RELATIVE CLAUSE ATTACHMENT PREFERENCE IN SECOND LANGUAGE SENTENCE PROCESSING: EVIDENCE FROM INDONESIAN LEARNERS OF ENGLISH

By:

HARDIAN ZUDIANTO

16706251008

A thesis submitted in partial fulfilment of the requirements for the degree of Magister Pendidikan

APPLIED LINGUISTICS

GRADUATE SCHOOL

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ABSTRACT

HARDIAN ZUDIANTO. *Relative Clause Attachment Preference in Second Language Sentence Processing: Evidence from Indonesian Learners of English*. **Yogyakarta: Graduate School, Yogyakarta State University, 2019.**

This research aims to reveal the relative clause attachment preference in L2 sentence processing from the perspective of Indonesian learners of English. This objective is specified into the investigation of attachment preference of the Indonesian learners of English and the effect of syntactic proficiency on their L2 English sentence processing. Consequently, both investigations shed light on the architecture and universality of L2 sentence processing.

Three quantitative studies were conducted in the attempt to achieve the research objectives. Yogyakarta State University graduate students of the English Education and Applied Linguistics program majoring in English Education and English Literature participated in a judgement task and two self-paced reading (SPR) tasks. The judgement task provided an offline measure for the identification of attachment preference, while an SPR task of an experimental design served as the online measure. Another SPR task was devised to examine the effect of syntactic proficiency on L2 sentence processing. The judgement task study was in the form of questionnaire, with Kuder Richardson 20 formula suggesting a high internal consistency of the instrument (KR-20 = 0.84), while the generalized-H index reflected a well-defined latent variable to be stable across studies (G-H = 0.93). Both SPR tasks recorded the participants' reaction time data on the monitor-displayed stimulus in milliseconds. An absolute cut-off method and outlier detection using z-scores were applied to the reaction time data to enhance the reliability of both studies. All instruments were consulted with an instrument validator, with the task administration followed a standardized procedure. The judgement task and the first SPR task both of which investigated the participants' attachment preference were analysed using the t-test comparison of means. Meanwhile a generalized linear model was utilized to examine the effect of syntactic proficiency on L2 sentence processing in the latter SPR task.

The results show a marked tendency for an Early Closure attachment preference in the offline measure of judgement task, while no distinctive preference identified in the online measure of SPR task, indicating a possible modulatory role of working memory. On the effect of syntactic proficiency on L2 sentence processing, the results of the SPR task reveal an apparent decrease in reaction time of the final clause as the participants' syntactic proficiency scores increase. The results of all three studies consulted with the previous research findings suggest an exposure-based nature of L2 sentence processing in the discussion of processing universality, and the modulatory role of syntactic proficiency in the architecture of L2 sentence processing. From these findings, the present research suggests the L2 researchers take into account the proposed L2 sentence processing model for further systematization of language processing, and L2 teachers to consider the underlying importance of syntactic parsing in developing learning approaches and materials.

Keywords: attachment preference, L2 sentence processing, syntactic proficiency

ABSTRAK

HARDIAN ZUDIANTO. *Preferensi Sematan Klausa Relatif dalam Pemrosesan Kalimat Bahasa Kedua: Keterangan dari Pembelajar Indonesia dengan Bahasa Inggris sebagai Bahasa Kedua*. **Yogyakarta: Program Pascasarjana, Universitas Negeri Yogyakarta, 2019.**

Penelitian ini bertujuan untuk menjelaskan preferensi sematan klausa relatif dalam pemrosesan kalimat bahasa kedua (L2) dari perspektif pembelajar Bahasa Indonesia dengan Bahasa Inggris sebagai bahasa kedua. Tujuan penelitian dirincikan sebagai investigasi klasifikasi preferensi sematan klausa relatif dan pengaruh kecakapan sintaksis dalam pemrosesan kalimat L2. Hasil penelitian juga diharapkan dapat menjelaskan arsitektur dan universalitas pemrosesan kalimat L2.

Tiga penelitian kuantitatif dilakukan sebagai upaya mencapai tujuan penelitian. Mahasiswa Program Pascasarjana Universitas Negeri Yogyakarta program studi Pendidikan Bahasa Inggris dan Linguistik Terapan dengan konsentrasi Pendidikan Bahasa Inggris dan Sastra Inggris berpartisipasi dalam suatu *judgement task (JT)* dan dua *self-paced reading (SPR)*. JT digunakan untuk mengidentifikasi preferensi sematan dalam membaca *offline*, sedangkan SPR berperan sebagai pengukur membaca *online*. SPR juga dimanfaatkan untuk meneliti pengaruh kecakapan sintaksis dalam pemrosesan kalimat L2. Instrumen JT berupa kuesioner dengan nilai Kuder Richardson 20 mencerminkan konsistensi internal yang tinggi (KR-20 = 0,84), sedangkan *generalized-H index* menunjukkan *latent variables* yang stabil (G-H = 0.93). Kedua penelitian SPR merekam data berupa waktu reaksi subjek penelitian dalam satuan *millisecond* terhadap stimulus dalam monitor komputer. Metode potongan absolut dan deteksi *outlier* menggunakan skor *z* diterapkan pada data reaksi waktu guna meningkatkan reliabilitas kedua penelitian SPR. Selain itu, semua instrument telah divalidasi oleh validator instrument, dan dilaksanakan dengan prosedur yang terstandardisasi. Data penelitian JT dan SPR pertama dianalisis menggunakan t-test untuk mengidentifikasi preferensi sematan. Sedangkan data SPR kedua dianalisis menggunakan *generalized linear model* untuk mengetahui pengaruh kecakapan sintaksis dalam pemrosesan kalimat L2.

Hasil penelitian menunjukkan kecenderungan yang jelas akan preferensi sematan *Early Closure* dalam aktivitas membaca offline JT, sedangkan tidak ditemukan perbedaan preferensi sematan dalam aktivitas membaca online SPR yang mengindikasikan peran modulasi *working memory*. Hasil penelitian pengaruh kecakapan sintaksis dalam pemrosesan kalimat L2 menunjukkan pengurangan waktu reaksi klausa akhir seiring bertambahnya skor kecakapan sintaksis. Hasil ketiga penelitian tersebut didukung oleh temuan penelitian terdahulu mengusulkan karakteristik *exposure-based* dalam konteks universalitas, serta peran modulasi kecakapan sintaksis dalam diskusi arsitektur pemrosesan kalimat L2. Berdasarkan hasil tersebut, penelitian ini menyarankan peneliti L2 untuk memperhitungkan model pemrosesan kalimat L2 dalam sistematisasi pemrosesan bahasa, dan bagi pengajar L2 untuk mempertimbangkan signifikansi sintaks dalam mengembangkan materi dan pendekatan pembelajaran pemrosesan kalimat.

Kata kunci: pemrosesan kalimat L2, preferensi sematan, kecakapan sintaksis

RATIFICATION SHEET

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Defended in front of the Board of Examiners
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STATEMENT OF ORIGINALITY

I, the undersigned:

Name	: Hardian Zudianto
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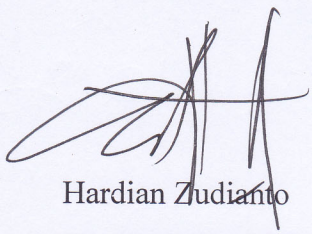
Hereby declare that this thesis entitled "Relative Clause Attachment Preference in Second Language Sentence Processing: Evidence from Indonesian Learners of English" is my own work and has not been considered for publication or as the requirement for the Magister degree elsewhere, and to the best of my knowledge it contains no materials previously published or written by another person except where due acknowledgement is made in the thesis.

Yogyakarta, 10 January 2010



Hardian Zudianto

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To my loving mother, father, and sister, for reminding me that going outside every once in a while is good for my health.

Write like you're not afraid

– Phoebe Waller-Bridge

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I wish that this thesis could be beneficial for the ever-developing second language learning pedagogy as well as the advancement of psycholinguistics literature, especially in the relatively young field of second language sentence processing. As with any endeavour of thesis writing, this piece of writing still leaves room for improvement. Further discussions, constructive criticisms, and suggestions related to this thesis are much welcome and highly appreciated.

Hardian Zudianto

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CHAPTER I

INTRODUCTION

A. Background of the Research

Sentence is a unit of language in which an idea begins to make sense. When a language invented a writing system which marks the beginning and end of a chain of words, such as a capital letter and a full stop, a complete thought takes form. Only within a sentence that syntactic principles apply and shape the otherwise detached words into a meaningful idea. In this regard, sentence comprehension seems to bear no significant problem, as long as a reader has an adequate vocabulary and syntactic knowledge. Yet, a sentence such as "Readers are reading this sentence of the introduction which is relatively short," may trouble some critical readers. They may find the need to point out some fault in the sentence, i.e. that the sentence is vague. It is unclear which one is being 'relatively short', whether it is 'this sentence' or 'the introduction'. The two noun phrases connected by the preposition 'of' make the sentence ambiguous, as both can equally be attached to the relative clause that follows. It is thus not clear as to which noun phrase the following relative clause is attached to.

In general circumstances, such as when the sentence is uttered out loud by a speaker in a daily conversation, the listener would assume that one of the interpretations is correct, that is by considering some information such as intonation or context. However, if such sentences are encountered in a written form, would the reader still easily interpret the sentence? There is apparently more to the answer to

this question than meets the eye. Ever since the discussion of the interpretation of sentences gained the researchers' interest in the early 1980s, researchers have contributed to a growing number of studies, offering theories and perspectives on how a written sentence is interpreted. Attempts to answer a seemingly simple question of how a sentence is interpreted or *processed* by the human mind, later known as sentence processing, have led to vast overarching topics in psycholinguistics. One of these topics, surfacing not long after the sentence processing renaissance in the late 1980s, has yet to provide a sound theoretical framework as researchers found a considerable amount of differing accounts, while theories and hypotheses struggle to align with each other. The description on *cross-linguistic processing difference* still leaves a lot to be desired, as the topic branches and researchers keep discovering new problems as well as propositions to the matter. Until today, discoveries of fundamental nature are still widely debated as recent advance of technology allows for the more accurate and reliable method to scrutinize the split-second processing of the different languages within the abstract spaces of the human psyche.

The discussion dates back to Cuetos and Mitchell's (1988) proposition about a cross-linguistic difference between the processing of English and Spanish sentences. At the time where Chomsky's universal grammar guided most of the linguistic paradigms, their seminal article proposed challenges to this notion in the field of psycholinguistics. Using similar sentence construction as exemplified above, they found that their subjects both from the native Spanish and native English speakers were capable of disambiguating the sentence by favouring only

one of the noun phrases, despite the lack of audible intonation or adequate context. The thing that draws the attention of the researchers until today, however, is that they found that native English speakers preferred the second noun phrase (NP2, e.g. "the introduction" in the example above), while the native Spanish speakers preferred the first noun phrase (NP1, as in "this sentence"). The study has since then been replicated a number of times in various languages with differing results. Some accounts reported a NP1 preference in the sentence processing of Dutch (Brysbaert & Mitchell, 1996), French (Zagar, Pynte, & Rativeau, 1997), Japanese (Kamide & Mitchell, 1997), and Greek (Papadopoulou & Clahsen, 2003), while a NP2 preference is found in English (Cuetos & Mitchell, 1988), Italian (De Vincenzi & Job, 1995), and Turkish (Dinçtopal-Deniz, 2010). As native speakers of the different languages demonstrate different NP preferences, these languages are then identified as either a language of Early Closure (EC) preference, constituting those which prefer the NP1, or a language of Late Closure (LC) preference for those which prefer the NP2.

Researchers have yet to agree on a sound explanation to these differences, yet these findings on cross-linguistic difference in sentence processing eventually lead to another question as researchers take the interest on the field of applied psycholinguistics. If native speakers of a language with certain attachment preference learn a language of different attachment preference, would their mother tongue (L1) preference influence their sentence processing strategy in the second language (L2)? Attempts to answer this question have thus far been inconclusive as the studies stumble on some issues. These include, first, the necessity of two distinct

experimental methods, the offline and online method. Sentence processing is a real time process in which readers interpret a string of words as they read it. This nature of sentence processing demands an experimental measure which is capable of examining the interpretation process as the activity of reading unfolds in real time. Known as the online method, this can be achieved using the measures of self-paced reading (SPR), eye-tracking, event-related potential (ERP), or functional magnetic resonance imaging (fMRI), among others. On the other hand, the nature of a written sentence which does not normally disappear as the readers completed the reading allows for a re-reading or re-interpretation. This calls for an offline method in which readers are given time to decide on their interpretation after reading which can be achieved using questionnaire or reading comprehension tasks. The problem arises when both the offline and online measures, which are predicted to show the same results, appear to reveal contradictory results as reported by a number of studies.

The second issue deals with a proposition which casts doubt on the notion of cross-linguistic influence in L2 sentence processing itself. This argument is supported by some accounts which found that native speakers of two languages with different preference can have the same preference in the same learned L2, therefore suggesting a number of variables which may explain the difference between L1 and L2 sentence processing (Cunnings, 2017; Jun, 2010; Pan, Schimke, & Felser, 2015). Exploration on variables other than cross-linguistic influence is still relatively new as novel findings are recently discovered and the proposed hypotheses are in urgent need of further research. The third issue addresses the nature of cross-linguistic research which demands exhaustive accounts on various

languages in the world. Thus far, research on cross-linguistic difference in L2 sentence processing has mostly centred on the Germanic and Romance languages. Comprehensive studies on the languages from diverse language families are necessary to offer different perspectives on this matter.

In response to these issues, the current study attempts to investigate the L2 sentence processing mechanism by examining the relative clause attachment preferences of Indonesian learners of English. The interest in L1 Indonesian is intended to offer some perspectives from the Austronesian language which thus far receives little attention in the cross-linguistic studies of sentence processing. It is also of interest that L2 English, a Germanic language, is concerned since the difference in language families of both L1 and L2 in this study is expected to yield further insights into the variables which may be at work in L1-L2 sentence processing difference. Both offline and online measures are taken into consideration to cater for the possible differences in the way readers interpret sentences as the reading process unfolds and when a re-reading is necessary. By addressing these issues in the current study, it is expected that this study can complement the literature of relative clause attachment preferences in L2, and thus contribute to the growing endeavour of unravelling the underlying mechanism of L2 sentence processing.

B. Identification of the Problems

The study of sentence processing of a second language fundamentally involves two language components, the speaker with a certain native language in

mind, and another language that is not the speaker's mother tongue (L2). Unlike monolingual sentence processing which concerns only the speaker's native language, the involvement of these two components opens up a whole different range of discussions, from those centred on the different features of the languages involved to those dealing with the speaker's acquisition of the L2. Recent discussions on second language sentence processing, however, have focused on the architectural problem of the sentence processing, the processing difference between the L1 and the L2, as well as re-assessment of the universality of second language sentence processing.

Each of the three topics of interest poses their own problems which are currently in demand of further research as conflicting accounts are frequent and new hypotheses are proposed. The architectural problem deals with the computational models of sentence processing. There are currently no proposed models of language processing of a second language on sentence level. It is thus far presumed that second language sentence processing has similar architecture to the monolingual sentence processing, while the study of computational difference has centred on the lexical level. The architecture of second language sentence processing is therefore currently guided by the same problems as monolingual sentence processing model such as the questions of modularity versus interactivity and serial processing versus parallel processing.

The second problem concerns the processing difference between the L1 and L2 sentence processing. Researchers agree that L1 sentence processing is different from L2 sentence processing. What they have yet to agree on is the nature of the

processing difference which is essentially divided into two viewpoints: whether the difference in L1 and L2 sentence processing is qualitative or quantitative in nature. This divisive issue lead to the discussions on the third problem, i.e. whether L2 sentence processing is universal or there is a cross-linguistic influence underlying the mechanism. As researchers attempt to explain the difference between the L1 and L2 sentence processing from its quantitative/qualitative nature, further discussions emerge suggesting that a qualitative difference would imply on the universality of L2 sentence processing as quantitative difference shall explain otherwise. This problem basically questions whether the difference is part of the acquisition of the L1 or specifically a process-generated strategy.

More issues in second language sentence processing are bound to be discovered as the interest grows rapidly in recent years. The three problems, however, represent the most recent concerns in the field as the trend in L2 sentence processing studies in the past decade have stemmed from these fundamental problems. It is therefore important to establish a thorough understanding of the basic principles in L2 sentence processing as proposed by these problems in order for further research to firmly advance.

C. Delimitation of the Problems

The wide range of the problems eventually demands a focused investigation which considers the limitation of the available research resources as well as the researcher's capacity to conduct the research of a certain scale. For this reason, this study addressed the three problems identified above from the perspective of

Indonesian learners of English. It aimed to provide subsequent research with the adequate theoretical background of the phenomenon, considering the limited knowledge of second language sentence processing of Indonesian learners at the moment. The use of Relative Clause attachment preferences in its experiment allowed this study to gain insights into the architecture of the L2 sentence processing, such as the modularity or seriality theories of the sentence processing. However, this study was not intended to explain or ascertain the specific sentence processing model as the design of the stimulus sentences in the study cannot provide the adequate means to do so.

The use of offline and online measures is expected to be able to inform any difference between the sentence processing in its immediate nature as in real time and in a delayed situation in which more information is taken as consideration. This shall narrow down the possible explanations behind the L1 and L2 differences, although further treatment of the stimuli or the participants is necessary to pinpoint the difference in quality or quantity of the L2 sentence processing. The employment of the native speakers of Indonesian background, which has not been previously studied to the researcher's knowledge, is expected to yield some perspectives on the universality of L2 sentence processing by adding this particular language background to the larger literature of L2 sentence processing. Nevertheless, the study was not specifically designed to provide evidence of universality or lack thereof, rather, any information on the universality of L2 sentence processing would be indirectly interpreted from the findings of the study.

It is also to be noted that this study did not employ the native English speakers for comparison due to the lack of available means and resources. Studies on English sentence processing, however, have been vast and exhaustive, providing the necessary accounts to compensate for it. This study also did not concern the investigation of Relative Clause attachment in the participants' L1 or in the Indonesian stimuli. Aside from the lack of researchers' expertise in the Indonesian construction equivalent to that of English Relative Clause design, recent findings have also shown evidence of the insignificance the L1 sentence processing have on the L2 sentence processing (Pan et al., 2015). Finally, in light of these limitations of the research, previous studies and literature were taken into consideration to complement for a comprehensive discussion. Meanwhile the wider range of the problems, despite not being the main concern of the current study, may be addressed when the findings suggest some relevance.

D. Formulation of the Problems

On the understanding of the background of the research and the delimitation of the problems, the problems of the research are formulated as follows.

1. What attachment strategy do the Indonesian learners of English prefer in the reading of English Relative Clause sentences?
2. Does syntactic proficiency affect the L2 sentence processing of Indonesian learners of English?

3. How does the English Relative Clause attachment preference of the Indonesian learners of English stand on the universality of L2 sentence processing?
4. How is the architecture of L2 sentence processing as suggested by the findings?

E. Research Objectives

Based on the formulation of the problems, the following research objectives are established.

1. To identify the attachment strategy preferred by the Indonesian learners of English in the reading of English Relative Clause sentences.
2. To reveal whether syntactic proficiency affect the L2 sentence processing of Indonesian learners of English
3. To evaluate how the English Relative Clause attachment preference of the Indonesian learners of English stands on the universality of L2 sentence processing.
4. To investigate the architecture of L2 sentence processing as suggested by the findings.

F. Significance of the Research

This research is expected to be beneficial to:

1. The enrichment of the psycholinguistic literature in the description of second language sentence processing.
2. The diversity of the second language sentence processing literature particularly in the discussion of universality in language processing.
3. The evaluation of effective reading strategy in second language learning pedagogy and material development.
4. The growing literature as the basis for further research in psycholinguistics and second language reading comprehension.

CHAPTER II

LITERATURE REVIEW

This chapter presents discussions on theories and hypotheses leading to the issue of relative clause attachment preference in second language sentence processing, as well as critical review of relevant studies. The fundamental theories of sentence processing begin the discussions to provide contexts and overview of the enduring dialogue in the field of sentence processing architecture. Discussions on cross-linguistic difference in sentence processing follow, describing the how and why the relative clause attachment preference matters and sparks the interest of psycholinguistics researchers until present. Second language sentence processing literature is then discussed, offering two opposite perspectives of qualitative and quantitative difference in L2 processing. This chapter ends with a review of relevant research, illustrated conceptual framework based on the entire discussions, and the proposed research questions.

A. Theoretical Review

Processing a single sentence, as seen from the psycholinguistics standpoint, can be a highly complex process involving vast sources of information. Within these sources of information are hypotheses and points of view experts have yet to agree with or align with each other. Meanwhile explorations of uncharted territories keep expanding on the new discoveries ever since the interest sparked around 40 years ago. This cognitive process, which by convention deals with the receptive

process of listening or reading, essentially refers to the interpretations of sentences (Ferreira & Çokal, 2016). The process is preceded by the recognition of words, which means that it only becomes available as the language processors have accessed the lexical entry for the words (Harley, 2014). Sentence processing within the realm of language processing also contributes to and takes precedence over the discourse processing (Traxler, 2012).

Sentence processing in itself is a particularly compelling process for it is the first stage of language processing to deal with a complete idea or thought, i.e. a sentence. It also concerns a unit of language in which grammatical rules begin to make sense and is contained within, but not without. These two things which make sentence processing compelling are actually two fundamental linguistic information which build the basis of sentence processing: the idea or thought as seen semantically, and the working grammatical rules which make up the independent unit of language structure, syntactically (van Gompel, 2013).

Syntactic and *semantic relations* are believed to be the earliest major sources of information processed in sentence processing. In principle, together they provide the necessary information on the relations between the meaning of words and their argument structures for the crucial following stage, the *thematic role* assignment (Friederici, 2011, 2017; Harley, 2014). The assignment of thematic roles is considered to be the goal of sentence processing. If ideally, the syntactic and semantic information align or lead to a complementary interpretation through the thematic role assignment, then comprehension can be achieved and sentence processing is deemed to be successful. Alternatively, further processing may take

place and integrate more sources of information such as prosody, linguistic frequency, discourse contexts, and/or visual contexts among others (Ferreira & Çokal, 2016). Figure 1 illustrates this model of sentence processing.

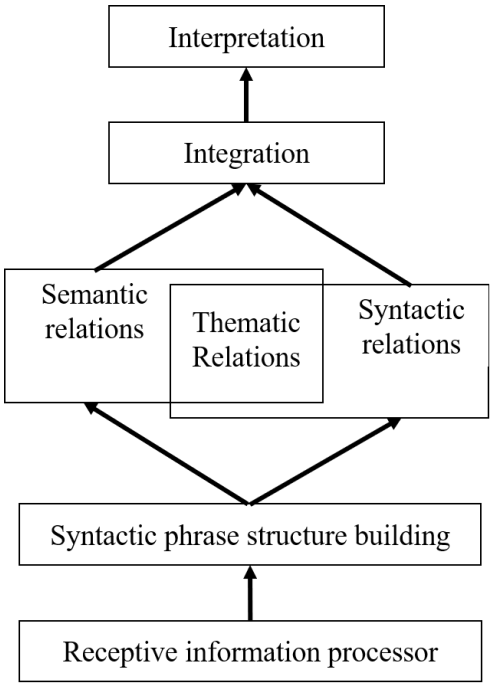


Figure 1. A Sentence Processing Model, Adapted from Friederici (2017)

Friederici's (2017) cognitive model of sentence processing which includes the general understanding of sentence processing pictured above is originally a model of auditory sentence comprehension with the information processor being the acoustic-phonological processor. This part of her sentence processing model, which she assumes to exclusively take place in the left hemisphere of the brain, offers a plausible representation of sentence processing as supported by her neurocognitive research. In this model, the processing of syntactic relations is believed to happen most immediately prior to the processing of semantic relations. The compatibility

or agreement derived from the processing of both sources of information lead to the computation of thematic relations or the thematic role assignment. The integration process in the model which takes place after the thematic role assignment refers to the consideration of other sources of information such as contexts and prosody which completes the interpretation of the sentence.

