A similar result was found for comprehension where active and passive sentences were comprehended at a similar accuracy rate. Lack of a specific deficit in the production of structures with derived word order suggests the impact of syntactic frequency on agrammatic sentence processing. As with previous studies on sentence comprehension and production in spontaneous speech, the present results provide evidence for the preservation of the passive structure in agrammatic speakers of Standard Indonesian.

Keywords: Broca's aphasia, sentence production, word order, passives, syntactic frequency, Standard Indonesian

3.1 Introduction

Individuals with agrammatic aphasia face difficulties in producing complex syntactic structures. However, the nature of this impairment is not firmly established. As with the current study, investigations on aphasic sentence production have often focused on word order, or the order in which constituents are placed in a sentence. Of particular interest are the distinct thematic role placements within the sentence types explored.

There are several theories pertaining to the description of sentence production impairments in agrammatic aphasia. Bastiaanse & Van Zonneveld's (2005) Derived Order Problem Hypothesis (DOP-H) proposed that all languages have a base word order, and that when constituents are placed differently, the structure is derived. As additional linguistic processing is required to derive a sentence structure from the base word order, the DOP-H predicts that sentences with derived word orders are more difficult to comprehend and produce than sentences with base word order. The DOP-H in the context of agrammatic sentence production has been supported by studies across multiple languages (e.g. Dutch: Bastiaanse, Hugen, Kos, & Van Zonneveld, 2002; English: Bastiaanse & Thompson, 2003; German: Burchert, Meißner, & De Bleser, 2008; Swahili: Abuom & Bastiaanse, 2013). However, Yarbay Duman, Altinok, Özgirgin, & Bastiaanse (2011) found that for Turkish agrammatic individuals, word order interacts with case: individuals with aphasia perform better comprehending sentence constructions requiring derived word order with salient and unambiguous case, such as object scrambling, than when the structure has less salient case marking (e.g. passives). Nevertheless, there is a subject-first advantage in Turkish (Mavis, Arslan &Aydin, 2009). When the subject has no nominative case and / or the object has no accusative case, performance on both base order and derived order sentences drops, showing that derived word order is not the only factor influencing agrammatic performance. Another theory, the Argument Structure Complexity Hypothesis (ASCH), focuses on the complexity of argument structure. Kim & Thompson (2000) reported that for agrammatic speakers, the production of verbs is easier when the argument structure is easier. For example, one argument verbs (like *to* walk) are easier to produce than three argument verbs (like *to give*) and unaccusative verbs (for which the theme is realized in subject position, like *to fall*) are easier to produce than verbs with the agent in subject position (like *to sleep*).

A body of studies have attributed thematic role assignment as one of the causes for the impairment (Dutch and English: Bastiaanse & Edwards, 2004; Bastiaanse, Edwards, Maas, & Rispens, 2003; Spanish: Benedet, Christiansen, & Goodglass, 1998). Using a sentence anagram task, Bastiaanse & Edwards (2004) tested English and Dutch speakers on active and passive sentences. They reported an impairment on the passive structures, regardless of the semantic reversibility of sentences. The result was also reflected in the comprehension scores where most of the errors were selecting reversed role distractors instead of the matching target pictures.

However, other studies have found that the passive morphology involved in sentence production causes severe trouble for agrammatic speakers (Faroqi-Shah & Thompson, 2003; Menn et al., 1998; Caplan & Hanna, 1998). As these studies were conducted in English, it suggests that the production of the auxilliary, V+-*ed*, and the by-phrase was the main issue. Faroqi-Shah & Thompson (2003) used a picture description task and found that although 50% of the errors for passives were reversed-role errors, 63% of these errors co-occurred with errors in passive morphology (i.e. in auxiliaries and/or prepositions). This suggests a different explanation towards sentence production impairment, whereby impaired grammatical morphology, rather than thematic role assignment, leads to the difficulty of producing non-canonical structures.

Cho & Thompson (2010) suggested the outcome of the morphology impairment to be associated with methodological aspects. The picture description tasks of Caplan & Hanna (1998) and Faroqi-Shah & Thompson (2003), which was designed to elicit grammatical morphology, provided the first noun of the sentence. As the pictures only depict two persons / animals (one of which being the first constituent), agrammatic speakers are less prone to producing reversed role errors. For instance, the error below (1a), which is a role reversal error, is not possible under this circumstance because the participants are already told the first noun is 'The dog'; this leads more possibilities of errors related to grammatical morphology, such as 1b, than role reversals as some forms of role reversal errors are impossible in the task. Additionally, Cho & Thompson (2010) found different instances of role reversal errors.

(1a)	Target:	The dog is scratched by the cat.
	Produced:	The cat is scratched by the dog.
(1b)	Target:	The dog is scratched by the cat.
	Produced:	The dog scratches the cat.

By definition, an example of a reversed-role error is (1a), as in Bastiaanse et al. (2003). Sentence (1a) shows a reversal of thematic roles from the intended target, which suggests a disruption in mapping thematic roles despite producing accurate passive morphology. However, sentence (1b) has also been referred to as a reversed role error (e.g. Faroqi-Shah & Thompson, 2003). The cause of (1b) is rather unclear: it could be interpreted as a reversed role error on an active sentence or a failed production of a passive with inaccurate passive morphology.

In addition to the nature of the impairment, the present study addresses the question of whether the impaired production of sentences with a derived word order is indeed universal across languages. In this context, while numerous cross-linguistic studies have reported this impairment, one study (Anjarningsih, Haryadi-Soebadi, Gofir, & Bastiaanse, 2012) on Standard Indonesian (SI) has suggested otherwise: in spontaneous speech, individuals with agrammatic aphasia were found to produce passives that were proportionate in number to that of the control participants. We hypothesize that syntactic frequency has an effect on the processing of sentences in SI, whereby high frequency has a positive influence on comprehending and producing sentences with derived word order.

3.1.1. Some relevant information on Standard Indonesian (SI)

SI is an Austronesian language within the Western Malayo-Polynesian subdivision. SI is acquired through education settings from kindergarten up to the university level and is the national language of Indonesia. While SI is related to its various dialects that exist throughout the Indonesian region, monolingual speakers do not comprise the majority, as individuals grow up acquiring either a regional language or a distinct dialect of SI.

SI is classified as a zero-marking language (Nichols & Bickel, 2013). Zero marking is defined as the absence of overt morphological markers that mainly exist in or are adjacent to the core arguments of a predicate (Sinnemäki, 2010).

This feature is depicted in numerous contexts in SI; SI has neither case nor gender markings. Transitive verbs are usually inflected with a prefix for voice (*meN-* indicates a transitive verb in the active voice and *di-* indicates passive voice). With very few exceptions, typical use of SI usually involves no verb inflection for tense, aspect, or agreement. For example, the verb *menendang* in (2b) provides a lexical entry as well as information regarding voice, which is active and indicates transitivity. The base clause of SI has two obligatory components: the subject and the predicate. The subject of a clause is, in general, what is being discussed or the topic. It is usually produced in the form of a noun or a pronoun phrase though nominal clauses can also appear in subject position. Clauses are either non-verbal, like in (2a) where the verb is omitted (locative expressions), or verbal, with a verb as the predicate centre (2b).

(2a) Budi ke pasar

Budi to market

"Budi goes to the market"

(2b) Budi **me**nendang bola

Budi **ACT-**kick ball

"Budi kicks the ball"

In general, SI has an SVO base word order. There is a debate on the base word order of SI on the basis of the frequency of the passive, which will be discussed later in this section. The impoverished morphology may suggest rigid order of constituents. However, certain constructions such as WH-questions (Stack, 2005) and forms of predicate nominalisations (McCune, 1979) may have a flexible word order.

While agent – verb - theme is considered the base order, the distinction between the base word order (e.g. active structures) and the passive as a derived word order is less decisive in terms of frequency of occurrence. Passives are frequently used in SI. Kaswanti-Purwo (1991) observed that 30-40% of the verbs in written SI are passivized. In another study, Wouk (1996) found that clauses with passivized verbs outnumber that of clauses containing verbs with a *meN-* prefix (active). In comparison, approximately 9% of English

sentences contain passive morphology (Givon, 1979). Additionally, the passive structure in English primarily appears in written form: Roland, Dick, & Elman (2007) found that passives occur four to five times more often in written than spoken form in English. The written to spoken distinction, however, does not hold true for SI. Passives in SI are acquired very early, under the age of 2 (Gil, 2006). One dominant contributing factor is the input frequency of the differing structures in adult speech towards children. 28% to 35% of the adult speech in the spoken corpus from Gil (2006) are passive structures, which is substantially more than the 4% to 5% found for English. While the cause of higher frequency of the passive structure in numerous Austronesian languages may not be attributed to a single factor, several considerations have been put forward for SI. First, the passive morphology in SI is salient. It provides unambiguous voice information, and is phonologically salient in comparison to the active prefix *meN-* because it cannot be reduced (via stem-initial assimilation) nor omitted (in the non-formal register of Indonesian, the active voice marker is often omitted for verbs with high frequency). Secondly, passives possess a pragmatic function in that they are considered polite and are commonly used towards people of higher social stature (Randriamasimanana, 1999). This may also be related to the fact that, like other South East Asian languages, SI has the feature of pronoun avoidance (Helmbrecht, 2005) and has many ways to refer to equals and superiors. In a way, passives may also be used to avoid the usage of second-person pronouns and references to one self. In that respect, it can be seen as a syntactic means for pragmatic purposes.

3.1.2. Sentence processing in Standard Indonesian aphasia

There are only a few studies focussing at the sentence level in SI aphasia. In particular, Anjarningsih, Haryadi-Soebadi, Gofir, & Bastiaanse (2012) analysed spontaneous speech of agrammatic speakers in SI. While the majority of the results confirm the characteristics of agrammatic aphasia across languages, there were two characteristics of SI agrammatic speech that are atypical according to the authors. The first is unimpaired verb production in speech, both in terms of accuracy and frequency compared to healthy age-matched individuals, whereas verb production has been found to be hampered in languages with verb inflection (cf. Saffran, Berndt & Schwartz, 1989 for English; Bastiaanse & Jonkers, 1998 for Dutch). One possible explanation is that SI has very limited grammatical morphology, particularly on the verb. Thus, in this case, the retrieval of verbs may be limited to the lexical units they

entail without containing additional information provided through verb morphology. The second point was that not only are agrammatic speakers capable of producing passive sentences, they also produce them at a normal ratio, comparable to that of healthy speakers.

For comprehension, Postman (2004) observed an agrammatic speaker of SI- who showed remarkably good comprehension of single-clause active and passive structures. On an additional task condition that included complex sentences with two verbal clauses, the participant could still comprehend the first clause of all trials correctly including the passive markers and thematic role assignment change involved in passive structures.

Jap, Martinez-Ferreiro, & Bastiaanse (2016) further expanded upon the investigation on sentence comprehension and tested 11 agrammatic aphasic speakers with four different sentence types: active, passive, subject cleft, and object cleft. The results show that active, passive, and subject cleft structures were comprehended at a comparable level with only the object cleft being significantly more difficult than the other three structures. Not only does this confirm that passives are relatively spared in comprehension, but it also shows that SI agrammatic speakers are, like agrammatic speakers of other languages, affected by the increased processing costs involved in comprehending sentences with derived word order that also have a low frequency. Furthermore, Jap et al. (2016) found that, unlike in Abuom, Shah, & Bastiaanse (2013) on Swahili, embedding did not have a significant effect on comprehension performance. A simplified interpretation of the results with the factors investigated is depicted below.

Table 3.1. Findings from Jap et al. (2016) on sentence comprehension in SI

Sentence type	Base order	Frequency*	Embedding	Impairment**
Active	+	+	-	n/a
Passive	-	+	-	-
Subject cleft	+	-	+	-
Object cleft	-	-	+	+

* +=highly frequent; - =infrequent. **relative to the active structure; n/a: not applicable

Table 3.1 entails first, that similar to what Bastiaanse, Bouma, & Post (2009) suggested, frequency alone cannot explain sentence comprehension performance. A frequency-based account alone cannot explain the results on the infrequent yet well-comprehended subject cleft structure. The effect of word order is still observed in the object cleft where agrammatic participants struggle to comprehend non-canonical structures that have low frequency. However, with the consideration of both factors, the authors propose that syntactic frequency, enforced by the pragmatic rule that passives should be used for politeness reasons, plays a role in preventing the breakdown of the passive, which was observed to be unimpaired.

3.1.3. Frequency in aphasic sentence processing

The role of frequency in sentence processing in typical speakers has been well-documented. Gahl & Menn (2016) summarize the underlying idea of probabilistic models as predictability. The likelihood of hearing or reading a certain linguistic structure following a context will affect the way individuals process the structure. Components of sentences that are predictable and more frequently encountered in language require less time and effort to process.

For aphasic language processing, Brysbaert & Ellis (2016) found that age of acquisition affects the retention of words after brain damage. They suggested that words acquired earlier in life are more accessible and contain richer meanings which prevent retrieval problems compared to words acquired later. While the same has not been investigated for the acquisition of structures, passives are indeed acquired and produced earlier in SI than other languages, and this may be a contributing factor to the ease of processing and relative frequency of the structure.

Lexical verb bias has also been observed in aphasic language processing. Gahl (2002) tested sentences with verbs that conform to a certain transitivity bias. For example, the verb ‘dissolve’ is more frequently used in a transitive structure and therefore has a transitive bias, but ‘explode’ is used more often in an intransitive structure. When those verbs are placed with a sentence structure matching its transitivity preference, aphasic speakers perform better. Another study by Gahl et al., (2003) investigated verbs with biases relating to the active-passive and theme-agent distinction. Again, they found an effect in comprehension, where passive sentences that contain a verb with a passive-bias are understood better than passives with an active-bias verb.

Finally, the study by Jap et al. (2016) suggested that the preservation of the passive structure in SI aphasic comprehension is at least partially caused by the frequent occurrence of the structure in the language.

3.1.4. The present study

We investigated the production of sentences in agrammatic speakers of SI. Two factors were incorporated, that is, word order and reversibility. The DOP-H predicts that passive sentences, as derived structures, pose more difficulties for the aphasic participants compared to the active sentences. However, previous findings on SI showed results that conflict with this theory of sentence processing in aphasia. The current study addresses the following questions:

- Is SI agrammatic speakers' production of the passive impaired (compared to active sentences)? And what is the effect of the high frequency of passive construction in SI on the production of passive sentences in SI agrammatic speakers?
- Is there a shared deficit between comprehension and production in SI agrammatism, as suggested by the DOP-H?

3.2 Methods

3.2.1 Participants

Twelve individuals with agrammatic aphasia were tested. Seven of the twelve were participants in the study by Jap et al. (2016; tested in 2014). They were re-tested with the diagnostic battery as well as the production and comprehension tests for this study, approximately a year later. The control group was comprised of 12 healthy age- and education-matched individuals. Aphasic and non-brain-damaged (NBD) participants were recruited from six nursing homes from several cities of Central Java, Indonesia (Surakarta, Brebes, Semarang, and Yogyakarta). Their demographic profiles were acquired from the staff of the nursing homes and through individual interviews. The aphasia types of the participants were determined by *Tes Afasia untuk Diagnosis, Informasi, dan Rehabilitasi* (TADIR: Indonesian Aphasia Test for Diagnosis, Information, and Rehabilitation; Dharmaperwira-Prins, 1996). According to this test, nine suffered from Broca's aphasia, three from

transcortical motor aphasia. However, they all met our criteria: they spoke nonfluently and used telegraphic speech with their auditory word comprehension being relatively well-preserved according to the TADIR. Additionally, aphasia severity was measured by using the Token Test (Jap & Arumsari, 2017) adapted from the Dutch *Aachener Aphasie Test* (AAT: Graetz, de Bleser, & Willmes, 1992). Table 3.2 provides an overview of the NBD participants and individuals with aphasia (individual data are provided in Appendix 3.2). A written informed consent form for the interview and testing was either signed or finger-stamped after being read to every participant.

Table 3.2. Demographics of the participants. Mean numbers are given with (sd). TPO=time post onset.

n	**Type**	**Education in years (sd)**	**Age (sd)**	**Gender**	**Handedness**	**TPO in years (sd)**	**TokenTest (sd)**
12	NBD	8.9 (3.1)	72 (6.7)	Male=9	Right	-	49.2 (0.9)*
12	agrammatic	13 (2.5)	69 (9)	Male=6	Right	5.4 (4.6)	29.9 (9.3)

* The Token Test norm is from a non-age-matched group (n=26, mean age= 28.3). Maximum score =50.

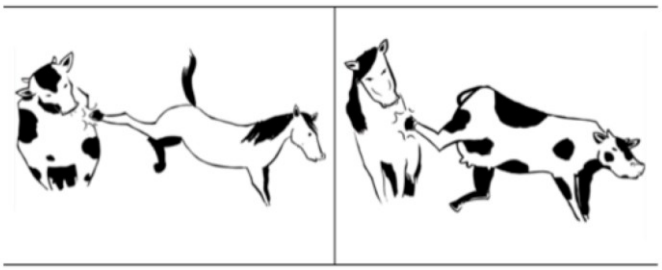
3.2.2 Materials and procedure

The sentence production contained 40 semantically reversible sentences and 20 non-reversible sentences distributed equally over two sentence types: active and passive structures. We decided to use both reversible and irreversible sentences. The reason is that role reversal errors result in correct sentences (that do not belong to the picture) whereas role reversal errors in irreversible sentences result in ungrammatical sentences (with the examples in Table 3: *the cow is kicked by the horse* vs. **the woman is written by the letter*). Examples of target sentences are provided in Table 3.3 (the full list is shown in the Appendix).

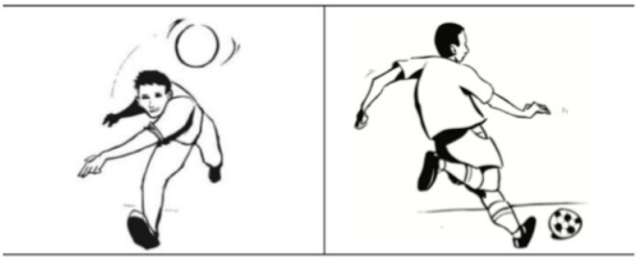
Table 3.3. The sentence types used in the task. Active irreversible (AI); passive irreversible (PI); active reversible (AR) ; passive reversible (PR).

	Agent	Verb	Theme
(1)	*Wanita*	*menulis*	*surat.*
AI	Woman	ACT-write	letter.
	The woman	writes	the letter.
	Theme	Verb	Agent
(2)	*Surat*	*ditulis*	*wanita.*
PI	Letter	PASS-write	woman.
	The letter	is written by	the woman.
	Agent	Verb	Theme
(3)	*Sapi*	*menendang*	*kuda.*
AR	Cow	ACT-kick	horse.
	The cow	kicks	the horse.
	Theme	Verb	Agent
(4)	*Kuda*	*ditendang*	*sapi.*
PR	Horse	PASS-kick	cow.
	The horse	is kicked by	the cow.

In addition, a set of practice items was used to introduce the four conditions. Each item was presented as a set of two pictures: one 'prime' picture that the experimenter described and the target picture which the participant was invited to describe. The name of the action was printed under the pictures to avoid word finding problems. An example of a reversible trial can be seen in Figure 3.1 For this example, the experimenter would prompt with the left picture "This is about kicking. For this picture you can say, 'the cow is kicked by the horse' and [pointing to the right picture] for this picture you can say….." and the expected target answer for the picture on the right side would be 'the horse is kicked by the cow'.



tendang



tendang

Figure 3.1. Example of a reversible (above) and non-reversible (below) sentence production trial

In the non-reversible trials, the verb between the prime and target differs, but object / theme remains the same; the verb of the target sentence is under the pictures (see Figure 3.1).

The procedure of the task was to firstly go through the practice items ensuring both the pictures and the verb text could clearly be seen. There were two sets of practice items; one for the non-reversible sentences and the other for the reversible sentences. In the practice session, both the active and the passive structure were introduced. When a practice item was answered incorrectly, the participant was provided feedback and corrected. The

participant was prompted to always use the prefix for expressing voice *di-* (passive) or *men-* (active) even though the active/transitive marker may be dropped or reduced. However, this is not the case for the passivized verb form.

We also tested sentence comprehension using the sentence-picture matching from Jap et al. (2016). In this task, the participant has to choose one out of four pictures (the target; a role reversal, and two others pictures with a different action one with the same agent and theme, and the other with agent and theme that is reversed from the target) a, matching a spoken sentence. For the comprehension test, all sentences are semantically reversible. Four sentence types were tested: actives, passives, subject clefts and object clefts. Figure 3.2 below shows an example stimulus with three distracters taken from Jap et al. (2016).

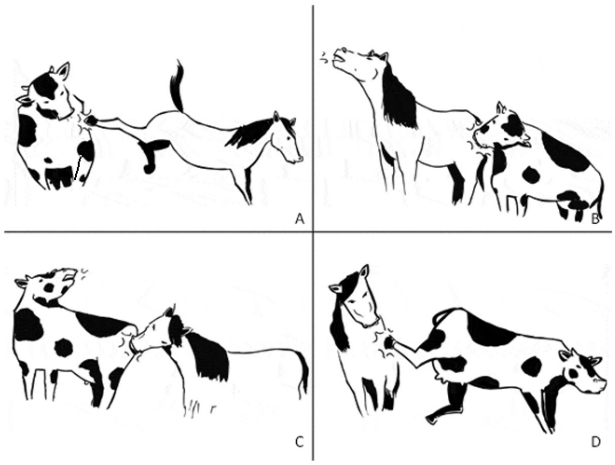


Figure 3.2. An example of a sentence comprehension item

3.2.3 Scoring

For the production task, quantitative and qualitative error analyses were performed. Each testing session was recorded and the answers were transcribed. One point was given for each correct response, which was defined as correct affixation of the verb and proper assignment of thematic roles for each item. Self-corrections and multiple attempts were permitted as long as the final answer is correct. For the comprehension test, a simple correct / incorrect scoring system was used.

3.3 Results

3.3.1 Production

The control group of 12 NBDs performed close to ceiling level (mean= 57.3, range = 54-60). This ceiling effect creates an issue with linear regression, and thus we decided to use a non-parametric test. The healthy speakers scored significantly higher than the aphasic speakers (Mann-Whitney U Test: U=0, *p*=.001). Table 3.4 summarizes the group results for aphasic participants. Individual data can be found in Table 3.5 where we discuss pattern within the group.

Table 3.4. Mean numbers correct and standard deviations (sd) on the sentence production test

n	type	mean (sd)	AI	PI	AR	PR
12	Agrammatic	45 (4.4)	8.2 (1.5)	7.3 (1.5)	16.7 (1.9)	13.1 (3.6)
	Max.	60	10	10	20	20

AI: Active irreversible; PI: Passive irreversible; AR: Active reversible; PR: Passive reversible

For the agrammatic group, we used a generalized linear mixed-effects logistic regression model with accuracy as the dependent variable while including the maximum random-effect structure shown by the data. The random effects in this model include: participants and trial items. We tested additional random slopes in this model which are as follows: education, age, location of testing (participants resided in different nursing homes and different cities), months post-onset, and fatigue/concentration effect (whether the item is the last ten trials in the test) but these variables did not warrant a significant improvement (in terms of AIC) of the model to be included. In our model, no main effects of reversibility (β=.02, *SE*=.25, *p*=.92), sentence type-in terms of active or passive (β=-.48, *SE*=.32, *p*=.12), nor an interaction between the two (β=-.41, *SE*=.38, *p*=.29) were observed when the three random slopes were included.

3.3.2 Individual performance

In Table 3.5, the individual data are given. Two agrammatic speakers (5 and 9) perform significantly worse on the production of passive reversible sentences, but not on the passive irreversibles.

Table 3.5. Individual accuracy data of the agrammatic speakers on the production and comprehension task (in %). Active irreversible (AI); passive irreversible (PI); active reversible (AR) ; passive reversible (PR); subject cleft (SC); object cleft (OC).

	Production					Comprehension				
No.	AI (n=10)	PI (n=10)	AR (n=20)	PR (n=20)	Total (n=60)	AR (n=10)	PR (n=10)	SC (n=10)	OC (n=10)	Total (n=40)
1	100	50	95	80	78	50	60	80	40	58
2	90	100	85	70	83	90	90	70	40	73
3	80	90	90	85	87	70	100	80	70	80
4	100	60	75	85	80	60	50	70	50	58
5	80	90	85	45*	72	90	100	90	30	78
6	90	70	95	75	83	80	80	70	70	75
7	60	80	85	75	77	80	50	70	50	63
8	50	80	75	65	68	90	50	90	60	73
9	100	70	95	20*	67	70	70	70	30	60
10	80	60	65	55	63	50	60	40	30	45
11	80	80	70	75	75	60	80	100	40	70
12	70	50	85	55	67	30	70	50	30	45
Mean	8.2	7.3	16.7	13.1	45	6.8	7.2	7.3	4.5	25.8
SD	1.6	1.6	2	3.8	4.6	1.9	1.9	1.7	1.5	4.8
%	82	73	83	65	75	68	72	73	45	65

*$p<0.02$, Fisher's exact.

3.3.3 Error analysis

Post hoc, the following error categories were distinguished based on the frequencies in which they occurred.

Target: (3a)	Sapi	ditendang	kuda
	Cow	**PAS-**kick	horse
	"The cow is kicked by the horse."		
Error types:			
1. Word order (role reversal): (3b)	Kuda	ditendang	sapi
	Horse	**PAS-**kick	cow
	"The horse is kicked by the cow."		
2. Omitted/wrong verb inflection:(3c)	Sapi	(Ø)tendang	kuda
	Horse	**(**Ø**)-**kick	cow
	"The horse kick(s/ed) the cow."		
3. Wrong verb: (3d)	Sapi	dipukul	kuda
	Cow	**PAS-**hit	horse
	"The horse is hit by the cow."		
4. Verb/argument omission: (3e)	(Ø)	ditendang	sapi
	(Ø)	**PAS**-kick	cow
	"(it) is hit by the cow."		

Table 3.6 shows the error data of the participants. We conducted a Wilcoxon's signed-rank test between error categories and found the following: word order errors occurred significantly more often than both incorrect verb (Z=-2.53, p=.012) and verb/argument omission (Z=-2.38, p=.018), but no significant difference was found between word order and verb inflection errors (Z=-.071, p=.94). Omitted/wrong verb inflection were found significantly more frequent than both wrong verb (Z=-2.52, p=.012) and verb/argument omission (Z=-2.39, p=.017).

Table 3.6. Results of the qualitative error analysis.

	Word order	**Omitted / wrong verb inflection**	**Wrong verb**	**Verb / argument omission**
Mean (sd)	6.5(3.7)	6.8(2.4)	0.8(0.9)	2.3(1.4)
Percentage	39%	40%	4%	13%

3.3.4 Sentence comprehension results

Using the sentence-picture matching task from Jap et al. (2016), the comprehension performance of the participants was also assessed. We retested each participant for the current study one year after the testing by Jap et al. (2016) and added 5 participants, and the results were analyzed. The mean scores for sentence comprehension can be seen below in Table 3.7.

Table 3.7. Mean numbers correct and standard deviations (sd) on the comprehension task

n	Type	Mean(sd)	Active	Subject cleft	Passive	Object cleft
12	Agrammatic	25.8 (4.8)	6.8 (1.9)	7.3 (1.7)	7.2 (1.9)	4.5 (1.5)
	Max.	40	10	10	10	10

The overall accuracy score for comprehension correlates significantly with production (r= .602, n= 12, p= .017).

In Table 3.5, the individual data are provided. It is noted that the subjects who showed a selective deficit on the production of reversible passive sentences did not show a selective deficit for comprehension of passive sentences, but they were both very poor (score of 3) on the comprehension of object clefts.

Looking at individual performances in Figure 3.3, a few participants show impaired production of passive but rather spared active sentences (i.e. participant 5 and 9). This was not reflected in their comprehension, however, with both participants scoring similarly in both active and passive sentences. In conclusion, we see a moderate (r=.60, p=.038) but significant correlation between comprehension and production, suggesting that a similar underlying word order deficit affects production and comprehension at the group level.

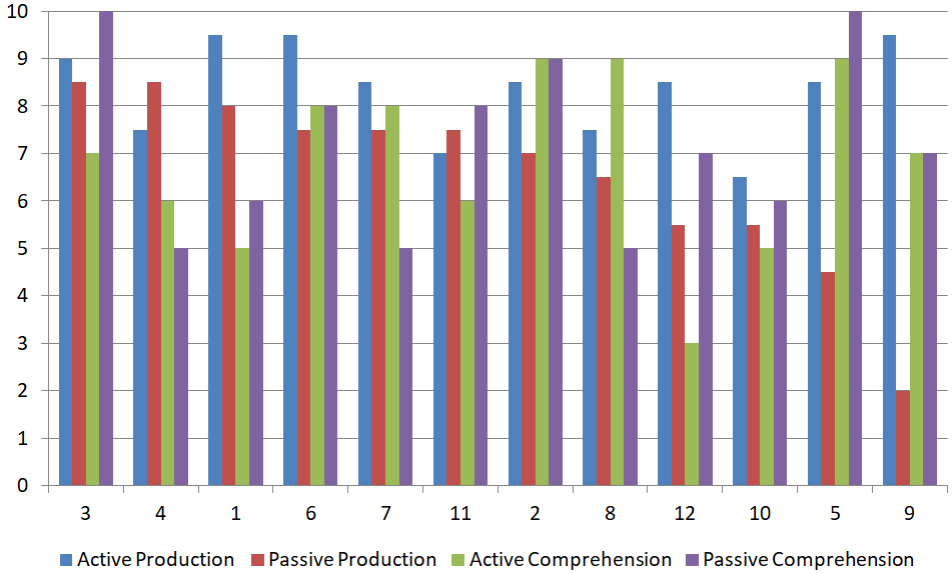


Figure 3.3. Individual accuracy rate: Agrammatic participants sorted by Passive Production in descending order

3.4. Discussion

The first question was whether the high frequency of the passive construction in SI protects it from disruption in agrammatic sentence production, as suggested by Postman (2004) and Jap et al. (2016) for comprehension and Anjarningsih et al. (2012) in spontaneous speech. As per the group results, we did not find a significant difference between the production performance of active and passive sentences in SI agrammatic speakers. Similar results were found in the comprehension study by Jap et al. (2016), where passive structures were found to be preserved. However, further scrutiny reveals that the scores for the non-canonical condition are quite diverse across subjects. The production error data predominantly show word order and omitted/incorrect verb inflection errors: the first error is, by definition, a reversed role error, and the latter which can potentially also be interpreted as such. A verb error, which can be interpreted as a lexical error, occurs significantly less frequently than errors related to thematic role assignment via role reversal.

The group of agrammatic individuals is not large, and the results should be interpreted with caution. Two agrammatic speakers have a severe impairment on the production of the reversible passive (participant 5 & 9). Hence, though the main effects of word order and reversibility were not found at the group level, the individual data show that the frequency of the passive construction in SI does not prevent production problems of all agrammatic speakers are impaired in the production of reversible passive sentences in SI.

The second question of the study was whether an effect of syntactic frequency can be observed in sentence production as it was found in comprehension in SI (Jap et al., 2016; Postman, 2004). The DOP-H, as a theory that covers both comprehension and production, predicts a correlation between production and comprehension with respect to word order. A significant, but not very high (r=.60) correlation was found when the overall scores were compared. This is what the DOP-H predicts, but a few remarks should be made. Although the score on comprehension of object clefts shows that comprehension of some sentences with derived word order is impaired, comprehension of passive sentences is relatively intact, both in comprehension and production, whereas the DOP-H predicts an impairment in the passive sentences because the word order is derived. It seems as though the frequency with which passive sentences are used in SI protects them from being 'experienced' as being derived: the agrammatic performance is similar as for active and passive sentences, whether they are reversible or not. The question is why frequency has such an effect. Bastiaanse, Bouma and Post (2009) suggest that syntactic frequency does not affect agrammatic performance and that derived word order is the only factor that can explain agrammatic production patterns. However, syntactic frequency may not be the direct reason per se for the lack of vulnerability. As mentioned in the Introduction, passive constructions are the polite form in SI, which causes the passive to be highly frequent. Thus, rather than syntactic frequency, it may be that a pragmatic constraint, politeness, protects the passive construction.

The current study is not the only one that presents results that cannot be completely be explained by the DOP-H. An opposite effect, a factor that diminishes performance predicted by the DOP-H was shown by Yarbay Duman et al. (2011). They found that in comprehension in Turkish, there are multiple levels of difficulty within the derived order sentences tested: case marking was also a determining factor. Agrammatic individuals seem to perform better on word-order-changing structures with salient case marking

(i.e. object scrambling) than structures where the case marking is less salient (i.e. passives). . Faroqi-Shah & Thompson (2003) found that performance on the derived structures dropped when auxiliary and past-tense morphemes were not provided, also suggesting additional complicating variables. The effect of complication factors (in their case derived word order and verb morphology) add up. In Swahili-English bilingual agrammatic speakers, Abuom et al. (2013) observed that word order interacts with embedding (for example, subject and object relatives) in that embedding adds an additional level of complexity and thus is more difficult to process. In the present study, we incorporated another factor which is syntactic frequency or rather, the pragmatic constraint of politeness, although it must be noted that other facets of frequency such as verb bias (Gahl, 2002) and its interaction with sentence structure may interfere with this effect. One way we controlled this potential confound is by accommodating an item-based random slope to our model.

3.4.1 Limitations

The current study shows that comprehension and production of passive structures in SI is relatively spared, whereas comprehension in less frequent derived order sentences (object clefts) is impaired, as predicted by the DOP-H. A complete parallel pattern for production and comprehension could not be made. We did include object clefts in our production study, but these were far too difficult for the first few agrammatic speakers and we decided to remove them from the protocol, in order to avoid frustration of the agrammatic speakers.

CHAPTER 4

Thematic Role Assignment in a Zero-marking language: Electrophysiological Evidence from Standard Indonesian

Abstract

The current study presents electrophysiological data from Standard Indonesian (SI), a zero-marking language that lacks many morphosyntactic features displayed by Indo-European languages, paired with a rigid word order. Previous studies have found processing differences between theme-first and agent-first word orders on both the critical 1st noun phrase (NP1) as well as other parts of the sentence: the verb and the second noun phrase (NP2) for Basque, German, and Japanese. We test the word order distinction with passives in SI, where the critical region for thematic role assignment is the prefix of the verb, an obligatory voice and transitivity marker. Unlike theme-first structures in languages such as English, passives in Standard Indonesian are frequent, and therefore if differences are found, they are not due to frequency. 24 right-handed healthy native speakers of Standard Indonesian participated (13 females; age=20-46, mean=28.2). The stimuli are comprised of 160 digitally recorded sentences divided into 4 conditions in a 2x2 design (semantic reversibility x word order) and 40 fillers. We are mainly interested in the word order differences between the passive and active, and whether the effects of word order persist over reversibility. While we did not find the active-passive reversible difference, we found a reversibility/animacy effect in all parts of the sentences involving a distinction between passive non-reversible sentences, (which have an inanimate NP1), and the three other conditions.

Keywords: ERP, word order, Standard Indonesian, non-anomalous sentences

4.1 Introduction

In recent years, a vast number of studies have investigated the neural responses during the processing of linguistic anomalies. The utilization of these violations has yielded distinct responses that are elicited by several aspects of sentence processing. The P600, for example, can be seen in response to syntactic violations such as violating the expected word order (Friederici, Hahne, & Mecklinger, 1996) or inflection (Osterhout & Mobley, 1995), as well as reflecting semantic integration (Brouwer, Fitz, & Hoeks, 2012) and processing of long-distance wh-dependencies (Gouvea et al., 2010) among others. Other ERP responses such as the N400 are found as a result of (among others) anomalies such as semantic incongruence (Kutas & Hillyard, 1980), integration of overall sentence meaning (Kutas & Federmeier, 2000), or memory retrieval (Brouwer, Fitz, & Hoeks, 2012).

While the study of ERP responses to linguistic anomalies has been effective, the tested structures are, by their own nature, anomalies which seldom appear in normal language use (Meltzer & Braun, 2013). This leads to the question of whether neural responses that are found in reaction to anomalies can also be observed during typical language comprehension. To address this question, there have been studies that focus on the ERPs of well-formed sentences with non-anomalous manipulations. Meltzer and Braun (2013) stated that this may be a difficult task, as not only do anomalies produce "quantitatively large responses", but also violations are usually restricted to one point in a sentence. For example, when a violation is detected or ambiguity is resolved, the time-locked signals at the onset of that critical word will provide a robust ERP response. The current study does not utilize violations and may result in less prominent, distinct evoked potentials, or the effect may build up over several words. Thus, ERPs usually associated with the processing of a single critical word such as the P600 or the N400 may not be as apparent.

The majority of the studies with grammatical or semantic violation as the manipulation have been conducted on Indo-European languages such as English, Italian, Dutch and German. Cross-linguistic studies allow for the distinction between language-specific processing strategies from universal language processing mechanisms. The current study attempts to contribute by presenting electrophysiological data from Standard Indonesian (from now on: Indonesian), a zero-marking language that lacks many morphosyntactic

features displayed by Indo-European languages, paired with a relatively rigid word order. The present study focuses on two aspects of sentence comprehension, the processing cost of a non-canonical word order and the role of reversibility (inanimate NP1 in non-canonical structures) in thematic role assignment.

4.1.1 Processing of Word Order

Numerous studies have documented differences between processing of different word orders. Differences have been found between subject and object relative clauses (Meltzer & Braun, 2013; King & Kutas, 1995) as well as simple sentences such as the subject-object and the object-subject word order distinction in German (Matzke, Mai, Nager, Rüsseler, & Münte, 2002). In most of these studies (which were done on languages with the canonical subject-first word order: either SOV or SVO), a similar conclusion was drawn: object-first structures require more effort to process than subject-first structures. For example, the sentence with an object-embedded relative clause in (1a) presents "The man", who is not the agent of the first verb, thereby not adhering to the typical English word order to put the agent first (Slobin & Bever, 1982). This results in a predicted increase in syntactic processing demand. The sentence with a subject-embedded relative clause (1b), however, does not violate this expectation, as it keeps the NP1 of the sentence as the agent of the action.

1a) The man who the woman violently scolded, admitted the error.

1b) The man who violently scolded the woman, admitted the error.

The ERP-studies that will be discussed in this section examine this distinction between canonical and non-canonical word orders, more specifically regarding the thematic role assignment by the verb. The studies discussed in detail here do not introduce any form of violation in their paradigm and investigate well-formed sentences exclusively.

Matzke et al. (2002) compared object-before-subject (OS) to subject-before-object (SO) structures in German while providing case information through the use of articles. Temporary ambiguity of case information was also included as a factor, by using feminine case markers on the article (*die*) of the

NP1, which, in German, can signify both the nominative and accusative case (2 and 3).

2) Object - Subject

Die begabte Sängerin	entdeckte	der talentierte Gitarrist.
The gifted singer(Fem. Nom/Acc.)	discovered	the talented guitar player(Masc.Nom.).

'The talented guitar player discovered the gifted singer.' [Ambiguous until 'der']

3) Subject - Object

Die begabte Sängerin	entdeckte	den talentierte Gitarrist.
The gifted singer(Fem. Nom./Acc.)	discovered	the talented guitar player(Masc.Acc.).

'The talented guitar player discovered the gifted singer.' (Ambiguous until 'den')

For the Object-Subject (2) compared to Subject-Object (3) structures in German, Matzke et al. (2002) found a Left Anterior Negativity (LAN) for the critical time window (the first NP) that continues to the rest of the sentence. Left fronto-temporal negativity was observed following the 2nd article for the Object-Subject condition. For the condition that is ambiguous up to the second article (as in example 2 and 3), a P600 was found in the disambiguation section (2nd article 'der') for the Object-Subject compared to Subject-Object structures. Matzke et al. (2002) attributed the initial LAN on the NP1 to working memory. In a similar experiment, Schlesewsky, Bornkessel, and Frisch (2003) found that the LAN is only observed in object-first non-pronominal NP1s in German, and not in pronominal NP1s (as displayed in example 4).

4) Object first pronominal structure

Gestern	hat	ihn	der Vater	dem Sohn	gegeben.
Yesterday	has	itACC	theNOM father	theDAT son	given

'Yesterday, the father has given it to the son'.

As such, it is implied that the LAN originates from a local syntactic mismatch via the violation of canonicity principles in non-pronominal NP1s, rather than higher working memory usage from dislocated objects in general.

4.1.2 Animacy and reversibility

Animacy also plays a role in sentence processing. Meltzer and Braun (2013) compared the processing difference between subject-embedded (1b) and object-embedded relative clauses (1a) in English. In addition to animacy, reversibility was another variable they controlled for. They found a P600 at the end of the critical clause (at the offset or approximately in the middle of the sentence), and a left anterior negativity following the end of the sentence. They interpreted the positive shift as reflecting the processing and retention of thematic information. Their study did not find evoked potential differences between processing reversible and non-reversible structures.

In a study on Japanese by Wolff, Schlesewsky, Hirotani, and Bornkessel-Schlesewsky (2008) similar results were observed. The sentences included were similar to those in German, in which the object-first structures were compared to subject-first structures with the use of a suffix in nominative or accusative case on the NP. ERP-correlates for object-initial compared to subject-initial structures after NP1 included an early (120-240ms) negativity which was referred to as a 'scrambling negativity', a broadly distributed positive shift at the NP1 of Object-Subject structures (400-650ms), an N400 at the NP2 for Subject-Object structures condition, and a late parietal negativity (650-1050ms) at the verb. Aside from the object scrambling, the positive shift at the NP1 for object-initial sentences was interpreted as the resolution of dependency introduced by an accusative-first argument. The late parietal negativity at the verb was also reported in another study to Japanese that used scrambled sentences (Hagiwara, Soshi, Ishihara, & Imanaka, 2007). Both studies attribute this negativity to general increased processing of scrambled sentences. Finally, the N400 at the NP2 for the Subject-Object condition is explained by the unexpected NP2, as the default reading of a subject-initial sentence is an intransitive event interpretation. In contrast, for the Object-Subject condition, the accusative case in NP1 signals a transitive reading for the rest of the sentence. Thus, the N400 at the NP2 of the Subject-Object condition is interpreted as a revision of the assumption that the sentence should be read as an intransitive.

Another study on simple declarative sentences in Basque (Erdocia, Laka, Mestres-Misse, & Rodriguez-Fornells, 2009), which marks NPs with the ergative and absolutive cases, showed a similar negativity (300-500ms) post-

onset of the NP1 of object-first sentences. Like in Japanese, the NP2 follows the NP1 in Basque with the verb in the final position. In the NP2 position, a left negativity (400-550ms) for object-first structures is found. Finally, in the P600 time window (700-900ms) in the verb position, a parietal positivity was observed. The negativity at the NP1 for object-first structures, although observed at a different time window, is suggested to be related to the scrambling negativity found in both German and Japanese. The effect at the NP2 is interpreted as a LAN that expresses working memory usage for displaced elements, or, alternatively, Erdocia et al. (2009) suggested that subjects and objects are processed differently regardless of their position. They hypothesized that the P600 observed at the verb position for object-first structures relates to an increase of processing costs when elements are displaced from their canonical positions. In Table 4.1 a summary of the findings of previous studies to grammatical SO and OS sentences is given.