As hinted previously, this model is only one of the various proposed models of sentence processing. Despite representing the general assumption that syntactic and semantic information being the two primary sources of information initiating the sentence processing, this is also a model of its own, particularly in the way the syntactic information is being processed independently in advance of the rest of information. The questions of which one is being processed first or if there is any strict order in the processing of information, whether each source of information is processed exclusively or in conjunction with the others, as well as what other sources of information influence the processing, have divided experts in their hypothesis and perspectives on the decoding of sentence processing. The following section discusses some of these issues relevant to the current research.

1. The Architecture of Sentence Processing

Assuming the syntactic information processing belongs to the initial stage of sentence processing, another question should arise. Does it work alone or separately from the other sources of information, or alternatively, is syntactic processing only one of multiple relevant information being processed in the initial stage at the same immediate manner? These questions

can also be translated into whether sentence processing is *modular* or *interactive*. A modular view of sentence processing believes that there is a separate information processing module which works individually, at least initially, with limited influence of other relevant information. Interactive model of sentence processing, on the other hand, argues that there is no restriction to an encapsulation of information, but all relevant constraints being processed immediately since the earliest stage of the sentence processing.

The notion of modularity of sentence processing originated from the proposal of modularity of mind popularized by Fodor (1983). His *modularity of mind* brings forth the significance of *informational encapsulation* which primary point is the restriction of the number of *confirmation relations* when the mind is analysing the input, resulting in quick perceptual identifications. As does the mind, the modularity of sentence processing assumes this notion in terms of limited computation of information within the database of a module which enables the system to be quick and automatic in its operation. In addition to the core idea of informational encapsulation, Ferreira and Nye (2018) specify two more properties of Fodor's (1983)'s modularity which include *neural specialization* and *superficiality*.

A notable support for the modularity of sentence processing comes from the neurocognitive view of language comprehension which contributes a body of work demonstrating a certain temporal structure in the processing of language. Friederici (2002, 2011) provides a neural basis of sentence

processing as she found a certain mapping of syntactic and semantic processing in the auditory sentence comprehension. Bornkessel-Schlesewsky et al., (2011) take a step further with the cross-linguistic aspect of sentence comprehension proposing a modular categorisation process which is explained by language-specific grammatical properties. Meanwhile Fedorenko, Duncan, and Kanwisher (2012) scrutinize the selective responses of specific regions of the brain to the language input. These neurocognitive works represent the occurrence of *neural specialization* which complements the modularity of sentence processing.

On the second property of superficiality, Ferreira and Nye (2018) make a case for *shallow output* of sentence processing, arguing that the output of sentence processing represents conditions for interpretation instead of a detailed computation of the early sources of information. These conditions for interpretation become a sufficient module to allow for an immediate and automatic interpretation to develop. Detailed computation may be performed in *post-processing* module in the case of unsatisfactory or misinterpreted processing output. It is also to be noted that Fodor's (1983) proposal admits to a limited extent of modularity, that is, a modular system does not have to include all the properties described above, rather to a certain amount of possible processing interest.

Opposing the modular processing architecture, some accounts on sentence processing reported a number of evidence of interactivity occurring during the information processing. Some of the recent ones include Rohde,

Levy, and Kehler (2011) whose findings demonstrate an interaction between syntactic and discourse processing. Nakamura, Arai, and Mazuka (2012) also found that prosody may influence the immediate processing of syntax, given an appropriate context. Meanwhile Gibson, Bergen, and Piantadosi (2013) account for the interactivity between a variety of relevant information which can be accessed in the processing of *noisy input*, a case when an input becomes imperfect due to a noisy environment or the processor mishearing or misreading the input. These bodies of evidence supporting the interactivity thesis of sentence processing however, as Ferreira and Nye (2018) argue, lack the necessary determination of what sources of information is being encapsulated as part of the sentence processing module as in the first two cases exemplified above, or have yet to utilize the methodology which allows for a distinction between the initial stage of sentence processing and those that follows as is the case of the latter example.

Advances in psycholinguistic and neurocognitive research have influenced the growing number of studies in their endeavour of explaining the architecture of sentence processing, either in favour of modularity or against it. Some studies acknowledge the processing modularity with special case exceptions such as Nakano, Saron, and Swaab (2010) with their consideration of individual differences, or Martín-Loeches et al. (2012) featuring an interest in emotional words in sentence processing. As the debate concerning the architecture of sentence processing keeps discovering new findings, recent researches on modularity of sentence processing have shifted

its focus on determining the kind of information that is encapsulated within the processing module as well as explaining the mechanism underlying the modularity feature of shallow output in sentence processing.

a. Syntax in Sentence Processing

Syntax embodies a vital role in sentence processing. Whether syntactic processing is a process of its own in a modular sense, or there are other sources of information working interactively, it is believed to take place in the starting point of sentence processing which makes it possible for the processor to process a sentence. A case in point, a native speaker of English will recognize the syntactic structure of a semantically nonsensical string of words as in Chomsky's (2002:15) classic example, "*Colorless green ideas sleep furiously*," but not, "*Furiously sleep ideas green colorless*".

Some studies found evidence that other sources of information may influence or dominate the syntactic analysis early in the sentence processing under certain circumstances (Gibson et al., 2013; Kim & Sikos, 2011; Nakamura et al., 2012; Rohde et al., 2011). The influence of other sources of information or their possible dominance over syntax do not necessarily undermine the role of syntactic processing in sentence processing, rather, they further acknowledge the essential role of syntactic information in the initial stage of sentence processing, that

is, at the same time or before the other sources of information contribute to the interpretation process.

Studies in sentence processing have mainly dealt with difficulties in interpreting sentences. Researchers in sentence processing would appeal to the notion of *syntactic parsing*, as it is believed to be able to explain those processing difficulties. These studies therefore would likely consider the role of syntactic processing to a degree or revolve around it. The concept of syntactic parsing concerns the way the *parsers* mentally processing sequences of words within a sentence as they identify how these words relate to each other and assign the relationship into a relevant structural information.

This parsing of syntax does not necessarily follow the way the words are presented sequentially in sentences, rather, this mental process may parse the sequences of words hierarchically as they are organized in a certain syntactic structure as in a syntactic tree diagram. This concept is another source of debate in sentence processing as experts question whether the syntactic parsing is sequential or hierarchical. Frank and Bod (2011) for one suggests that parsers are insensitive to hierarchical syntactic parsing and appeal more to the sequential model, while Fossum and Levy (2012) directly refute their argument by providing evidence of a hierarchical model which is found to improve prediction accuracy in sentence processing. Regardless,

most agree that syntactic parsing is, though may not be strictly, *incremental*.

Incrementality has been generally accepted as the nature of parsing mechanism in sentence processing. Linguistic sources of information are not computed randomly on surface necessity basis, but systematically incremental, with higher level processing begins as soon as it becomes available before the lower level processing is completed. This results in a rapid, without delay, processing of linguistic input or as theorists say the 'cascading water' (Snedeker, 2013). This incrementality concerns not only the syntactic parsing but sentence processing in general. However, it is in the incrementality of syntactic parsing that parsers are notably advantaged by the anticipatory nature as a result of the continuous incremental parsing.

This often leads to the discussion of prediction in syntactic processing as syntactic constituents can be projected before they are received (Spivey, Anderson, & Farmer, 2013). Arai's (2013) experiments on lexically specific syntactic information, for example, demonstrated the assistance of incremental verb-specific information processing in anticipating upcoming syntactic structure. Another discussion of significance associated with the incrementality of syntactic parsing is the case of syntactic ambiguity. As linguistic inputs are processed as immediately as they are encountered, processing difficulties in the form of temporary ambiguity are common

occurrences in sentence interpretation prompted by an incorrect analysis. This case of processing difficulty, particularly in the form of processing ambiguity, is frequently utilized by experts as the means to analyse and provide evidence for the sentence processing models.

b. Models of Sentence Processing

The models of sentence processing are often determined by how they treat the processing of the syntactic information. Two prominent models of sentence processing which influence many researches in sentence processing until today are *the garden-path model* coined by Frazier (1987) and *the constraint-based model* which represents a number of parallel processing models. The distinction between the two models can be identified by the architecture of the processing models. Garden-path model recognizes a modular syntactic processing which recalls back on the previous argument on *information encapsulation* in that inferences following the syntactic parameters are highly restricted, leading to a quick and automatic structuring of the linguistic resources in the initial stage of processing (Frazier, 2013).

On the other hand, constraint-based model assumes the interactive architecture in the sense that it utilizes all available information as considerations for potential interpretations, seeing syntactic information as only one of the various relevant linguistic inputs to be computed. Other information which represents the

constraints comes from various kinds of input such as contexts, prosodic cues, word meaning, or subcategory information, among others.

The modularity assumption is not the only architectural distinction between the two models. They also differ in the way the garden-path model favour serial processing, while constraint-based model is parallel in nature. Seriality in the garden-path model is observed in the way a single syntactic structure is computed at a time. Following the single syntactic analysis output in the initial stage of processing, thematic interpreter assigns thematic roles by considering the syntactic output and other relevant linguistic information such as semantic or context in confirmatory nature, leading to a working interpretation. If the thematic role assignment results in an implausible interpretation, then *reanalysis* process is necessary.

Meanwhile the constraint-based model is parallel as it acknowledges multiple potential interpretations which may compete with each other, which then requires the processor to rank these interpretations and entertain the most plausible one (McRae & Matsuki, 2013). The confirmation of plausibility in the constraint-based model can be challenged by the case of processing difficulty, in which a *re-ranking* of the potential interpretations may succeed. Figure 2 and 3 illustrates the garden-path and constraint-based model respectively.

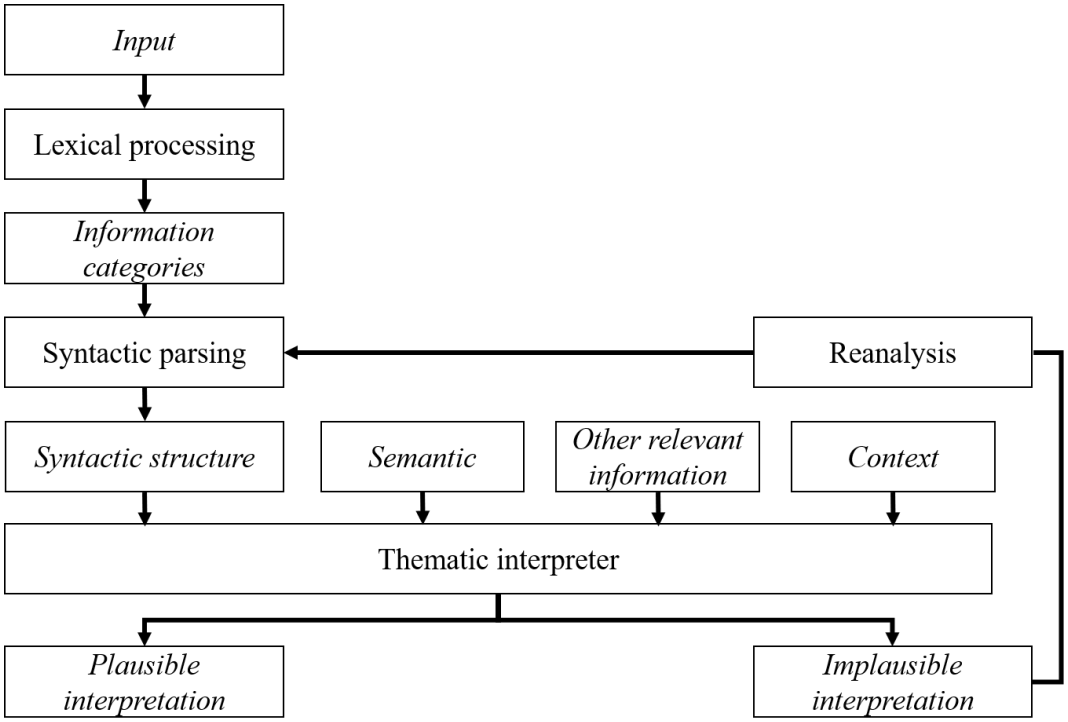


Figure 2. The Garden Path Model (Frazier, 1987)

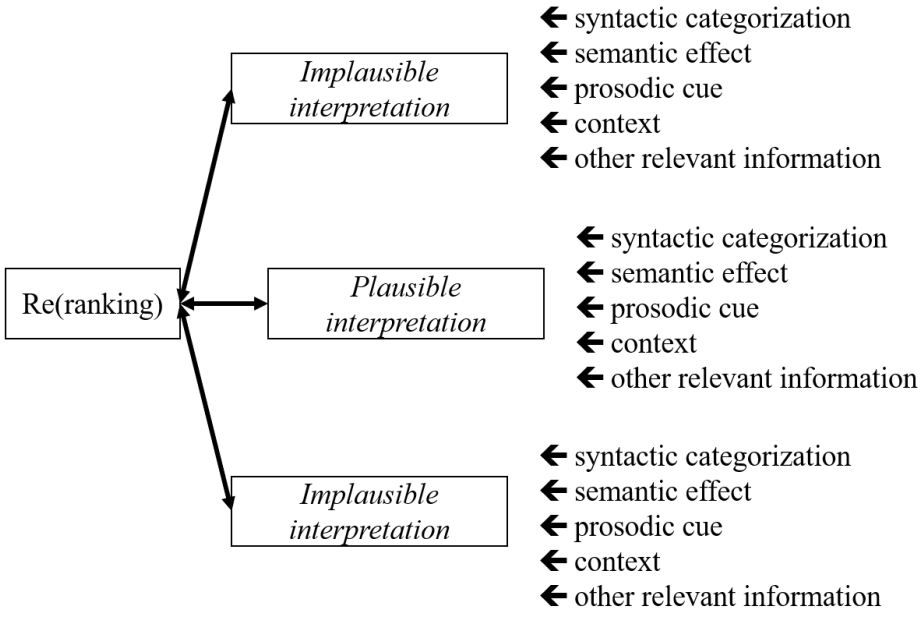


Figure 3. Constraint-based Model

It is to be noted that the garden-path model proposes two parsing strategies, the *minimal attachment* strategy and the *late closure* strategy. In her own words, Frazier (1987: 562) addresses the minimal attachment strategy, "Do not postulate any potentially unnecessary nodes," and the late closure strategy, "If grammatically permissible, attach new items into the clause or phrase currently being processed (i.e., the phrase or clause postulated most recently)." Using the minimal attachment strategy, Frazier (1987) argues that parsers will find sentence (1) easier to parse compared to (2).

(1) "*The girl knew the answer by heart.*"
(2) "*The girl knew the answer was correct.*"

In the hierarchical sense of syntactic parsing, the former sentence has fewer nodes than the latter, considering that 'by heart' is identified as a Prepositional Phrase (PP) which *necessarily* belongs to the Verb Phrase (VP) 'knew the answer' in the NP + VP construction. On the other hand, 'was correct' in the second example is a VP2 following the main NP + VP1 nodes. This VP2 is initially not computed as a *necessary* node since the main structure already have a VP1. By this reasoning, the minimal attachment strategy confuses the parsers as they encounter an unnecessary node which leads to an implausible interpretation requiring a reanalysis.

(3) "*Jessie put the book Kathy was reading in the library*"

A problem may arise, however, when there are two comparable minimal attachments to parse as in the sentence (3) above, in which the PP 'in the library' can both modify the VP 'put' and 'reading'. In this case, minimal attachment strategy alone cannot guide the parsing decision. The late closure strategy therefore activates as parsers, according to this principle, will attach the PP 'in the library' into the phrase that is postulated most recently, 'reading', rather than the formerly processed 'put'. This late closure strategy is discussed further in later section as it raises some questions when second language processing is concerned.

Other than the two models of sentence processing which often take the centre stage, there are other processing models which mostly take inspiration from, an extension of, or a refinement of the two models. *Construal* processing model (Frazier & Clifton, 1996, 1997) extend the garden path model in that it now allows for contextual information to influence the parsing decision, as well as for a parallel processing to take place, under a specific set of circumstances. This set of circumstances refers to what they termed the *primary* and *non-primary* relations which is covered in more details in the next section, considering its interest in the cross-linguistic difference in sentence processing.

Departing from the syntax-focused processing model, the *good enough* processing model (Ferreira, Bailey, & Ferraro, 2002; Ferreira,

Engelhardt, & Jones, 2009; Ferreira & Patson, 2007) claims that processors compute the available information and build interpretation only as much as the processing task requires. When processors encounter some lexical information such as 'the man', 'the dog', and 'bit' in a sentence, they will assuredly process the relationship between the lexical information as "*the dog bit the man*" rather than "*the man bit the dog*", or confidently interpret a construction of "*the dog is bitten by the man*" to be implausible. The good enough model proposes that processors develop a shallow processing of the input. As demonstrated in the previous example, when lexical information alone has been sufficient to interpret the sentence, processors may dismiss the syntactic parsing and not engage in a detailed processing, unless implausible interpretation is identified, and more detailed processing is required.

Another alternative sentence processing model which is often discussed in the language processing literature is the *unrestricted-race* model or the *race-based* model (Traxler, Pickering, & Clifton, 1998; van Gompel, Pickering, Pearson, & Liversedge, 2005; van Gompel, Pickering, & Traxler, 2007; Van Gompel, Pickering, & Traxler, 2001). In a way, this model adopts both the garden-path model and the constraint-based model while rejecting some primary aspects of those models. It resembles the constraint-based model in the way that the initial processing acknowledges the influence of multiple information

including the syntactic and non-syntactic information which are computed in parallel, that is until a single syntactic analysis is pursued.

Unlike the constraint-based model, however, the pursued syntactic analysis does not dismiss other possible syntactic structure alternatives which remain active, albeit not being pursued. Any of these alternative syntactic analyses may be pursued instead in reanalysis when the currently pursued syntactic analysis turns out to be implausible. The fact that only a single syntactic analysis is pursued at one point in time and assigned for further processing designates it as the refinement of the serial processing in the garden-path model.

These last three models, along with the garden-path and constraint-based models, demonstrate how processing models have evolved and developed over the years and still have until today. As evidence observed in sentence processing research has yet to agree on the processing model which best represents sentence processing, there may be more processing models which can cover more ground and explain this seemingly conflicting evidence in the future.

2. Cross-linguistic Difference in Sentence Processing

The study of sentence processing is made more complex when more than one language is involved. Researchers have questioned whether the processing of a second language (L2) is the same as that of the first language (L1), whether there is any interaction between the linguistic components of

the two languages, which parts of the processing mechanism of L2 and L1 are shared and which ones differ or even compete, or what processing elements are involved in this divergence of the processing. Fundamentally, these questions resonate with the idea of whether the language is universal, including the case of sentence processing. Experts have referred to Cuetos and Mitchell's (1988) seminal research article which examined the processing of Spanish and English ambiguous relative clause sentences by their respective native speakers.

(4) "*Someone shot the maid of the actress who was on the balcony*"

In their work, Cuetos and Mitchell (1988) discuss sentences such as (4) as interpreted by the speakers in their native languages. The sentence is ambiguous whether the one 'who was on the balcony' is 'the maid' (Noun Phrase 1) or 'the actress' (Noun Phrase 2). Referring back to the Late Closure strategy as discussed in the previous section, it is predicted that speaker would choose 'the actress' (NP2) as the one 'on the balcony' instead of 'the maid' (NP2), as evidenced in many researches concerning the English native speakers, including this one of Cuetos and Mitchell's (1988). However, when dealing with the Spanish native speakers processing the sentence in a comparable Spanish construction, they reported that, in contrast to the English native speakers, they tend to prefer 'the maid' (NP1) as the one 'on the balcony'. This ground-breaking finding of the *early closure* strategy in Spanish raises a whole lot of new questions regarding the nature of sentence processing in other languages and inevitably leads to an interest in its

significance for the second language sentence processing. After all, Cuetos and Mitchell (1988) have shown that apparently sentence processing is not as universal as it was thought to be.

Researches exploring the cross-linguistic difference in sentence processing have since then focused on examining Cuetos and Mitchell's (1988) Relative Clause (RC) construction, trying to explain among others which languages prefer late closure strategy or early closure strategy in their parsing decision, what causes this particular cross-linguistic difference in each language, whether it is a process-generated strategy or arbitrary, and how NP preference in the L1 RC construction influences the NP preference in its L2 construction. These attempts have led theorists to consider two distinct proposals, the *exposure-based* account and the *universalist* account (Cuetos, Mitchell, & Corley, 1996; Fernández, 2003). The exposure-based account proposes that syntactic parsing decision in the RC attachment preferences is built upon the experience of processing similar structure as speakers are exposed to their L1 during the acquisition. The universalist account, on the other hand, posits that the preferences are independent of the speaker, but are particular to the linguistic aspect being processed as syntactic information is parsed.

a. The Exposure-based Accounts

Among the hypotheses explaining the cross-linguistic differences which lean towards the exposure-based account include the *modifier*

straddling hypothesis, *recency and predicate proximity*, as well as *tuning* hypothesis. Modifier straddling hypothesis (Cuetos & Mitchell, 1988; Cuetos et al., 1996; Mitchell & Cuetos, 1991) suggests that the preferences of Late Closure (LC) or Early Closure (EC) in RC attachment are influenced by the construction of the modifier of a noun phrase in each language, in other words, whether the adjective precedes or follows the noun head. For example, English is a *pre-modifier* language in which the adjective precedes the noun head, and thus it is predicted that native speakers of English would prefer the LC parameter rather than the EC. Spanish on the other hand, is a post-modifier language, which makes the native speakers of Spanish favour the EC parameter over the LC.

Recency and predicate proximity (Gibson, Pearlmutter, Canseco-Gonzalez, & Hickok, 1996; Pearlmutter & Gibson, 2001) introduce two possible factors which guide the parsing decision, the *recency preference* and the *predicate proximity*. Recency preference is similar to Frazier's (1987) late closure strategy in which upcoming items are to be attached to the most recently postulated structure. As recency preference does not account for the cross-linguistic difference, Gibson et al., (1996: 41) hypothesize a second factor, the predicate proximity, which says, “Attach as close as possible to the head of a predicate phrase.” This principle is based on the assumption that a sentence is organized around a predicate at its core, and so the predicate and its

arguments are ranked higher by parsers in their attachment preference. The predicate proximity principle therefore implies a cross-linguistic difference as languages have different word order, and more specifically, different average distance between the head of a predicate and its arguments.

With regard to this matter, Gibson and colleagues (1996) suggest that languages with a rigid word order, such as the SVO in English, will be less likely to activate this second factor due to the relatively low average distance from verbal heads to their arguments, and consequently speakers will rely more on the recency preference or the LC. Meanwhile languages with a freer word order such as Spanish will have stronger predicate proximity factors which lead the speakers to prefer EC to LC in the RC attachment preferences.