Table 4.1. Summary of previous studies: comprehension of well-formed sentences.

Language	Conditions	NP1	NP2	V	Note
German* (Matzke et al., 2002)	SVO-OVS Ambiguity (fem. NP1 vs masc. NP1)	LAN (400-600ms, 600-800ms)	- Negativity (400-1000ms) - P600 (600-800ms, 800-1000ms) for amb. fem. NP1	Not discussed	Nom/Acc case was provided by articles preceding NPs.
Japanese* (Wolff et al., 2008)	SOV-OSV	- Scrambling negativity (120-240ms) - positivity (400-650ms)	N400 (300-500ms)	Late negativity (650-1000ms)	Nom/Acc case was provided by markers following the NPs.
Basque* (Erdocia et al., 2009)	SOV-OSV	Negativity (300-500ms)	Negativity (400-550ms)	P600 (700-900ms)	Erg/Abs case was provided by markers after NPs.
	Conditions	NP1	RC onset	RC offset	
English (Meltzer & Braun, 2013)	S.RC – O.RC Reversibility	Negativity (400-800ms) for reversible (i.e. ani. NP1 vs inani. NP1)	Not found	positivity (-300-100ms) for rev. conditions	Only found reversibility effects, no word order effect.

*all components are evoked comparing object-first to subject-first structures

To conclude, in German, Basque, and Japanese, three languages which use case information for thematic role assignment, effects of the non-agent NP1 compared to the canonical agent NP1 are found not only in the disambiguation region (NP1), but also in other parts of the sentence as a generalized increase in processing effort. Meltzer and Braun (2013) did not find an ERP effect of word order when comparing object-embedded relative clauses to subject-embedded relative clauses. However, the behavioral results in their study were not consistent with their ERP findings as they found an effect of word order, reversibility, and an interaction between both for reaction times (RT). Specifically, reversible object-embedded structures have the highest RT and most errors. Additionally, the study in English compared two relative clause structures while the other studies used simple sentences by manipulating case marking. The effects of embedding were not discussed in the English Relative Clause study, although the "simple active" structure was incorporated as a control condition. The present study examines the word order effect in a language without case markings that indicate thematic roles.

4.1.3. Some relevant properties of Standard Indonesian

Indonesian is a zero-marking language (Nichols & Bickel, 2013) without case or gender markings. Transitive verbs are usually only inflected for voice (active or passive); there is no verb inflection for tense, aspect, or agreement. Indonesian has SVO word order (Sneddon, 1996), however, the ordering of constituents can be flexible, and it is possible (though infrequent) for verbs to take the initial position. Chung (2008) suggested that Indonesian belongs to a branch of the Austronesian language family that was originally verb-initial, as the passivized transitive, active-transitive as well as intransitive verbs can take the 1st position.

The usual transitive passive (5b) has the theme in the initial position. Examples of typical simple active and simple passive sentences are as follows:

5a) Simple active (agent-theme / SVO)

Perempuan	itu	**men**dorong	laki-laki	itu
girl	the	**ACT**-push	boy	the

'the girl is pushing the boy'

5b) Simple passive (theme-agent / OVS)

Laki-laki	itu	**di**dorong	(oleh)	perempuan	itu
boy	the	**PAS**-push	(by)	girl	the

'the boy is pushed by the girl'

The canonical sentence (4a) displays a verb with an active-transitive voice marking (*men-*). Likewise, the passive (4b) is expressed by the prefix (*di-*) on the verb where 'the boy' is the theme of the action. Similar to English, the by-phrase is optional in the passive. Additionally, the preposition (*oleh*) 'by' may be omitted when the agent is immediately adjacent to the verb (Cole & Hermon, 2008). As the current study observes the evoked potential distinctions between the simple active and simple passive, it is also worthy to note that the typical passive in Indonesian, unlike in most Indo-European languages, is highly frequent. It is acquired at a very early age (around 2 years old; Gil, 2006) compared to English (4-5 years old), which can be attributed to its high input frequency 28-35% in Indonesian, compared to 4-5% in English. This difference is also reflected in written form: only 9% of English verbs display passive morphology (Givón, 1979) compared to 30-40% of Indonesian verbs (Kaswanti-Purwo, 1991) having the passive marker '*di-*'.

4.1.4. The present study

The current study investigates the processing of non-anomalous, simple sentences with differing word orders. Similar to the previous studies discussed, the two variables manipulated are word order of sentences and reversibility. The central question is: *are active and passive sentences processed differently as evidenced by ERPs in Indonesian?* The focus will be on the critical point in time.

Four conditions were included: reversible active, reversible passive, non-reversible active, and non-reversible passive. There are some aspects of the Indonesian language that make the topic of the present study worth pursuing. First, the thematic roles of the NPs are coded by the passivization prefix on the verb rather than by case marking on the NPs. Second, unlike the studies on German (Matzke et al., 2002) and Basque (Erdocia et al., 2009), there are no ambiguity manipulations involved. Third, the structures tested in the current study are both frequent and typical. The object-first conditions in the previous studies are infrequent in the respective languages when compared to their subject-first counterparts, for example, the object-embedded relative clause in English (Reali & Christiansen, 2007) and the Object-Subject structure in

German (Verhoeven, 2015). While arguments against exclusively syntactic frequency-based account of sentence processing have been established for German (Bornkessel, Schlesewsky, & Friederici, 2002), there is behavioral evidence for the influence of sentence-level frequency and how it interacts with other syntactic contrasts such as lexical bias of verbs (Gahl et al., 2003; Gahl & Menn, 2016; Jap et al., 2016).

The predictions (the materials in the next subchapter) for the current study are:

(a) An ERP contrast is expected between canonical and non-canonical sentences on the critical region (verb) that only persists in the reversible condition. We expect a posterior positivity (P600) at the disambiguation point as a revision of thematic information is needed: NP1 should be reassigned from the default agent role to become the theme of the action.
(b) An ERP contrast should be found between canonical and non-canonical sentences in the NP2 time windows. Additionally, based on earlier studies we expect a 'generalized' increase of processing costs in comprehending the non-canonical structures. For example, the verb in Basque (Erdocia et al., 2009) and Japanese (Wolff et al., 2008) provides no additional thematic information, but within that section, ERP differences for object-first compared to subject-first structures were observed.

4.2 Method

4.2.1 Participants

24 right-handed healthy native speakers of Indonesian were recruited (13 females; age=20-46 years, mean=28.2 years) in Groningen, The Netherlands. All participants were tested with an Indonesian translation of the short form of the Edinburgh Handedness Inventory (Veale, 2014) to ensure they were classified as right-handed. Participants gave informed consent and were financially compensated. Most of the participants were post-graduate students who were a member of the Indonesian Student Association in Groningen.

4.2.2 Materials

The stimuli used in this experiment are comprised of 160 sentences that fall into 4 conditions for a 2x2 design (semantic reversibility x word order). The items (Table 4.2) were pre-tested for grammaticality via participants from an online survey.

Table 4.2. Stimuli examples for each condition

Condition	**NP1**	**PP**	**VP**	**NP2**	**PP**
Active reversible	Teman	dari luar kota	menonton	kakak	di panggung.
	A friend	from out of town	**ACT**watch	sibling	on stage
	A friend from out of town watches (my) brother/sister on stage.				
Passive reversible	Kakak	di panggung	ditonton	teman	dari luar kota
	Sibling	on stage	**PAS**watch	a friend	from out of town
	(my) Brother/sister on stage is watched by a friend from out of town.				
Irreversible active	Teman	dari luar kota	menonton	acara TV	di rumah.
	A friend	from out of town	**ACT**watch	TV show	at home
	A friend from out of town watches the TV show at home.				
Irreversible passive	Acara TV	di rumah	ditonton	teman	dari luar kota
	TV show	at home	**PAS**watch	a friend	from out of town
	The TV show at home is watched by a friend from out of town.				

Reversible sentences involved an animate subject and object, and were constructed while avoiding plausibility bias. Non-reversible sentences involved an animate subject (see Appendix 4 for a complete list of sentences) and a non-animate object (e.g., a TV show). Word order was manipulated by using two structures: simple active and simple passive sentences. Based on previous studies on well-formed sentence processing, the contrast of interest is passive-active, and whether the effects of word order persist over reversibility. The verbs and the NPs were matched for the active-passive pairing for both reversibility conditions.

Table 4.3. Length of segments preceding the verb and NP2 triggers

	NP1+PP1 length (in ms)	**Verb length (in ms)**
mean	1530	516
min.	877	308
max.	2490	842
SD	350	108

Additionally, there are 40 ungrammatical filler sentences related to the comprehension task of the experiment. An example of a filler sentence is given in (6), where the violation is in the use of a verb (in bold). Each participant is required to judge the grammaticality of each sentence in the experiment.

6) Kemarin malam	penculik	sudah menghindari	**serang**	polisi	ke markas mereka.
Yesterday night	kidnapper	has avoided	**attack**	(by) police	to their hideout

4.2.3 Procedure

As the materials were presented auditorily, the sentences were digitally recorded from a female monolingual Indonesian speaker, initially sampled at 44.1 kHz and segmented. Digital triggers were manually inserted on three time points of every sentence: the onset of NP1, the onset of the verb (i.e. the onset of the prefix), and the onset of NP2. It is important to note that the triggers for the verb and NP2 are in the middle of the sentence. For the sake of later analysis, the durations of the sentences up to the verb are shown in Table 4.3 below. There is a 50-100ms-gap between the offset of the verb to the onset of NP2 for most trials.

Participants were seated in front of the presentation monitor, and the spoken sentences were presented through headphones. Using the E-Prime software for stimuli presentation, the experiment started with written instructions that were previously explained orally by the experimenter. During the whole experiment, a fixation cross was on the screen, except when the participant had to respond to the grammaticality judgment task. Prior to the experiment, participants were instructed to minimize head movement

during the trials and not close their eyes while performing the experiment, though they were not asked to refrain from blinking.

At the beginning of a trial, the sentence was played, and when the sentence finished playing, the cue to give a response was shown as a question *Apakah kalimat ini gramatikal?:* "was the sentence grammatical?" The participant pressed the 'p' for grammatical or the 'q' for ungrammatical sentences. There was no time limit to respond. Following the response, there was a between-trial delay of 1000ms before the start of the next trial. To avoid fatigue, there were pauses after every 50 trials, where the participant could take a break and resume the experiment whenever ready. The total test session, including cap and electrode preparation, was approximately two hours per participant.

4.2.4 EEG recording and preprocessing

EEG was recorded from 64 Ag-Acl electrodes fixed at the participant's scalp using an elastic cap with a 10-20 system. The cap had two dedicated electrodes for the left and right mastoids. To monitor horizontal and vertical eye movements, two electrodes were placed in the outer canthi of each eye, and two more were placed above and below the left eye. Electrode impedances were kept below 5k Ω. The EEG was amplified and digitized with a sampling rate of 512 Hz.

The EEG data were re-referenced to the two mastoid electrodes before being filtered with a 0.1-40.0 Hz band-pass filter with a low cut-off filter slope of 24dB/octave and high cut-off slope of 48dB/octave. Artifact rejection for blinks and movement were conducted manually and automatically using the BrainVision Analyzer 2 program. The ERPs were calculated per participant, per electrode, and per condition in intervals of -200ms to 1000ms to each time-locked trigger, before the grand average was calculated across participants.

A baseline correction of 200ms was performed. There was the alternative method of not using baseline corrections, as suggested by Wolff et al., (2008) and Friederici, Wang, Herrmann, Maess, & Oertel (2000) who conducted auditory experiments. The reasoning behind this is in the mid-sentence time windows when using auditory presentation, the waves of each trial cannot be identical prior to the onset of the critical word, therefore

potentially distorting the baseline. Wolff et al., (2008) instead had more narrow bandpass filters (0.3-20.0Hz) to exclude slow drifts while still including language-related ERP. However, Steinhauer (2013) criticized this method of using a higher filter instead of baseline-correction because first of all, the modified filter does not distinguish artifacts (slow drifts) and real slow waves related to language processing, then, the filter also convert sustained effects into apparent local effects such as ELANs, and finally, the increased filtering does not directly address the problem of distorted baseline resulting from auditory materials before the onset of the critical region.

4.2.5 Statistical analysis

For the comprehension task, error rates and reaction times were analyzed descriptively and using t-tests to compare means between the conditions. Repeated measures ANOVAs were performed on the mean amplitude of values per condition in each time window of interest. For each time window and condition, we performed two ANOVAs, one on the midline electrodes, and one on the lateral electrodes with 'hemisphere' as an added factor for the latter analysis. The ANOVAs comprised the following three factors: CONDITION (active reversible, active non-reversible, passive reversible, and passive non-reversible) ANTERIORITY (anterior, central, and posterior), and HEMISPHERE (left and right). The Greenhouse-Geisser correction was used for all analyses. Bonferroni correction was used for the post-hoc pairwise comparisons.

Electrodes were grouped into 9 ROIs (Figure 4.1): left anterior (F7, F5, F3, FC3, FC5), mid anterior (F1, Fz, F2, FC1, FCz, FC2), right anterior (F4, F6, F8, FC4, FC6), left central (TP7, C5, C3, CP5, CP3), mid central (C1, Cz, C2, CP1, CPz, CP2), right central (C4, C6, CP4, CP6, TP8), left posterior (P7, P5, P3, PO7, PO5, O1), mid posterior (P1, Pz, P2, PO3, POz, PO4), and right posterior (P4, P6, P8, PO6, PO8, O2). Several of the frontal electrodes were excluded, and in the end, there were 5 to 6 electrodes per ROI.

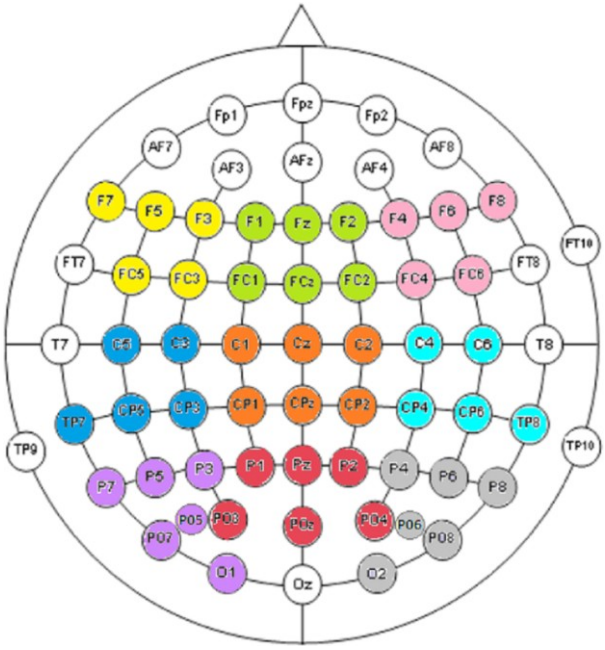


Figure 4.1 The 9 ROIs included in the analysis. It is divided according to laterality and anteriority.

Initially, the time-windows were chosen via visual inspection, as there is no previously published ERP study on Indonesian, hence, the use of pre-defined time-windows would have been extremely speculative. However, a follow-up analysis used time-windows of 200ms from 100ms to 900ms to also detect evoked potentials that are built up over several words that emerge over a longer time scale, as found for the English relative clauses (Meltzer & Braun, 2013). We did not analyse the effect on NP1. A the comparison on NP1 comprises comparing words with different properties (such as animacy), it would be very difficult to disentangle lexical effects from the thematic role-assignment effect. Also, it is highly unlikely that thematic-role assignment effect could be measured at such an early point in a sentence. We carried out two comparisons: on the verb and on the noun immediately following the verb.

4.3 Results

4.3.1. Behavioral results

Accuracy rate for the behavioral task was at 77% excluding trials on the fillers. The errors may originate from the effect of hypercorrection, in which the participant suspects grammatical sentences to be ungrammatical due to the low number of ungrammatical fillers (1 in 5 sentences). A two-way ANOVA was conducted to examine the effect of canonicity and reversibility on accuracy in the comprehension task. Error rates for each condition can be seen in Figure 4.2. There are main effects of canonicity (F(1,3836)=86.31, p<.001) and reversibility (F(1,3836)=4.05, p=.044). However, an interaction between canonicity and reversibility is not observed (F(1,4795)=1.53, p=.216). Additionally, the fillers, which are grammatically incorrect were identified as such 64% of the time, which is significantly less accurate than all other conditions (p<.001). These differences have to be interpreted with care, as all trials other than the fillers were rated as grammatical to native Indonesian speakers in a preliminary experiment to test grammaticality of the items.

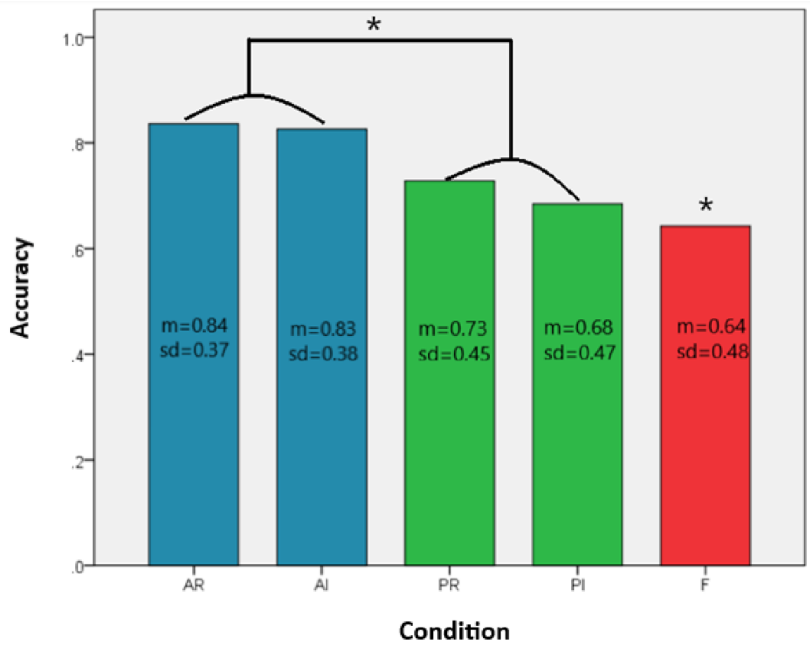


Figure 4.2. Accuracy rates by condition. AR: active reversible; PR: passive

reversible; AI: irreversible active; PI: irreversible passive; F: fillers (*statistically significant; main effects of canonicity and reversibility were observed, but the interaction between the two factors was not).

The reaction time was calculated only for correct trials. Reaction times exceeding 4000 ms were excluded from the analysis. The reaction time means for each condition were: 1090.4 ms (active reversible), 1038.3 ms (active non-reversible), 1094.9 ms (passive reversible), and 1157.7 ms (passive non-reversible). A two-way ANOVA was conducted. We found no effects of canonicity ($F(1,2645)=2.91$, $p=.088$), reversibility ($F(1,2645)=0.21$, $p=.884$), nor an interaction of the two ($F(1,2645)=2.50$, $p=.114$) on RT. Fillers have significantly faster RT (for correct trials) compared to all other conditions ($p<.001$).The reaction time for each condition is shown in Figure 4.3 below.

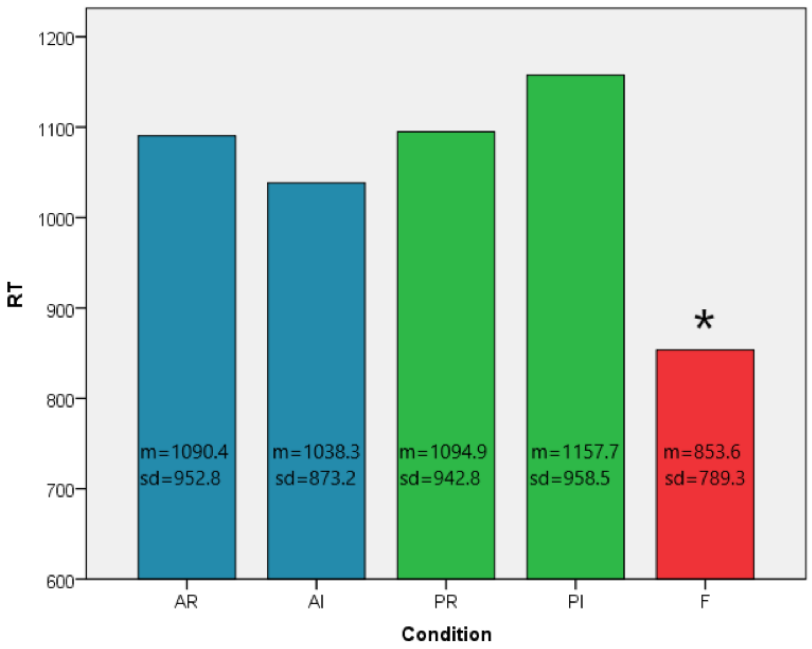


Figure 4.3. Reaction time (in ms) by condition. AR: active reversible; PR: passive reversible; AI: irreversible active; PI: irreversible passive; F: fillers

4.3.2. ERP data

ANOVA results for the ERP will be discussed based on the parts of sentences starting with the verb then NP2.

Visually, it is not easy to discern any effects on the verb (see Figure 4.4 below) except that passive non-reversible sentences seem to differ from both active reversible and passive non-reversible at different points. The effect on the noun (see Figure 4.5 below) following the verb is visually much clearer – passive non-reversible sentences elicit a more positive effect that the sentences in all other conditions.

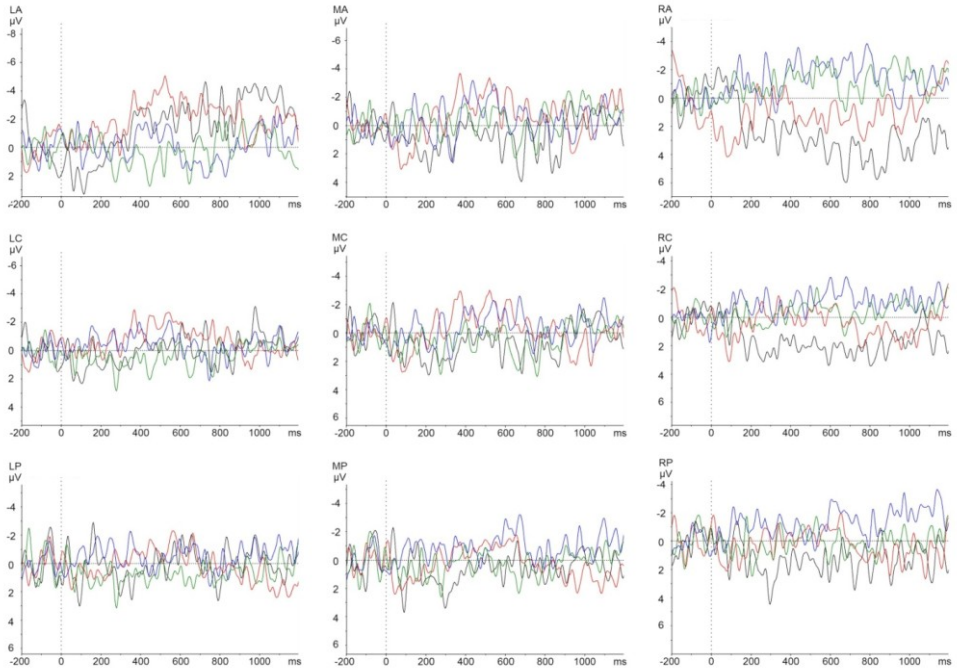


Figure 4.4 Grand average ERPs (n=24) time-locked to the onset of the verb. Figures are averaged according to the 9 pre-defined ROIs. Black is for active reversible; red is for passive reversible; blue is for active non-reversible; and green is for passive non-reversible.

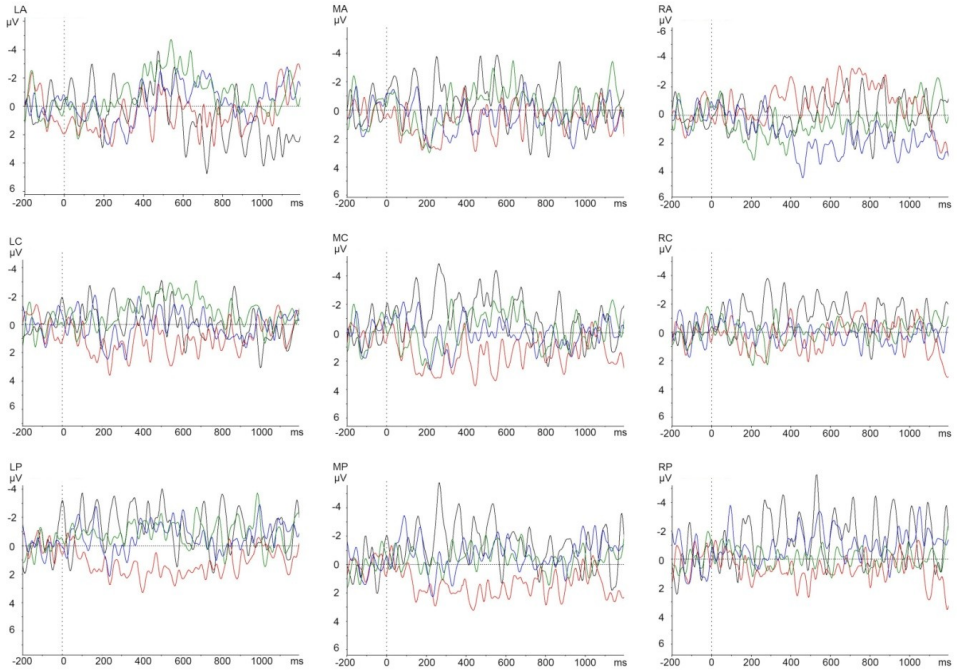


Figure 4.5 Grand average ERPs (n=24) time-locked to the onset of the second noun phrase. Figures are averaged according to the 9 pre-defined ROIs. Black is for active reversible; red is for passive reversible; blue is for active non-reversible; and green is for passive non-reversible.

4.3.3 Verb Analysis

The first time window with any significant or close-to-significant results was the 300-500 ms time window. In the lateral analysis, a marginally significant interaction between condition and anteriority (F (6, 138) = 2.59, p < .1) was observed. The follow-up showed that active reversible sentences elicited a more positive effect than passive irreversible sentences in the posterior regions (t (23) = -2.59, p < .05). In the following time window (500-700 ms), condition entered into a marginally significant two-way interaction with hemisphere (F (3, 69) = 2.44, p < .1), which was driven by the difference between passive reversible and passive irreversible sentences in the right hemisphere (passive reversible elicited a more positive effect; t (23) = 4.72, p = .001).

4.3.4 NP2 Analysis

In the first time window with significant results (500-700 ms), a lateral ANOVA yielded a significant main effect of condition (F (3, 69) = 2.97, p < .05), as well as a close-to-significant interaction with anteriority (F (6, 138) = 2.82, p = .05). The post-hoc tests showed that passive irreversible sentences elicited a more positive waveform than active reversible (t (23) = 2.83, p < .05) and active irreversible sentences (t (23) = 2.91, p < .05) in the central regions. In the posterior regions, passive irreversible condition was more positive that active reversible (t (23) = 4.4, p = .001) and active irreversible (t (23) = 3.57, p = .01), as well as marginally more positive than passive reversible (t (23) = 2.85, p < .1). In the midline, there was a marginally significant main effect of condition (F (3, 69) = 2.41, p < .1), as well as a close-to-significant interaction between condition and anteriority (F (6, 138) = 2.37, p > .1). The follow-up revealed that passive irreversible sentences elicited a more positive effect than active reversible (t (23) = 3.68, p < .01) and active irreversible sentences (t (23) = -3.22, p < .05) in the posterior region.

In the following time window (700-900 ms), the main effect of condition was significant (F (3, 69) = 3.76, p < .05), and it also entered into a close-to-significant two-way interaction with hemisphere (F (3, 69) = 2.3, p < .1). The post-hoc tests revealed that passive irreversible sentences elicited a more positive waveform than active reversible (t (23) = 3.72, p < .01) and active irreversible sentences (t (23) = 3.68, p < .01) in the right hemisphere. Lastly, the midline analysis showed a marginally significant effect of condition (F (3, 69) = 2.48, p < .1). Passive irreversible sentences elicited a marginally more positive response than active reversible (t (23) = 2.77, p < .1) and a significantly more positive response than active non-reversible sentences (t (23) = 3.01, p < .05).

The verb analysis showed two effects: active reversible sentences elicited a more positive response than passive irreversible sentences in the posterior lateral regions in the 300-500 ms time window. In the following time window (500-700 ms), passive reversible sentences elicited a more positive response compared to passive irreversible sentences in the right hemisphere.

The noun analysis showed a difference between the waveforms elicited by passive irreversible sentences on the one side, and both active reversible and irreversible on the other side. Passive irreversible sentences consistently

elicited a more positive response compared to active reversible and active irreversible sentences in centro-posterior regions with a slight preference for the right hemisphere. Such an effect is consistent with the P600 effect. Passive reversible sentences did not significantly differ from either passive irreversible or active sentences.

4.4 Discussion

In this study, we measured ERPs during the comprehension of simple, well-formed Indonesian sentences, presented via natural speech at a normal speech rate. The experiment was designed to capture neural activity in both time-locked to the critical word and as a build-up effect that surfaces over the period of multiple words. Most ERP studies investigating sentence processing have a single critical time point, usually where the disambiguation or grammatical/semantic violation occurs. This method has been successful in providing characterization of evoked potentials for linguistic manipulations such as syntactic (Osterhout & Mobley, 1995) and semantic anomalies (Kutas & Hillyard, 1980). In the studies that investigated non-anomalous sentence processing, word order as well as the semantic reversibility of sentences have both been recognized as important factors for detecting distinct processing costs associated with different sentence types. Additionally, a form of animacy violation with an argument that is a semantically unrelated word produces a P600 rather than an N400 (Bornkessel-Schlesewsky & Schlesewsky, 2008). The observed difference in the present study could be related to animacy distinction between the conditions.

While most of the evoked potentials found in the studies of non-anomalous sentence processing have not been specifically characterized or identified, the current analysis of ERPs yields neural components that have also been reported in studies using violation or ambiguity. The NP1 was not analysed as the comparison would instead look at the lexical (first-word) properties of each item such as animacy, and it would be challenging to tease apart the influence of lexical factors from what we were mainly interested in, which is thematic role assignment.

4.4.1 ERPs at the Verb

There are two findings for the verb. The first one is a positive shift for the active reversible compared to the passive non-reversible sentences in the

300-500ms time window in the posterior area. This can be attributed to the difference in prefixes and represent a split between the active and passive sentences. Secondly, in the 500-700ms time window, the passive reversible condition showed a more positive effect compared to passive non-reversible sentences in the right hemisphere.

Since the verb is the point of disambiguation in the sentences tested in this experiment, there are no direct comparisons possible with the regions tested in other studies. As with studies in other languages, we observed the ERP generated by passive structures. Matzke et al., (2002) found a P600 at the onset of the NP2 for object-first structures where the NP1 is ambiguous (feminine noun phrase where the case marking can be interpreted as nominative or accusative), and therefore the P600 was found at the disambiguating point of the sentence. Additionally, Meltzer and Braun (2013) also found a "P600-like positivity" at the offset of the critical region in their object-relative condition in English, which was at the end of the relative clause. From the findings of previous studies on non-anomalous sentence processing, we expected to find effects in passive reversible structures at the disambiguation point. While we did find a significant effect in the reversible passive, it was observed in one of the time windows (500-700ms) and not in comparison to actives but rather when compared against non-reversible passive. Instead, a more sustained evoked potential was observed in the non-reversible condition lasting for two time windows. The first explanation for why differences are observed is as we surmised that this observed effect is a reflection of the processing difference between the reversibility conditions. An alternative explanation is that the sentences tested in this experiment are simple and commonly used; we will elaborate on this below.

4.4.2 ERPs at NP2

The analysis for the NP2 elicited a sustained positivity from 500 to 900ms for the passive non-reversible sentences when compared to actives in centro-posterior regions. This positive effect is also slightly right lateralized. The distribution and time window are consistent with what has been observed for the P600 effect, with some studies reporting a right-hemispheric preference (Gouvea et al., 2010). We did not find an effect on the passive reversible, as they did not show a waveform difference when compared to active structures and the passive non-reversible. A phenomenon similar to ERP differences

after the verb in SI, was also found for other languages. For Basque (Erdocia et al., 2009), German (Matzke et al., 2002), and Japanese (Wolff et al., 2008), ERP differences were found in other areas outside the disambiguation point, suggesting an increase in general processing costs for object-first structures.

Based on previous studies, word order was expected to have an effect, specifically, a posterior positivity between 500-900ms (P600) was predicted in the passive reversible compared to the active reversible. While we did not find this in the passive reversible, we did find a sustained positivity in two consecutive time windows between 500-700ms and 700-900ms. Additionally, there are noticeable but marginal differences with the passive reversible as well at the 500-700ms time window. We speculate that this is mainly due to the fact that the passive non-reversible has an inanimate noun in the NP1 position, and this causes the parser to maintain a non-canonical reading of the sentence from the beginning. This could demand a higher processing load as it involves revising and reassignment of an initial agent-first thematic role reading of the sentence.

An alternative explanation is related to the fact that task demands, which have been proposed to be correlated with P600 amplitude (Brouwer, Fitz, & Hoeks, 2012), are higher when parsing passive non-reversible structures. This explanation is partially supported by the behavioural data which showed that the passive non-reversible structure not only has a numerically lower mean accuracy rate compared to all other experimental conditions, but also requires more time on average to process (higher RT). The difference is not significant, however, so this line of interpretation has to be treated with caution. Based on previous studies, a prediction was made regarding processing difference between agent-first and theme-first sentence types. This voice distinction was not observed in our data as we found reversibility to produce more robust ERP differences.

4.4.3 Syntactic frequency in processing non-anomalous sentences

The disparity for the ERPs observed at the verb and NP2 compared to findings in previous studies leads to the discussion of differences between the materials used. Maybe the differences between object- and subject-first structures in the previous studies are not limited to non-canonical word order. As mentioned in the Introduction, unlike in Basque, English and German, passive sentences in Indonesian are highly frequent. In German, for example,

SVO structures are 4.4 times more frequent than OVS (Weber & Müller, 2004). In English, the proportion for subject relatives is almost 5 times higher than that of object relatives (Roland, Dick, & Elman, 2007). None of the studies on non-anomalous sentence processing discussed or compared the frequency of the structures they tested.

The next question is whether these frequencies lead to processing differences. Going back to the English relative clause example, the asymmetry between object and subject relative clauses has long been established in multiple ways: ERP differences (Müller, King & Kutas, 1997), comprehension by agrammatic individuals (Caramazza & Zurif, 1976; Caplan, 2003), reading times (King & Just, 1991), and eye movement (Traxler, Morris, & Seely, 2002). Object relatives, in all these studies, are comprehended less accurately, slower, or show an evoked potential interpreted as increased processing. However, Reali and Christiansen (2007) examined frequency differences in relative clauses compiled from multiple corpora in English and found that pronominal object relative clauses are significantly more frequent than pronominal subject relative clauses. They proceeded to conduct 4 experiments comparing object and subject-relative clauses with the use of indexical (you), first person, third person, and impersonal (it) pronouns on the NP2. The reading times of the more complex object-relative clauses in each of the 4 experiments were significantly faster than the subject-relative clauses, which is in line with constraint-based perspectives on language (e.g. MacDonald, Pearlmutter, & Seidenberg, 1994). They suggest that part of the effect originated from syntactic frequency, and that syntactic frequency may override the effect of syntactic complexity.

Syntactic frequency may contribute to the discussion of our findings. In the current data, the comparison between actives and passives is associated with predicted evoked potentials that signify increased processing costs as found in other studies which focus on word order. This surfaced after the verb as a sustained wave of positivity resembling a P600 at its commonly observed time window (as other studies have shown). The actives and passives do not differ in formal complexity or sentence length, and the verb marker usually does not change the length of the verb. Additionally, passives are frequent; passivization appears in 30-40% of Indonesian verbs in written form (Kaswanti-Purwo, 1991). For a variation of Indonesian that is spoken in Jakarta, Gil (2006) also found passives to be as frequent as the colloquial form

of actives (*n*-) in spoken discourse in both adults and children. To provide a comparison, passives are infrequent in both written (9%) and spoken (3%) English (Roland, Dick, & Elman, 2007). Simple transitive structures make up 30% and 31% of written and spoken discourse in English respectively.

4.4.4 Conclusion

The ERPs observed in this study on SI are somewhat inconsistent with earlier findings of non-anomalous sentence processing in other languages. We did not find a passive reversible effect compared to active reversible in the verb area despite observing several interactions. Based on previous studies that focused on object versus subject-first structures, we expected a prominent evoked potential for this word order pairing. This is possibly what we found on the NP2 region, where a positive shift (500ms to 900ms) with a centro-posterior distribution with a slight preference for right hemisphere for passive irreversible was observed. We attribute this P600-like effect to the (re)assignment of thematic roles after the disambiguation region for these conditions, which is the verb. The structure of passive non-reversible sentences was anticipated after the processing of the NP1: most likely in transitive sentences, a passivized structure would follow, and the NP2 should be the agent. As a zero-marking language, one would assume that the verb, which provides thematic information, is the most critical region in a sentence. However, in the current study, we found more robust differences between actives and passives in the in the NP2 region after the verb. Distinct potentials were found after the verb at NP2 which suggests revision and retention of thematic information after the verb.

CHAPTER 5

General Discussion

5.1 Overview

The aim of this dissertation was to assess the impact of syntactic frequency as a factor in sentence processing. To achieve this, we utilized the frequency distinction between passive and active sentences in Standard Indonesian. Over the various chapters, we have attempted to fulfill the general research objectives listed below:

1. To generate a description and analysis of agrammatic sentence comprehension in Standard Indonesian.
2. To generate a description and analysis of agrammatic sentence production in Standard Indonesian.
3. To investigate event-related-potentials recorded during the processing of sentences with derived word orders in Standard Indonesian.

In the present chapter, we provide a brief overview of each chapter and discuss the findings.

5.2 Overview of the results

The results of the three studies addressed the research questions from Chapter 1 as follows: (1) SI-speaking agrammatic individuals with Broca's aphasia have spared comprehension of the passive sentence structure; (2) They also have relatively spared production of passive sentences; (3) Neural correlates found in the investigation of parsing non-anomalous sentences by healthy adult SI speakers did not show a robust effect from the increased processing cost of derived structures, but rather an effect of animacy.

When taken together, all experimental data provided in this dissertation point to the general fact of the matter that syntactic frequency in SI may overrule, at least partially, the effect of word order in several different contexts. We observed the syntactic frequency effect in aphasic and normal sentence processing. Table 6.1 below shows a summary of the experimental results discussed in the previous chapters.

Table 5.1 Summary of experimental results

	Predictions	Results	Conclusions
Chapter 2 Sentence comprehension	- Effect of syntactic frequency - Non-canonical word order poorly comprehended compared to canonical - Effect of embedding	Active = passive S.Cleft > O.Cleft Active = S.Cleft Passive > O.Cleft	Syntactic frequency overrules word order in the case of passive vs active. However, it cannot be the sole determinant as in the case of S.Cleft>O.Cleft. Effect of embedding not observed.
Chapter 3 Sentence production	- Effect of syntactic frequency - Non-canonical word order produced inaccurately compared to canonical, especially in reversible sentences - Word order errors	In group data, no main effect/ interaction of either reversibility or voice. Several individuals perform poorly in the production of reversible passive sentences.	Syntactic frequency effect in preservation of production of passive sentences. Errors are predominantly word order and wrong/missing verb inflection
Chapter 4 ERP sentence processing	- Effect of syntactic frequency - Non-canonical word order leads to increased processing cost - Animacy effects in non-reversible passive sentences	No observed difference between active and passive reversible on the verb. Animacy effects found in multiple time windows in the verb and NP2	Syntactic frequency effect is possible as the predicted processing difference from parsing derived word orders is not observed. Animacy effects mainly for non-reversible passive sentences were found.

5.2.1 Impact of syntactic frequency on aphasic sentence processing

As hinted by preceding studies (Postman, 2004; Anjarningsih et al., 2012), the passive structure in SI has been found to be better preserved in agrammatic speakers in comparison to other languages. We proceeded to test these assumptions via a sentence comprehension and sentence production test.

In Chapter 2, it was observed that while comprehension of passive sentences was indeed unimpaired, we could not conclude that an aphasic sentence comprehension account solely based on frequency in SI is viable. The clefts were explored for that purpose, in which both structures are infrequent but differ in terms of word order. When both structures are not frequent, the impact of word order is still observed in that the object cleft is comprehended significantly worse than the subject cleft. A similar finding is discussed in Chapter 3, where no effect of word order or reversibility was reported. This implies that the impact of syntactic frequency occurs across modalities – at the very least in SI.

5.2.2 Non-anomalous ERPs of SI reversible sentences

Chapter 4 features an exploratory study of non-anomalous sentence processing in SI. It can be observed that in previous studies of non-anomalous sentence processing focusing on word order (German: Matzke et al., 2002; Japanese: Wolff et al., 2008; Basque: Erdocia et al., 2009), each study reports some form of significant neural response, albeit not the same between studies, of the processing of non-canonical structures when compared to canonical ones. However, one must also note that there is another difference between the sentence structures compared in each study, which is frequency.

Syntactic frequency can affect processing but was not thoroughly discussed in these studies. In the German study which compares SVO and OVS structures, for example, it should be noted that SVO structures occur 4.4 times more often than OVS structures (Weber & Müller, 2004). Thus, one of the points Chapter 4 brings to the table is the fact that if a significant processing difference in the form of a neural correlate is found in the comparison of active and passive reversible sentences in SI, it would unlikely be the result of a confound caused by frequency as both structures are highly frequent. In this context, we found processing differences between the active and passive

reversible sentence at the disambiguation point (onset of the prefix of the verb).

Still in line with predictions regarding animacy, what we observed was a significant amplitude difference in multiple time windows for the passive non-reversible structure. We attribute this to the inanimate NP1, which may provide participants with enough information to predict the upcoming structure (that NP1 is likely a theme and the subsequent constituents would be a passivized verb and an agent). This non-reversible passive can be compared to the other three structures, where an animate NP1 means that the disambiguation point of whether the sentence would be interpreted as passive or active lies on the prefix of the verb.

5.2.3. The DOP-H, TDH, and the present results

Returning to the two theoretical frameworks discussed, we compare the results of the experimental chapters on comprehension and production of agrammatic aphasic SI speakers with the predictions made by the models. Table 6.2 below shows each sentence and structure tested, predictions by each theory, and the results.