The tuning hypothesis (Brysbaert & Mitchell, 1996; Cuetos et al., 1996) is unlike the previous two exposure-based hypotheses in the way that it does not restrict the exposure to a certain parameter such as a modifier or a predicate phrase, but the exposure to the linguistic environment as a whole. For this reason, research on tuning hypothesis mostly rely on statistical frequency distribution of the cross-linguistic problem of interest as provided by corpus-based data. In the case of RC attachment preferences, for example, a language needs to demonstrate a high frequency of unambiguous EC preference in the corpus data, in order to predict that native speakers of the language would prefer the

EC to LC attachment in the ambiguous case. This hypothesis, however, has been rejected by a number of corpus research such as Gibson and Schütze (1999) or Mitchell and Brysbaert (1998) who both found that the preference as shown by the corpus data is in disagreement with the preference as demonstrated by the behavioural data.

b. The Universalist Accounts

Contrary to the exposure-based account which explains the cross-linguistic difference from the point of view of the speakers' L1 acquisition experience, the universalist account attempts to address this issue by referring to the specific linguistic information being processed after the syntactic parsing takes place, or in other words, cross-linguistic difference being the result of a process-generated strategy. Two hypotheses which fall under this category are the *construal* model (Frazier & Clifton, 1996, 1997) and the prosodic phrasing (Fodor, 1998; Jun, 2003). The construal model, as briefly discussed earlier, revised the garden-path model by allowing a parallel processing of other non-syntactic information to influence the parsing decision under a set of circumstances in the form of *primary* and *non-primary* relations.

Frazier and Clifton (1996) define the primary relations as the main subject-predicate relation together with the complements and other obligatory constituents in a finite main clause. Meanwhile the rest of the constituents which is non-obligatory such as the relative clause,

adjunct predicates, or conjunction acting as elaborations of argument positions are considered the non-primary relations. The significance of this distinction in the cross-linguistic difference is that, while primary relations follow the garden-path parsing strategy (i.e. late closure and minimal attachment), the non-primary relations do not.

As with the case of RC attachment which is categorized as non-primary phrases, it is argued that there is no initial structural preference. Rather than being attached, non-primary phrases are associated to the current thematic processing domain, in this case, either NP1 or NP2 in the RC attachment preference. Within this domain, processor then interpret the phrases using additional syntactic *and* non-syntactic information which may include semantic or pragmatic information processed in parallel. In response to Cuetos and Mitchell's (1988) finding of EC preference in Spanish as opposed to LC preference in English, Frazier and Clifton (1996) suggest that it has something to do with the availability of unambiguous alternative of the genitive form in English, but not in Spanish. The genitive NP1 of NP2 in English is made unambiguous in the construction of NP2's NP1, which does not exist in Spanish. This principle thus guides the Spanish speakers to prefer EC as it introduces a discourse participant (NP1) to the already existing discourse entity (NP2) through additional parallel processing of the non-syntactic information.

Another proposal which offers explanation on the cross-linguistic difference of RC attachment processing is the prosodic phrasing or the prosodic segmentation (Fodor, 1998, 2002). Prosodic phrasing postulates that prosodic information interacts with syntactic parsing in the early stage of sentence processing, providing a natural prosodic contour for the construction which intuitively guides the parsing decision. Recent studies have also found evidence that prosodic phrasing apply even in the processing of silent reading where a mental projection of prosodic phrasing is invoked implicitly (Drury, Baum, Valeriote, & Steinhauer, 2016; Gross, Millett, Bartek, Bredell, & Winegard, 2014; Hwang & Steinhauer, 2011; Kentner & Vasishth, 2016), giving prominence to Fodor's (2002) Implicit Prosody Hypothesis (IPH). This prosodic contour, either projected explicitly or implicitly, is reported to have different patterns of RC attachment ambiguity resolution in different languages, demonstrating a cross-linguistic evidence of the processing of prosodic contour (Checa-Garcia, 2016; Jun, 2003, 2010; Kuang & Angeles, 2010; Niikuni & Muramoto, 2014).

Both the universalist account and the exposure-based account have been met with criticism with inconsistent results in various studies. Recent studies have suggested that research in cross-linguistic differences need to consider individual differences among the native participants and the use of online task experiment. Regardless, among these accounts, implicit prosodic phrasing is

presumed to be still in its developing stage as it is hard to examine due to its close relation to the initial syntactic parsing (Buxó-Lugo & Watson, 2016; Kreiner & Eviatar, 2014; Nakamura et al., 2012). Further research with an experimental design which can distinguish between syntactic parsing and prosodic processing in early sentence processing stage may reveal some information towards an agreeable explanation on the cross-linguistic difference, particularly in the RC attachment preferences.

3. Second Language Sentence Processing

Unlike the case of monolingual sentence processing where researchers have offered various computational models on sentence level, discussions on second language sentence processing which naturally involves two languages have yet to figure out any working computational model which caters to the relationship of the two languages on sentence processing level. Interest in second language processing has thus far focused on the lexical processing instead, in which word recognition model has been debated over the last several decades with the most frequently consulted ones include the Bilingual Interactive Activation (BIA+) model (Dijkstra & Heuven, 1998, 2002), the Bilingual Model of Lexical Access (BIMOLA) (Léwy & Grosjean, 1999, 2008), as well as the Developmental Lexicon model (DevLex II) (Li & Zhao, 2013; Zhao & Li, 2010). This section will not further discuss these models in detail as it concerns the language processing post-word recognition stage. However, it is to be noted that what these models inform is the fundamental

viewpoint that the first language and second language involved in the second language processing interact as early as the lexical processing stage. This claim has been supported by the literature on the bilingual lexical processing models (Brysbaert & Duyck, 2010; Dijkstra & van Heuven, 2002; Grainger, Midgley, & Holcomb, 2014; Li & Zhao, 2013), suggesting that lexical activation from both languages are non-selective and that there is an integrated lexicon which stores the lexical representations of the two languages.

Apart from the lexical processing models, a number of research on second language sentence processing also accounts for the cross-linguistic activation on the word processing level. Hopp (2014, 2016) found that syntactic co-activation in the second language parsing is not only guided, but also restricted, by the processing of lexical information. This can cause a non-nativelike syntactic parsing, as in attenuation and delay effects in the L2 structure building, when there are greater demands on the lexical processing. The interactive lexical processing models may also explain how second language learners have a weaker capacity of lexical prediction in the L2 as reported by Martin et al. (2013). Clahsen and Felser's (2006a) finding on the adult L2 learners' reliance on the lexical-semantic cues over the syntactic information provide further explanation on how the cross-linguistic activation begin in the lexical processing stage.

It may begin on the level of lexical processing, but the L1 cross-linguistic influence on the second language processing has also been found to

occur on syntax level which can only be accessed as a string of lexical items forms a sentence. Tolentino and Tokowicz (2011) argue that cross-language similarity is significant to the processing of L2 syntax. In their review of a number of fMRI and ERP studies examining cross-linguistic influence in various L1 and L2 languages, they found that the results of the studies were associated with the syntactic construction that were cross-linguistically unique to the L2. Dowens, Guo, Guo, Barber, and Carreiras's (2011) ERP study of syntactic processing by Chinese learners of Spanish further confirms this proposition as they found L2 processing effects caused by the lack of gender and number agreement in the L1 Chinese as they are present in the L2 Spanish.

Evidence of similar nature is also reported in Roberts and Liszka's (2013) study which compared French and German learners of L2 English in the processing of present perfect tense/aspect violations, revealing that sensitivity to the tense/aspect violations was only found in the French learners while none was observed in the German learners. They suggest that this is due to the grammaticized aspect which is present in both French and English, but not German. Most recently Kim, Baek, and Tremblay (2015) also compare learners of two L1 languages with distinct island constraint properties, the Spanish and Korean, in the processing of L2 English. Their finding echoes the previous studies' where only Korean learners demonstrated insensitivity to syntactic violations due to the language's distinct island constraint construction as opposed to the Spanish construction

which share a similar construction with English. All these studies provide evidence for the L1 influence over the L2 processing in syntax level, albeit the lack of any proposed computational model of second language sentence processing which can further explain this L1 influence in the L2 syntactic processing.

Although it has been widely accepted that L1 influence over L2 processing is detected on syntax level, it still proved to be difficult to provide a working computational model on sentence level as literature on second language sentence processing is still pretty much evolving while theories and hypotheses are still being explored. As a starting point, It is important to note that second language processing is incremental as is the case in the monolingual language processing, although not necessarily hierarchical (Felser & Cunnings, 2012; Roberts & Felser, 2011). The anticipatory nature of incrementality then led to the growing interest in the studies of prediction or anticipation in second language sentence processing.

The general consensus on this matter is that L2 processors do not actively predict forthcoming lexical items, or is limited in their active lexical prediction, compared to the L1 processors' predictive ability. Martin et al. (2013), in their study examining L1 English monolinguals and L1 Spanish-L2 English bilinguals, account for a weaker capacity of lexical prediction in the L2 processors which they suggest is part of the consequences of slower and less accurate linguistic processing of L2. Foucart, Martin, Moreno, and Costa's (2014) findings are in line with the previous studies', only that they

further argue that L2 proficiency and similarity between the two languages can play a role in the L2 anticipation to a degree. Comparing groups of monolinguals, late bilinguals, and early bilinguals in their study, they detected anticipation processes in bilinguals whose languages are relatively similar. Meanwhile in the case of bilinguals' languages which are unique to each other, they foresee that it is possible for the bilinguals to anticipate upcoming words like monolinguals as they become proficient in the L2.

Although differences may present in the anticipatory behaviour between the L1 and L2 processing, Kaan (2014) disagrees that these differences are qualitative in nature, suggesting instead that the differences are in the same manner as those accounted for individual differences in the monolingual processing such as the frequency biases, competing information, lexical accuracy and consistency, and task effects. Prediction or anticipation in language processing, in the end, may contribute less than it seems in revealing the nature of second language processing as Huettig and Mani (2016) argue that not all processors appear to predict upcoming items and that either L1 or L2 can be interpreted in the absence of prediction.

a. Shallow Structure Hypothesis

Syntactic parsing is still the primary focus of sentence processing discussion in recent years and this later extends to the nature of syntactic parsing in the second language sentence processing. Clahsen and Felser's (2006a, 2006b) keynote article on Shallow Structure

Hypothesis (SSH) in particular has led this discussion on second language syntactic parsing, raising the question of whether L2 processors shallow parse the syntactic information unlike that of L1 processors' deep parsing. The hypothesis proposes that L2 processors are guided more by lexical-semantic information during the sentence processing, but less so by the syntactic cues.

Clahsen and Felser (2006b) suggest that even when L2 processors have a good understanding of the grammatical aspect of the L2, they would still have problems computing the complex hierarchical representation in real time, resulting in a shallow and less-detailed syntactic representation during the comprehension. For this reason, an online measure is necessary in addition to the offline task design to provide evidence for or against this hypothesis. As demonstrated by Dinçtopal-Deniz (2010) who examined the RC attachment in Turkish L2 learners of English, their study reported different findings between the online and offline tasks in which learners showed a high attachment preference in the offline task, but less consistently in the online task.

Felser and Cunnings (2012), in their study of L2 reflexive processing with discourse-prominent stimuli, provides further detail to the hypothesis that L2 processors are not only guided by non-structural cues, but also that they process these non-structural cues faster than the L1 peers. Felser, Cunnings, Batterham, and Clahsen (2012) also add that L2 processors' semantic-driven processing happened in the initial

stage of sentence processing, proposing that the L2 processing is not dependent on the detailed hierarchical representation of syntax computation.

Not only a semantic-dependent processing, Roberts and Felser's (2011) results on the study of L2 learners' insensitivity to syntactic plausibility suggest that L2 processors may also be influenced by pragmatic information. Roberts' (2012) later study, however, addresses the possibility of working memory capacity and proficiency to affect L2 processors' parsing, in that L2 processors with higher working capacity or greater proficiency may no longer shallow process the input, but likely to process the input like L1 processors. These last findings on working memory and proficiency have also been reported in other works and later taken as counterevidence rejecting the Shallow Structure Hypothesis.

b. Proficiency and Working Memory

The propositions opposing the SSH basically believe that the difference between L1 and L2 sentence processing is quantitative in nature, rather than being qualitatively distinct (Lim & Christianson, 2013; Omaki & Schulz, 2011; Reichle & Birdsong, 2014). This means that L2 processors can compare with the L1 processors given quantitatively similar parameters. What these parameters refer to are still broadly explored with recent studies suggesting L2 proficiency and

working memory as primary variables modulating the possible native-like *deep* structure processing of L2.

Some evidence regarding the proficiency variable was observed by Coughlin and Tremblay (2013) in a study examining a processing sensitivity to number agreement violations by English native speakers and French non-native speakers of high proficiency, both of which demonstrated sensitivity of a comparable degree. Similarly, Witzel, Witzel, and Nicol's (2012) study on English native speakers and Chinese highly proficient non-native speakers found that both groups were equally biased toward specific structural interpretations. Nativelikeness in proficient L2 learners is also reported by Reichle and Birdsong (2014) in their ERP study in which highly proficient English learners of French exhibited similar ERPs to the French native speakers as both groups distinguish informational and contrastive focus in a focus structure processing task, a distinction that the low proficiency subgroup failed to identify.

It is to be noted that the accounts on proficiency above also mentioned that proficiency is closely related to the working memory as both have been observed to have a positive relationship in modulating nativelikeness in the L2 processing. Linck, Osthus, Koeth, and Bunting's (2014) study for one suggests that working memory is a significant component underlying bilingual performance on measures of L2 proficiency. Both variables, therefore, are argued not to work

exclusively in their modulatory roles, rather with one affecting the other. From this point of view, there is essentially one main variable that is responsible for the L2 processing in its quantitative nature.

As it gained its deserved attention in the L2 processing discussion most recently, working memory is believed to be the primary source of the quantitative difference in L2 processing, while the modulatory role of proficiency can be traced back to the working memory capacity (Cunnings, 2017; Juffs, 2015; Reichle, Tremblay, & Coughlin, 2016). This claim is supported by several experimental accounts relying on online measures such as ERPs and self-paced reading. In SSH supporting accounts, it is widely acknowledged that L2 learners are more sensitive to semantic-pragmatic cues, while not so much by syntactic information. The earlier statement is also acknowledged by the proponents of WM influence (Pan & Felser, 2011; Pan et al., 2015), only that they argue that the reliance on semantic-pragmatic cues does not indicate shallow parsing.

The working memory (WM) proposal explains that it is the reliance on accessing and revising information in memory that is responsible for the L1-L2 differences, positing that successful L2 processing demands access to information from memory which influences L2 processors in the form of retrieval interference (Cunnings, 2017). However, it is still unclear how exactly WM explains the difficulties in L2 processing. Hopp (2014) suggests that the

processing of L2 in memory is more limited than that of L1 processing which causes the L2 processors to erase some information from memory to satisfy the prioritized information. Cunnings (2017) further deduces that this erasing process of the already assigned interpretation to be the source of the L2 processing difficulty.

On the other hand, Dai (2015) in a study comparing L2 processors of high and low WM found that high WM processors took longer time to process the stimulus than the low WM processors, therefore concluding that all possible interpretations are actually active in L2 processors of high WM which results in the processing difficulty. This contradicts the previous claim which says that WM limitation being the cause of L2 processing difficulty. Research concerning WM's role in L2 processing is still an ongoing process with a growing body of work pursuing the answer to this contradiction as well as other propositions left unexplained. As one of the more popular topics in recent L2 processing research, it is expected that WM studies will be able to shed some light on a working computational model of L2 sentence processing.

B. Review of Relevant Research

As previously addressed, evidence for incrementality is also found in the sentence processing of second language, albeit not necessarily hierarchical. This allows for the ambiguity resolution research in the second language sentence

processing which has been adopted by a number of studies in recent years. Researchers in sentence processing have been notably interested in finding out the relative clause (RC) attachment preferences in various languages, which later also apply in the studies of second language sentence processing in languages with distinctive L1-L2 linguistic properties. Three of these accounts, in particular, have contributed to the growing body of research in second language sentence processing, examining L2 learners of English with different L1 background: Chinese (Dai, 2015), Turkish (Dinçtopal-Deniz, 2010), and both Chinese and German (Pan et al., 2015), respectively. This section will discuss the three studies which are considered to offer different perspectives on this matter from the past few years.

Each of these studies has its own particular topic of interest with the L2 RC attachment preference at its core deciding variable. Dai (2015) is interested in working memory as a possible influence in L1 and L2 processing differences. Dinçtopal-Deniz (2010) investigates the role of animacy of the noun phrases involved in the RC attachment as well as trying to seek evidence of the Shallow Structure Hypothesis. Meanwhile Pan et al. (2015) took an interest in how referential context information possibly affects the L2 RC attachment preferences. Despite the different focus of the three studies, all of them involve the investigation of L2 RC attachment preference as the fundamental requirement for the more exhaustive L2 processing description. The findings of the RC attachment preference experiments of these studies are discussed as relevant research findings for the current study.

The three studies have similar method in investigating the L2 RC attachment preferences. All these studies adopted Cuetos and Mitchell's (1988) experimental design on examining the RC attachment preference of L2 learners of English, as well as employing both offline and online measures for the experiments. The offline experiments were measured by comprehension tasks in the form of questionnaire, while the online experiments were measured by reaction time technique through the means of self-paced reading tasks. The studies compared the L2 learners of English from different L1 background with the native speakers of English as the control group, except for Dai (2015) which compared the RC attachment preferences of the same participants in the L2 English and L1 Chinese materials.

There is no significant difference between the three studies in terms of methodology aside from the native language of the participants, numbers of participant, or detailed stimulus sentences. Among these differences, the L1 background difference is especially worthy of notice as it is expected to give insights to how L1 RC attachment preference may influence the L2 RC attachment preference. It may also offer some ideas on whether there is any difference between the L1 which prefers the Late Closure (LC) strategy and the one which prefers the Early Closure (EC) strategy as they interact with the L2 English whose native speakers are identified with the LC preference. Some important details of all three studies are summarized in the following table to provide a clear comparison between the findings of each study.

Table 1. Summary of Relevant Research Findings

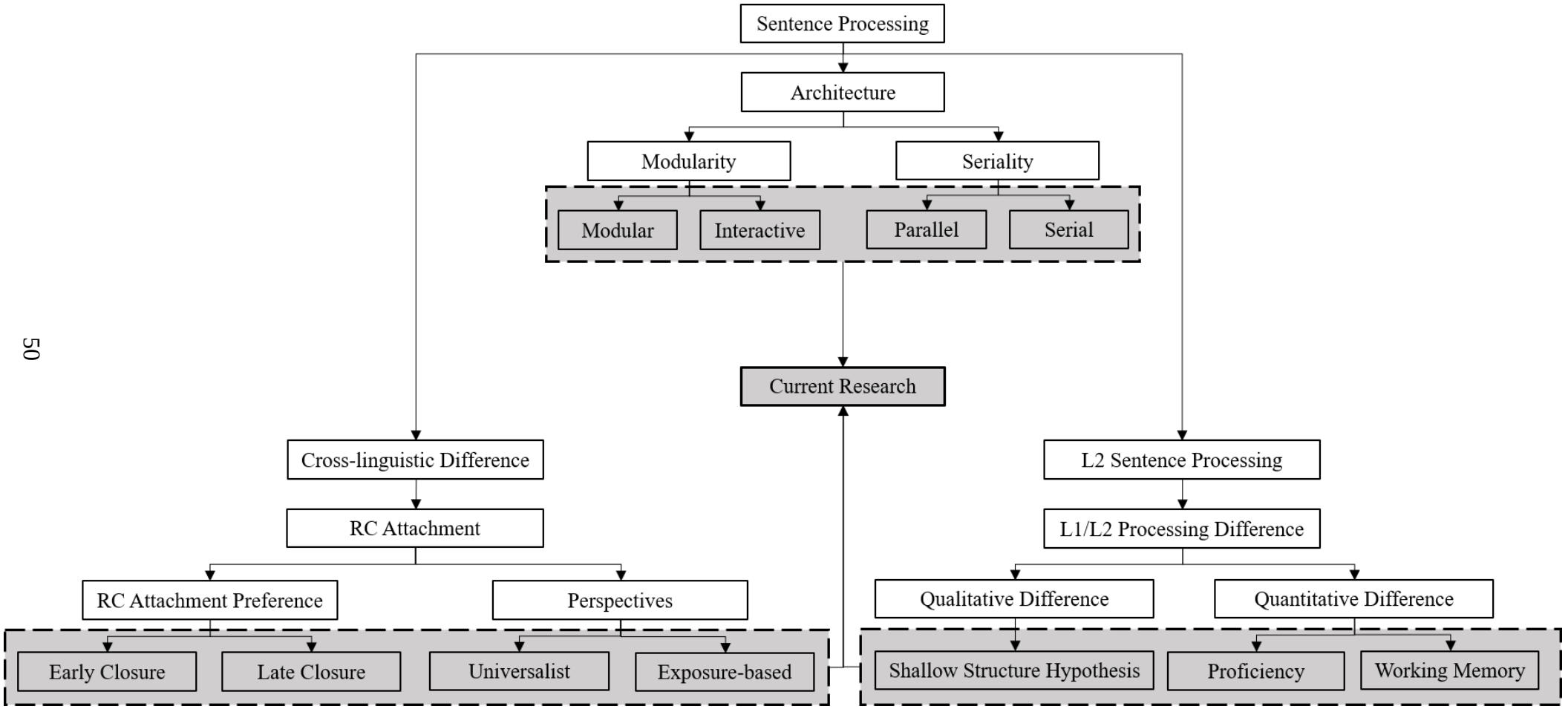
<table>
<tr><th rowspan="2">Studies</th><th rowspan="2">L1</th><th colspan="2">L1 Attachment Preference</th><th colspan="2">L2 English Attachment Preference</th><th colspan="2">English Control Attachment Preference</th></tr>
<tr><th>Offline</th><th>Online</th><th>Offline</th><th>Online</th><th>Offline</th><th>Online</th></tr>
<tr><td rowspan="2">Dinçtopal-Deniz (2010)</td><td rowspan="2">Turkish</td><td rowspan="2">LC</td><td rowspan="2">LC</td><td rowspan="2">EC</td><td>EC (animate)</td><td rowspan="2">LC</td><td rowspan="2">LC</td></tr>
<tr><td>LC (inanimate)</td></tr>
<tr><td>Dai (2015)</td><td>Chinese</td><td colspan="2">Unclear</td><td>EC</td><td>LC</td><td colspan="2">Not examined</td></tr>
<tr><td rowspan="2">Pan et al. (2015)</td><td>German</td><td colspan="2" rowspan="2">Not examined</td><td>EC</td><td>Unclear</td><td rowspan="2">LC</td><td rowspan="2">Unclear</td></tr>
<tr><td>Chinese</td><td>EC</td><td>Unclear</td></tr>
</table>

As seen in Table 1, the studies share the same finding in the offline L2 RC attachment preference of the L2 learners, as well as the offline RC attachment preference of the English control group when available. Meanwhile the rest of the findings are varied and do not show a certain pattern. Dinçtopal-Deniz's (2010) finding with regard to the different strategies preferred in the online L2 RC attachment disambiguation is explained by the animacy of the NPs. On the other hand, the lack of preference in Pan's et al. (2015) finding on the same category is interpreted as a result of the L2 learners' sensitivity to contextual cues more than the structural information, which resonates with the Shallow Structure Hypothesis.

The SSH is also suggested as an explanation to Dai's (2015) different results between the offline and online experiment in the L2 RC attachment preference. Dai (2015) argues that the offline tasks allowed for the participants to integrate the various lexical-semantic sources of information, which is not possible to perform in the online means of self-paced reading. Considering the agreement and

disagreement observed in the findings of these three studies, the current research is expected to offer new insights and perspectives to the topic of interest as well as contributing to the growing number of studies in the L2 sentence processing research.

C. Conceptual Framework



D. Research Questions

Reviewing the extensive literature and the relevant research findings, three research questions are posed in response to the objectives of the research established in the first chapter.

1. What attachment strategy do the Indonesian learners of English prefer in the offline processing of English Relative Clause sentences?
2. What attachment preference do the Indonesian learners of English prefer in the online processing of English Relative Clause sentences?
3. Does syntactic proficiency have an effect on the L2 sentence processing of English Relative Clause sentences by the Indonesian learners of English?