Table 6.2 Summary of predictions compared to results of SI data

Sentence type	**TDH**	**DOP-H**	**Results**
Comprehension			
Active	Above chance	No impairment	Above chance & no impairment
Passive	Below chance	Impaired/ sig. poorer than active	Above chance & comparable to active
Subject cleft	Above chance	Comparable to active	Above chance & comparable to active
Object cleft	Below chance	Impaired/ sig. poorer than active	Below chance & sig. poorer than active
Production			
Active (reversible)	No predictions	No impairment	Above chance & no impairment
Passive (reversible)	No predictions	Impaired/ sig. poorer comprehended active	Above chance & comparable to active

Both the TDH and DOP-H successfully predicted the cleft structures from the comprehension data. The object cleft was comprehended significantly poorer than the active, passive, and subject-cleft and was at below chance level accuracy. At the same time, the subject cleft which was a canonical but embedded structure was comprehended at a level comparable to the active structure, and well above chance level. However, both theories did not successfully predict the passive structure in comprehension, where we found agrammatic speakers were able to comprehend passives at a rate that is comparable to active sentences. The current study also found the production of passives to be unimpaired in overall, which is contrary to the DOP-H as it predicts impairment in production to be similar to comprehension. The TDH does not predict production. The pattern we found was that frequency of structures compound with the linguistic complexity/effort required by movement in non-canonical structures: All canonical structures, be it low-frequency like the subject cleft or high-frequency like the active, are well-preserved. However, non-canonical structures behave differently where low-frequency non-canonical structures like the object cleft is impaired (in comprehension) and higher frequency non-canonical structures like the passive in SI is relatively preserved.

5.3 Limitations

There are several limitations of the studies conducted. First, for Chapter 2 and Chapter 3, the aphasic groups are relatively small. While this is indeed what we had to work with, the results have to be interpreted carefully, and it would be rather inadvisable to make strong conclusions. Second, the ERP data from Chapter 4 did not seem to be very revealing, and this is possibly due to the fact that we did not utilize the violation paradigm. Although the non-violation paradigm seemed to be the most appropriate paradigm when we designed the study (as, for instance, studies in other languages have observed effects using a similar design on a comparable set of materials), the lack of clear results in most conditions made us believe that a violation paradigm can be more revealing at the very least to collect initial data on sentence processing in SI.

5.4 Clinical implications and future research

One straightforward implication from this dissertation is to avoid relying on passive structures to detect grammatical deficits in Indonesian non-fluent aphasic speakers. Our results were consistent with previous findings (Postman, 2004; Anjarningsih et al., 2012) where the passives are relatively well preserved both in terms of comprehension and production in SI. This would have an immediate impact on aphasia assessment in SI as the TADIR (Indonesian aphasia test battery) utilizes passives to test for grammatical deficits for both sentence comprehension and production. Furthermore, this could open new possibilities for additional assessment tools to be adapted into SI to assist in profiling aphasic symptoms. Some of the ones which we used in this dissertation are the Token Test and components of the VAST (verb comprehension, sentence comprehension, and sentence production/ elicitation).

In this series of experimental data, we attempt to show how elements of syntactic frequency can impact the processing of different word orders. As there has been evidence of the role of syntactic frequency, future research on sentence processing could be conducted while anticipating the possible impact of frequency. Also referring to the limitations, an improvement to upcoming studies in the topic could also incorporate a larger group of aphasic participants. In the context of SI, there are few studies on SI sentence processing which incorporates ERPs and grammatical violations in the larger context of utilizing word orders of differing or similar frequency. Additionally, we have yet to know the extent to which syntactic frequency in SI plays a role outside of the well-formed active and passive sentences tested in the present study.

Appendix

Appendix 2.1. Background Information of the participants with aphasia

No	Education (years)	Age	Origin	Gender	Handed-ness	Time post-onset (years)	First language	Token Test
1	12	70	Brebes	M	Right	1.5	Javanese	28/50
2	12	71	Brebes	M	Right	10	Betawi	33/50
3	9	53	Brebes	F	Right	13	Javanese	30/50
4	12	66	Surakarta	M	Right	3	Javanese	37/50
5	12	65	Surakarta	F	Right	3-4	Javanese	37/50
6	16	57	Semarang	M	Right	5	Javanese	37/50
7	12	73	Semarang	F	Right	0.5	Javanese	29/50
8	12	82	Semarang	F	Right	10	Javanese	26/50
9	12	68	Ungaran	F	Right	7	Javanese	28/50
10	12	81	Sleman	F	Right	0.5	Javanese	30/50
11	12	70	Sleman	M	Right	11	Javanese	31/50

Appendix 2.2. Individual sentence comprehension scores for participants with aphasia

No	total	active	s-cleft	passive	o-cleft
1	25	8	7	5	5
2	23	9	5	7	2
3	31	9	9	10	3
4	29	9	9	5	6
5	23	6	7	5	5
6	28	6	10	8	4
7	18	3	5	7	3
8	18	5	4	6	3
9	24	7	7	7	3
10	22	7	4	7	4
11	25	6	9	7	3
maximum	40	10	10	10	10
mean	24.2	6.8	6.9	6.7	3.7
sd	3.93	1.80	2.07	1.42	1.14
%	60	28	29	28	15

Note: Appendix 2.2 shows the raw accuracy scores of each sentence type with each condition having 10 trials. *Total* shows the combined score of each participant.

Appendix 2.3. Individual errors for participants with aphasia (maximum number of errors= 40)

No.	Total	Reversed Role	Lexical Distractor	Reversed Role Lexical Distractor
1	15	12	2	1
2	17	16	1	0
3	9	8	1	0
4	11	8	3	0
5	17	12	3	2
6	11	9	1	1
7	22	15	6	1
8	22	14	4	4
9	16	15	1	0
10	18	10	7	1
11	15	10	5	0
total	173	129	34	10
mean	15.7	11.7	3.1	0.9
sd	4	2.8	2.1	1.2
%		75	20	6

Appendix 2.4. Score form and list of sentences for Sentence Comprehension

Sentence Comprehension Score Form

Num	Type	✔	Target	✔	Reversed Role Distractor	✔	Lexical distractors	✔	Reversed Role / Lexical Distractors	Target
1	1		Perempuan itu menghadiahi laki-laki.		Laki-laki itu menghadiahi seorang perempuan.		Perempuan itu melukis muka laki-laki.		Laki-laki itu melukis muka perempuan.	C
2	1		Pria itu merekam seorang wanita.		Wanita itu merekam seorang pria.		Pria itu menggambar seorang wanita.		Wanita itu menggambar seorang pria.	A
3	1		pria melukis wanita.		wanita melukis pria.		pria memotret wanita.		wanita memotret pria	D
4	4		Pria itulah yang wanita itu selamatkan.		Pria menyelamatkan wanita.		Wanita memanggil pria.		Pria memanggil wanita.	B
5	4		Wanita itulah yang pria itu bantu.		Wanita membantu pria.		Pria mendorong wanita.		Wanita mendorong pria.	B
6	3		Pria itulah yang membalut seorang wanita.		Wanita membalut pria.		Pria menyuntik wanita.		Wanita menyuntik pria.	C
7	2		Pria itu dicium seorang wanita.		Pria mencium wanita.		Wanita memeluk pria.		Pria memeluk wanita.	A
8	3		Sapi itulah yang menendang kuda.		Kuda menendang sapi.		Sapi menggigit kuda.		Kuda menggigit sapi.	D
9	1		Kucing mencakar anjing.		Anjing mencakar kucing.		Kucing menjilat anjing.		Anjing menjilat kucing.	B
10	2		Wanita itu dipotret seorang pria.		Wanita memotret pria.		Pria melukis wanita.		Wanita melukis pria.	C
11	4		Pria itulah yang wanita itu rekam.		Pria merekam wanita.		Wanita menggambar pria.		Pria menggambar wanita.	A
12	3		Laki-laki itulah yang menggambar perempuan.		Perempuan menggambar laki-laki.		Laki-laki merekam perempuan.		Perempuan merekam laki-laki.	D
13	4		Pria itulah yang wanita itu balut.		Pria membalut wanita.		Wanita menyuntik pria.		Pria menyuntik wanita.	B
14	1		Sapi menggigit kuda.		Kuda menggigit sapi.		Sapi menendang kuda.		Kuda menendang sapi.	A
15	4		Wanita itulah yang pria itu gendong.		Wanita menggendong pria.		Pria menarik wanita.		Wanita menarik pria.	D
16	2		Perempuan itu dihadiahi laki-laki.		Perempuan itu menghadiahi laki-laki		Laki-laki melukis muka perempuan.		Perempuan melukis muka laki-laki.	C
17	2		Kucing dijilat anjing.		Kucing menjilat anjing.		Anjing mencakar kucing.		Kucing mencakar anjing.	A
18	3		Pria itulah yang mencium seorang wanita.		Wanita mencium pria.		Pria memeluk wanita.		Wanita memeluk pria.	B
19	1		wanita membantu pria.		pria membantu wanita.		wanita mendorong pria.		pria mendorong wanita	C
20	4		Wanita itulah yang pria itu peluk.		Wanita memeluk pria.		Pria mencium wanita.		Wanita mencium pria.	B
21	3		Wanita itulah yang menarik seorang pria.		Pria menarik wanita.		Wanita menggendong pria.		Pria menggendong wanita.	B
22	3		Kucing itulah yang menjilat anjing.		Anjing menjilat kucing.		Kucing mencakar anjing.		Anjing mencakar kucing.	A
23	1		Pria itu menyuntik wanita.		wanita itu menyuntik pria.		Pria itu membalut lengan wanita.		Wanita itu membalut lengan pria	D
24	3		Wanita itulah yang memotret seorang pria.		Pria memotret wanita.		Wanita melukis pria.		Pria melukis wanita.	C
25	3		Pria itulah yang memanggil seorang wanita.		Wanita memanggil pria.		Pria menyelamatkan wanita.		Wanita menyelamatkan pria.	D
26	3		Perempuan itulah yang menghadiahi laki-laki.		Laki-laki menghadiahi perempuan.		Perempuan melukis muka laki-laki.		Laki-laki melukis muka perempuan.	A
27	2		Sapi ditendang kuda.		Sapi menendang kuda.		Kuda menggigit sapi.		Sapi menggigit kuda.	B
28	1		Pria itu menyelamatkan wanita.		Wanita itu menyelamatkan pria.		Pria itu memanggil wanita.		Wanita itu memanggil pria.	C
29	4		Kucing itulah yang anjing itu cakar.		Kucing mencakar anjing.		Anjing menjilat kucing.		Kucing menjilat anjing.	D
30	4		Sapi itulah yang kuda itu gigit.		Sapi menggigit kuda.		Kuda menendang sapi.		Sapi menendang kuda.	C
31	4		Perempuan itulah yang laki-laki itu hadiahi.		Perempuan menghadiahi laki-laki.		Laki-laki menggambar muka perempuan.		Perempuan menggambar muka laki-laki.	A
32	2		Pria itu dipanggil wanita.		Pria memanggil wanita.		Wanita menyelamatkan pria.		Pria menyelamatkan wanita	B
33	1		Wanita itu menggendong pria.		Pria itu menggendong wanita.		Wanita itu menarik pria.		Pria itu menarik wanita.	C
34	1		Wanita itu memeluk seorang pria.		Pria itu memeluk seorang wanita.		Wanita itu mencium seorang pria.		Pria itu mencium seorang wanita.	D
35	2		Wanita itu ditarik pria.		Wanita menarik pria.		Pria menggendong wanita.		Wanita menggendong pria.	A
36	2		Pria itu disuntik wanita.		Pria menyuntik wanita.		Wanita itu membalut lengan pria.		Pria itu membalut lengan wanita.	A
37	2		Laki-laki itu digambar perempuan.		Laki-laki menggambar perempuan.		Perempuan merekam laki-laki.		Laki-laki merekam perempuan.	D
38	2		Wanita itu didorong seorang pria.		Wanita mendorong pria.		Pria membantu wanita.		Wanita membantu pria.	B
39	3		Wanita itulah yang mendorong seorang pria.		Pria mendorong wanita.		Wanita membantu pria.		Pria membantu wanita.	C
40	4		Pria itulah yang wanita itu lukis.		Pria melukis wanita.		Wanita memotret pria.		Pria memotret wanita.	D

Total Correct /40	
Canonical	Non-canonical
Actives (1) /10	Passives (2) /10
Subject clefts (3) /10	Object clefts (4) /10
Total /20	Total /20

Breakdown of errors	
Reversed role distractors	
Lexical distractors	
Reversed role/lexical distractors	

Appendix 2.5. Score form and list of sentences for Sentence Comprehension (translated)

Sentence Comprehension Score Form

Num	Type	✔	Target	✔	Reversed Role Distractor	✔	Lexical distractors	✔	Reversed Role / Lexical Distractors	Target
1	1		The woman gifted the man.		The man gifted the woman.		The woman painted the man's face.		The man painted the woman's face.	C
2	1		The man recorded the woman.		The woman recorded the man.		The man drew the woman.		The woman drew the man.	A
3	1		The man painted the woman.		The woman painted the man.		The man photographed the woman.		The woman photographed the man.	D
4	4		It is the man that the woman saved.		The man saved the woman.		The woman called the man.		The man called the woman.	B
5	4		It is the woman that the man helped.		The woman helped the man.		The man pushed the woman.		The woman pushed the man.	B
6	3		It is the man that bandaged the woman.		The woman bandaged the man.		The man injected the woman.		The woman injected the man.	C
7	2		The man kissed the woman.		The man kissed the woman.		The woman hugged the man.		The man hugged the woman.	A
8	3		The cow kicked the horse.		The horse kicked the cow.		The cow bit the horse.		The horse bit the cow.	D
9	1		The cat scratched the dog.		The dog scratched the cat.		The cat licked the dog.		The dog licked the cat.	B
10	2		The woman was photographed by the man.		The woman photographed the man.		The man painted the woman.		The woman painted the man.	C
11	4		It is the man that the woman recorded.		The man recorded the woman.		The woman drew the man.		The man drew the woman.	A
12	3		It is the man that drew the woman.		The woman drew the man.		The man recorded the woman.		The woman recorded the man.	D
13	4		It is the man that the woman bandaged.		The man bandaged the woman.		The woman injected the man.		The man injected the woman.	B
14	1		The cow bit the horse.		The horse bit the cow.		The cow kicked the horse.		The horse kicked the cow.	A
15	4		It is the woman that the man carried.		The woman carried the man.		The man pulled the woman.		The woman pulled the man.	D
16	2		The woman was gifted by the man.		The woman gifted the man.		The man painted the woman's face.		The woman painted the man's face.	C
17	2		The cat was licked by the dog.		The cat licked the dog.		The dog scratched the cat.		The cat scratched the dog.	A
18	3		It is the man that kissed the woman.		The woman kissed the man.		The man hugged the woman.		The woman hugged the man.	B
19	1		The woman helped the man.		The man helped the woman.		The woman pushed the man.		The man pushed the woman.	C
20	4		It is the woman that the man hugged.		The woman hugged the man.		The man kissed the woman.		The woman kissed the man.	B
21	3		It is the woman that pulled the man.		The man pulled the woman.		The woman carried the man.		The man carried the woman.	B
22	3		It is the cat that licked the dog.		The dog licked the cat.		The cat scratched the dog.		The dog scratched the cat.	A
23	1		The man injects the woman.		The woman injects the man.		The man bandaged the woman.		The woman bandaged the man.	D
24	3		It is the woman that photographed the man.		The man photographed the woman.		The woman painted the man.		The man painted the woman.	C
25	3		It is the man that called the woman.		The woman called the man.		The man saved the woman.		The woman saved the man.	D
26	3		It is the woman that gifted the man.		The man gifted the woman.		The woman painted the man's face.		The man painted the woman's face.	A
27	2		The cow is kicked by the horse.		The cow kicked the horse.		The horse bit the cow.		The cow bit the horse.	B
28	1		The man saved the woman.		The woman saved the man.		The man called the woman.		The woman called the man.	C
29	4		It is the cat that the dog scratched.		The cat scratched the dog.		The dog licked the cat.		The cat licked the dog.	D
30	4		It is the cow that the horse bit.		The cow bit the horse.		The horse kicked the cow.		The cow kicked the horse.	C
31	4		It is the woman that the man gifted.		The woman gifted the man.		The man painted the woman's face.		The woman painted the man's face.	A
32	2		The man is called by the woman.		The man called the woman.		The woman saved the man.		The man saved the woman.	B
33	1		The woman carried the man.		The man carried the woman.		The woman pulled the man.		The man pulled the woman.	C
34	1		The woman hugged the man.		The man hugged the woman.		The woman kissed the man.		The man kissed the woman.	D
35	2		The woman was pulled by the man.		The woman pulled the man.		The man carried the woman.		The woman carried the man.	A
36	2		The man was injected by the woman.		The man injected the woman.		The woman bandaged the man.		The man bandaged the woman.	A
37	2		The man is drawn by the woman.		The man drew the woman.		The woman recorded the man.		The man recorded the woman.	D
38	2		The woman was pushed by the man.		The woman pushed the man.		The man helped the woman.		The woman helped the man.	B
39	3		It is the woman that pushed the man.		The man pushed the woman.		The woman helped the man.		The man helped the woman.	C
40	4		It is the man that the woman painted.		The man painted the woman.		The woman photographed the man.		The man photographed the woman.	D

Total Correct	/40

Canonical		Non-canonical	
Actives (1)	/10	Passives (2)	/10
Subject clefts (3)	/10	Object clefts (4)	/10
Total	/20	Total	/20

Breakdown of errors	
Reversed role distractors	
Lexical distractors	
Reversed role/lexical distractors	

Appendix 3.1. Individual data for aphasic speakers

Subject	TADIR Rep/Comp	Active Non-reversible	Passive Non-reversible	Active Reversible	Passive Reversible	Total
1	1/4	10	5	19	16	47
2	3/2	9	10	17	14	50
3	4/4	8	9	18	17	52
4	3/4	10	6	15	17	48
5	4/4	8	9	17	9	43
6	2/4	9	7	19	15	50
7	1/3	6	8	17	15	46
8	4/2	5	8	15	13	41
9	3/3	10	7	19	4	40
10	4/3	8	6	13	11	38
11	2/4	8	8	14	15	45
12	3/3	7	5	17	11	40
Total	n/a	98	88	200	157	540
Mean	n/a	8.2	7.3	16.7	13.1	45.0
SD	n/a	1.6	1.6	2	3.8	4.6
%	n/a	82%	73%	83%	65%	75%

Note: Appendix 3.1 shows the TADIR raw scores (out of 4) representing accuracy for repetition and comprehension (for aphasia type diagnosis) as well as the raw accuracy scores of each sentence type with the Active Non-reversible and Passive Non-reversible conditions having 10 trials and the Active Reversible and Passive Reversible conditions having 20 trials. *Total* shows the combined score of each participant.

Appendix 3.2. Individual error data for aphasic speakers (n=8)

	Type	Total	Word order	Omitted/wrong verb infl.	Wrong verb	Verb/argument omission
4	Broca	12	5	6	0	1
5	TMA	17	3	9	2	3
6	Broca	10	2	6	1	1
8	Broca	19	9	5	1	1
9	Broca	20	7	11	0	2
10	TMA	22	9	4	2	5
11	Broca	15	4	8	0	3
12	Broca	20	13	5	0	2
	Total	135	52	54	6	18
	Mean	16.9	6.5	6.8	0.8	2.3
	SD	4.2	3.7	2.4	0.9	1.4
	%		39%	40%	4%	13%

Note: Participants 5 and 10 suffered from transcortical motor aphasia (TMA), which is characterized by a comparatively intact repetition (see Appendix 3.1 for their TADIR repetition scores) when compared to the Broca participants.

Appendix 3.3 Score form and list of sentences for Sentence Production

Non-reversible				
No	Prime/prompt	Target	✔	Type
1	Wanita itu menjahit kain.	Wanita itu merajut kain.		1
2	Pria itu mengetik surat.	Wanita itu menulis surat.		1
3	Boneka itu dipeluk anak.	Boneka itu dibawa anak.		2
4	Wanita itu menulis surat.	Pria itu menstempel surat.		1
5	Pria itu melempar bola.	Pria itu menendang bola.		1
6	Surat itu dicap pria itu.	Surat itu ditulis wanita.		2
7	Pria itu menggunting rambut.	Pria itu menyisir rambut.		1
8	Anak itu membawa boneka.	Anak itu memeluk boneka.		1
9	Pria itu menyapu lantai.	Wanita itu mengepel lantai.		1
10	Kayu itu dibelah pria.	Kayu itu digergaji pria.		2
11	Lantai itu dipel wanita.	Lantai itu disapu pria.		2
12	Surat itu ditulis wanita.	Surat itu diketik pria.		2
13	Bola itu ditendang pria.	Bola itu dilempar pria.		2
14	Baju itu dijemur wanita.	Baju itu dilipat wanita .		2
15	Pria itu menggergaji kayu.	Pria itu membelah kayu.		1
16	Wanita itu mencuci baju.	Wanita itu menyeterika baju.		1
17	Rambut itu disisir pria.	Rambut itu digunting pria.		2
18	Kain itu dirajut wanita.	Kain itu dijahit wanita.		2
19	Wanita itu melipat baju.	Wanita itu menjemur baju.		1
20	Baju itu diseterika wanita.	Baju itu dicuci wanita.		2
Reversible				
No	Prime/prompt	Target	✔	Type
1	Laki-laki itu menghadiahi perempuan.	Perempuan itu menghadiahi laki-laki.		1
2	perempuan itu digambar laki-laki.	Laki-laki itu digambar perempuan.		2
3	pria itu memotret wanita.	Wanita itu memotret pria.		1
4	wanita itu menyelamatkan pria.	Pria itu menyelamatkan wanita.		1
5	pria itu mendorong wanita.	Wanita itu mendorong pria.		1
6	wanita itu menyuntik pria.	Pria itu menyuntik wanita.		1
7	pria itu dipeluk wanita.	Wanita itu dipeluk pria .		2

8	kuda itu menendang sapi.	Sapi itu menendang kuda.		1
9	anjing dijilat kucing.	Kucing dijilat anjing.		2
10	wanita melukis pria.	pria melukis wanita.		1
11	Wanita itu merekam pria.	Pria itu merekam wanita.		1
12	perempuan itu menggambar laki-laki.	Laki-laki itu menggambar perempuan.		1
13	wanita itu dibalut pria.	Pria itu dibalut wanita.		2
14	Sapi itu digigit kuda.	Kuda itu digigit sapi.		2
15	pria itu digendong wanita.	Wanita itu digendong pria.		2
16	laki-laki itu menggambar perempuan.	perempuan itu menggambar laki-laki		1
17	anjing itu dicakar kucing	Kucing itu dicakar anjing.		2
18	wanita itu dicium pria.	Pria itu dicium wanita.		2
19	pria membantu wanita.	wanita membantu pria.		1
20	pria itu memeluk wanita.	Wanita itu memeluk pria.		1
21	pria itu menarik wanita.	Wanita itu menarik pria.		1
22	anjing itu menjilat kucing.	Kucing itu menjilat anjing.		1
23	wanita itu disuntik pria.	Pria itu disuntik wanita.		2
24	pria itu dipotret wanita.	Wanita itu dipotret pria.		2
25	wanita itu memanggil pria.	Pria itu memanggil wanita.		1
26	laki-laki itu dihadiahi oleh perempuan .	Perempuan itu dihadiahi oleh laki-laki .		2
27	kuda ditendang sapi.	Sapi ditendang kuda.		2
28	wanita itu diselamatkan pria.	Pria itu diselamatkan wanita.		2
29	anjing mencakar kucing.	Kucing mencakar anjing.		1
30	kuda menggigit sapi.	Sapi menggigit kuda.		1
31	perempuan itu digambar laki-laki	laki-laki itu digambar perempuan		2
32	wanita itu dipanggil pria.	Pria itu dipanggil wanita.		2
33	pria itu menggendong wanita.	Wanita itu menggendong pria.		1
34	wanita itu mencium pria.	Pria itu mencium wanita.		1
35	pria itu ditarik wanita.	Wanita itu ditarik pria.		2
36	wanita itu membalut pria.	Pria itu membalut wanita.		1
37	wanita itu direkam pria.	Pria itu direkam wanita.		2
38	perempuan itu dibantu laki-laki .	laki-laki itu dibantu perempuan.		2
39	pria itu didorong wanita.	Wanita itu didorong pria.		2
40	wanita itu dilukis pria.	Pria itu dilukis wanita.		2

Appendix 3.4 Score form and list of sentences for Sentence Production (translated)

Non-reversible				
No	Prime/prompt	Target	✔	Type
1	The woman sewed the fabric.	The woman knitted the fabric.		1
2	The man typed the letter.	The woman wrote the letter.		1
3	The doll was hugged by the child.	The doll was carried by the child.		2
4	The woman wrote the letter.	The man stamped the letter.		1
5	The man threw the ball.	The man kicked the ball.		1
6	The letter was stamped by the man.	The letter was written by the woman.		2
7	The man cut the hair.	The man combed the hair.		1
8	The child carried the doll.	The child hugged the doll.		1
9	The man swept the floor.	The woman mopped the floor.		1
10	The wood was split by the man.	The wood was chainsawed by the man.		2
11	The floor was mopped by the woman.	The floor was swept by the man.		2
12	The letter was written by the woman.	The letter was typed by the man		2
13	The ball was kicked by the man.	The ball was thrown by the man.		2
14	The shirt was hung by the woman.	The shirt was folded by the woman.		2
15	The man chainsawed the wood.	The man split the wood.		1
16	The woman washed the shirt.	The woman ironed the shirt.		1
17	The hair was combed the man.	The hair was cut by the man.		2
18	The fabric was knitted by the woman.	The fabric was sewn by the woman.		2
19	The woman folded the shirt.	The woman hung the shirt.		1
20	The shirt was ironed by the woman.	The shirt was washed by the woman.		2
Reversible				
No	Prime/prompt	Target	✔	Type
1	The man gifted the woman.	The woman gifted the man.		1
2	The woman is drawn by the man.	The man was drawn by the woman.		2
3	The man photographed the woman.	The woman photographed the man.		1
4	The woman saved the man.	The man saved the woman.		1
5	The man pushed the woman.	The woman pushed the man.		1
6	The woman injected the man.	The man injected the woman.		1

7	The man is hugged by the woman.	The woman was hugged by the man.	2
8	The horse kicked the cow.	The cow kicked the horse.	1
9	The dog is licked by the cat.	The cat was licked by the dog.	2
10	The woman painted the man.	The man painted the woman.	1
11	The woman recorded the man.	The man recorded the woman.	1
12	The woman drew the man.	The man drew the woman.	1
13	The woman is bandaged by the man.	The man was bandaged by the woman.	2
14	The cow is bitten by the horse.	The horse was bitten by the cow.	2
15	The man is carried by the woman.	The woman was carried by the man.	2
16	The man drew the woman.	The woman drew the man.	1
17	The dog is scratched by the cat.	The cat was scratched by the dog.	2
18	The woman is kissed by the man.	The man was kissed by the woman.	2
19	The man helped the woman.	The woman helped the man.	1
20	The man hugged the woman.	The woman hugged the man.	1
21	The man pulled the woman	The woman pulled the man.	1
22	The dog licked the cat.	The cat licked the dog.	1
23	The woman is injected by the man.	The man was injected by the woman.	2
24	The man was photographed by the woman.	The woman was photographed by the man.	2
25	The woman called the man.	The man called the woman.	1
26	The man was gifted by the woman.	The woman was gifted by the man.	2
27	The horse was kicked by the cow.	The cow was kicked by the horse.	2
28	The woman was saved by the man.	The man was saved by the woman.	2
29	The dog scratched the cat	The cat scratched the dog.	1
30	The horse bit the cow.	The cow bit the horse.	1
31	The woman was drawn by the man.	The man was drawn by the woman.	2
32	The woman was called by the man.	The man was called by the woman.	2
33	The man carried the woman.	The woman carried the man.	1
34	The woman kissed the man.	The man kissed the woman.	1
35	The man was pulled by the woman.	The woman was pulled by the man.	2
36	The woman bandaged the man.	The man bandaged the woman.	1
37	The woman was recorded by the man.	The man was recorded by the woman.	2

38	The woman was helped by the man.	The man was helped by the woman.		2
39	The man was pushed by the woman.	The woman was pushed by the man.		2
40	The woman was painted by the man.	The man was painted by the woman.		2

Appendix 4.1 Sentence list for ERP Experiment in Standard Indonesian

ACT-REV

	NP1	PP	VP	NP2	PP/adj phrase
1	Polisi	dari dalam mobil itu	Menembak	perampok	di jalanan.
2	Kakak	di rumah saya	Mengeringkan	adik	setelah ia mandi.
3	Singa	di hutan itu	Memakan	serigala	setelah memburunya.
4	Adik	di bandara	Memeluk	kakak	sebelum ia berangkat.
5	Adik	di taman bermain	Mendorong	kakak	saat diajak pulang.
6	Wanita	dari rumah sebelah	melukis	adik	tahun lalu.
7	Wartawan	dari stasiun TV	Memotret	kakak	di kantornya.
8	Ibu	dari luar negeri	Menelpon	bapak	setiap hari.
9	Manajer	di kantor	Menghapus	rekan saya	dari daftar penerima bonus.
10	Ibu	setiap hari	Menyisir	adik	setelah ia mandi.
11	Perawat	di rumah sakit	Menyuntik	pasien itu	tiga kali sehari.
12	Ibu	bersama dengan bapak	Mencium	adik	di stasiun kereta.
13	Penculik	di mal	Mengikat	satpam	di lantai dasar.
14	Keluarga	dari luar kota	Menonton	kakak	di panggung.
15	Adik	dengan semangat	Menarik	temannya	hingga terjatuh.
16	Perampok	dengan beringas	Memukul	pria itu	di depan rumahnya.
17	Anak itu	dari dulu	Mengikuti	ibunya	ke mana-mana.
18	Teman Budi	dari daerah	Menggelitiki	adiknya	setiap kali bertemu.
19	Ibu	dari tadi	Memanggil	kakak	untuk makan siang.
20	Teman saya	dengan gemar	Mengagetkan	adiknya	pada malam hari.
21	Guru	dengan tegas	Memperingatkan	para siswa	untuk tidak menyontek.
22	Satpam	dari dalam komplek	Melihat	pencuri	sedang mengendap-ngendap
23	Dosen	di universitas itu	Mendengar	mahasiswa	sedang menyanyi.

24	Pemandu	di museum	Membantu	pengunjung	untuk memahami sejarah museum itu.
25	Turis	di pantai itu	Menyelamatkan	anak kecil	dari serangan ikan hiu.
26	Pria	di lapangan sekolah	Menggendong	temannya	saat pulang.
27	Perawat	di klinik	Menyuntik	dokter	untuk vaksinasi.
28	Siswi seni lukis	dari kelas sebelah	Menggambar	temannya	saat ia tertidur.
29	Anak itu	dengan tidak sengaja	Menendang	temannya	saat bermain
30	Tikus itu	dengan cepat	Menggigit	anjing	di pinggir jalan.
31	Anjing	di rumah selalu	Menjilat	kelinci itu	di siang hari.
32	Kucing liar	dengan ganas	Mencakar	anjing	di rumah kami
33	Kolega	dari kantor	Menghadiahi	ayah	saat ia ulang tahun.
34	Psikolog	dari rumah sakit	Memahami	pasien	saat ia bercerita.
35	Polisi	dari berbagai distrik	menjaga	para pettingi negara	saat berangkat ke bandar udara.
36	Guru itu	setiap hari	Melindungi	siswanya	dari cobaan merokok dan narkoba.
37	Guru bahasa Inggris	dari luar negeri	Mengajari	pegawai perusahaan	sebelum mereka berangkat ke Inggris.
38	Pendidik	di institut seni itu	Melatih	pelajarnya	dengan cara visualisasi sebelum menggambar.
39	Atlet	dari Indonesia	Mempelajari	olahragawan lain	sebelum bertanding.
40	Peneliti	dari universitas itu	Mengamati	para siswa	dengan seksama.
			PAS-REV		
41	perampok	di jalanan.	Ditembak	Polisi	dari dalam mobil itu
42	adik	setelah mandi	Dikeringkan	Kakak	di rumah saya
43	serigala	di hutan itu	Dimakan	Singa	setelah tertangkap.
44	kakak	sebelum berangkat	Dipeluk	Adik	di bandara
45	kakak	setiap hari	Didorong	Adik	di taman bermain
46	adik	tahun lalu.	dilukis	Wanita	dari rumah sebelah
47	kakak	di kantor	Dipotret	Wartawan	dari stasiun TV
48	bapak	setiap hari.	Ditelpo	Ibu	dari luar negeri

			n		
49	rekan saya	di kantor	Dihapus	Manajer	dari daftar penerima bonus.
50	Adik	setiap hari	Disisir	Ibu	setelah mandi.
51	Pasien	di rumah sakit	Disuntik	Perawat	tiga kali sehari.
52	adik	sebelum berangkat	Dicium	Ibu	di stasiun kereta.
53	satpam	di mal	Diikat	Penculik	di lantai dasar.
54	kakak	saat tampil di panggung	Ditonton	Keluarga	dari luar kota
55	Teman	dari sekolah	Ditarik	Adik	saat jalan-jalan.
56	pria itu	saat jalan pulang	dipukul	penjahat	pada malam hari.
57	ibunya	ke mana-mana	Diikuti	Anak itu	sejak dulu.
58	Adik	setiap kali bertemu.	Dikelitiki	Teman Budi	dari daerah
59	kakak	dari tadi	Dipanggil	Ibu	untuk makan siang
60	adiknya	seringkali	Dikagetkan	Teman saya	pada sore hari.
61	para siswa	di sekolah	Diperingatkan	Guru	untuk tidak menyontek.
62	pencuri	di dalam komplek	Dilihat	Satpam	saat sedang mengendap-ngendap
63	mahasiswa	di kur universitas	Didengar	para dosen	saat menyanyi.
64	pengunjung	di museum	Dibantu	Pemandu	untuk memahami sejarah museum itu.
65	anak kecil	di pantai itu	Diselamatkan	Turis	dari serangan ikan hiu.
66	Anak kecil	di lapangan sekolah	Digendong	Seorang pria	saat pulang.
67	dokter	di klinik	Disuntik	Perawat	untuk vaksinasi.
68	temannya	dari kelas sebelah	Digambar	Siswi seni lukis	saat ia tertidur.
69	temannya	dengan tidak sengaja	Ditendang	Anak itu	saat bermain
70	anjing	di pinggir jalan	Digigit	Tikus itu	pada malam hari.
71	kelinci	di rumah	Dijilat	Anjing itu	pada siang hari.
72	anjing	di toko hewan	Dicakar	Kucing liar	saat jalan keluar.
73	ayah	saat ulang tahun	Dihadiahi	Kolega	dari kantor
74	pasien	rumah sakit jiwa	Dipahami	Psikolog	saat ia bercerita.
75	para pettingi negara	dari berbagai distrik	Dijaga	Polisi	saat berangkat ke bandar udara.

76	Siswa	setiap hari	Dilindungi	Guru konseling	dari cobaan merokok dan narkoba.
77	pegawai perusahaan	dari luar negeri	Diajari	Guru bahasa Inggris	sebelum mereka berangkat ke Inggris.
78	Pelajar	di institut seni itu	Dilatih	Pendidik	untuk memahami karya seni.
79	Olahragawan	dari Indonesia itu	Dipelajari	Atlet	dari luar negeri.
80	Para siswa	dari universitas itu	Diamati	Peneliti	dengan seksama.
			ACT-IRR		
81	Pemburu	dari dalam mobil itu	Menembak	rusa	di hutan.
82	Kakak	di rumah saya	Mengeringkan	baju	setelah makan siang.
83	Singa	di hutan itu	Memakan	kelinci	setelah memburunya.
84	Adik	di bandara	Memeluk	bonekanya	sebelum ia berangkat.
85	Adik	dari tadi	Mendorong	sepedanya	saat pulang dari sekolah.
86	Guru	dari kelas seni	Melukis	patung	di museum.
87	Wartawan	dari stasiun TV	Memotret	tupai itu	di taman kota.
88	Ibu	dari luar negeri	Menelpon	bapak	setiap hari.
89	Manajer	di kantor	Menghapus	papan pengumuman	setiap minggu
90	Ibu	setiap hari	Menyisir	rambut adik	setelah ia mandi.
91	Perawat	di rumah sakit hewan	Menyuntik	kucing itu	tiga kali sehari.
92	Ibu	bersama dengan bapak	Menciu m	anjing peliharaan kami	sebelum mereka berangkat.
93	Penjual	di pasar	Mengikat	barang-barangnya	ke gerobak sebelum jualan.
94	Keluarga	dari luar kota	Menonton	film	di bioskop
95	Adik	dengan semangat	Menarik	mainannya	saat diajak jalan-jalan.
96	Penjahat	dengan beringas	Memukul	anjing itu	di lapangan rumah.
97	Anak-anak	dari dulu	Mengikuti	serial TV	tentang detektif.
98	Teman	dari daerah	Menggelitiki	hamster kami	setiap kali melihatnya.
99	Ibu	dari tadi	Memanggil	binatang peliharaan kami	untuk makan.

100	Teman saya	seringkali	Mengagetkan	kodok	di sawah.
101	Polisi itu	dengan tegas	Memperingatkan	anjing pelacak	untuk tidak berkelakuan nakal.
102	Satpam	di komplek	Melihat	sepeda motor itu	sebelum hilang.
103	Dosen	di universitas itu	Mendengar	suara trompet	dari lapangan upacara.
104	Perawat	di rumah sakit hewan	Membantu	binatang-binatang itu	agar tenang saat diberikan obat.
105	Turis	di pantai itu	Menyelamatkan	perlengkapan berselancar	saat hampir terbawa arus.
106	Pria	di lapangan sekolah	Menggendong	banyak tas	saat menjemput anaknya.
107	Dokter hewan	dari rumah sebelah	Menyuntik	kelinci kami	setiap tahun.
108	Siswi seni lukis	dari kelas sebelah	Menggambar	gunung Alpen	saat ia berwisata ke Austria.
109	Siswa	di lapangan sekolah itu	Menendang	bola	sekeras mungkin.
110	Kelinci kami	setiap hari	Menggigit	kabel-kabel	di rumah.
111	Anjing	di rumah selalu	Menjilat	kaki pengunjung	pada pagi hari.
112	Kucing	di jalanan	Mencakar	pohon itu	hingga banyak bekas cakaran.
113	Kolega	dari kantor	Menghadiahi	burung kakatua miliknya	saat ia ulang tahun.
114	Psikolog	dari rumah sakit	Memahami	halusinasi pasien	sebagai gejala gangguan mental.
115	Polisi	dari kota ini	menjaga	mobil-mobil petinggi negara	di parkiran.
116	Adik	di rumah	Melindungi	mainan-mainannya	dari pengunjung yang ingin ikut bermain.
117	Ibu	dua kali sehari	Mengajari	anjing peliharaan kami	agar tidak menggonggong pada pengunjung.
118	Para peternak kuda	di daerah	Melatih	kuda	setiap hari.
119	Peneliti	dari Indonesia	Mempelajari	perilaku monyet	di laboratorium.
120	Mahasiswa	dari universitas itu	Mengamati	siklus air	di hutan hujan tropis.
			PAS-IRR		
121	rusa	di hutan.	Ditembak	Pemburu	dari dalam mobil itu

122	baju	di rumah saya	Dikeringkan	Kakak	setelah makan siang.
123	kelinci	di hutan itu	Dimakan	Singa	setelah ditangkapnya.
124	Boneka itu	kemarin sore	Dipeluk	Adik	di bandara sebelum ia berangkat.
125	Sepeda itu	dari tadi	Didorong	Adik	saat pulang dari sekolah.
126	patung	di museum.	Dilukis	Guru	dari kelas seni
127	tupai	di taman kota.	Dipotret	Wartawan	dari stasiun TV
128	Telepon bapak	setiap hari.	Ditelpon	Ibu	dari luar negeri
129	papan pengumuman	setiap minggu	Dihapus	Manajer	di kantor
130	rambut adik	setiap hari	Disisir	Ibu	setelah mandi.
131	kucing	di rumah sakit hewan	Disuntik	Perawat	tiga kali sehari.
132	anjing itu	sebelum kami berangkat	Dicium	Adik	di halaman luar.
133	Barang-barang	di pasar	Diikat	Penjual	ke gerobak sebelum jualan.
134	film	di bioskop	Ditonton	Keluarga	dari luar kota
135	Mainan-mainannya	dengan semangat	Ditarik	Adik	saat diajak jalan-jalan.
136	anjing	di lapangan rumah.	dipukul	penjahat	dengan beringas
137	serial TV	tentang detektif itu	Diikuti	Anak-anak	sejak dulu
138	hamster kami	saat tidur	Dikelitiki	Teman kami	dari daerah
139	binatang peliharaan kami	dari tadi	Dipanggil	Ibu	untuk makan.
140	kodok-kodok	di sawah	Dikagetkan	Teman saya	setiap hari
141	anjing pelacak	dengan tegas	Diperingatkan	Polisi itu	untuk tidak berkelakuan nakal.
142	sepeda motor	di komplek	Dilihat	Satpam	sebelum hilang.
143	suara trompet	dari lapangan upacara.	Didengar	Dosen	di universitas itu
144	binatang-binatang	di rumah sakit hewan	Dibantu	Perawat	agar tenang saat diberikan obat.
145	perlengkapan berselancar	di pantai itu	Diselamatkan	Turis	saat hampir terbawa arus.
146	banyak tas	dari tempat duduk teman	Digendong	Pria itu	saat menjemput.

		saya			
147	kelinci kami	setiap tahun.	Disuntik	Dokter hewan	dari rumah sebelah
148	gunung Alpen	di Austria	Digambar	Siswi seni lukis	dari kelas sebelah
149	bola	di lapangan sekolah	Ditendang	Siswa itu	sekeras mungkin
150	kabel-kabel	di rumah.	Digigit	Kelinci kami	setiap hari
151	kaki para pengunjung	di rumah selalu	Dijilat	Anjing kami	pada pagi hari
152	pohon	di jalanan	Dicakar	Kucing	hingga banyak bekas cakaran.
153	burung kakatua	di rumah	Dihadiahi	ayah	saat ulang tahun.
154	Halusinasi	sebagai gejala gangguan mental.	Dipahami	Psikolog	dari rumah sakit
155	mobil-mobil petinggi negara	di parkiran.	Dijaga	Polisi	dari kota ini
156	mainan-mainannya	di rumah	Dilindungi	Adik	dari pengunjung yang ingin ikut bermain.
157	anjing peliharaan kami	beberapa kali sehari	Diajari	Ibu	agar tidak menggonggong pada pengunjung.
158	kuda	di daerah	Dilatih	Para peternak	agar kuat.
159	perilaku monyet	di laboratorium.	Dipelajari	Peneliti	dari Indonesia
160	siklus air	di hutan hujan tropis.	Diamati	Mahasiswa	dari universitas itu

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161	Kemarin malam penculik sudah menghindari serang polisi ke markas mereka.
162	Kemarin malam adikku sudah menginginkan main dari kayu itu.
163	Kemarin malam Ibu temanku sudah menjabat pimpin partai di tingkat provinsi.
164	Kemarin malam ahli komputer sudah melindungi catat medis dari serangan hacker.
165	Kemarin malam Partai Demokrat sudah memenangkan pilih umum di Indonesia.
166	Besok pagi masyarakat akan memahami ujar Presiden di rapat kabinet.
167	Besok pagi pelatih akan memaksa main untuk berlatih keras.
168	Besok pagi KPU akan memastikan hitung kursi dari hasil Pemilu.
169	Besok pagi efek krisis akan mempengaruhi dapat karyawan di pabrik kami.
170	Besok pagi Ayah akan menulis sebuah adu atas sebuah bank.