The first two research questions directly respond to the first research objective, while the third questions respond to the second objective. With regard to the third and fourth research objectives which concern the universality and architecture of L2 sentence processing respectively, the different methodological nature associated with the first and the second research questions is of significance. It is to be noted that relative clause attachment preference is not the goal of this research, but a device to understand the working mechanism of L2 sentence processing. A comparison between the results of offline processing addressed in the first question which allows a reanalysis process, and the online processing addressed in the second question which does not, should further inform some aspects of universality and architecture of L2 sentence processing. Additionally, the answer to the third question will contribute to the discussion of L2 sentence processing architecture when compared to the previous research findings.

CHAPTER III

RESEARCH METHOD

A. Type of the Research

This research approached the problems using two quantitative measures to satisfy the two different nature of sentence processing. Readers naturally process sentences incrementally as they keep building interpretations words after words (online), then finalize the interpretations as they finished reading the whole sentence with possible re-reading(s) and re-interpretation (offline). Three separate studies were conducted in response to the research questions, one applying the offline measure and two the online measure. The offline study, which employed a sample survey research design, examined the sentence processing from its final interpretation. Meanwhile the two online studies, which adopted the experimental and ex-post facto design respectively, investigated the sentence processing as it progresses in real time towards a final interpretation. The use of these two distinct measures holds particular significance for this study as some necessary information would not be available from either measure on its own.

All studies are cross-sectional quantitative research in which the study of Relative Clause (RC) attachment preferences is projected onto comparison of means constituting the disambiguation strategy of Early Closure (EC) and Late Closure (LC). The judgement task questionnaire (Bader & Hussler, 2010; Schütze & Sprouse, 2013) was devised in the offline survey design, while self-paced reading (SPR) task (Jegerski, 2013; Keating & Jegerski, 2015; Marsden, Thompson, &

Plonsky, 2018) was utilized in the experimental and ex-post facto studies representing the online measure. Details on each of these research designs are elaborated in the following sections.

B. Population and Sample

This study is interested in Indonesian learners of English of intermediate level and above considering that the interpretation of RC sentence construction would require this particular level of English proficiency. Indonesians have normally learned English since the junior high school of their formal education or by the age of 13. However, only bachelor's students of English programs receive meaningful exposure and use their English regularly. For these reasons, the target population of the study was Indonesian graduate students who have completed their bachelor's degree in English programs, including English Education, English Literature, and English Linguistics.

The study was conducted at the Graduate School of Yogyakarta State University, and the participants of the study were volunteers from the English Education major as well as Applied Linguistics students minoring in English Education and English Literature. Prior to their admission, the students have taken the standardized official English proficiency test provided by the university, the ProTEFL (Proficiency Test of English as a Foreign Language), which is an equivalent of the paper based TOEFL in terms of scoring and qualification (Pusat Pengembangan Bahasa Yogyakarta State University, 2019).

A homogenous convenience sampling technique was utilized as learners volunteered to participate according to their availability. A homogenous convenience sampling, however, is not exactly the same as the conventional convenience sampling since it controls the homogeneity of the sample using a set of criteria. Adhering to the assumptions of the inferential statistics used in this study, homogenous convenience sampling is argued to have a clearer generalizability than its conventional or heterogeneous counterpart (Jager, Putnick, & Bornstein, 2017). Furthermore, the theoretical sentence processing which is the interest of the study assumes that the underlying representation across the population is relatively stable with major interpersonal variation being proficiency. As proficiency was included as the predictor variable of the third study, this allows for the homogenous convenience sample to be more representative of the population (Buchstaller & Khattab, 2013).

To achieve a sample that is representative of the target population, the homogeneity of the sample was controlled by consulting several sampling criteria. These included a minimum ProTEFL score of 450 in the first attempt of the test, a regular use of Indonesian and English in the participants' academic life, no history of reading disability, and active attendance in the participants' respective program. This resulted in a total of 119 participants, 55 of whom participated in the first study, while the remaining 62 participated in the second study. Of the 62 participants of the SPR study, a group of 30 was commissioned as the control group, and 32 as the experimental group. Additionally, 37 of the 62 SPR participants in the second study volunteered to participate in the third study.

C. Variables of the Research

As there were three studies in this research, a survey study, an experiment and an ex-post facto study, there were several different variables in each study. The survey study aimed to identify the participants' RC attachment preference in an offline reading of ambiguous RC sentences. To address this objective, a judgement task was devised with the ambiguity-controlled RC sentences as the independent variable and the participants' RC attachment preference being the dependent variable.

The second study was an SPR experiment examining the RC attachment preference in an online reading of globally ambiguous RC sentences for the control group, and locally ambiguous RC sentences for the experimental group. Unlike the offline judgement task in the first study, the participants' RC attachment preference was not directly expressed by the participants. It can be observed, however, from the reaction time of parts of the RC sentences through the SPR design. For this reason, the reaction time represents the dependent variable of the second study. Meanwhile the manipulated RC sentences in terms of its ambiguity were the independent variable.

The third study was similar to the second study with its SPR task design, only that the treatment of the RC sentences was not a local ambiguity. Rather, the RC sentences for this study were never ambiguous as syntactic marker was added to each sentence. It aimed further at explaining whether syntactic proficiency affects the RC attachment preference. Adopting the ex-post facto research design, the independent variable was already part of the participants' quality, namely the

syntactic proficiency. The dependent variable on the other hand, similar to the previous SPR study, was represented by the reaction time of the specifically designed target items.

D. Data Collecting Technique and Instruments

As previously mentioned, this research used two different measures, an offline measure for the first study and an online measure for the second and third study. The design of both measures adopted Cuetos and Mitchell's (1988) classic design which has been replicated by a number of studies including the recent ones. These measures which represent two different data collecting techniques as well as different instruments are described separately as follows.

1. Offline Measure: Judgement Task

The first study utilized a judgement task (Bader & Hussler, 2010; Schütze & Sprouse, 2013) presented to the participants in sheets of paper. There were 46 items for the participants to make interpretative decisions on. These included 20 target items interspersed with 26 filler items. Each of the items consisted of a sentence, a comprehension question, and two answer choices. The sentences in the target items were ambiguous RC sentences. Meanwhile the filler items were in the form of multi-clause sentences, other than that of RC construction, which were designed to distract the participants from getting used to the structure of the target items. An example of the target item is as follows.

Kate read the prologue of the novel which was quite long.
Being quite long:
A. The prologue
B. The novel

All the RC sentences, as exemplified above, were globally ambiguous, or can be interpreted in two different ways even after an entire sentence was read. In this case, it is unclear whether the RC "which was quite long" attaches to the first Noun Phrase (NP1) "the prologue" or the second Noun Phrase (NP2) "the novel". The comprehension question is not in the form of WH-question. This is to avoid the risk of influencing the participants' interpretation when the two NPs have different animacy, as generally indicated by the pronoun "Who" for animate NPs or "What" for inanimate NPs.

The judgement task was administered to 55 participants. The participants were encouraged to respond with their earliest understanding of the sentences, as written in the task instruction, in order for them to provide their most natural offline reading interpretation once all the necessary information was processed. The participants were also requested to work on each item in the way they were ordered so that no pool of target items being read consecutively and risks biasing their interpretation. Each of the participants' responses were coded with EC or Early Closure for the items responded with NP1 choices, and LC or Late Closure for those with NP2 choices. These coded responses were then organized into a table for analysis.

2. Online Measure: Self-paced Reading Task

a. Task Design

The self-paced reading (SPR) task as the online measure was devised for the second and third studies. It was aided by a python-based software, the PsychoPy (Peirce et al., 2019), which is capable of recording reaction time in millisecond. This software also allows its users to upload and download the experimental materials as well as the responses, only by visiting a website provided by the material designer. This feature was utilized in both SPR studies, in which the participants downloaded the materials and did the task on their own laptop, before uploading their responses back to the researcher's database. Nevertheless, the researcher was present while the participants were working on the SPR task. This was by consideration that the online reading task was something new to the participants, therefore the researcher was to stand by in the same room for possible necessary guidance albeit the detailed step-by-step instructions preceding the SPR task.

The entire SPR task was displayed on a computer monitor in full screen with a grey background and white letters. In each experimental study, the task consists of seven main components: an introduction, instructions, 5 practice items, 10 target items, 29 filler items, 2 intermissions, and a closing statement. These components were displayed consecutively as mentioned except for the target items and

the filler items which were displayed randomly, as well as the intermissions which divide the whole task into three relatively equal sessions. Additionally, there were breaks between each stimulus item in the form of displayed three dots (…) which signalled the participants of an end of a stimulus item and for a new one to appear.

The introduction began with a greeting, an overview of what the participants were about to see, and what they are expected to do. There were several separate instructions including the way to read the stimulus, a note about comprehension questions, and the way to answer comprehension questions, each of which was followed by examples in the form of practice items. The instruction section ended with a reminder that the following section would begin displaying items to which their responses would be recorded as the research data. The intermissions displayed a suggestion for the participants to take a breather and refresh their attention in-between sessions. The SPR task ended with a congratulatory statement, a gratitude, and a notice to wait for the responses to be saved and automatically uploaded to the researcher's database. All components other than the stimulus items were written in the participants' native language, Indonesian, to avoid any confusion or unclear instructional messages.

The stimulus items consisted of RC sentences for the target items and multi-clause sentences for the filler items. Each of these items was followed by a separate display of comprehension question. The

comprehension questions were in the same format as those in the offline judgement task study. The answers to these questions, however, were not taken as the main data. Rather, they may inform indirectly about the interpretation of the reaction time. Furthermore, an additional third option 'Undecided' were added to allow for further consideration in analysing the reaction time. All the stimulus sentences were displayed clause by clause in which participants were in control as to how long they were shown on the monitor.

The participants can press the spacebar on their keyboard for the current display to change to the one that follows anytime they wish to, with the exception of the comprehension question display in which they have to press the number 1 or 2 or 3 on the numerical keyboard respective to the answer they chose. The time in which each clause was displayed, as automatically recorded by the program, represented the reading time or the reaction time. The participants were encouraged to pace their reading as naturally as the way they would read the sentences in an offline reading in order to prompt a near-natural reaction time data. Only the reaction time of the third clause was taken as the main data, as elaborated in the discussion of stimulus materials below.

b. Stimulus Materials

The second and third studies followed the same procedure as described above. The only difference was in the materials of the SPR

experiment. The materials of the second study were based on the first offline study which took advantage of the ambiguity of RC sentences. However, instead of using globally ambiguous RC sentences, the materials for the experimental group were designed to represent locally ambiguous RC sentences. These sentences are only temporarily ambiguous, as by the end of the sentence, another clause is added to disambiguate the RC attachment ambiguity. The following RC sentence exemplified the stimulus materials for the second study with the slashes indicating the split in which the three clauses were displayed separately in turn.

Kevin greeted the son of his sister / who stood in front of the door / wearing a pink dress.

Where the RC sentences in the offline judgement task would have ended in the second clause, the RC sentences in the online SPR task have an additional clause which refers back to the attached NP, in this case NP2, thus disambiguating the sentence. In the example, the additional clause “wearing a pink dress” can only commonly explain the NP2 “his sister”, while being pragmatically incompatible with the NP1 “the son”. All the additional clauses in the SPR experiments were designed to explain the NP2, while being incompatible with the NP1 by utilizing pragmatic conventions. This was decided on the basis of the offline judgement task results which showed significant preference for the NP1 (Early Closure), noting that the second and third studies were

conducted after the results of the first study were analysed. Considering that the participants tended to attach the RC to the NP1 in the offline study, it was hypothesized that an additional clause which is incompatible with the NP1 would cause a processing error, encourage a re-analysis of the sentence by re-attaching the RC to the NP2, and thus result in longer reaction time. This was the reason why only the reaction time of the third clause was taken as the main data, as re-analysis attempt would begin as the participants arrived at this disambiguating clause.

The materials for the control group were designed based on the stimulus materials of the experimental group above. The control group was expected to give 'neutral' consistent reaction time of the third clause throughout. For this reason, the first clause of the same RC sentences as those in experimental group were modified, so that the third clause was compatible to both NP1 and NP2. The following example shows the modification of the previous RC sentence as designed for the control group.

Kevin greeted the daughter of his sister / who stood in front of the door / wearing a pink dress.

As seen in this modified RC sentence, the NP1 was changed from "the son" to "the daughter", causing both NPs to have equal chance of being attached to the Relative Clause as well as explained by the third clause. By having both NPs compatible with the third clause, any

attachment strategy preferred by the participants of the control group would not prompt any re-analysis, and thus no extended reaction time expected from the processing of third clause. The modification for all the RC sentences was restricted to only the first clause and was kept minimum by only changing a word. This way, the rests of the sentence were comparable for the statistical analysis. The items in the control group was also followed by comprehension questions, despite having no real answer. They functioned mainly as motivation for the participants to actually read the sentences instead of just pressing the button.

The stimulus materials for the third study were inspired by the second study. It basically shared a similar construction, except that the RC sentences in the third study were never ambiguous. These sentences were marked by syntactic marker in the form of gender and number agreement.

Peter played with the children of the landlord / who has been close to him / as if he was his uncle.

These particular RC sentences were designed to account for syntactic sensitivity as possible variable affecting the RC attachment preferences, which was the focus of the third study. Similar to the second study, the third clause was only compatible with the NP2, which worked in conjunction with the syntactic marker in the Relative Clause. As shown in the example, the verb “has” can only be in an agreement

with the NP2 “the landlord”. It is therefore hypothesized that syntactically sensitive participants would notice the subject-verb agreement and dismiss any ambiguity. For this reason, the reaction time in the second clause was also considered in the analysis of the third study. Additionally, the syntactic proficiency data representing the independent variable of the third study were collected from the participants’ proTEFL results on syntactic proficiency as provided by Pusat Pengembangan Bahasa Yogyakarta State University (2019).

E. Instrument Validity and Reliability

Different strategies were used to enhance the reliability and minimize threats to validity between the two types of the studies, as both the judgement task survey study and the self-paced reading task dealt with instrument validity and reliability differently. In the judgement task study, the reliability was addressed by calculating the Kuder-Richardson 20 (KR-20) formula, considering that the study took the form of a questionnaire with dichotomous variable. The result suggested a high internal consistency of the instrument with the reliability estimate of KR-20 = 0.84. With regard to the analysis of the data, it was ensured that the test assumptions were met, and the descriptive statistics of the data were reported so that the results of the study can be interpreted with reference to how the data were distributed.

The validity of the judgement task was established using exploratory factor analysis with oblique rotation (direct oblimin). As the judgement task questionnaire was intended to measure one construct based on the model theory (i.e. the RC

attachment preference), a single factor and closeness to unidimensionality were sought from the analysis. The KMO and Bartlett's test verified the sampling adequacy, KMO = 0.67 (above the acceptable limit of 0.50 as in Kaiser and Rice, 1974), Bartlett's test of sphericity is significant at $p < 0.001$. A Parallel Analysis based on Minimum Rank Factor Analysis (ten Berge & Kiers, 1991) suggested one extracted factor by consideration of the 95 percentile of random % of variance, which is in agreement with the model factor.

The index of Explained Common Variance (ECV) was used as an indicator to the essential unidimensionality. The values of Item Explained Common Variance (I-ECV) were attached in the appendices, while the overall assessment of Explained Common Variance (ECV = 0.71) suggested that the data can be treated as essentially unidimensional (Rodriguez, Reise, & Haviland, 2016a, 2016b; Stucky, Thissen, & Orlando Edelen, 2013). With regard to the construct replicability, generalized-H index was used to evaluate how well the items represent a common factor. The analysis identified the value of G-H = 0.93, which is well above the recommended value of 0.80 (Hancock & Mueller, 2001), suggesting a well-defined latent variable that is likely to be stable across studies.

As for the SPR experiment, different strategies were used to address the reliability and validity of the task. SPR data in the form of reaction time are sensitive data represented in milliseconds. There are risks of reflex unintentional button presses which result in an impossibly fast reading time, or readers being distracted by uncontrolled variable which causes an overly long reading time. For this reason, two levels of data trimming were applied before the data were converted to the

aggregate means for analysis. The first data trimming was done by applying an absolute cutoff method in which a reaction time data below 200 ms or over 6000 ms will not be counted as suggested by Jegerski (2013). Only then the z-scores of all the remaining data were computed to find any outliers and to further trim the data, i.e. no data were to have the z-scores greater than 2.58. With respect to the standardization of the task administration, the same instructions and procedure were administered, while random interference from testing environment was minimized. Thick description on the procedure is also provided in the previous section with a note of two intermissions for the participants to rest and refresh their attention.

Several strategies were used to minimize threats to validity of the SPR task. Initial attempt was done by consulting an expert as the instrument validator. The task items were verified by the instrument validator to be in congruence with the theoretical framework and the research objectives. As the design of the SPR task has been previously implemented in relevant studies, the results of these studies using similar instruments were also taken as consideration to establish the validity once the results were analysed. This helps confirm that the task does not measure anything else but the RC attachment preferences. Additionally, the construct behind the instruments was clearly defined while the relevance of the use of the data to the intended interpretation was described. The results were also organized in a comprehensive manner for the readers to decide on whether the findings were applicable to their context.

For both the judgement task and the SPR task studies, several sampling criteria were applied to prospective participants to reduce any extraneous variables

coming from the sample. Adequate coding and scoring procedures of both tasks were also provided to illustrate how the data were generated and consistently measured. Descriptive statistics and test assumptions were calculated and reported to show the data distribution as well as the suitability of the statistical test. Finally, the collected data are comprehensively organized and available for reviewing in the appendices.

F. Data Analysis Technique

In response to the research questions, the comparison of means was used in the first and second study to determine whether there is any significant difference between two distinct groups, while a regression model was applied to the third study to see if there is any causal relationship between the variables. The first study was interested in the difference between the number of selections made by the participants with regard to the Early Closure strategy and the Late Closure strategy. Considering that both selections were collected from the same 55 participants, the paired-samples t-test was utilized to compare the two preferences. The second study used the independent t-test as it followed the experimental design of comparing the experimental group with the control group, each of which received a different treatment of RC sentences as the stimulus materials. The third study used the regression model to see whether the independent variable of syntactic proficiency has an effect on RC attachment reaction time.

In order for the data to be ready for the significance testing, several steps of preparation were made depending on the type of the study. In the judgement task

study, the collected data were coded based on the preferred RC attachment in each sentence of the target items. If an NP1 was preferred, then the item was identified with the code 'EC' for Early Closure strategy. Alternatively, if an NP2 was preferred, the item was coded 'LC' for Late Closure strategy. The coding process was definite in nature and organized in a table as exemplified in Table 2. Once all the data were coded, the sum of the preferred RC attachment in each participant was calculated and ready for the computerized analysis of both the descriptive statistics and the significance testing. The comparison of means between the number of EC and LC selections using the paired-samples t-test shall be able to estimate the significance of differences between the two RC attachment preferences. The following null hypothesis was proposed as a criterion for the significance testing of the first study.

Ho: There is no significant difference between the selections of Early Closure and Late Closure strategy by the Indonesian learners of English in the offline reading of English Relative Clause sentences.

Table 2. Judgement Task Data Analysis Sheet (Study 1)

Participants	Target Items					Number of Selections	
	R01	**R02**	**R03**	**…**	**R20**	**EC**	**LC**
J01	EC	EC	LC	…	EC	…	…
J02	EC	LC	EC	…	EC	…	…
J03	EC	EC	LC	…	EC	…	…
J04	EC	EC	EC	…	EC	…	…
…	…	…	…	…	…	…	…

Notes:
J01 : Participants of the judgement task study by chronological order.
R01 : Relative clause target items by chronological order
EC : Selection of Early Closure strategy
LC : Selection of Late Closure strategy

The analysis of the SPR data in the second study required no significant data coding relevant to the analysis. The only coding process involved was with respect to the distinction between the control participants and the experimental participants. The preparation for the significance testing of the SPR task was concerned more with the identification of outliers and data trimming to provide reliable data as explained in the previous section. These data were then transformed into aggregate means for each participant in both the control group and the experimental group. Table 3 shows the organization of the data trimming and the aggregate means of the participants in each group. The data of the participants in the experimental group were organized in a separate yet identical table, with the only difference being the codes of the experimental participants. After all the aggregate means for each participant were calculated, the results from both the control group and the experimental group were compiled in a table as seen in Table 4, representing the

processed data available for the t-test analysis. The null hypothesis significance testing for the second study is presented as follows.

Ho: There is no significant difference in reaction time between the Indonesian learners of English who read the English Relative Clause sentences with Late Closure disambiguation (experimental group) and those who read the sentences without particular disambiguation (control group) in the online reading activity.

Table 3. SPR Experiment Data Analysis Sheet (Study 2)

Participants	**Target Items**	**Reaction Time (ms)**	**Outliers (z > 2.58)**	**Aggregate Means (without outlier)**
C01	GA01	919	1.096	…
	GA02	2133	0.015	
	GA03	1971	0.160	
	…	…	…	
	GA10	2479	0.292	
…	…	…	…	…
E01	LA01	1600	0.490	…
	LA02	2485	0.297	
	LA03	5793	3.242 (Outlier)	
	…	…	…	
	LA10	2734	0.519	
…	…	…	…	…

Table 4. Data Analysis Sheet for Independent T-test (Study 2)

Aggregate Means of Experimental Group		**Aggregate Means of Control Group**	
Participants	**Means of Reaction Time**	**Participants**	**Means of Reaction Time**
E01	…	C01	…
E02	…	C02	…
E03	…	C03	…
…	…	…	…

Notes:

C01 : Control group participants of the SPR task in the second study by chronological order.

E01 : Experimental group participants of the SPR task in the second study by chronological order.

GA01 : Globally ambiguous Relative Clause sentences by chronological order as the stimulus sentences for the control group.

LA01 : Locally ambiguous Relative Clause sentences by chronological order as the stimulus sentences for the experimental group.

Similar to the second study, the analysis of the third study began with the data trimming and the calculation of the aggregate means. It is to be noted, however, that two reaction time data were recorded in the third study, i.e. the reaction time data for display 2 and display 3. As pointed out in the data collecting technique, the RT stimulus items were displayed in three parts: the locally ambiguous clause, the defining RT clause, and the disambiguating clause. In the third study, the defining RT clause in the second display was designed to contain syntactic marker which might indicate the participants' syntactic sensitivity.

To address this variable, a table dedicated for the reaction time data of the second display was created in addition to that of the third display, both of which were identical in design as observed in Table 5. The aggregate means for the

reaction time data of both display 2 and display 3 were then compiled in a different table (Table 6) which also accommodated the independent variable of syntactic proficiency. The final data used for the regression analysis included the syntactic proficiency scores and the aggregate means of the trimmed reaction time data. Corresponding to the two sets of reaction time data of interest, two null hypotheses were suggested in the third study.

Ho_1: There is no significant effect of syntactic proficiency score on the reaction time of the defining relative clause (Display 2) in the online reading of Relative Clause sentences by the Indonesian learners of English.

Ho_2: There is no significant effect of syntactic proficiency score on the reaction time of the final clause (Display 3) in the online reading of Relative Clause sentences by the Indonesian learners of English.

Table 5. SPR Task Data Analysis Sheet (Study 3)

Participants	Target Items	Reaction Time of Display 2 (ms)	Outliers (z > 2.58)	Aggregate Means (without outlier)
S01	D201	4035	1.587	…
	D202	1316	0.948	
	D203	1150	1.103	
	…	…	…	
	D210	2933	0.560	
…	…	…	…	…
S01	D301	2208	0.116	…
	D302	1824	0.474	
	D303	1898	0.405	
	…	…	…	
	D310	2289	0.040	
…	…	…	…	…

Table 6. Data Analysis Sheet for Regression Test (Study 3)

Participants	Syntactic Proficiency Score	Aggregate Means of Display 2	Aggregate Means of Display 3
S01	…	…	…
S02	…	…	…
S03	…	…	…
…	…	…	…

Notes:

S01 : Participants of the third study on the effect of syntactic proficiency by chronological order.