171	Saat ini dokter sedang memeriksa para lari untuk mengetes doping.
172	Saat ini para siswa sedang memikirkan jawab untuk pertanyaan tes.
173	Saat ini Indonesia sedang memproduksi makan untuk pasar ekspor.
174	Saat ini demonstran sedang memukul jabat DPR di gedung dewan.
175	Saat ini angin topan sedang merusak mukim warga di pesisir pantai.
176	Besok pagi Pak Camat akan menanggapi ucap warga tentang BLT.
177	Besok pagi kakak akan mengalahkan para saing di lomba renang.
178	Besok pagi polisi akan mengetahui tindak curang di pasar ini.
179	Besok pagi ibu akan menentukan undang untuk resepsi kakak.
180	Besok pagi bosku akan melaporkan main di bagian iklan.
181	Tadi sore adik sudah memilih halte di universitas.
182	Tadi sore anak-anak sudah menyadari kebetulan mereka.
183	Tadi sore para siswa sudah memainkan gajah di ruang kelas.
184	Besok siang marketing akan menawarkan singa kepada khalayak ramai.
185	Besok siang polisi hutan akan menangkap cacing liar untuk diproses hukum.
186	Saat ini semua siswa sedang memakai sampo dari Balai Pustaka.
187	Saat ini Kebun Binatang sedang mengurus bunga langka dari Sulawesi.
188	Besok sore partai akan memutuskan pertanyaan resmi untuk masalah rekrutmen.
189	Besok siang para siswa akan menanyakan harga pesawat kepada gurunya.
190	Tadi sore anak-anak sudah menyadari kebetulan mereka.
191	Serang para pemberontak begitu dashyat hingga pihak militer harus mundur.
192	Meneliti terbaru menunjukkan bahwa kopi baik untuk kesehatan.
193	Makan paling sedap adanya di kantin universitas itu.
194	Melihat ayah saya tidak tajam maka ia mengenakan kacamata.
195	Pimpin rapat sudah berkata untuk tidak mempermasalahkan anggaran.
196	Temu baru diciptakan oleh seorang peneliti di labnya.
197	Pakai model ini sedang banyak dijual di mall-mall.
198	Tunjuk wayang itu sangat menarik bagi rekan-rekan saya.
199	Lahir cucu disambut keluarga kami dengan meriah.
200	Panggil polisi terhadap pejabat itu akan dijawab besok pagi.

Appendix 4.2 Sentence list for ERP Experiment in English (translated)

	ACT-REV				
	NP1	**PP**	**VP**	**NP2**	**PP / adj phrase**
1	Police	from inside the car	shoot	robber	on the street.
2	Elder brother	in my house	dry	little brother	after he took a shower.
3	Lion	in that forest	eat	wolf	after hunting him.
4	Sister	at the airport	hug	brother	before he leaves.
5	Sister	in the playground	push	brother	when invited to go home.
6	Woman	from the next house	paint	sister	last year .
7	Reporter	from TV stations	take a picture	brother	in his office.
8	Mother	from overseas	call	father	every day.
9	Manager	in the office	remove	my colleague	from the list of bonus recipients.
10	Mother	every day	comb	sister	after he took a shower.
11	Nurse	in the hospital	inject	that patient	three times a day.
12	Mother	together with father	kiss	sister	at the train station.
13	Kidnapper	in the mall	bind	security	on the ground floor.
14	Family	from out of town	watch	brother	on stage.
15	Sister	with spirit	pulls	her friend	until she falls.
16	Robber	violently	hit	that man	in front of his house.
17	That boy	since a long time ago	follow	her mother	everywhere.
18	Budi's friend	from the area	tickle	his sister	every time I meet.
19	Mother	from earlier	call	brother	for lunch.
20	My Friend	with enthusiasm	surprise	his sister	at night.
21	Teacher	strictly	warn	the students	not to cheat.
22	Security	from within the complex	see	thief	sneaking
23	Lecturer	at the university	hear	college student	singing.
24	Guide	in the museum	help	visitors	to understand the history of the museum.
25	Tourist	on that beach	save	little child	from shark attacks.
26	Man	on the school grounds	carry	his friend	when going home.

27	Nurse	in the clinic	inject	doctor	for vaccination.
28	Painting students	from the next class	draw	their friend	when he falls asleep.
29	That boy	by accident	kick	his friend	when playing
30	The mouse	quickly	bite	dog	on the roadside.
31	Dog	always at home	lick	the rabbit	at noon.
32	Wild cat	viciously	scratch	dog	in our house
33	Colleague	from the office	reward	father	when it's birthday.
34	Psychologist	from the hospital	understand	patient	when he told stories.
35	Police	from various districts	guard	state officials	when leaving for the airport.
36	The teacher	every day	protect	student	from the temptation of smoking and drugs.
37	English teacher	from abroad	teach	company employee	before they left for England.
38	Educator	at the art institute	train	student	by visualizing before drawing.
39	Athlete	from Indonesia	learn (about)	other sportsmen	before competing.
40	Researcher	from the university	observe	the students	carefully.
			PAS-REV		
41	Robber	on the street	was shot	by the police	from inside the car
42	Little brother	after taking a bath	was dried	by the older brother	in my house
43	Wolf	in that forest	was eaten	by the lion	after being caught.
44	Brother	before leaving	was hugged	by the sister	at the airport
45	Brother	every day	was pushed	by the sister	in the playground
46	Sister	last year	was painted	by the woman	from the next house
47	Brother	in the office	was photographed	by the reporter	from TV stations
48	Father	every day	was called	by the mother	from abroad
49	My Colleague	in the office	was deleted	by the manager	from the list of bonus recipients.
50	Sister	every day	was combed	by the mother	after taking a shower.
51	Patient	in the hospital	was injected	by the nurse	three times a day.
52	Sister	before leaving	was kissed	by the mother	at the train station.

53	Security staff	in the mall	was tied	by the kidnapper	on the ground floor.
54	Brother	when performing on stage	was watched	by the family	from out of town
55	Friend	from school	was pulled	by the sister	when walking.
56	That Man	when you go home	was beaten	by the criminals	at night.
57	Her Mother	everywhere	was followed	by the boy	long time ago
58	Sister	every time I meet.	was checked	by budi's friend	from the area
59	Brother	from earlier	was called	by the mother	for lunch
60	His Sister	often	was surprised	by the friend	in the afternoon.
61	The Students	in school	was warned	by the teacher	not to cheat.
62	Thief	inside the complex	was seen	by the security	while sneaking around.
63	College Student	at university	was heard	by the lecturers	when singing.
64	Visitors	in the museum	was helped	by the guide	to understand the history of the museum.
65	Little Child	on that beach	was saved	by the tourist	from shark attacks.
66	Little Child	on the school grounds	was carried	by the a man	when going home.
67	Doctor	in the clinic	was injected	by the nurse	for vaccination.
68	Her Friend	from the next class	was drawn	by the painting students	when he falls asleep.
69	Her Friend	by accident	was kicked	by the boy	when playing
70	Dog	road side	was bitten	by the mouse	at night.
71	Rabbit	at home	was licked	by the dog	at noon.
72	Dog	in a pet shop	was clawed	by the wild cat	when the exit.
73	Father	on his birthday	was rewarded	by the colleague	from the office
74	Patient	from psychiatric hospital	was understood	by the psychologist	when he told stories.
75	State officials	from various districts	was guarded	by the police	when leaving for the airport.
76	Student	every day	was protected	by the counseling	from the trials of smoking and drugs.

				teacher	
77	Company Employee	from abroad	was taught	by the english teacher	before they left for England.
78	Student	at the art institute	was trained	by the educator	to understand artwork.
79	Sportsman	from Indonesia	was learned (about)	by the athlete	from abroad.
80	Students	from the university	was observed	by the researcher	carefully.
			ACT-IRR		
81	Hunter	from inside the car	shoot	deer	in the forest.
82	Brother	in my house	dry out	clothes	after lunch.
83	Lion	in that forest	eat	rabbit	after hunting him.
84	Sister	at the airport	hug	the doll	before she leaves.
85	Sister	from earlier	push	bicycle	when coming home from school.
86	Teacher	from art classes	paint	statue	in the museum.
87	Reporter	from a TV station	photograph	the squirrel	in the city park.
88	Mother	from abroad	call	father	every day.
89	Manager	in the office	remove	bulletin board	every week
90	Mother	every day	comb	sister's hair	after she took a shower.
91	Nurse	in animal hospitals	inject	the cat	three times a day
92	Mother	together with father	kiss	our pet dog	before they leave.
93	Seller	in the market	bind	the items	to the cart before selling.
94	Family	from out of town	watch	film	in the cinema
95	Sister	with enthusiasm	pull	the toy	when invited to take a walk.
96	Criminals	violently	hit	the dog	at home.
97	Children	since a long time ago	follow	tv series	about detective.
98	Friend	from the area	tickle	our hamster	every time you see it.
99	Mother	from earlier	call	our pet	to eat.
100	My friend	often	surprise	frogs	in the rice fields.
101	The police officer	strictly	warn	sniffer dogs	not to behave badly.
102	Security	in the complex	look	the	before it's gone.

				motorcycle	
103	Lecturer	at the university	hear	trumpet sound	from the field.
104	Nurse	in animal hospitals	help	the animals	to be calm when given medication.
105	Tourist	on that beach	save	surfing equipment	when almost carried away by the current.
106	Man	on the school grounds	hold	lots of bags	when picking up his child.
107	Veterinarian	from the house next door	inject	our rabbit	every year.
108	Painting students	from the next class	draw	alpine mountain	when they traveled to Austria.
109	Student	on the school grounds	kick	ball	as hard as possible.
110	Our rabbit	every day	bite	cables	at home.
111	Dog	always at home	lick	visitor's feet	in the morning.
112	Cat	on the street	scratch	the tree	till there are many scratch marks.
113	Colleague	from the office	reward	his parrot	on its birthday.
114	Psychologist	from the hospital	understand	hallucinations	as a symptom of mental disorders.
115	Police	from this city	guard	state officials' cars	in parking.
116	Sister	at home	protect	the toys	from visitors who want to play.
117	Mother	twice a day	teach	our pet dog	not to bark at visitors.
118	Horse breeders	in the area	train	horse	every day.
119	Researcher	from Indonesia	learn	monkey behavior	in the laboratory.
120	College student	from the university	observe	water cycle	in tropical rainforests.
			PAS-IRR		
121	Deer	in the forest	was shot	by the hunter	from inside the car
122	Clothes	in my house	was dried	by the brother	after lunch.
123	Rabbit	in that forest	was eaten	by the lion	after he was caught.
124	The doll	yesterday afternoon	was hugged	by the sister	at the airport before she leaves.
125	The bike	from earlier	was pushed	by the sister	when coming home from school.
126	Statue	in the museum	was painted	by the teacher	from art classes

127	Squirrel	in the city park	was photographed	by the reporter	from TV stations
128	Father's phone	every day	was called	by the mother	from abroad
129	Bulletin board	every week	was deleted	by the manager	in the office
130	Sister's hair	every day	was combed	by the mother	after taking a shower.
131	Cat	in animal hospitals	was injected	by the nurse	three times a day.
132	The dog	before we leave	was kissed	by the sister	in the outer yard.
133	Goods	in the market	was tied	by the seller	to the cart before selling.
134	Film	in the cinema	was watched	by the family	from out of town
135	The toys	with enthusiasm	was pulled	by the sister	when invited to take a walk.
136	Dog	at home	was beaten	by the criminals	violently
137	TV Series	about the detective	was followed	by the children	since a long time ago
138	Our hamster	when sleeping	was tickled	by the friend	from the area
139	Our pet	from earlier	was called	by the mother	to eat.
140	Frogs	in the rice field	was surprised	by the friend	every day
141	Sniffer dog	strictly	was warned	by the police officer	not to behave badly.
142	Motorcycle	in the complex	was seen	by the security	before it's stolen.
143	Trumpet sound	from the ceremony field.	was heard	by the lecturer	at the university
144	Animals	in animal hospitals	was helped	by the nurse	to be calm when given medication.
145	Surfing equipment	on that beach	was saved	by the tourist	when almost carried away by the current.
146	Lots of bags	from my friend's seat	was carried	by the man	when picking us up.
147	Our rabbit	every year	was injected	by the veterinarian	from the next house
148	Alpine Mountain	in Austria	was drawn	by the painting students	from the next class
149	Ball	on the school grounds	was kicked	by the student	as hard as possible
150	Cables	at home	was bitten	by the rabbit	every day
151	The legs of the	at home	was licked	by the dog	in the morning

	visitors				
152	Tree	on the street	was clawed	by the cat	to many scratches.
153	Parrots	at home	was rewarded	by the father	when it's birthday.
154	Hallucinations	as a symptom of mental disorders	was understood	by the psychologist	from the hospital
155	State officials' cars	in parking	was guarded	by the police	from this city
156	The toys	at home	was protected	by the sister	from visitors who want to play.
157	Our pet dog	several times a day	was taught	by the mother	so as not to bark at visitors.
158	Horse	in the area	was trained	by the farmers	to be strong.
159	Monkey behavior	in the laboratory	was learned (about)	by the researcher	from Indonesia
160	Water cycle	in tropical rainforests.	was observed	by the college student	from the university

FILLERS

161	Last night the kidnappers had avoided the police attack on their headquarters.
162	Yesterday night my sister wanted to play in the woods.
163	Last night my friend's mother had served as the party leader at the provincial level.
164	Last night computer experts protected medical records from hacker attacks.
165	Last night the Democratic Party won the general election in Indonesia.
166	Tomorrow morning the community will understand the President's words in a cabinet meeting.
167	Tomorrow morning the coach will force to play hard.
168	Tomorrow morning the General Election Committee will make sure to count the seats from the election results.
169	Tomorrow morning the effects of the crisis will affect employees in our factory.
170	Tomorrow morning my father will write a complaint over a bank.
171	Currently the doctor is examining the runners to test for doping.
172	Currently students are thinking about answering the test questions.
173	Currently Indonesia is producing food for the export market.
174	At present the demonstrators are hitting the House of Representatives members in the council building.
175	At present, hurricanes are damaging the residents of the coast.
176	Tomorrow morning the sub-district head will respond to residents about Government cash aid.
177	Tomorrow morning brother will beat the rivals in the swimming competition.

178	Tomorrow morning the police will find out the cheating in this market.
179	Tomorrow morning the mother will determine the invitation for the older sister's reception.
180	Tomorrow morning my boss will report the ads in the advertisement section.
181	Last afternoon the sister had chosen a bus stop at the university.
182	Last afternoon the children were aware of their coincidence.
183	Last afternoon the students had played elephants in the classroom.
184	Tomorrow afternoon marketing will offer lions to the public.
185	Tomorrow afternoon the forest police will catch wild worms for legal processing.
186	Currently all students are wearing shampoo from a state publisher.
187	Currently the Zoo is taking care of rare flowers from Sulawesi.
188	Tomorrow afternoon the party will decide the official question for recruitment issues.
189	Tomorrow afternoon the students will ask the teacher for the price of the plane.
190	This afternoon the children realized their coincidence.
191	The attack of the rebels was so fierce that the military had to retreat.
192	Recent research shows that coffee is good for health.
193	The most delicious meal in the university cafeteria.
194	Seeing my father wasn't sharp, he wore glasses.
195	Lead the meeting said not to question the budget.
196	The new meeting was created by a researcher in his lab.
197	Use this model is being sold in many malls.
198	The puppet show was very interesting for my colleagues.
199	Born grandchildren welcomed our family with great excitement.
200	Call the police to the official will be answered tomorrow morning.

References

Abuom, T. O., & Bastiaanse, R. (2013). Production and comprehension of reference of time in Swahili–English bilingual agrammatic speakers. *Aphasiology*, *27*(2), 157–177. https://doi.org/10.1080/02687038.2012.699632

Abuom, T. O., Shah, E., & Bastiaanse, R. (2013). Sentence comprehension in Swahili–English bilingual agrammatic speakers. *Clinical Linguistics & Phonetics*, *27*(5), 355–370. https://doi.org/10.3109/02699206.2013.775346

Anjarningsih, H. Y., Haryadi-Soebadi, R. D., Gofir, A., & Bastiaanse, R. (2012). Characterising agrammatism in Standard Indonesian. *Aphasiology*, *26*(6), 757–784. https://doi.org/10.1080/02687038.2011.648370

Bastiaanse, R., Bouma, G., & Post, W. (2009). Linguistic complexity and frequency in agrammatic speech production. *Brain and Language*, *109*(1), 18–28. https://doi.org/10.1016/j.bandl.2008.12.004

Bastiaanse, R., & Edwards, S. (2004). Word order and finiteness in Dutch and English Broca's and Wernicke's aphasia. *Brain and Language*, *89*(1), 91–107. https://doi.org/10.1016/S0093-934X(03)00306-7

Bastiaanse, R., Edwards, S., Maas, E., & Rispens, J. (2003). Assessing comprehension and production of verbs and sentences: The Verb and Sentence Test (VAST). *Aphasiology*, *17*(1), 49–73. https://doi.org/10.1080/729254890

Bastiaanse, R. & Jonkers, R. (1998). Verb retrieval in action naming and spontaneous speech in agrammatic and anomic aphasia. *Aphasiology*, *12*, 99–117.

Bastiaanse, R., Hugen, J., Kos, M., & van Zonneveld, R. (2002). Lexical, morphological, and syntactic aspects of verb production in agrammatic aphasics. *Brain and Language*, *80*(2), 142–159. https://doi.org/10.1006/brln.2001.2585

Bastiaanse, R., & Thompson, C. K. (2003). Verb and auxiliary movement in agrammatic Broca's aphasia. *Brain and Language*, *84*(2), 286–305. https://doi.org/10.1016/S0093-934X(02)00553-9

Bastiaanse, R., & van Zonneveld, R. (2005). Sentence production with verbs of alternating transitivity in agrammatic Broca's aphasia. *Journal of Neurolinguistics*, *18*(1), 57–66. https://doi.org/10.1016/j.jneuroling.2004.11.006

Bastiaanse, R., & Van Zonneveld, R. (2006). Comprehension of passives in Broca's aphasia. *Brain and Language*, 96,135–142. https://doi.org/10.1016/j.bandl.2005.06.012

Benedet, M. J., Christiansen, J. A., & Goodglass, H. (1998). A Cross-Linguistic Study of Grammatical Morphology in Spanish- and English-Speaking Agrammatic Patients*. *Cortex*, *34*(3), 309–336. https://doi.org/10.1016/S0010-9452(08)70758-5

Brysbaert, M., & Ellis, A. W. (2016). Aphasia and age of acquisition: are early-learned words more resilient? *Aphasiology*, *30*(11), 1240–1263. https://doi.org/10.1080/02687038.2015.1106439

Bornkessel, I., Schlesewsky, M., & Friederici, A. D. (2002). Grammar overrides frequency: Evidence from the online processing of flexible word order. *Cognition*, *85*, B21-B30.

Bornkessel-Schlesewsky, I., & Schlesewsky, M. (2008). An alternative perspective on "semantic P600" effects in language comprehension. *Brain research reviews*, *59*(1), 55-73.

Burchert, F., De Bleser, R., & Sonntag, K. (2003). Does morphology make the difference? Agrammatic sentence comprehension in German. *Brain and Language, 87*, 323–342.

Burchert, F., Hanne, S., & Vasishth, S. (2013). Sentence comprehension disorders in aphasia: The concept of chance performance revisited. *Aphasiology*, *27*(1), 112-125.

Burchert, F., Meißner, N., & Bleser, R. D. (2008). Production of non-canonical sentences in agrammatic aphasia: Limits in representation or rule application? *Brain and Language*, *104*(2), 170–179. https://doi.org/10.1016/j.bandl.2007.06.004

Caplan, D., & Hanna, J. E. (1998). Sentence Production by Aphasic Patients in a Constrained Task. *Brain and Language*, *63*(2), 184–218. https://doi.org/10.1006/brln.1998.1930

Caplan, D., & Futter, C. (1986). Assignment of thematic roles to nouns in sentence comprehension by an agrammatic patient. *Brain and Language*, *27*, 117-134.

Caramazza, A., & Zurif, E. B. (1976). Dissociation of algorithmic and heuristic processes in language comprehension: Evidence from aphasia. *Brain and Language, 3,* 572–582.

Chomsky, N. (1981). *Lectures on Government and Binding,* Foris, Dordrecht.

Cho, S., & Thompson, C. K. (2010). What goes wrong during passive sentence production in agrammatic aphasia: An eyetracking study. *Aphasiology*, *24*(12), 1576-1592.Cole, P., & Hermon, G. (2008). Malay/Indonesian syntax from an Austronesian perspective: an introduction. *Lingua*, 118, 1431-1439.

Chung, S. (2008). Indonesian clause structure from an Austronesian perspective. *Lingua*, *118*, 1554-1582.

Cole, P., & Hermon, G. (2008). Malay/Indonesian syntax from an Austronesian perspective: an introduction. *Lingua*, 118, 1431-1439.

Cumming, S., & Wouk, F. (1987). Is there 'discourse ergativity' in Austronesian languages?. *Lingua*, *71*, 271-296.

Dharmaperwira-Prins, R. (1996). *Tes Afasia untuk Diagnosis, Informasi, dan Rehabilitasi*. Jakarta: Balai Penerbit Fakultas Kedokteran Universitas Indonesia.

Duman, T. Y, Ozgirgin, N., Altinok, N., & Bastiaanse, R. (2011). Sentence comprehension in Turkish Broca's aphasia: An integration problem. *Aphasiology*, *25*, 908–926.

Englebretson, R. (2008). From subordinate clause to noun-phrase: yang constructions in colloquial Indonesian. *Crosslinguistic studies of clause combining: The multifunctionality of conjunctions*, 1-33.

Erdocia, K., Laka, I., Mestres-Missé, A., & Rodriguez-Fornells, A. (2009). Syntactic complexity and ambiguity resolution in a free word order language: Behavioral and electrophysiological evidences from Basque. *Brain and language*, *109*, 1-17.

Ewing, M.C., & Cumming, S. (1998). Relative clauses in Indonesian discourse: Face to face and cyberspace interaction. In *Papers from the Fifth Annual Meeting of the Southeast Asian Linguistics Society,* S.L. Chelliah & W.J. de Reuse (Eds), 79-96. Tempe AZ: Arizona State University.

Faroqi-Shah, Y., & Thompson, C. K. (2003). Effect of lexical cues on the production of active and passive sentences in Broca's and Wernicke's aphasia. *Brain and Language*, *85*(3), 409-426.

Ferreira, F. (2003). The misinterpretation of noncanonical sentences. *Cognitive Psychology*, *47*, 164-203.

Friederici, A. D., Hahne, A., & Mecklinger, A. (1996). Temporal structure of syntactic parsing: early and late event-related brain potential effects. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*, 1219.

Friederici, A. D., Wang, Y., Herrmann, C. S., Maess, B., & Oertel, U. (2000). Localization of early syntactic processes in frontal and temporal cortical areas: a magnetoencephalographic study. *Human brain mapping*, *11*, 1-11.

Gahl, S. (2002). Lexical biases in aphasic sentence comprehension: An experimental and corpus linguistic study. *Aphasiology*, *16*(12), 1173–1198. https://doi.org/10.1080/02687030244000428

Gahl, S., & Menn, L. (2016). Usage-based approaches to aphasia. *Aphasiology*, *30*(11), 1361–1377. https://doi.org/10.1080/02687038.2016.1140120

Gahl, S., Menn, L., Ramsberger, G., Jurafsky, D. S., Elder, E., Rewega, M., & Holland Audrey, L. (2003). Syntactic frame and verb bias in aphasia: Plausibility judgments of undergoer-subject sentences. *Brain and Cognition*, *53*(2), 223–228. https://doi.org/10.1016/S0278-2626(03)00114-3

Gazdar, G., Klein, E.H., Pullum, G.K., & Sag, I.A. (1985). *Generalized Phase Structure Grammar.* Harvard University Press.

Gibson, E., Sandberg, C., Fedorenko, E., Bergen, L., & Kiran, S. (2016). A rational inference approach to aphasic language comprehension. *Aphasiology*, *30*(11), 1341-1360.

Gil, D. (2006). The acquisition of voice morphology in Jakarta Indonesian. In Gagarina, N., & Gülzowm I. (Eds.) *The acquisition of verbs and their grammar: The effect of particular languages* (pp. 201-227). Springer Netherlands.

Givon, T. (1979). From Discourse to Syntax: Grammar as a Processing Strategy in Discourse and Syntax. *Syntax and Semantics Ann Arbor, Mich.*, *12*, 81–112.

Gouvea, A. C., Phillips, C., Kazanina, N., & Poeppel, D. (2010). The linguistic processes underlying the P600. *Language and cognitive processes*, *25*(2), 149-188.

Graetz, P., De Bleser, R., & Willmes, K. (1992). Akense afasietest (AAT). *Lisse, Swets, Zeitlinger*.

Grodzinsky, Y. (1990). *Theoretical perspectives on language deficits*. MIT press.

Grodzinsky, Y. (1995). A restrictive theory of agrammatic comprehension. *Brain and Language, 50*, 27–51.

Grodzinsky, Y. (2000). The neurology of syntax: Language use without Broca's area. *Behavioral and Brain Sciences, 23*, 1–71.

Grodzinsky, Y., Piñango, M.M., Zurif, E.B. & Drai, D., (1999). The critical role of group studies in neuropsychology: comprehension regularities in Broca's aphasia. *Brain and language*, 67 2, 134-47.

Hagiwara, H., Soshi, T., Ishihara, M., & Imanaka, K. (2007). A topographical study on the event-related potential correlates of scrambled word order in Japanese complex sentences. *Journal of Cognitive Neuroscience*, *19*, 175-193.

Hassall, T. (2005). Taboo Object Relative Clauses In Indonesian. Seals XV, 1.

Helmbrecht, J. (2005). Politeness distinctions in pronouns. *The World Atlas of Language Structures*, 186–190.

Hopper, P. (1983). Ergative, passive, and active in Malay narrative. In F. Klein-Andreu (Ed.). *Discourse perspectives on syntax* (pp. 67-88). New York: Academic Press.

Jap, B. A., & Arumsari, C. (2017). Adaptation of the Token Test in Standard Indonesian. *Makara Hubs-Asia*, *21*(1), 44-51.

Jap, B. A., Martinez-Ferreiro, S., & Bastiaanse, R. (2016). The effect of syntactic frequency on sentence comprehension in standard Indonesian Broca's aphasia. *Aphasiology*, *30*(11), 1325–1340. https://doi.org/10.1080/02687038.2016.1148902

Juliano, C., & Tanenhaus, M. K. (1994). A constraint-based lexicalist account of the subject/object attachment preference. *Journal of Psycholinguistic Research*, *23*, 459-471.

Kaplan, R. M., & Bresnan, J. (1982). Lexical-functional grammar: A formal system for grammatical representation. *Formal Issues in Lexical-Functional Grammar*, 29-130.Postman, W. A. (2004). Processing of complex sentences in a case of aphasia in Indonesian: Thematic vs. linear strategies. *Journal of Neurolinguistics*, *17*, 455-489.

Kaswanti-Purwo, B. (1988). Voice in Indonesian: A discourse study. *Passive and voice*, *16*, 195.

Kaswanti Purwo, B. (1991). Perkembangan bahasa anak: Pragmatik dan tata bahasa. In S. Dardjowidjojo (Ed.),PELLBA 4(pp. 157–202). Jakarta: Penerbit Kanisius.

Lewis, M. P., Simons, G. F., and Fennig, C. D.(Eds.). (2013). *Ethnologue: Languages of the world: Seventeenth edition*. Dallas, Texas: SIL International. Online version: http://www.ethnologue.com.

Kim, M., & Thompson, C. K. (2000). Patterns of Comprehension and Production of Nouns and Verbs in Agrammatism: Implications for Lexical Organization. *Brain and Language*, *74*(1), 1–25. https://doi.org/10.1006/brln.2000.2315

King, J., & Just, M. A. (1991). Individual differences in syntactic processing: The role of working memory. *Journal of memory and language*, *30*, 580-602.

King, J. W., & Kutas, M. (1995). Who did what and when? Using word-and clause-level ERPs to monitor working memory usage in reading. *Cognitive Neuroscience, Journal of*, *7*, 376-395.

Kutas, M., & Federmeier, K. D. (2000). Electrophysiology reveals semantic memory use in language comprehension. *Trends in cognitive sciences*, *4*, 463-470.

Kutas, M., & Hillyard, S. A. (1980). Event-related brain potentials to semantically inappropriate and surprisingly large words. *Biological psychology*, *11*, 99-116.

Lewis, M. P., Simons, G. F., and Fennig, C. D.(Eds.). (2013). *Ethnologue: Languages of the world: Seventeenth edition*. Dallas, Texas: SIL International. Online version: http://www.ethnologue.com.

MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). The lexical nature of syntactic ambiguity resolution. *Psychological Review*, *101*, 676.

MacWhinney, B. (1987). The competition model. *Mechanisms of Language Acquisition*, In MacWhinney, B (Ed.), *Mechanisms of language acquisition* (pp. *249-308*). Hillsdale, NJ: Lawrence Erlbaum.

Matzke, M., Mai, H., Nager, W., Rüsseler, J., & Münte, T. (2002). The costs of freedom: an ERP–study of non-canonical sentences. *Clinical Neurophysiology*, *113*, 844-852.

Maviş, I., Arslan, S., & Aydin, Ö. (2019). Comprehension of word order in Turkish aphasia. *Aphasiology*, 1-17.

McCune, K. (1979). Passive function and the Indonesian passive. *Oceanic Linguistics*, 119-169.

Meltzer, J. A., & Braun, A. R. (2013). P600-like positivity and left anterior negativity responses are elicited by semantic reversibility in nonanomalous sentences. *Journal of neurolinguistics*, *26*, 129-148.

Menn, L., Reilly, K. F., Hayashi, M., Kamio, A., Fujita, I., & Sasanuma, S. (1998). The Interaction of Preserved Pragmatics and Impaired Syntax in Japanese and English Aphasic Speech. *Brain and Language*, *61*(2), 183–225. https://doi.org/10.1006/brln.1997.1838

Mistica, M., Andrews, A., Arka, I. W., & Baldwin, T. (2009, December). Double Double, Morphology and Trouble: Looking into Reduplication in Indonesian. In *Australasian Language Technology Association Workshop 2009* (p. 44).

Mitchell, D.C. (*1994*). *Sentence parsing. In* Gernsbacher, M. (Ed.), *Handbook of Psycholinguistics* (pp. *375-409*). New York: Academic Press.

Mitchell, D. C., Cuetos, F., Corley, M. M., & Brysbaert, M. (1995). Exposure-based models of human parsing: Evidence for the use of coarse-grained (nonlexical) statistical records. *Journal of Psycholinguistic Research*, *24*, 469-488.

Müller, H. M., King, J. W., & Kutas, M. (1997). Event-related potentials elicited by spoken relative clauses. *Cognitive Brain Research*, *5*, 193-203.

Nelson, G. (1997). Cleft constructions in spoken and written English. *Journal of English Linguistics*, *25*, 340-348.

Nichols, J. & Bickel, B. (2013). Locus of Marking: Whole-language Typology. In: Dryer, Matthew S. & Haspelmath, Martin (eds.) The World Atlas of Language Structures.

Nomoto, H. (2010). Making sense of the optionality of voice marking in Malay/Indonesian. In *Proceedings of workshop on Indonesian-type voice system* (pp. 37-44).

Osterhout, L., & Mobley, L. A. (1995). Event-related brain potentials elicited by failure to agree. *Journal of Memory and language*, *34*, 739-773.

Postman, W. A. (2002). Thematic role assignment in Indonesian: A case study of agrammatic aphasia (Doctoral Dissertation). Cornell University.

Postman, W. A. (2004). Processing of complex sentences in a case of aphasia in Indonesian: thematic vs. linear strategies. *Journal of Neurolinguistics*, *17*(6), 455–489. https://doi.org/10.1016/j.jneuroling.2004.09.001

Postman, W. A. (2011). Some critical concerns for adapting the Bilingual Aphasia Test to Bahasa Indonesia. *Clinical linguistics & phonetics, 25,* 619-627.

Rafferty, E. (1982). *Discourse structures of the Chinese Indonesian of Malang*. Jakarta: University Atma Jaya.

Randriamasimanana, C. (1999). The Malayo-Polynesian Origins of Malagasy. In Neile A. Kirk & Paul J. Sidwell (ed), *From Neanderthal to Easter Island: A tribute to, and a celebration of the work of W. Wilfried Shuhmacher Presented on the occasion of his 60th birthday*. AHL Studies in the Science & History of Language 2, Volume 2., (pp. 26-43]. Melbourne, Australia.

Reali, F., & Christiansen, M. H. (2007). Processing of relative clauses is made easier by frequency of occurrence. *Journal of Memory and Language*, *57*(1), 1-23.

Roland, D., Dick, F., & Elman, J. L. (2007). Frequency of basic English grammatical structures: A corpus analysis. *Journal of Memory and Language*, *57*(3), 348–379. https://doi.org/10.1016/j.jml.2007.03.002

Saffran, E.M., Berndt, R.S., Schwartz, M.F. (1989). The quantitative analysis of agrammatic production: Procedure and data. *Brain and Language, 37*, 440-479.

Schlesewsky, M., Bornkessel, I., & Frisch, S. (2003). The neurophysiological basis of word order variations in German. *Brain and Language*, *86*, 116-128.

Schwartz, M. F., Linebarger, M. C., Saffran, E. M., & Pate, D. S. (1987). Syntactic transparency and sentence interpretation in aphasia. *Language and Cognitive Processes*, *2*, 85-113.

Sinnemäki, K. (2010). Word order in zero-marking languages. *Studies in Language. International Journal Sponsored by the Foundation "Foundations of Language," 34*(4), 869–912. https://doi.org/10.1075/sl.34.4.04sin

Slobin, D. I., & Bever, T. G. (1982). Children use canonical sentence schemas: A crosslinguistic study of word order and inflections. Cognition, 12(3), 229–265.

Sneddon, J. N. (1996). *Indonesian: A comprehensive grammar*. London: Routledge.

Stack, M. (2005). Word order and intonation in Indonesian. *LSO Working Papers in Linguistics 5: Proceedings of WIGL*. 168-182.

Steinhauer, K. (2013). The DOs and DON'Ts in psycholinguistic ERP research. *Neurophysiologie Clinique/Clinical Neurophysiology*, *1*, 69.

St John M. F., Gernsbacher M. A. (1998). Learning and losing syntax: Practice makes perfect and frequency builds fortitude. In: Healy AF, Bourne LE Jr, (Eds.). *Foreign language learning: Psycholinguistic studies on training and retention*. Mahwah, NJ, USA: Lawrence Erlbaum Associates, Incorporated. pp. 231–255.

Suwarso, S. (1994). *Struktur kalimat pasif dalam Bahasa Melayu Klasik*. Unpublished research report, University of Indonesia, Depok, Indonesia.

Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: Evidence from eye movements. *Journal of Memory and Language*, *47*, 69-90.

Trueswell, J., & Tanenhaus, M. (1994). Toward a lexical framework of constraint-based syntactic ambiguity resolution. In Clifton, C., Frazier, L. & Rayner, K. (Eds.) *Perspectives on sentence processing* [pp. 155-179]. Hillsdale, NJ: Erlbaum.

Veale, J. F. (2014). Edinburgh Handedness Inventory–Short Form: a revised version based on confirmatory factor analysis. *Laterality: Asymmetries of Body, Brain and Cognition*, *19*, 164-177.

Verhaar, J. W. (1978). Some notes on the verbal passive in Indonesian.*NUSA: Linguistic Studies in Indonesian and Languages in Indonesia*, *6*, 11-19.

Verhoeven, E. (2015). Thematic asymmetries do matter! A corpus study of German word order. *Journal of Germanic Linguistics*, *27*(1), 45-104.

Weber, A., & Müller, K. (2004, August). Word order variation in German main clauses: A corpus analysis. In *Proceedings of the 20th International conference on Computational Linguistics* (pp. 71-77).

Wolff, S., Schlesewsky, M., Hirotani, M., & Bornkessel-Schlesewsky, I. (2008). The neural mechanisms of word order processing revisited: Electrophysiological evidence from Japanese. *Brain and language*, *107*, 133-157.

Wouk, F. (1996). Voice in Indonesian Discourse and its Implications for Theories of the Development of Ergativity. *Studies in Language. International Journal Sponsored by the Foundation "Foundations of Language," 20*(2), 361–410. https://doi.org/10.1075/sl.20.2.05wou

Yarbay Duman, T., Altınok, N., Özgirgin, N., & Bastiaanse, R. (2011). Sentence comprehension in Turkish Broca's aphasia: An integration problem. *Aphasiology*, *25*(8), 908–926. https://doi.org/10.1080/02687038.2010.550629

Summary

Parsing a sentence demands a level of cognitive processing depending upon several factors, one of them being the word order that the sentences are presented in. For non-brain damaged adults, these word order differences do not seem to have a large impact at the behavioral level. However, for individuals with agrammatic aphasia, the processing of sentences that do not adhere to the base/canonical word order is proposed to be a laborious process with several research implying that they cannot process it at all- suggesting that these individuals have to resort to a guessing strategy to determine the assignment of thematic roles.

Many influential studies explained the impairment through a morphosyntactic account of aphasic language processing. Despite the fact that there is cross-linguistic evidence for this notion, the possibility of other factors influencing sentence processing, such as the difference in the frequency of syntactic structures, is not well explored. In this case, oftentimes the passive sentence structure is compared to active sentences in trials involving comprehension and production. However, from a usage-based perspective, the passive, in a number of the languages tested, is remarkably different from the active. To illustrate, in English, the passive is not used until age 4 or 5 with an input frequency of 4-5% (Gil, 2006), and it is also predominantly a written structure (BNC & WSJ Treebank 2 at 9%), occurring 3 to 4 times more often than in spoken instances (BNC Spoken at 3%; Switchboard at 2%) keeping in mind that the majority of the studies investigate auditory language processing. As a comparison, active transitive sentences have a frequency of 30% and 31% respectively in BNC and BNC spoken (Roland, Dick, & Elman, 2007). Whether or not such a difference in frequency could impact sentence processing becomes one of the central questions surrounding the current study. To address the question, Standard Indonesian (SI), which has a comparatively higher frequency of the passive (Gil, 2006) compared to languages like English, is investigated. The passive structure is more prominent in SI as it is acquired early around the age of 2;0 with an input frequency of 28-35%, and the usage becomes increasingly more common with adults (Gil, 2006). Moreover, 30 to 40% of the verbs in SI texts contain passive morphology (Kaswanti Purwo, 1991).

In the current thesis, the impact of word order towards sentence processing is examined in SI. The series of experiments investigate individuals with agrammatic aphasia and non-brain damaged individuals using behavioral and online (ERP) measures.

Chapter 1 establishes the topic and the theoretical framework through a general introduction of sentence processing, particularly in aphasia. As these were closely wound with the purpose and basis of the study, a concise description of the background was provided. Relevant information on Standard Indonesian sentence structure and verbs was then discussed. Key concepts surrounding the Indonesian passive structure and word order were deemed to be necessary to foreground the discussion of the three following chapters. The purpose and direction of the study, as well as the research questions were explicitly delineated. Lastly, the structure of the thesis was described in the final subsection.

Chapter 2 covers sentence comprehension in Indonesian aphasic speakers. In this study, aphasic individuals listened to four types of reversible structures, namely active, passive, subject cleft, and object cleft and had to select a matching picture out of sets of four pictures for every trial. From the design, the expectation was to be able to tease apart the potential effect of syntactic frequency in comprehension. Both subject-cleft and object-cleft are two infrequent structures in Indonesian, while active and passive structures are relatively frequent. Additionally, the passive and object-cleft are non-canonical structures. The predictions were straightforward: an absolute usage-based approach would see both the clefts impaired, while a representational account of processing would see both the non-canonical structures impaired. The results showed that neither approach could fully explain the current data. We found that only the object-cleft was impaired out of the four structures, which implies that a structure is impaired when it is both infrequent and non-canonical (which suggests that it requires more linguistic operations to parse resulting in increased processing costs). Further discussion of the SI passive is delineated, and implications and recommendations are put forward.

Chapter 3 revolves around sentence production of aphasic speakers of Standard Indonesian. To explore the impact of frequency towards sentence processing, production was investigated for a group of aphasic speakers.

Using a sentence elicitation task, twelve agrammatic aphasic speakers were tested. With a production task, the nature of the deficit can be specified further by examining the errors made by each individual. Additionally, the aphasic group's comprehension was also tested allowing the analysis to examine whether deficits that occur in the individual level are observed in both modalities. Consistent with the findings of the previous chapter, production of passive sentences in SI at the group level were also spared. However, we found the reversible passive production scores to be rather varied between individuals with a small number of participants showing poor production of passives- something that was not observed for the active structure.

Chapter 4 explores online sentence processing in non-brain-damaged individuals to see whether the frequency of the passive structure has an impact on typical language processing. The basis of this experiment was previous studies in Basque, German, and Japanese that found processing differences between theme-initial sentences compared to agent-first structures. This word order distinction is examined in Indonesian, where, if indeed an electrophysiological response distinguishing the structures we tested were found, it would unlikely be caused by one sentence structure being overwhelmingly more frequent than the other. 24 right-handed non-brain-damaged native speakers of Standard Indonesians took part in listening to 160 digitally recorded sentences which were divided into 4 conditions (reversibility x word order). Unlike the previous related studies, no clear effect of word order for reversible structures was observed, but the passive non-reversible condition showed a sustained positivity in two consecutive time windows within 500 to 900ms in the centro-posterior regions when compared to actives. This positive wave is also slightly right lateralized. The distribution and time window are consistent with what has been observed for the P600 effect, and we speculated that this is due to the inanimate first noun phrase in the passive non-reversible which causes the parser to expect as well as maintain a theme-first reading of the sentence throughout. This may increase processing load as it requires the revision of an expected agent-first interpretation and thematic role assignment of the first noun phrase.

Chapter 5 provides an overview of the results of the three previous experimental chapters as well as discusses its implications, both clinical and scientific, when seen in the light of the results of previous studies. It also discusses the limitations the set of experimental studies have. The conclusion

drawn in the General Discussion was that altogether, syntactic frequency significantly impacts sentence processing for SI speakers with agrammatic aphasia as the passive structure is found to be unimpaired in both comprehension and production. Additionally, ERP differences related to word order found in studies of other languages when processing theme-first sentences with no violations were not observed in our ERP findings; the results instead reflected animacy effects in the non-reversible passive structure.

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P.O. Box 716
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