D201 : Display 2 of Relative Clause stimulus sentences by chronological order.

D301 : Display 3 of Relative Clause stimulus sentences by chronological order.

Reaction time data by nature are necessarily positive, generally right skewed, and with the variance of the response grows with its mean. Unlike an experimental design which provides a clear distinction between two compared groups as seen in the second study, these characteristics may pose a problem for an ex-post facto design of the third study. For this reason, generalized linear model with gamma family which accommodates this type of data was used for the significance testing, while the log linear link function was chosen by consideration of the AIC value. This model was preferred as it suits the model assumptions to the data instead of forcing the data to fit a set of model assumptions as is the case of the classical approach of data transformation (Fox, 2016; McCullagh & Nelder, 1983). All the statistical analyses in this research were computed using the IBM SPSS version 25.

CHAPTER IV

FINDINGS AND DISCUSSION

A. Research Findings

The findings of the research are presented in three sections based on the research questions in chapter 2. These include the attachment preference of the Indonesian learners of English in both the offline and online processing of English Relative Clause (RC) sentences in response to the first two questions, and the effect of syntactic proficiency on second language processing as posed by the last question. These findings will be discussed in the next sub-chapter responding to the research objectives established in the first chapter.

1. Attachment Preference of the Indonesian Learners of English in the Offline Processing of English Relative Clause Sentences

In the judgement task study, there were 55 participants whose selections of Relative Clause attachment strategies from 20 target items were examined. The descriptive statistics revealed that on average, the participants favoured the Early Closure strategy (M = 14.80, SD = 4.18) more than the Late Closure strategy (M = 5.20, SD = 4.18). Table 7 provides an overview of the descriptive statistics of the data obtained in the judgement task study.

Table 7. Descriptive Statistics of Early Closure and Late Closure Selections in the Judgement Task Study

Selections of RC Attachment Strategy		Statistics	*SE*
Early Closure Strategy	*N*	55	
	M	14.80	0.563
	Mdn	16.00	
	SD	4.178	
	Minimum	2	
	Maximum	20	
	Skewness	-0.894	0.322
	Kurtosis	0.686	0.634
Late Closure Strategy	*N*	55	
	M	5.20	0.563
	Mdn	4.00	
	SD	4.178	
	Minimum	0	
	Maximum	18	
	Skewness	0.894	0.322
	Kurtosis	0.686	0.634

The paired-samples *t*-test was conducted to further determine whether the difference was significant. As the assumption of independence to conduct the paired-samples *t*-test was met by design when the data were collected, it was ensured that the distribution of both selections did not deviate significantly from normal by calculating the *z*-scores of skewness and kurtosis (Kim, 2013). The resulting *z*-scores for both the Early Closure selections ($z_{skewness}$ = -2.78, $z_{kurtosis}$ = 1.08) and the Late Closure selections ($z_{skewness}$ = 2.78, $z_{kurtosis}$ = 1.08) were not significant at $p < 0.001$. This indicates that both distributions were not kurtotic, and despite being slightly skewed, they took comfort from the central limit theorem as confirmed by the P-P plots in the

appendices. The subsequent paired-samples *t*-test produced the following results as summarized in the following table.

Table 8. T-test Analysis of the Early Closure and Late Closure Selections in the Offline Reading of English Relative Clause Sentences by the Indonesian Learners of English

	***M*(SD)**	***M* difference**	**CI_{95} of the Difference**		***t*(*df*)**	**Cohen's *d***
			Lower	**Upper**		
Early Closure Selections	14.80(4.18)	9.60	7.34	11.86	*t*(54)= 8.519	2.30 (large)
Late Closure Selections	5.20(4.18)					

As seen in Table 8, the results showed that the mean difference between the Early Closure selections and the Late Closure selections, 9.60, 95% CI [7.34, 11.86], was significant, $t(54) = 8.519$, $p < 0.001$. The magnitude of the difference was assessed by computing the Cohen's *d* which represented an effect of $d = 2.30$, denoting a large effect size. These results suggested that in an offline reading, there was a marked tendency for the participants to attach the RC to the first noun phrase which demonstrated the preference for the Early Closure strategy, as opposed to the second noun phrase or the preference for the Late Closure strategy.

2. Attachment Preference of the Indonesian Learners of English in the Online Processing of English Relative Clause Sentences

An independent-samples *t*-test was conducted to determine whether there were differences in reaction time between the experimental group (N = 32) and the control group (N = 30) of the SPR experiment. The mean reaction time data at the targeted items for each group are shown in Table 9. As prerequisites to conducting the test, the assumption of normality was first addressed by calculating the z-scores of the skewness and kurtosis of the distributions, while the assumption of homogeneity of variance was observed by examining the Levene's test.

Table 9. Descriptive Statistics of the Reaction Time Data of the Experimental and Control Group in the SPR Experiment

Reaction Time		Statistics	*SE*
Experimental Group	*N*	32	
	M	2117.31	71.563
	Mdn	2056.00	
	SD	404.821	
	Minimum	1574	
	Maximum	3193	
	Skewness	0.762	0.414
	Kurtosis	0.157	0.809
Control Group	*N*	30	
	M	2032.07	79.588
	Mdn	1988.50	
	SD	435.922	
	Minimum	1335	
	Maximum	2809	
	Skewness	0.066	0.427
	Kurtosis	-1.169	0.833

The skewness and kurtosis z-scores for the distribution of experimental group ($z_{skewness}$ = 1.84, $z_{kurtosis}$ = 0.19) and the control group ($z_{skewness}$ = 0.15, $z_{kurtosis}$ = -1.40) suggest that the distribution of reaction time data for both groups did not deviate significantly from normal at $p < 0.05$. Levene's test also suggests that the variances for the experimental group and control group were approximately equal, $F(1, 60) = 0.58$, $p = 0.451$. With the assumptions met, the independent-samples *t*-test was conducted which results are presented in Table 10.

Table 10. T-test Analysis of the Experimental and Control Group in the Online Reading of English Relative Clause Sentences by the Indonesian Learners of English

	***M*(SD)**	***M* difference**	**CI_{95} of the Difference**		***t*(*df*)**	**Cohen's *d***
			Lower	**Upper**		
Experimental group	2117.31 (404.82)	85.25	-128.33	298.82	*t*(60)= 0.798	0.20 (small)
Control group	2032.07 (435.92)					

On average, the participants in the experimental group read the RC target items longer (M = 2117.31, SD = 404.82) than those in the control group (M = 2032.07, SD = 435.92). However, this difference, 85.25, 95% CI [-128.33, 298.82] was not significant, $t(60) = 0.798$, $p = 0.428$. The Cohen's d value also represented a small effect size, $d = 0.20$. These estimates reflect a failure to reject the null hypothesis and suggest that there was no significant difference indicated by the t-test between the experimental group and the

control group in terms of their reaction time in the online reading of the RC target items.

3. Effect of Syntactic Proficiency on L2 Sentence Processing of English Relative Clause Sentences by the Indonesian Learners of English

The third study examined the possible effect of syntactic proficiency on the RC attachment reaction time of 37 participants. Unlike the second study which only recorded the reaction time of the disambiguating clause as shown in the third display of the SPR design, the third study was also interested in the reaction time data of the defining relative clause which was shown in the second display. This led to two recorded reaction time data, those of the defining relative clause and those of the final clause, both of which will be addressed as reaction time data of Display 2 and Display 3 respectively. The descriptive statistics of reaction time data in each display is summarized in Table 11.

Table 11. Descriptive Statistics of the Reaction Time of Display 2 and Display 3 in the SPR Task

Reaction Time		Statistics	*SE*
Reaction Time of Display 2	*N*	37	
	M	1922.16	61.343
	Mdn	1917.00	
	SD	373.135	
	Minimum	1186	
	Maximum	2722	
	Skewness	0.021	0.388
	Kurtosis	-0.529	0.759
Reaction Time of Display 3	*N*	37	
	M	2240.46	71.394
	Mdn	2199.00	
	SD	434.272	
	Minimum	1171	
	Maximum	3069	
	Skewness	-0.459	0.388
	Kurtosis	0.253	0.759

A generalized linear model of gamma regression with the log link was conducted to analyse both the Display 2 and Display 3 data, considering the nature of reaction time data which are positive, continuous data, with the tendency to be positively skewed and heteroscedastic. Generalized linear model suits the model assumptions to the data which in this case was a gamma distribution (Fox, 2016; McCullagh & Nelder, 1983). For this reason, it was preferred over the simple linear regression which would risk some transformation bias due to fitting the data into a set of model assumptions.

Regardless, the assumption of independence was consulted to see whether there was any autocorrelation in the cases of the dependent variables using the runs test. The results of the runs test with median cut point

confirmed that the order of both the Display 2 cases, Z = -1.33 (p = 0.183), and Display 3 cases, Z = -0.33 (p = 0.742) were random, and thus the analysis proceeded to the gamma regression. The following table summarizes the results of the gamma regression analysis of the reaction time data in both the Display 2 and Display 3.

Table 12. Regression Analysis of the Effect of Syntactic Proficiency on L2 Sentence Processing of English Relative Clause Sentences by the Indonesian Learners of English

Effect of Syntactic Proficiency on Reaction Time Data	***B***	***SE B***	**Wald CI_{95}**		***p***
			Lower	**Upper**	
Display 2	-0.009	0.007	-0.023	0.004	0.174
Display 3	-0.018	0.007	-0.031	-0.005	0.008

From Table 12, it can be observed that syntactic proficiency did not appear to have a significant effect on the reaction time data of Display 2, -.009, 95% CI [-0.023, 0.004], p = 0.174. When it concerns the Display 3, however, it was found that as the participants' syntactic proficiency score increased by a single unit, there was a decrease of 0.018, 95% CI [-0.031, -0.005] along the reaction time data, statistically significant at p = 0.008. It was previously hypothesized that there would be an effect of syntactic proficiency on the reaction time of both the Display 2 and Display 3. Examining the results of the test, it is evident that only the null hypothesis on the Display 3 reaction time was rejected. The interpretation of the findings of all three studies are discussed in the next sub-chapter.

B. Discussion

The findings as revealed in the previous section based on the research questions are discussed in the present sub-chapter in response to the research objectives. As established in the first chapter, these objectives concern the attachment strategy of the Indonesian learners of English in the reading of English RC sentences, the effect of syntactic proficiency on L2 sentence processing of Indonesian learners of English, the finding's stand on the universality of L2 sentence processing, and the architecture of L2 sentence processing as suggested by the findings. The findings which answer the first and second questions are relevant to all four research objectives as discussed below. Meanwhile the findings which answer the third research question are mainly discussed in response to the third and fourth research objectives.

1. Attachment Strategy of the Indonesian Learners of English in the Reading of English Relative Clause Sentences

Two studies were conducted to see the Relative Clause (RC) attachment strategy preferred by the Indonesian learners of English. The RC attachment preference as seen in the offline reading activity in the first study is designed to give an idea on the attachment preference when a reanalysis process is allowed. Meanwhile the second study with an online reading experiment was devised to examine the attachment preference as the reading process occurred incrementally. Both studies were expected to yield significant results if they were to establish a firm interpretation of the phenomenon. However, only the

offline study provided evidence of the particular attachment strategy favoured by the Indonesian learners of English, while the online study was unable to strengthen the notion.

The highly significant result of the offline study as indicated by the large effect size revealed the Early Closure (EC) as the markedly preferred RC attachment strategy of the Indonesian learners of English. In the case of second language processing of English RC sentences, this classified the Indonesian learners into the EC parsers of L2 English which include among others the Turkish (Dinçtopal-Deniz, 2010), the Chinese (Dai, 2015; Pan, Schimke, & Felser, 2015), and the German (Pan et al., 2015). The results also established the difference of preferences between the Indonesian learners and the native speakers of English which previous studies have widely acknowledged to favour the Late Closure (LC) strategy (Cuetos & Mitchell, 1988; Dinçtopal-Deniz, 2010; Frazier & Fodor, 1978; Pan et al., 2015). Consequently, the difference contributes to the growing records of speakers of L2 English to represent cross-linguistic difference in the second language sentence processing.

The EC preference in an offline reading can be interpreted as a final preference after learners inputted and processed all the available information. This information may include syntactic information (Friederici, 2011; Martín-Loeches et al., 2012), semantic information (Kim & Sikos, 2011; Rohde et al., 2011), implicit prosodic information (Fodor, 1998, 2002), and possible extra-sentential information which is entertained by the learners

(Felser & Cunnings, 2012; Jacob & Felser, 2016; Pan et al., 2015). Considering the ambiguous nature of the RC stimulus sentences in which the syntactic and semantic information alone cannot provide a definite plausible interpretation, reanalysis process is assumed as learners are to use additional information to arrive at the EC preference. The design of the first study does not provide the means to pinpoint this additional information as it is more exploratory in nature and taken as the basis for the subsequent studies. However, further implications can be derived from this finding with regard to the architecture and universality of L2 sentence processing. These implications will be discussed in a separate section as the explanation on the non-significant result of the second study and the findings of the third study may complement the discussion.

The result of the online study might have failed to provide further evidence on the EC preference of Indonesian learners in their online reading of English RC sentences. Nevertheless, it may shed some light on the nature of L2 sentence processing. As previously mentioned, the difference between the offline and online reading activity lies in the possibility of reanalysis. The offline reading allowed for the participants to reanalyse the sentence when an initial interpretation is deemed implausible. The online reading, on the other hand, did not. It presumed the initial interpretation to be plausible.

Unlike the offline reading stimuli which were globally ambiguous that it may require a reanalysis to make sense of the sentences, the stimuli of the online reading were only locally ambiguous and can be made sense by the

end of the sentence. The non-significant difference in reaction time of target items between the experimental and the control group can be interpreted as the inability of the participants to make sense of the online reading stimuli, given the lack of reanalysis. This problem recalls what is becoming a major topic in L2 sentence processing as of late, the case of working memory (Cunnings, 2017; Dai, 2015; Hopp, 2014; Juffs, 2015; Linck et al., 2014; Reichle & Birdsong, 2014; Reichle et al., 2016).

It is worthy of notice that Pan's et al. (2015) study of the reviewed relevant research returned the same results with no significant preference in the online reading of both the L2 learners of German and Chinese. In their study, they did not directly address the influence of working memory on the second language sentence processing. However, they suggested that L2 learners are more sensitive to constructing discourse-appropriate interpretation, rather than relying on the structural information as in the case with the native speakers. Fundamentally, this reliance on discourse information requires accessing and revising information from memory (Cunnings, 2017), which brings back the notion of reanalysis. With the understanding of how working memory works hand in hand with reanalysis, several accounts have attempted to explain the way the concept affects the L2 learners in their sentence processing of the second language.

Hopp (2014) observes that L2 learners are generally more limited in memory and processing resources. Consequently, a prioritization of a certain information at the expense of others may be necessary. This process might be

more complicated in the L2 sentence processing considering the possibility of a basic structural information being the initially prioritized information conforming to the syntax-first model (Ferreira & Nye, 2018), while the L2 learners attempt to entertain the non-structural, discourse-level, interpretation in the end. In the case of locally ambiguous RC sentences, the structural information does not complement the discourse information until the last part of the sentence. This false initial interpretation would need to be erased in the reanalysis process to make sense of the final interpretation. In this respect, Cunnings (2017) notes that L2 learners have difficulty in fully erasing the initial interpretation when it is already assigned in memory. Unlike native speakers who are believed to be able to maintain all parses active in memory, higher working memory is necessary for L2 learners to revise parses for the final interpretation (Dai, 2015). When accessing information from memory is required for a successful interpretation, Cunnings (2017) adds that L2 learners are more vulnerable to retrieval interference that active parses might be lost or overwhelmed. Other studies go further by proposing working memory to have a modulatory effect on nativelikeness of L2 sentence processing (Reichle & Birdsong, 2014; Reichle et al., 2016), as they found that the less proficient learners in their studies may suffer higher load on working memory when processing sentences in the second language.

Research on the role of working memory in second language sentence processing is still relatively in its early stage and keep developing. Studies in L2 sentence processing have discovered its possible essential role in the way

L2 learners process sentences in their second language (Juffs, 2015; Linck et al., 2014), with recent ones begin to formulate theories and hypothesis surrounding the concept (Cunnings, 2017; Reichle et al., 2016). Further research is expected to be able to determine how working memory serves to explain the architecture of L2 sentence processing. Working memory has notably challenged the previous popular belief of shallow structure hypothesis (SSH) (Clahsen & Felser, 2006a, 2006b) by opposing the qualitative nature of L2 sentence processing assumed by the hypothesis (Lim & Christianson, 2013; Omaki & Schulz, 2011). The current study also attempts to provide some insights into the proposition of SSH as well as the qualitative versus quantitative nature of L2 sentence processing as discussed in the next section.

2. Effect of Syntactic Proficiency on L2 Sentence Processing of Indonesian Learners of English

In the third study, syntactic proficiency was taken into consideration as a predictor variable in the processing of L2 Relative Clause sentences. Unlike the locally ambiguous RC stimulus sentences of the second study, a syntactic marker in the form of subject-verb agreement was added to the RC stimulus sentences of the online reading in the third study so that they were never ambiguous in the first place. Based on the finding of Early Closure preference in the previous study, the reaction time in Display 2 and Display 3 of the self-paced reading design was predicted to be affected by the syntactic proficiency

of the Indonesian L2 learners. The reaction time in Display 2, where the syntactic marker was located, was hypothesized to increase along with the syntactic proficiency scores of the L2 learners. Meanwhile the reaction time in Display 3, where the final interpretation was parsed, was hypothesized to decrease as the syntactic proficiency scores increase. As the findings suggest, only the latter hypothesis appeared to be supported by the results of the statistical analysis.

The statistically significant result of the Display 3 indicates the possible effect of syntactic proficiency on the L2 sentence processing of the Indonesian learners of English. The Display 3, where the L2 learners were supposed to arrive at the plausible interpretation, would be easily and more quickly parsed by the more proficient learners for they were aided by the syntactic marker. On the other hand, less syntactically proficient learners would struggle as they were likely to miss the syntactic marker, rendering the sentence incomprehensible without a successful reanalysis.

This finding aligns with the previous studies which found that proficient L2 learners show some sensitivity to syntactic agreement in L2 sentence processing (Coughlin & Tremblay, 2013). Given the adequate proficiency level, this sensitivity can be comparable to that of native speakers which may further lead to nativelikeness (Coughlin & Tremblay, 2013; Roberts & Liszka, 2013; Witzel et al., 2012). More accounts also expand on this sensitivity in other forms of syntactic information such as focus marking using WH-questions (Reichle & Birdsong, 2014) as well as tense/aspect

agreement (Roberts & Liszka, 2013). It is also substantial to note that since the less proficient L2 learners did not demonstrate such sensitivity, the effect of proficiency on L2 sentence processing can be interpreted to be quantitative in nature. This means that highly proficient L2 learners may process L2 sentences in the same way as the native speakers, contrary to the popular belief of Shallow Structure Hypothesis (Roberts & Liszka, 2013; Witzel et al., 2012).

It is significant that this finding challenges the Shallow Structure Hypothesis (SSH) (Clahsen & Felser, 2006a) which essentially lies on the belief that L2 sentence processing is qualitatively different from its L1 counterpart. The SSH claims that non-native speakers *shallow parse* syntactic information in L2 sentence processing and are guided more by the lexical-semantic information. This shallow parsing extends to the highly proficient L2 learners, arguing that non-native speakers cannot acquire the deep parsing quality of the native speakers regardless of the proficiency level (Clahsen & Felser, 2006b; Felser & Cunnings, 2012; Felser et al., 2012).

This hypothesis was considered to be the guiding principle of L2 sentence processing until around the last decade when researchers found evidence that L2 learners with higher proficiency level may no longer shallow parse the sentences, but process the syntactic information like the native speakers (Coughlin & Tremblay, 2013; Reichle & Birdsong, 2014; Roberts, 2012; Witzel et al., 2012). These studies call into question the SSH and propose alternative hypotheses in reconsidering the nature of L2 sentence

processing. The current finding therefore supports these alternatives, proposing that L2 learners are also guided by syntactic information as in native speakers' sentence processing, and that the difference between the L2 and L1 sentence processing is quantitative in nature with the more proficient learners being closer to nativelikeness.

As briefly mentioned in the previous section, proponents of the quantitative difference between the L2 and L1 sentence processing does not only include the role of proficiency, but also that of working memory. Several accounts reported that proficiency and working memory are in fact not mutually exclusive (Coughlin & Tremblay, 2013; Juffs, 2015; Linck et al., 2014; Reichle et al., 2016; Roberts, 2012). The way working memory and proficiency interact with each other, however, has yet to be unravelled as research on the modulatory roles of both components in L2 sentence processing are still in development, while discussion on the relationship between the two is often reported as an afterthought.

Reichle and Birdsong (2014) found that only the low proficient learners in their study demonstrate less nativelike processing, and thus propose that proficiency affects the amount of memory load in learners' working memory. Similarly, Roberts (2012) points out that only L2 learners with higher working memory capacity and greater proficiency can achieve nativelikeness in processing L2 sentences. In a study in which working memory and proficiency are amongst the centre of discussion, Linck et al. (2014) observe that working memory is positively associated with proficiency. They suggest

that the cognitive processes underlying the L2 processing involve working memory as a significant component on measures of L2 proficiency. Several other studies believe that working memory takes the primary modulatory role in the nativelike L2 processing, while the effects of proficiency can be explained by the quantitative difference in working memory capacity (Cunnings, 2017; Juffs, 2015; Reichle et al., 2016).

From this point of view, the significant result of the Display 3 statistical analysis can as well take into consideration the role of working memory. In addition to the lack of syntactic sensitivity as previously observed, learners with low syntactic proficiency might also experience a memory overload which is also the case in Reichle and Birdsong's (2014) study among their less proficient learners. Recalling the discussion on the second study, this higher load of working memory may be caused by the false prioritization of the initial interpretation and failure to fully erase this implausible interpretation (Cunnings, 2017; Hopp, 2014). On the contrary, the more proficient learners were found to be capable of overcoming this working memory limitation in the third study.

Between the second study which indicates limitation on working memory and the third study which suggests otherwise for the syntactically proficient learners, the difference lies on the construction of the RC stimulus sentences, in which the latter utilized syntactic markers. The syntactic marker is thus predicted to assist the L2 learners in accessing and retaining their working memory for a plausible interpretation by confirming the plausibility

of the active parsing. This achieved interpretation by the syntactically proficient learners as associated with the addition of syntactic markers can be interpreted to support the notion of mutual relationship between working memory and proficiency.

Consequently, the interaction between working memory and proficiency may be the underlying force behind the non-significant result of the Display 2 statistical analysis. The current study hypothesized that the less proficient learners would simply miss the syntactic markers in the stimuli. This would cause their reaction time to be shorter than that of the syntactically proficient learners who were predicted to notice the markers and modify their active processing accordingly. The prediction regarding the proficient learners might be the case as the significant result of the Display 3 supports the hypothesis. On the other hand, the case with the less proficient learners which rejected the hypothesis might require further explanation.

Taking into account the modulatory role of working memory and proficiency, it is possible that the syntactically proficient learners and the less proficient learners were actually all engaged in the complication added by syntactic markers. The less proficient learners did not simply dismiss the syntactic marker as initially predicted. Like the proficient learners, they might be aware of the markers which disagree with the Early Closure preference. Unlike their syntactically proficient peers, however, they were unable to parse the syntactic markers into a plausible interpretation which matched their active interpretation in the working memory. By consideration of the

modulatory role of both working memory and proficiency, the current study therefore proposes a more detailed explanation in favour of the previous finding (Coughlin & Tremblay, 2013; Reichle & Birdsong, 2014; Roberts & Liszka, 2013). The *syntactic insensitivity* of the less proficient learners may not be restricted to parsing the syntactic information, rather it concerns both the inability to parse *and* adjust this information in the active processing within the working memory, causing a higher load on working memory and eventually failure in reanalysis.

3. The Current Finding's Stand on the Universality of L2 Sentence Processing

Thus far the finding of EC preference in the current study has been described in its exploratory nature. However, consulted with the previous literature, this finding might provide some insights into the universality of L2 sentence processing. Two assumptions on the L1-L2 sentence processing difference take precedence over the following explanation on universality of sentence processing. The first assumption conceives that L1 processing influences L2 processing, causing the attachment preference of both L1 and L2 processing to be the same. Meanwhile the second assumption observes that there is no influential relationship between the L1 and L2 processing, and that any similarity or difference in attachment preference between the two processing is caused by other variables but the L1 background.

These assumptions are to be considered in the following explanation on universality in L2 sentence processing since the attachment preference of the Indonesian learners in their L1 has yet to be studied, while research in L1 processing influence is still of rarity. Pan's et al. (2015) study, one of the few studies in this regard, suggests that there is no relationship between the L1 and L2 sentence processing. This is based on their finding in which the German and Chinese native speakers showed the same attachment preference in their L2 English, despite having a different attachment preference in their respective L1 background. Further research is necessary to see whether their findings can be generalized to other L1 background.

With the assumptions in mind, the EC preference found in the Indonesian learners' L2 English processing may support the *modifier straddling hypothesis* (Cuetos & Mitchell, 1988; Cuetos et al., 1996; Mitchell & Cuetos, 1991) of the exposure-based account as well as the *construal model* (Frazier & Clifton, 1996, 1997) of the universalist account when the L1 influence is assumed. The modifier straddling hypothesis proposes that attachment preference in relative clause is related to the position of modifier in the noun phrase construction of the language concerned. A language with a pre-modifier noun phrase construction is associated with the Late Closure (LC) preference, while the language with post-modifier noun phrase construction identifies with the EC preference. Indonesian, the first language of interest in the current study, has a post-modifier noun phrase construction

and thus may explain the EC preference in the learners' L2 English processing.

On the universalist account, the construal model argues that relative clause attachment preference is affected by the availability of unambiguous alternative form of genitive construction in said language. English has an NP2's NP1 construction which offers an unambiguous alternative to the NP1 of NP2 construction, causing the native speakers to prefer the LC strategy by the model's description. Indonesian, on the other hand, does not have such alternative construction which may lead the Indonesian learners to prefer the EC strategy in processing the ambiguous English relative clause sentences.

Without the L1-L2 influential relationship assumed, the current finding of EC preference does not align with both accounts considering that the L2 English has both the pre-modifier noun phrase construction and the unambiguous alternative of NP2's NP1 genitive form which would expect an LC preference. Nevertheless, the finding disagrees with the *recency and predicate proximity principles* (Gibson et al., 1996; Pearlmutter & Gibson, 2001) of the exposure-based account, regardless of the L1 influence assumption. The principles believe that word order, specifically on the average distance between the head of a predicate and its arguments, guides a processor's attachment preference.

Emphasizing the importance of predicate as the core of sentence organization, this account hypothesizes that a language with rigid word order and low average distance between the predicate head and its arguments as in

the SVO organization would find its speakers favouring the LC strategy. On the other hand, a language with a freer word order and relatively high average distance from the predicate head to its arguments would see that its speakers tend to prefer the EC strategy. In the case of the current study, both the L1 Indonesian and the L2 English have the rigid SVO order with the arguments close with the verb head. In this respect, the finding of EC preference violated the principles as the Indonesian learners would be predicted to prefer LC. The finding therefore does not reflect either the influence of the L1 Indonesian or the L2 English processing in itself due to the shared SVO word order.

Taking into consideration the differing arguments between the exposure-based account and the universalist account, a L1 influence assumption which echoes the former proposition would find the modifier straddling hypothesis to be more representative of the current finding. Meanwhile the universalist account which assumes the influence of process-generated strategy, rather than that of L1 exposure, would contradict the description of the construal model. Alternatively, hypothesis on *prosodic phrasing* can be entertained as the explanation to the finding of EC preference. However, further research on this particular subject is necessary as the design of the current study is deemed inadequate to neither support nor reject the hypothesis.

4. The Architecture of L2 Sentence Processing as Suggested by the Findings

Taken together, the three studies of the current research reveal the significance of reanalysis in the preference of Early Closure (EC) of the Indonesian learners of English, the effect of syntactic proficiency on L2 parsing, and the implied importance of working memory in L2 sentence processing. With reference to the previous literature, some distinctions on the architecture or the computational model of L2 sentence processing can be drawn from the findings. As discussed in the previous sections, recent studies propose that L2 sentence processing model is fundamentally the same as that of L1 processing, apart from some quantitative differences (Cunnings, 2017; Hopp, 2014; Juffs, 2015; Linck et al., 2014; Reichle & Birdsong, 2014; Reichle et al., 2016).

A sentence processor would initially input and process the lexical information as a prerequisite to the sentence level processing. This lexical processing is limited to the recognition of words by matching sequence of syllables or phonemes and the lexical entry in the target language. Once the processor has access to the lexical entry necessary to build and develop relations between words in the sentence, processing of the sentence level information unfolds incrementally. This sentence level information may include syntax, semantic, implicit prosody, discourse, context, and other kinds of extra-sentential information contributing to a plausible interpretation (Friederici, 2011, 2017; Jacob & Felser, 2016; Pan et al., 2015). Beyond this

basic understanding of sentence processing, the questions on modularity and seriality of sentence processing remains a primary discussion.

The significant results of the first study on the Early Closure (EC) preference and the third study on the effect of syntactic proficiency make arguably the most pronounced contributions of the current research to the architecture of L2 sentence processing. The finding of EC preference of the Indonesian learners strengthens the various previous studies in disproving the early belief of strictly modular and serial architecture of sentence processing as claimed by the garden-path model which only allows a Late Closure (LC) preference (Frazier, 1987). The finding on the effect of syntactic proficiency further acknowledges a degree of modularity limited to the initial syntactic processing as previously suggested by the syntax-first models (Ferreira & Nye, 2018; Friederici, 2011, 2017). When syntactic information alone cannot provide the plausible interpretation as in the ambiguous RC sentences in the first study, other types of information may be used to process the sentences. However, when an adequate syntactic information is present, it is being relied on by the active processing in working memory as shown by the effect of syntactic proficiency in the third study. With respect to the seriality of sentence processing, the syntactic parsing difficulty of both the syntactically proficient and the less proficient learners as observed in the third study indicates a parallel processing which occupied their working memory.

Putting things together, the current research supports the initial modularity of syntactic parsing, that is under normal circumstances when

syntactic information is adequate. This is followed immediately by the semantic processing which makes up the thematic relations when combined with the parsed syntactic information. Finally, additional information is processed in parallel as necessary to arrive at the plausible interpretation.

Establishing the core architecture of the sentence processing model, the quantitative differences which put emphasis on the distinction between L1 and L2 sentence processing are to be included in the whole picture of L2 sentence processing model. These quantitative differences, as comprehensively discussed in the previous sections, include syntactic proficiency and working memory. As examined in the previous discussions, the two components are reported to have a positive relationship in their influence on the active processing (Coughlin & Tremblay, 2013; Linck et al., 2014; Reichle et al., 2016; Roberts, 2012). The influence of both syntactic proficiency and working memory in L2 sentence processing may begin as early as the syntactic parsing and remain significant until a plausible interpretation is achieved. Figure 4 illustrates the L2 sentence processing model as suggested by the current research.

As seen in Figure 4, the sentence processing stages under normal circumstances begin with modular syntactic parsing, which supported by semantic processing, forms the thematic relations. Thematic relations in the sense of sentence processing represents the relations between words as they are parsed to determine the syntactic features such as verb agreement or case marking, as well as semantic features such as animacy or semantic roles

(Friederici, 2017; Harley, 2014). Thematic relations are the parts which add up incrementally to the active processing. Alternatively, in such circumstances as when syntactic information is deemed inadequate to generate a working active processing, additional information such as discourse, context, or prosodic information may be sought out. This additional information is processed in parallel as necessary as shown by the stages connected by the arrows with dotted line. This parallel processing both reassesses and complements the thematic relations assigned by the syntactic and semantic processing. When parallel processing occurs, multiple active processing may generate at the same time. Eventually, only one which leads to a plausible interpretation will be entertained.

The figure also shows working memory and syntactic proficiency encasing the main sentence processing stages before a plausible interpretation is decided. This represents their modulatory roles in L2 sentence processing from the initial parsing of syntax to maintaining the active processing (Cunnings, 2017; Reichle & Birdsong, 2014; Reichle et al., 2016). The double-headed arrows connecting the two indicate a relationship in which one may affect the other in positive association (Coughlin & Tremblay, 2013; Linck et al., 2014; Reichle et al., 2016; Roberts, 2012). The higher the syntactic proficiency and working memory capacity of a processor, the higher the chance they arrive at the plausible interpretation effectively. On the contrary, low syntactic proficiency may lead to unnecessary active processing which would burden the working memory, while low working memory

capacity would limit the ability to maintain necessary active processing from the syntactic parsing.

C. Limitation of the Research

There were several methodological limitations to the current research which leave some room for improvement for future research. First of all, sentence processing studies which utilize the relative clause attachment preference mostly present their stimulus in isolation. A contextualized stimulus, therefore, may provide a more authentic way of processing in sentence processing studies. With regard to the first study, the offline reading method did not provide the adequate means to show the detailed nature of reanalysis process. An eye-tracking method, the more advanced alternative, would be able to clearly show the reanalysis process by providing an accurate observation of the participants' eye movements while reading. Unlike the offline reading task devised in the study, this method offers detailed information on the nature of reanalysis which can reveal some significant insights undetected in the current research. In the case of online method, it is of note that the reliance of self-paced reading method on reaction time requires the stimulus sentences to be carefully designed. The number of words in each Relative Clause stimulus could be designed to be more similar in size. Despite the use of aggregate means of the whole stimuli for each participant, reaction time is still a sensitive data in which measurement error in milliseconds could make a difference. With similar number of words for all the stimulus sentences, such error can be further minimized.

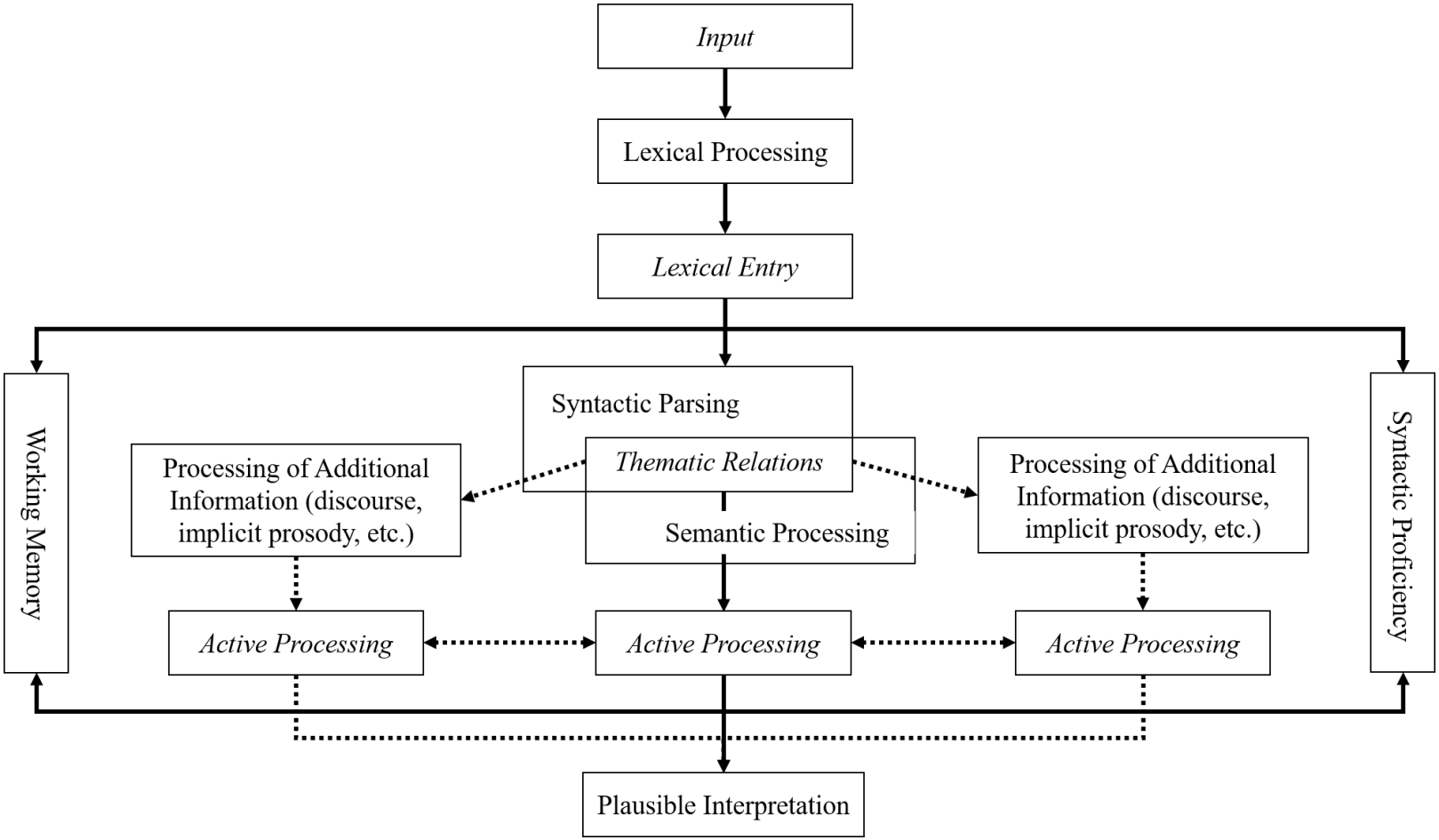


Figure 4. Second Language Sentence Processing Model as Suggested by the Findings

Another limitation to address also concerns the self-paced reading method which assumes that participants would read as naturally as the way they read under normal circumstances. This limitation with respect to the segmented sentences in SPR design has been considered insignificant by previous studies which adopted the same method as Cuetos and Mitchell's (1988) seminal work. However, precautionary measure could be taken by using better segmentation or word by word presentation as well as having a qualitative observation such as interview with the participants, especially that the study deals with L2 sentence processing in which participants may be too cautious of reading a language not of their own. Reflecting on these limitations, it is expected that future research would improve on the weaknesses of the current research while staying true to the purpose of the study. With appropriate methodological refinement to the current study, future research should be able to expand on the descriptions and points of view concerning the L2 sentence processing research.

CHAPTER V

CONCLUSIONS, IMPLICATIONS, AND SUGGESTIONS

A. Conclusions

Four main conclusions are drawn corresponding to each research objective established in the first chapter. The attachment strategy of the Indonesian learners of English is concluded from the findings of the first and second study. The effect of syntactic proficiency on L2 sentence processing is answered based on the findings of the third study. Meanwhile the universality and architecture of L2 sentence processing are derived from the findings of all three studies.

1. Attachment Strategy of the Indonesian Learners of English in the Reading of English Relative Clause Sentences

The current research identified an Early Closure (EC) attachment strategy used by the Indonesian learners of English based on the significant result of the first study. The marked preference of EC attachment strategy, as opposed to the Late Closure (LC) strategy, established a sentence processing difference between the Indonesian learners and the native speakers of English who are known to prefer the LC strategy (Cuetos & Mitchell, 1988; Dinçtopal-Deniz, 2010; Frazier & Fodor, 1978; Pan et al., 2015). This finding, however, was not supported by the second study which result appeared to be non-significant. This non-significant result may be interpreted as the inability of the participants of both the experimental and control group

to access the active processing in the working memory. The lack of reanalysis in the online reading study is predicted to cause higher working memory load for the Indonesian learners. As also reported by previous studies, sentence processing is generally more demanding in terms of working memory access for L2 learners compared to the native speakers (Cunnings, 2017; Dai, 2015; Hopp, 2014; Linck, Osthus, Koeth, & Bunting, 2014; Reichle & Birdsong, 2014; Reichle, Tremblay, & Coughlin, 2016).

2. Effect of Syntactic Proficiency on L2 Sentence Processing of Indonesian Learners of English

The effect of syntactic proficiency on L2 sentence processing was examined by observing the reaction time of two segments of the RC stimulus sentences. The reaction time on the segment where the syntactic marker was located did not indicate any significant effect of syntactic proficiency. Meanwhile the observation on the segment where the final interpretation was processed revealed a significant decrease in reaction time as the syntactic proficiency scores of the participants increase. The former finding suggests a struggle of both the syntactically proficient and the less proficient learners in processing the addition of syntactic marker, contrary to the initial prediction that only the syntactically proficient learners would react to the marker while the less proficient learners would simply dismiss it. The significant result of the latter finding, however, confirms that while the syntactically proficient learners succeeded in processing the syntactic marker, the less proficient

learners did not. This finding is significant in the way that it challenges the Shallow Structure Hypothesis (SSH) (Clahsen & Felser, 2006a, 2006b), a guiding principle of L2 sentence processing until recent studies on proficiency and working memory have been proving otherwise (Coughlin & Tremblay, 2013; Cunnings, 2017; Linck et al., 2014; Reichle & Birdsong, 2014; Reichle et al., 2016; Roberts, 2012; Witzel, Witzel, & Nicol, 2012).

3. The Current Finding's Stand on the Universality of L2 Sentence Processing

Consulted with the previous literature, the finding on EC preference of the Indonesian learners of English may offer some insights into the universality of L2 sentence processing. One particular proposition from the exposure-based account, the *modifier straddling hypothesis* (Cuetos & Mitchell, 1988; Cuetos et al., 1996; Mitchell & Cuetos, 1991), aligns with the finding of the current research. As a proponent of the exposure-based account, the hypothesis assumes that attachment preference is built on the experience of processing similar structure during L1 acquisition. In the sense of L2 sentence processing, this means that the attachment preference in the L1 may influence the attachment preference in the L2. Modifier straddling hypothesis proposes that the position of modifier in the noun phrase construction of a language influence the attachment preference of a processor. For this reason, the Indonesian learners which L1 has the post-modifier noun phrase construction prefer the EC strategy when reading the RC sentences in their

L2 English, a language with a pre-modifier noun phrase construction associated with the LC strategy.

4. The Architecture of L2 Sentence Processing as Suggested by the Findings

Based on the findings of the current research, several suggestions were offered with respect to the architecture of L2 sentence processing. The finding on the EC preference further corroborates the previous studies' criticism on the strictly modular and serial garden-path model which only allows LC preference (Frazier, 1987). The finding on the effect of syntactic proficiency indicates a degree of modularity on the initial syntactic parsing as proposed by the syntax-first model (Ferreira & Nye, 2018; Friederici, 2017). Nevertheless, the interactive and parallel processing may occur following the early syntactic parsing stage, as processing difficulty was observed from both the syntactically proficient and the less proficient learners in the second and third study, indicating parallel active processing which lead to higher working memory load.

Apart from the core architecture of modularity and seriality of sentence processing, the current findings also suggest a modulatory role of both the syntactic proficiency and working memory (Cunnings, 2017; Reichle & Birdsong, 2014; Reichle et al., 2016). The two components influence the L2 sentence processing as early as the syntactic parsing stage to the decision making on the plausible interpretation. Taken together, the current research

proposes initial modular syntactic parsing which allows parallel processing of additional information as necessary to arrive at the plausible interpretation, meanwhile syntactic proficiency and working memory modulate the attainment of such interpretation.

B. Implications

The findings of the current research as concluded above carry significant implications for some related linguistic fields of study. These may range from the field of psycholinguistics in which L2 sentence processing is one of the main concerns of the study, to the field of applied linguistics which aims to apply the knowledge in its more practical sense. Listed below are the implications as seen from some fields of study which could take advantage of the current findings.

1. Psycholinguistics

With the finding of EC preference in Indonesian learners' reading of L2 English, the current research adds to the growing records of cross-linguistic difference between L1 and L2 sentence processing, in which the Indonesian learners have different attachment preference from the native speakers of the L2 who have been observed to prefer the LC strategy. This finding offers such addition from the perspective of an Austronesian language which receives little attention in the study of sentence processing, and therefore would contribute to the furtherance of psycholinguistic taxonomy and universality of L2 processing. The finding on the effect of syntactic proficiency on L2

sentence processing would also advance the systematization of the language processing within the psycholinguistics realm.

2. Linguistics Research Methodology

From the perspective of research methodology, the online reading study in this research has yielded interesting findings unobtainable through the means of offline reading alone. Linguistics research focusing on the receptive skills could make use of such online method to uncover more insights which can only be observed in real-time as the activity of reading or listening unfolds. A combination of both the offline and online methods might reveal a clearer picture of the matter at hand.

3. Applied linguistics

Given the findings' contribution to the architecture of L2 sentence processing, the field of applied linguistics could use the L2 sentence processing model as considerations for the practical solutions to L2 related problems. The applied linguistics sub-field of second language acquisition, for example, might consider the influence of syntactic proficiency in L2 reading comprehension to develop a reading method from the perspective of syntactic parsing. Difficulties in reading comprehension caused by individual differences might also be diagnosed by referring to the L2 sentence processing model, leading to an appropriate treatment to the problem. In

similar manner, the study of bilingualism and clinical linguistics could also draw on the L2 sentence processing model.

C. Suggestions

The current research offers a study of second language comprehension from the theoretical point of view as the problems in question still require deeper understanding on its theoretical basis. Further research is necessary before a practical implementation can be firmly suggested. However, some aspects of the current findings might inspire some practical applications of the developing theories. With that in mind, the current research puts forward the following suggestions for some related parties.

1. Second Language Teachers

Considering the significance of syntactic proficiency and the syntax-first model of L2 sentence processing, it is recommended that second language teachers consider a syntactic perspective to the teaching of reading comprehension. Reading comprehension is easily associated with semantic understanding while overlooking the role of syntactic parsing. Yet, the current findings as supported by the previous literature suggest that syntactic information is the essential initial information being processed, which in turn affects the processing of other information such as semantic or discourse. A syntactic approach to reading would theoretically help learners parse sentences into appropriate segmentations, make sense of the semantic and

other additional information, and avoid confusions caused by implausible active processing which leads to higher working memory load. A *genre-based approach* to teaching reading can accommodate this need by providing necessary exposures of certain syntactic constructions. Depends on the salience of syntactic structures within reading texts, an explicit learning of syntax may follow. Additionally, a hierarchical perspective of parsing syntactic information can be encouraged by analysing syntax based on syntactic tree diagram or certain linguistic model such as systemic functional linguistics. Teachers may also be informed of the L2 sentence processing model as a possible guidance in identifying learners' difficulty in reading comprehension.

2. Second Language Learning Material and Task Designers

Material development and task design in reading comprehension activities often rely on vocabulary and text organization with little attention to syntactic patterns of reading texts. The current findings which emphasize the role of syntactic parsing in reading therefore propose a reading material and task design which prompts a post-reading discussion on the syntactic patterns featured in the reading texts. A task resembling an online reading task of the current research is also advised as a measure of learners' real-time reading skill which indicates learners' fluency, strategy, and effectiveness in reading the second language. With some understanding of the architecture of

L2 sentence processing, such tasks can also be used to diagnose any problems faced by the learners as well as individual differences in reading.

3. Researchers of Related Fields

The current research focuses on the Indonesian learners of English and the syntactic proficiency in L2 sentence processing. More accounts on the sentence processing of the Austronesian speakers and other language families would be a welcome addition. It is expected that they would clarify some proposed theories on the universality of sentence processing as well as completing the missing puzzle pieces of the sentence processing taxonomy. The current research also observes a possible influential role of working memory, but has yet to address it as the focus of the research. Further research is encouraged to examine the role of working memory capacity and the nature of its relationship with syntactic proficiency. Furthermore, the proposition of implicit prosodic phrasing as an explanation to the differing accounts of attachment preferences is a relatively under-researched, yet promising subject of interest. It is thus suggested for researchers in related fields of study to analyse the potential significance of implicit prosodic phrasing as part of the sentence processing architecture.

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APPENDICES

APPENDIX 1

RESEARCH INSTRUMENTS

A. Instrument of Study 1 (Judgement Task)

Codes:

F : Filler Items T : Target Items

Draw a circle on your chosen answer based on your earliest understanding in response to the required information.

1	Andy went to the butcher, and to the bakery his brother went. Going to the bakery: A. Andy B. Andy's brother	F
2	The case that the inspector solved concerned the corrupt police officer. Solving the case: A. The inspector B. The police officer	F
3	Kate read the prologue of the novel which was quite long. Being quite long: A. The novel B. The prologue	T01
4	The car that was grandpa's favourite was given to uncle Jay. Giving the car: A. Uncle Jay B. Grandpa	F
5	The repairman repaired the watch of the costumer that looked quite old. Looking quite old: A. The costumer B. The watch	T02
6	What had made Matt angry was Larry's little prank. Doing the prank: A. Larry B. Matt	F
7	The sparrow flew away when the eagle perched on the tree. Perching on the tree: A. The eagle B. The sparrow	F

8 The lecturer walked into the classroom of the building that was spacious. T03
Being spacious:
A. The classroom
B. The building

9 The way the student delivered the speech charmed the lecturer. F
Delivering the speech:
A. The lecturer
B. The student

10 Elijah visited the palace of the kingdom that was very lively. T04
Being very lively:
A. The palace
B. The kingdom

11 The medicine that Rand bought worked wonders for Matt. F
Buying the medicine:
A. Matt
B. Rand

12 The employee met the secretary of the manager who was well-dressed. T05
Being well-dressed:
A. The manager
B. The secretary

13 The gun that the brigadier hold was the one belonging to the colonel. F
Holding the gun:
A. The brigadier
B. The colonel

14 The book documented the language of the tribe that was considered endangered. T06
Being considered endangered:
A. The tribe
B. The language

15 The bicycle that Lenny bought was previously owned by Terry. F
Owning the bicycle:
A. Terry
B. Lenny

16 What the movie didn't show you is that the book had ended in cliff-hanger. F
Ending in cliff-hanger:
A. The movie
B. The book

17 Sophie photographed the model of the agency that was on the rise. T07
Being on the rise:
A. The model
B. The agency

18 The reason why Lily left was because Malcolm had come to pick her up. F
Being picked up:
A. Malcolm
B. Lily

19 Billy crossed the river of the forest that was such a scenic beauty. T08
Being such a scenic beauty:
A. The river
B. The forest

20 The port you'll be seeing is where you can find the big lighthouse. F
Being about to be seen:
A. The lighthouse
B. The port

21 Liam noticed the doctor of his daughter who was approaching him. T09
Approaching Liam:
A. The daughter
B. The doctor

22 The festival had just begun as the parade entered the gate. F
Having just begun:
A. The festival
B. The parade

23 What Diana did not expect was that Joel had been waiting inside as well. F
Waiting inside:
A. Diana
B. Joel

24 The singer covered the song of the band that was widely acclaimed. T10
Being widely acclaimed:
A. The band
B. The song

25 The small town flooded as the river was clogged by plastic waste. F
Being clogged:
A. The river
B. The town

26 Emily couldn't find the book of the author that was once popular. T11
Being once popular:
A. The book
B. The author

27 How the dancer got eliminated surprised the remaining contestants. F
Being surprised:
A. The dancer
B. The contestants

28 Rachel opened the door of the storeroom that showed signs of abandonment. T12
Showing signs of abandonment:
A. The door
B. The storeroom

29 Mr. Andrews' dictionary that Mary borrowed is to be returned upstairs. F
Possessing the dictionary:
A. Mary
B. Mr. Andrews

30 Cole watched the concert of the musician that was phenomenal. T13
Being phenomenal:
A. The musician
B. The concert

31 With the animals gone, what were left of the forest were ashes and dust. F
Remains in the forest:
A. Ashes and dust
B. Animals

32 The architect designed the gate of the house which looked spooky. T14
Looking spooky:
A. The house
B. The gate

33 Whatever technology changed the town, the people remained the same. F
Not changing:
A. The town
B. The people

34 Tom oversaw the opening of the event which was scheduled on Tuesday. T15
Being scheduled on Tuesday:
A. The opening
B. The event

35 Though the mare had run throughout the hills, it stopped before the swamp. F
The mare's last stop:
A. The swamp
B. The hills

36 This city was where the two country revolutionists met back in 1950s. F
The place they met:
A. The city
B. The country

37 Brandon rested beside the lake of the park that was rarely visited. T16
Being rarely visited:
A. The lake
B. The park

38 A scream echoed in Wallowa Lake as a moment later a gunshot was heard. F
Being heard first:
A. The gunshot
B. The scream

39 Ted learned the history of the kingdom that he found fascinating. T17
Ted found it fascinating:
A. The kingdom
B. The history

40 The program that got corrupted just now reset the robot. F
Being corrupted:
A. The program
B. The robot

41 The moment the wanderer woke up, the wizard had cast a spell on him. F
Being cast a spell:
A. The wizard
B. The wanderer

42 Joe tracked the footprints of the deer that disappeared after the rain. T18
Disappearing after the rain:
A. The deer
B. The footprints

43 The time traveller went back to the moment he first met his late wife. F
Having passed:
A. The wife
B. The traveler

44 The machine processes the request of the customer that is recognized by the database. T19

Being recognized by the database:

A. The request
B. The customer

45 The vampire committed suicide by facing the sun as it's rising on the horizon. F

Being on the horizon:

A. The vampire
B. The sun

46 They entertained the children of the refugees who were there at the main camp. T20

Being there at the main camp:

A. The children
B. The refugees

B. Instrument of Study 2 (Self-paced Reading Experiment)

Codes:

INT : Introduction

INS : Instructional frame

INM : Intermission

F : Filler item

TE : Target item for experimental group

TC : Target item for control group

CLS : Closing statement

… : In-between stimuli break

Table 1. Instrument of SPR Experiment (Study 2)

Frame no.	Items	Code
1	Salam! Anda akan membaca beberapa kalimat dalam bahasa Inggris. Setiap kalimat akan ditampilkan dalam dua atau tiga bagian. Anda dapat menekan tombol 'spacebar' pada keyboard untuk memunculkan bagian-bagian kalimat tersebut satu per satu sehingga membentuk satu kalimat utuh. Silahkan membaca senatural mungkin seakan bagian-bagian kalimat tersebut tersusun seperti satu kalimat biasanya. Untuk membiasakan diri dalam membaca melalui program ini, beberapa kalimat pertama akan disediakan sebagai latihan. ~ Tekan spacebar untuk mulai membaca ~	INT
2	Patricia has prepared the special birthday cake for her little brother	P01
3	who just turned 12 this month.	
4	…	
5	The visitors are not allowed to take any pictures	P02
6	once inside the museum.	
7	…	
8	The cat that went missing last week	P03
9	has finally been found safe and sound	
10	as confirmed by the owner.	
11	…	

12	Beberapa kalimat akan diikuti oleh pertanyaan pemahaman (*comprehension question*) yang disertai 3 pilihan jawaban untuk memastikan bahwa Anda memahami apa yang Anda baca. Untuk memilih jawaban, tekan tombol '1' atau '2' atau '3' pada keyboard, sesuai dengan pilihan jawaban yang Anda pahami. Berikut dua contoh kalimat yang masing-masing akan diikuti oleh pertanyaan pemahaman.	INS
13	The newscaster presented an update on the thief	P04
14	that was caught earlier this morning.	
15	Being caught earlier this morning: (1) The newscaster (2) The thief (3) Undecided Silahkan menekan tombol '1' atau '2' atau '3' pada keyboard sesuai pilihan jawaban yang Anda anggap benar. Sebagai contoh, Anda dapat menekan tombol '2'.	
16	Dengan menekan salah satu nomor yang merepresentasikan pilihan jawaban Anda, respon jawaban Anda akan otomatis terekam dan Anda dapat melanjutkan pada kalimat berikutnya. Berikut satu contoh lagi kalimat yang diikuti oleh pertanyaan pemahaman. Silahkan membaca hingga kalimat tersebut selesai dan jawab pertanyaan sesuai dengan yang Anda anggap benar dengan cara yang sama seperti yang telah Anda lakukan.	INS
17	Brad visited the gorgeous lake	P05
18	that is located between the two nearby villages	
19	making it a popular spot for resting.	
20	Located between the two nearby villages: (1) Brad's home (2) The gorgeous lake (3) Undecided	
21	Well done! Tidak semua kalimat diikuti oleh pertanyaan pemahaman. Namun pertanyaan-pertanyaan tersebut akan muncul secara random pada beberapa kalimat. Cobalah untuk memahami setiap kalimat yang Anda baca.	INS
22	ATTENTION Apabila hendak berhenti sejenak untuk istirahat atau lainnya (menerima telpon, ke belakang, dsb), mohon untuk menyelesaikan membaca sampai akhir kalimat terlebih dahulu, dan dapat berhenti sejenak jika telah sampai pada tampilan 'triple dots' atau "..."	

23	Ini adalah akhir dari sesi latihan membaca melalui program ini. Silahkan memulai membaca kalimat-kalimat berikutnya sama halnya seperti yang telah Anda lakukan pada sesi latihan. Ready. Go.	
24	Zach is exhausted	F01
25	having travelled from town to town for the whole week.	
26	…	
27	Sneaking up on its prey without a sound	F02
28	the lion ambushed the lonely deer.	
29	Sneaking up without a sound: (1) The lion (2) The lonely deer (3) Undecided	
30	…	
31	Working for his boss for the whole night each day	F03
32	Peter only gets to rest in the morning	
33	earning him the title of the night owl.	
34	Earning the title of the night owl? (1) The boss (2) Peter (3) Undecided	
35	Kate wrote the novel adaptation of the movie	F04
36	which moves people to tears.	
37	…	
38	Coming out of its cocoon	F05
39	the caterpillar has transformed into a beautiful butterfly.	
40	…	
41	Kevin greeted the son of his sister	**TE01**
	Kevin greeted the daughter of his sister	**TC01**
42	who stood in front of the door	
43	wearing a pink dress.	
44	Standing in front of the door: (1) His sister (2) The son/daughter (3) Undecided	
45	…	

46	The cops, noticing that the suspect was making a move	F06
47	was trying to keep pace with him.	
48	only to lose him in the crowds.	
49	Having lost in the crowds: (1) The cops (2) The suspect (3) Undecided	
50	…	
51	After being warned by her friends	F07
52	never again had Emily gone out past midnight.	
53	…	
54	Two detectives joined the investigation of the kidnapping	**TE02**
	Two detectives witnessed a plotting of a kidnapping	**TC02**
55	that has been occurring since yesterday	
56	led by a fugitive criminal.	
57	Having been occurring since yesterday: (1) The investigation/a plotting (2) The kidnapping (3) Undecided	
58	So cold are the nature of this town	F08
59	that locals rarely go outside at night.	
60	…	
61	The judge, having made his decision	F09
62	is ready to pronounce sentence on the defendant.	
63	Having made the decision: (1) The judge (2) The defendant (3) Undecided	
64	…	
65	Only after the morning comes	F10
66	do William have the courage to pass that tunnel.	
67	willingly taking a detour every time he comes home late.	
68	The time William would willingly pass the tunnel: (1) Late night (2) Past morning (3) Undecided	
69	Anda telah mencapai sepertiga dari aktivitas ini. Silahkan istirahat sejenak, regangkan badan, tarik nafas dan hembuskan. Apabila sudah, mari kita lanjutkan. Ready. Go.	INM01

70	The detective was out of town	F11
71	leaving the paperwork for his one and only assistant.	
72	Doing the paperwork: (1) The detective (2) The assistant (3) Undecided	
73	…	
74	Running out of time	F12
75	Eliza tried hard to stay calm and focus to complete the task.	
76	which she failed to do so eventually.	
77	Eliza's task: (1) Completed (2) Failed (3) Undecided	
78	…	
79	Living in the big city	F13
80	rarely has the children enjoyed such mountainous sceneries.	
81	…	
82	The seminar was held in the auditorium of the university	F14
83	that is relatively new.	
84	…	
85	Erebus was the ship of the crew	**TE03**
	Crozier was the captain of the crew	**TC03**
86	which had been missing in Antarctica	
87	known to have died by lead poisoning.	
88	Having been missing in Antarctica: (1) The crew (2) The ship/captain (3) Undecided	
89	…	
90	Jessica, amazed by the beautiful castle in front of her	F15
91	intend to explore every inch of it.	
92	…	
93	The curious cat, startled by the cold water	F16
94	is hurrying to get out of the sink.	
95	…	
96	Sarah was to go to the office of the manager	**TE04**
	Sarah was to meet the manager of the actress	**TC04**
97	that was on the second floor	
98	sitting by the window.	
99	Being on the second floor: (1) The office/manager (2) The manager/actress (3) Undecided	
100	…	

101	Hardly ever does Jack visited his grandparents	F17
102	being a businessman who travels overseas.	
103	…	
104	The chef is serving the main dish of his specialty	F18
105	which has been anticipated by the diners.	
106	…	
107	Reunited with his wife	F19
108	hardly ever have there been any sadness	
109	reflected on his face.	
110	…	
111	Ben watched the classic film of the late director	**TE05**
	Ben watched the documentary of the late director	**TC05**
112	that was praised by the critics	
113	directing with such unique vision.	
114	Being praised by the critics: (1) The late director (2) The classic film/documentary (3) Undecided	
115	…	
116	The abstract statue, located in the center of the park	F20
117	are the hallmark of this old town	
118	since it was reformed in the 90s.	
119	…	
120	Mary conversed with the father of the bride	**TE06**
	Mary conversed with the mother of the bride	**TC06**
121	who was in front of the car	
122	wearing a beautiful gown.	
123	Being in front of the car: (1) The father/mother (2) The bride (3) Undecided	
124	Anda telah mencapai dua per tiga dari aktivitas ini. Silahkan istirahat sejenak, regangkan badan, tarik nafas dan hembuskan. Apabila sudah, mari kita lanjutkan pada bagian sepertiga terakhir aktivitas ini. Ready. Go.	INM02

125	Praised by his customers	F21
126	Bob is motivated to improve his cooking skill.	
127	Being praised: (1) The customer (2) Bob (3) Undecided	
128	…	
129	Neil hosts the prime-time show of the channel	F22
130	that makes him popular.	
131	…	
132	The beach, looking full of garbage left by some of the visitors	F23
133	frustrate the local leaders	
134	who as well lacking support from the locals.	
135	Leaving garbage at the beach: (1) Locals (2) Visitors (3) Undecided	
136	…	
137	Left by his father for a week	F24
138	never have the kid shown such an excitement to see him back.	
139	…	
140	Laura had been waiting for the brother of the landlady	**TE07**
	Laura had been waiting for the sister of the landlady	**TC07**
141	who was seen attending the party	
142	with a pregnant belly.	
143	Being seen attending the party: (1) The landlady (2) The brother/sister (3) Undecided	
144	…	
145	The region has survived for years	F25
146	being able to keep the peace with neighbouring towns	
147	which have now become united.	
148	…	
149	The paper crafts, made by the kindergarten kids	
150	is on display at the festival today.	
151	…	
152	The article mentioned the wife of the actor	**TE08**
	The article mentioned the brother of the actor	**TC08**
153	who made a surprise appearance that day	
154	announcing himself he'll become a father.	
155	Making a surprise appearance that day: (1) The wife/brother (2) The actor (3) Undecided	

156	…	
157	Luke, holding hands with his wife	F26
158	walked on the red carpet of the award ceremony	
159	posing for the camera	
160	Posing for the camera: (1) Luke (2) His wife (3) Undecided	
161	…	
162	Mr. Smith, making a name of himself as a brilliant comedian	F27
163	is the star of the show.	
164	…	
165	This chapter focuses on the sister of the hero	**TE09**
	This chapter focuses on the enemy of the hero	**TC09**
166	who was in the neighbouring country	
167	to marry the princess.	
168	Being in the neighboring country: (1) The hero (2) The sister/enemy (3) Undecided	
168	…	
170	The old man, asked by his grandson about his youth	F28
171	is taking a trip down his memory lane	
172	when he first met his wife.	
173	…	
174	The book featured a queen of a kingdom	**TE10**
	The book featured a castle of a kingdom	**TC10**
175	that was praised by the people	
176	located on top of the tallest mountain.	
177	Being praised by the people: (1) The queen/castle (2) The kingdom (3) Undecided	
178	…	
179	The rules concern the members of the groups	F29
180	which register after February.	
181	Well done! Anda telah mencapai akhir dari aktivitas ini. Terima kasih banyak atas waktu dan tenaga yang Anda berikan. Semoga menjadi amal yang bermanfaat dan pengalaman yang berharga. Tekan spacebar untuk menyimpan data Anda.	CLS

C. Instrument of Study 3 (Self-paced Reading Task)

Codes:

INT : Introduction

INS : Instructional frame

INM : Intermission

F : Filler item

T : Target item

CLS : Closing statement

… : In-between stimuli break

Table 2. Instrument of SPR Task (Study 3)

Frame no.	Items	Code
1	Salam! Anda akan membaca beberapa kalimat dalam bahasa Inggris. Setiap kalimat akan ditampilkan dalam dua atau tiga bagian. Anda dapat menekan tombol 'spacebar' pada keyboard untuk memunculkan bagian-bagian kalimat tersebut satu per satu sehingga membentuk satu kalimat utuh. Silahkan membaca senatural mungkin seakan bagian-bagian kalimat tersebut tersusun seperti satu kalimat biasanya. Untuk membiasakan diri dalam membaca melalui program ini, beberapa kalimat pertama akan disediakan sebagai latihan. ~ Tekan spacebar untuk mulai membaca ~	INT
2	Patricia has prepared the special birthday cake for her little brother	P01
3	who just turned 12 this month.	
4	…	
5	The visitors are not allowed to take any pictures	P02
6	once inside the museum.	
7	…	
8	The cat that went missing last week	P03
9	has finally been found safe and sound	
10	as confirmed by the owner.	
11	…	

12	Beberapa kalimat akan diikuti oleh pertanyaan pemahaman (*comprehension question*) yang disertai 3 pilihan jawaban untuk memastikan bahwa Anda memahami apa yang Anda baca. Untuk memilih jawaban, tekan tombol '1' atau '2' atau '3' pada keyboard, sesuai dengan pilihan jawaban yang Anda pahami. Berikut dua contoh kalimat yang masing-masing akan diikuti oleh pertanyaan pemahaman.	INS
13	The newscaster presented an update on the thief	P04
14	that was caught earlier this morning.	
15	Being caught earlier this morning: (1) The newscaster (2) The thief (3) Undecided Silahkan menekan tombol '1' atau '2' atau '3' pada keyboard sesuai pilihan jawaban yang Anda anggap benar. Sebagai contoh, Anda dapat menekan tombol '2'.	
16	Dengan menekan salah satu nomor yang merepresentasikan pilihan jawaban Anda, respon jawaban Anda akan otomatis terekam dan Anda dapat melanjutkan pada kalimat berikutnya. Berikut satu contoh lagi kalimat yang diikuti oleh pertanyaan pemahaman. Silahkan membaca hingga kalimat tersebut selesai dan jawab pertanyaan sesuai dengan yang Anda anggap benar dengan cara yang sama seperti yang telah Anda lakukan.	INS
17	Brad visited the gorgeous lake	P05
18	that is located between the two nearby villages	
19	making it a popular spot for resting.	
20	Located between the two nearby villages: (1) Brad's home (2) The gorgeous lake (3) Undecided	
21	Well done! Tidak semua kalimat diikuti oleh pertanyaan pemahaman. Namun pertanyaan-pertanyaan tersebut akan muncul secara random pada beberapa kalimat. Cobalah untuk memahami setiap kalimat yang Anda baca.	INS
22	ATTENTION Apabila hendak berhenti sejenak untuk istirahat atau lainnya (menerima telpon, ke belakang, dsb), mohon untuk menyelesaikan membaca sampai akhir kalimat terlebih dahulu, dan dapat berhenti sejenak jika telah sampai pada tampilan 'triple dots' atau "..."	

23	Ini adalah akhir dari sesi latihan membaca melalui program ini. Silahkan memulai membaca kalimat-kalimat berikutnya sama halnya seperti yang telah Anda lakukan pada sesi latihan. Ready. Go.	
24	Zach is exhausted	F01
25	having travelled from town to town for the whole week.	
26	…	
27	Sneaking up on its prey without a sound	F02
28	the lion ambushed the lonely deer.	
29	Sneaking up without a sound: (1) The lion (2) The lonely deer (3) Undecided	
30	…	
31	Working for his boss for the whole night each day	F03
32	Peter only gets to rest in the morning	
33	earning him the title of the night owl.	
34	Earning the title of the night owl? (1) The boss (2) Peter (3) Undecided	
35	Kate wrote the novel adaptation of the movie	F04
36	which moves people to tears.	
37	…	
38	Coming out of its cocoon	F05
39	the caterpillar has transformed into a beautiful butterfly.	
40	…	
41	The band is performing the soundtracks of the movie	**T01**
42	that has become fans' favourite	
43	featuring a heartthrob's acting debut.	
44	Having become fans' favourite: (1) The movie (2) The soundtracks (3) Undecided	
45	…	

46	The cops, noticing that the suspect was making a move	F06
47	was trying to keep pace with him.	
48	only to lose him in the crowds.	
49	Having lost in the crowds: (1) The cops (2) The suspect (3) Undecided	
50	…	
51	After being warned by her friends	F07
52	never again had Emily gone out past midnight.	
53	…	
54	The magazine featured a survey of rich celebrities	**T02**
	that have gone trending	
55	whose names appeared in hashtags.	
56	Having gone trending: (1) The survey (2) Rich celebrities (3) Undecided	
57	So cold are the nature of this town	F08
58	that locals rarely go outside at night.	
59	…	
60	The judge, having made his decision	F09
61	is ready to pronounce sentence on the defendant.	
62	Having made the decision: (1) The judge (2) The defendant (3) Undecided	
63	…	
64	Only after the morning comes	F10
65	do William have the courage to pass that tunnel.	
66	willingly taking a detour every time he comes home late.	
67	The time William would willingly pass the tunnel: (1) Late night (2) Past morning (3) Undecided	
68	Anda telah mencapai sepertiga dari aktivitas ini. Silahkan istirahat sejenak, regangkan badan, tarik nafas dan hembuskan. Apabila sudah, mari kita lanjutkan. Ready. Go.	INM01
69		

70	The detective was out of town	F11
71	leaving the paperwork for his one and only assistant.	
72	Doing the paperwork: (1) The detective (2) The assistant (3) Undecided	
73	…	
74	Running out of time	F12
75	Eliza tried hard to stay calm and focus to complete the task.	
76	which she failed to do so eventually.	
77	Eliza's task: (1) Completed (2) Failed (3) Undecided	
78	…	
79	Living in the big city	F13
80	rarely has the children enjoyed such mountainous sceneries.	
81	…	
82	The seminar was held in the auditorium of the university	F14
83	that is relatively new.	
84	…	
85	Girls bought the bags of the designer	**T03**
86	that has been gaining popularity recently	
87	designing with such unique touch.	
88	Having been gaining popularity recently: (1) The designer (2) The bags (3) Undecided	
89	…	
90	Jessica, amazed by the beautiful castle in front of her	F15
91	intend to explore every inch of it.	
92	…	
93	The curious cat, startled by the cold water	F16
94	is hurrying to get out of the sink.	
95	…	
96	Peter played with the children of the landlord	**T04**
97	who has been close to him	
98	as if he was his uncle.	
99	Having been close to Peter: (1) The children (2) The landlord (3) Undecided	
100	…	
101	Hardly ever does Jack visited his grandparents	F17
102	being a businessman who travels overseas.	

103	…	
104	The chef is serving the main dish of his specialty	F18
105	which has been anticipated by the diners.	
106	…	
107	Reunited with his wife	F19
108	hardly ever have there been any sadness	
109	reflected on his face.	
110	…	
111	Jane used to have the painting of the statues	**T05**
112	that have been missing	
113	known to have intricate carving to it.	
114	Having been missing: (1) The statues (2) The painting (3) Undecided	
115	…	
116	The abstract statue, located in the center of the park	F20
117	are the hallmark of this old town	
118	since it was reformed in the 90s.	
119	…	
120	Jim is about to greet the old friends of his wife	**T06**
121	who has been waiting in the garden	
122	ready to welcome them to her party.	
123	Having been waiting in the garden: (1) The old friends (2) Jim’s wife (3) Undecided	
124	Anda telah mencapai dua per tiga dari aktivitas ini. Silahkan istirahat sejenak, regangkan badan, tarik nafas dan hembuskan. Apabila sudah, mari kita lanjutkan pada bagian sepertiga terakhir aktivitas ini. Ready. Go.	INM02

125	Praised by his customers	F21
126	Bob is motivated to improve his cooking skill.	
127	Being praised: (1) The customer (2) Bob (3) Undecided	
128	…	
129	Neil hosts the prime-time show of the channel	F22
130	that makes him popular.	
131	…	
132	The beach, looking full of garbage left by some of the visitors	F23
133	frustrate the local leaders	
134	who as well lacking support from the locals.	
135	Leaving garbage at the beach: (1) Locals (2) Visitors (3) Undecided	
136	…	
137	Left by his father for a week	F24
138	never have the kid shown such an excitement to see him back.	
139	…	
140	Alex is painting the bedrooms of his house	**T07**
141	which was currently redesigned	
142	being an old house that it is.	
143	Being currently redesigned: (1) Alex’s house (2) The bedrooms (3) Undecided	
144	…	
145	The region has survived for years	F25
146	being able to keep the peace with neighbouring towns	
147	which have now become united.	
148	…	
149	The paper crafts, made by the kindergarten kids	
150	is on display at the festival today.	
151	…	
152	Anne brought some rainbow cakes of the new bakery	**T08**
153	that was featured in a food magazine	
154	being only opened earlier this month.	
155	Being featured in a food magazine: (1) Rainbow cakes (2) The new bakery (3) Undecided	
156	…	

157	Luke, holding hands with his wife	F26
158	walked on the red carpet of the award ceremony	
159	posing for the camera	
160	Posing for the camera: (1) Luke (2) His wife (3) Undecided	
161	…	
162	Mr. Smith, making a name of himself as a brilliant comedian	F27
163	is the star of the show.	
164	…	
165	The governor visited the farmers of the village	**T09**
166	that has caught public's attention	
167	located between two flooding rivers.	
168	Having caught public's attention: (1) The village (2) The farmers (3) Undecided	
169	…	
170	The old man, asked by his grandson about his youth	F28
171	is taking a trip down his memory lane	
172	when he first met his wife.	
173	…	
174	The cat played with the toys of the baby	**T10**
175	which was lying on the floor	
176	crying for the sitter's attention.	
177	Lying on the floor: (1) The toys (2) The baby (3) Undecided	
178	…	
179	The rules concern the members of the groups	F29
180	which register after February.	
181	Well done! Anda telah mencapai akhir dari aktivitas ini. Terima kasih banyak atas waktu dan tenaga yang Anda berikan. Semoga menjadi amal yang bermanfaat dan pengalaman yang berharga. Tekan spacebar untuk menyimpan data Anda.	CLS

APPENDIX 2

ADMINISTRATIVE DOCUMENTS

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS NEGERI YOGYAKARTA
PROGRAM PASCASARJANA
Jalan Colombo Nomor 1 Yogyakarta 55281
Telepon (0274) 550835, 550836, Fax (0274) 520326
Laman: pps.uny.ac.id E-mail: pps@uny.ac.id, humas_pps@uny.ac.id

SURAT KETERANGAN VALIDASI

Yang bertanda tangan di bawah ini:

Nama	: Ashadi
Jabatan/Pekerjaan	: Dosen PBI
Instansi Asal	: UNY

Menyatakan bahwa instrumen penelitian dengan judul:
Relative Clause Attachment Preference in Second Language Sentence Processing: Evidence from Indonesian Learners of English

dari mahasiswa:

Nama	: Hardian Zudianto
Program Studi	: Linguistik Terapan
NIM	: 16706251008

(sudah siap/~~belum siap~~)* dipergunakan untuk penelitian dengan menambahkan beberapa saran sebagai berikut:

1. Sampling utk NS & NNS di pastikan tdk melebar
2. Instrument Questionnaire perlu di perbaiki yg redundant & repetitive

Demikian surat keterangan ini kami buat untuk dapat dipergunakan sebagaimana mestinya.

Yogyakarta, 5 November 2018
Validator,

Ashadi

*) coret yang tidak perlu

KEMENTERIAN RISET, TEKNOLOGI, DAN PENDIDIKAN TINGGI
UNIVERSITAS NEGERI YOGYAKARTA
PROGRAM PASCASARJANA
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Laman: pps.uny.ac.id Email: pps@uny.ac.id, humas_pps@uny.ac.id

Nomor 14257UN34.17/LT/2018 27 Desember 2018
Hal : Permohonan Data Skor Grammar ProTEFL PBI S2 2017-2018

Yth. Kepala Pusat Pengembangan Bahasa UNY
Jl. Colombo No.1, Karangmalang, Caturtunggal, Kec. Depok, Kab. Sleman, DIY 55281

Bersama ini kami mohon dengan hormat, kiranya Bapak/Ibu/Saudara berkenan memberikan izin kepada mahasiswa jenjang S-2 Program Pascasarjana Universitas Negeri Yogyakarta:

Nama	: HARDIAN ZUDIANTO
NIM	: 16706251008
Program Studi	: Linguistik Terapan
Konsentrasi	: Pendidikan Bahasa Asing

untuk melaksanakan kegiatan permohonan data skor grammar protefl pbi s2 2017-2018 dalam rangka penulisan tesis yang dilaksanakan pada:

Waktu	: Desember 2018 s.d Januari 2019
Lokasi/Objek	: Pusat Pengembangan Bahasa UNY
Judul Penelitian	: Relative Clause Attachment Preference in Second Language Sentence Processing: Evidence from Indonesian Learners of English
Pembimbing	: Dra. Pangesti Wiedarti, M.Appl. Ling., Ph.D.

Demikian atas perhatian, bantuan dan izin yang diberikan, kami ucapkan terima kasih

Wakil Direktur I,

Dr. Sugito, MA.
NIP 19600410 198503 1 002

Tembusan:
Mahasiswa Ybs.

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Laman: pps.uny.ac.id Email: pps@uny.ac.id, humas_pps@uny.ac.id

Nomor : 13500 /UN34.17/LT/2018 30 November 2018
Hal : Izin Penelitian

Yth. Kaprodi PBI PPs UNY

Bersama ini kami mohon dengan hormat, kiranya Bapak/Ibu/Saudara berkenan memberikan izin kepada mahasiswa jenjang S-2 Program Pascasarjana Universitas Negeri Yogyakarta:

Nama	: HARDIAN ZUDIANTO
NIM	: 16706251008
Program Studi	: Linguistik Terapan
Konsentrasi	: Pendidikan Bahasa Asing

untuk melaksanakan kegiatan penelitian dalam rangka penulisan tesis yang dilaksanakan pada:

Waktu	: Desember 2018
Lokasi/Objek	: Program Studi Pendidikan Bahasa Inggris, PPs UNY
Judul Penelitian	: Relative Clause Attachment Preference in Second Language Sentence Processing: Evidence from Indonesian Learners of English
Pembimbing	: Dra. Pangesti Wiedarti, M.Appl. Ling., Ph.D.

Demikian atas perhatian, bantuan dan izin yang diberikan, kami ucapkan terima kasih

Wakil Direktur I,

Dr. Sugito, MA.
NIP 19600410 198503 1 002

Tembusan:
Mahasiswa Ybs.

KEMENTERIAN RISET, TEKNOLOGI, DAN PENDIDIKAN TINGGI
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Laman: pps.uny.ac.id Email: pps@uny.ac.id, humas_pps@uny.ac.id

Nomor : 3795/UN34.17/LT/2019 — 18 Maret 2019
Hal : Izin Penelitian

Yth. Kaprodi Linguistik Terapan S2 UNY
PPs UNY, Jl. Colombop No. 1 Karang Malang, Caturtunggal, Depok Sleman Yogyakarta

Bersama ini kami mohon dengan hormat, kiranya Bapak/Ibu/Saudara berkenan memberikan izin kepada mahasiswa jenjang S-2 Program Pascasarjana Universitas Negeri Yogyakarta:

Nama	: HARDIAN ZUDIANTO
NIM	: 16706251008
Program Studi	: Linguistik Terapan
Konsentrasi	: Pendidikan Bahasa Asing

untuk melaksanakan kegiatan penelitian dalam rangka penulisan tesis yang dilaksanakan pada:

Waktu	: Maret s.d April 2019
Lokasi/Objek	: Program Studi Linguistik Terapan S2 PPs UNY
Judul Penelitian	: Relative Clause Attachment Preference in Second Language Sentence Processing: Evidence from Indonesian Learners of English
Pembimbing	: Dra. Pangesti Wiedarti, M.Appl. Ling., Ph.D.

Demikian atas perhatian, bantuan dan izin yang diberikan, kami ucapkan terima kasih

Wakil Direktur I,

Dr. Sugito, MA.
NIP. 19600410 198503 1 002

Tembusan:
Mahasiswa Ybs.

APPENDIX 3
RESEARCH DATA

A. Data of Study 1 (Judgement Task)

Codes:

J01 : Participants of the judgement task study by chronological order.

R01 : Relative clause target items by chronological order

EC : Selection of Early Closure strategy

LC : Selection of Late Closure strategy

Table 3. Judgement Task Data Analysis Sheet

Participants	Target Items																				Number of Selections	
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	EC	LC
J01	EC	EC	LC	EC	EC	EC	LC	LC	EC	EC	LC	EC	LC	LC	EC	LC	EC	EC	EC	EC	13	7
J02	EC	LC	EC	EC	EC	EC	EC	EC	EC	LC	EC	LC	LC	EC	LC	EC	EC	LC	EC	EC	14	6
J03	EC	EC	LC	LC	EC	EC	LC	LC	EC	LC	LC	EC	LC	EC	LC	EC	EC	EC	EC	EC	12	8
J04	EC	EC	EC	EC	EC	LC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	18	2
J05	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	18	2
J06	LC	EC	LC	LC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	16	4
J07	LC	EC	EC	EC	LC	LC	EC	EC	LC	LC	LC	LC	LC	LC	LC	LC	EC	EC	EC	EC	9	11
J08	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	19	1
J09	EC	LC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	17	3

J10	LC	EC	LC	EC	EC	LC	EC	EC	LC	EC	EC	EC	EC	LC	LC	EC	LC	EC	EC	LC	12	8
J11	EC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	EC	EC	LC	LC	EC	LC	4	16
J12	EC	EC	LC	EC	EC	LC	LC	EC	LC	LC	EC	LC	LC	EC	LC	LC	EC	EC	LC	LC	9	11
J13	EC	LC	LC	EC	EC	LC	LC	EC	EC	EC	EC	EC	LC	LC	LC	LC	LC	EC	LC	EC	10	10
J14	LC	EC	LC	EC	EC	EC	EC	LC	LC	EC	LC	LC	LC	EC	LC	EC	EC	EC	LC	EC	11	9
J15	EC	EC	EC	LC	EC	LC	EC	LC	EC	LC	LC	LC	LC	LC	EC	LC	EC	EC	LC	EC	10	10
J16	EC	LC	LC	EC	LC	LC	LC	LC	EC	LC	LC	LC	EC	EC	LC	EC	EC	LC	LC	LC	7	13
J17	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	19	1
J18	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	18	2
J19	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	EC	EC	EC	EC	LC	EC	EC	17	3
J20	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0
J21	EC	EC	LC	LC	LC	EC	LC	LC	EC	EC	EC	EC	LC	EC	LC	EC	LC	EC	EC	EC	12	8
J22	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	19	1
J23	EC	EC	EC	LC	EC	LC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	LC	EC	16	4
J24	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0
J25	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	19	1
J26	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	LC	LC	LC	EC	EC	EC	EC	EC	EC	EC	16	4
J27	EC	EC	LC	LC	EC	EC	EC	EC	EC	LC	LC	LC	LC	EC	LC	LC	LC	EC	EC	LC	10	10
J28	EC	LC	EC	EC	EC	LC	EC	EC	EC	EC	LC	LC	EC	EC	EC	EC	EC	EC	LC	EC	15	5
J29	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	LC	EC	18	2
J30	LC	EC	EC	LC	EC	LC	EC	EC	LC	LC	LC	EC	LC	EC	LC	LC	EC	EC	LC	EC	10	10
J31	LC	LC	LC	EC	LC	EC	EC	LC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	14	6
J32	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	LC	EC	LC	LC	EC	LC	EC	EC	14	6
J33	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	LC	LC	EC	EC	LC	EC	EC	EC	EC	15	5
J34	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	LC	EC	LC	LC	EC	EC	EC	EC	15	5
J35	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	19	1
J36	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0

J37	EC	EC	LC	LC	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	17	3
J38	EC	EC	LC	EC	EC	EC	EC	LC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	EC	17	3
J39	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	LC	EC	EC	LC	EC	EC	17	3
J40	LC	EC	EC	EC	EC	LC	EC	EC	EC	EC	EC	EC	LC	LC	EC	EC	EC	EC	EC	EC	16	4
J41	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	LC	LC	EC	LC	EC	EC	LC	EC	LC	13	7
J42	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0
J43	EC	EC	EC	EC	EC	EC	LC	EC	EC	EC	LC	EC	LC	EC	LC	LC	EC	EC	EC	LC	14	6
J44	LC	EC	LC	LC	EC	EC	EC	EC	EC	EC	LC	LC	LC	LC	LC	EC	LC	EC	LC	EC	10	10
J45	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0
J46	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	EC	EC	EC	LC	EC	EC	17	3
J47	LC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	EC	EC	LC	EC	EC	LC	EC	EC	16	4
J48	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	LC	LC	LC	EC	LC	LC	EC	EC	EC	EC	15	5
J49	EC	EC	LC	EC	EC	LC	EC	EC	EC	LC	EC	EC	LC	EC	LC	EC	EC	EC	EC	EC	15	5
J50	LC	EC	LC	LC	EC	EC	EC	EC	EC	LC	EC	LC	EC	EC	LC	EC	LC	EC	EC	LC	12	8
J51	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0
J52	EC	LC	LC	LC	LC	LC	LC	LC	EC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	LC	2	18
J53	EC	EC	EC	EC	EC	LC	EC	EC	EC	EC	LC	EC	LC	EC	EC	EC	EC	LC	EC	EC	16	4
J54	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	20	0
J55	EC	EC	EC	EC	EC	EC	EC	LC	EC	LC	LC	LC	LC	LC	EC	LC	EC	LC	EC	EC	12	8

B. Data of Study 2 (Self-paced Reading Experiment)

Codes:

E01 : Experimental group participants of the SPR task in the second study by chronological order.

C01 : Control group participants of the SPR task in the second study by chronological order.

LA01 : Locally ambiguous Relative Clause sentences by chronological order as the stimulus sentences for the experimental group.

GA01 : Globally ambiguous Relative Clause sentences by chronological order as the stimulus sentences for the control group.

Table 4. Data Analysis Sheet of the Experimental Group (Study 2)

Participants	Target Items	Reaction Time (ms)	Outliers (z > 2.58)	Aggregate Means (without outlier)
E01	LA01	3735	1.489	3193
	LA02	3583	1.341	
	LA03	5195	2.910 (Outlier)	
	LA04	2552	0.338	
	LA05	2482	0.270	
	LA06	2385	0.175	
	LA07	3202	0.970	
	LA08	3781	1.534	
	LA09	2253	0.047	
	LA10	4762	2.489	
E02	LA01	1786	-0.408	1886
	LA02	1848	-0.347	
	LA03	3163	0.932	
	LA04	1165	-1.012	
	LA05	1376	-0.807	
	LA06	938	-1.233	
	LA07	2418	0.207	
	LA08	2546	0.332	
	LA09	904	-1.266	
	LA10	2712	0.493	

E03	LA01	2440	0.229	1574
	LA02	1698	-0.493	
	LA03	2173	-0.031	
	LA04	642	-1.521	
	LA05	2132	-0.071	
	LA06	1274	-0.906	
	LA07	873	-1.296	
	LA08	1666	-0.525	
	LA09	1313	-0.868	
	LA10	1529	-0.658	
E04	LA01	4152	1.895	2697
	LA02	2069	-0.132	
	LA03	2110	-0.092	
	LA04	1786	-0.408	
	LA05	3933	1.682	
	LA06	1842	-0.353	
	LA07	2584	0.369	
	LA08	1800	-0.394	
	LA09	4358	2.096	
	LA10	2340	0.131	
E05	LA01	1554	-0.634	1949
	LA02	2138	-0.065	
	LA03	1804	-0.390	
	LA04	2055	-0.146	
	LA05	2339	0.130	
	LA06	2606	0.390	
	LA07	2405	0.195	
	LA08	1286	-0.894	
	LA09	1470	-0.715	
	LA10	1837	-0.358	
E06	LA01	836	-1.332	1688
	LA02	1431	-0.753	
	LA03	2065	-0.136	
	LA04	2402	0.192	
	LA05	1415	-0.769	
	LA06	934	-1.237	
	LA07	2535	0.321	
	LA08	2450	0.238	
	LA09	1219	-0.960	
	LA10	1595	-0.594	

E07	LA01	908	-1.262	1672
	LA02	1137	-1.039	
	LA03	1770	-0.423	
	LA04	739	-1.427	
	LA05	2201	-0.004	
	LA06	1234	-0.945	
	LA07	4156	1.899	
	LA08	1338	-0.844	
	LA09	938	-1.233	
	LA10	2296	0.089	
E08	LA01	2559	0.345	1694
	LA02	2206	0.001	
	LA03	4879	2.603 (Outlier)	
	LA04	1160	-1.017	
	LA05	1691	-0.500	
	LA06	1244	-0.935	
	LA07	1379	-0.804	
	LA08	1626	-0.564	
	LA09	1346	-0.836	
	LA10	2036	-0.164	
E09	LA01	1292	-0.889	2309
	LA02	2256	0.050	
	LA03	2154	-0.050	
	LA04	1775	-0.418	
	LA05	3757	1.511	
	LA06	1310	-0.871	
	LA07	1426	-0.758	
	LA08	3257	1.024	
	LA09	2257	0.051	
	LA10	3602	1.360	
E10	LA01	2407	0.197	2091
	LA02	3126	0.896	
	LA03	2313	0.105	
	LA04	1438	-0.746	
	LA05	2001	-0.199	
	LA06	1282	-0.898	
	LA07	3376	1.140	
	LA08	1626	-0.564	
	LA09	1344	-0.838	
	LA10	2001	-0.199	

E11	LA01	1024	-1.149	1731
	LA02	2335	0.127	
	LA03	1586	-0.602	
	LA04	1472	-0.713	
	LA05	2003	-0.197	
	LA06	2039	-0.162	
	LA07	2823	0.602	
	LA08	1602	-0.587	
	LA09	1005	-1.168	
	LA10	1418	-0.766	
E12	LA01	1095	-1.080	1834
	LA02	2615	0.399	
	LA03	3157	0.927	
	LA04	1345	-0.837	
	LA05	1626	-0.564	
	LA06	2126	-0.077	
	LA07	1376	-0.807	
	LA08	1658	-0.532	
	LA09	1094	-1.081	
	LA10	2251	0.045	
E13	LA01	1168	-1.009	1634
	LA02	11878	Cut-off Outlier	
	LA03	9213	Cut-off Outlier	
	LA04	1319	-0.862	
	LA05	2365	0.156	
	LA06	1016	-1.157	
	LA07	1370	-0.813	
	LA08	1303	-0.878	
	LA09	948	-1.223	
	LA10	3583	1.341	
E14	LA01	1656	-0.534	2661
	LA02	3935	1.684	
	LA03	7503	Cut-off Outlier	
	LA04	5087	2.805 (Outlier)	
	LA05	2082	-0.120	
	LA06	1702	-0.490	
	LA07	2021	-0.179	
	LA08	4820	2.545	
	LA09	1123	-1.053	
	LA10	3951	1.699	

E15	LA01	1636	-0.554	1994
	LA02	2715	0.496	
	LA03	2826	0.604	
	LA04	1200	-0.978	
	LA05	1776	-0.418	
	LA06	1654	-0.536	
	LA07	2135	-0.068	
	LA08	2037	-0.163	
	LA09	2200	-0.005	
	LA10	1756	-0.437	
E16	LA01	2804	0.583	2893
	LA02	2333	0.125	
	LA03	4617	2.348	
	LA04	1155	-1.022	
	LA05	4051	1.797	
	LA06	2187	-0.017	
	LA07	1821	-0.374	
	LA08	3969	1.717	
	LA09	1972	-0.227	
	LA10	4018	1.765	
E17	LA01	1257	-0.923	2095
	LA02	1972	-0.227	
	LA03	3092	0.863	
	LA04	3221	0.989	
	LA05	1606	-0.583	
	LA06	1057	-1.117	
	LA07	1340	-0.842	
	LA08	1625	-0.564	
	LA09	3505	1.265	
	LA10	2271	0.064	
E18	LA01	1446	-0.739	2299
	LA02	2381	0.171	
	LA03	4549	2.281	
	LA04	1712	-0.480	
	LA05	2107	-0.095	
	LA06	2295	0.088	
	LA07	1934	-0.264	
	LA08	2073	-0.128	
	LA09	1393	-0.790	
	LA10	3104	0.875	

E19	LA01	1047	-1.127	1992
	LA02	7864	Cut-off Outlier	
	LA03	3303	1.069	
	LA04	2240	0.034	
	LA05	2068	-0.133	
	LA06	2409	0.199	
	LA07	1507	-0.679	
	LA08	4953	2.675 (Outlier)	
	LA09	5295	3.007 (Outlier)	
	LA10	1373	-0.810	
E20	LA01	1657	-0.533	1607
	LA02	2782	0.562	
	LA03	1782	-0.412	
	LA04	1281	-0.899	
	LA05	1438	-0.746	
	LA06	1001	-1.172	
	LA07	1063	-1.111	
	LA08	1376	-0.807	
	LA09	1407	-0.777	
	LA10	2282	0.075	
E21	LA01	1684	-0.507	1880
	LA02	1667	-0.524	
	LA03	3100	0.871	
	LA04	950	-1.221	
	LA05	3063	0.835	
	LA06	950	-1.221	
	LA07	984	-1.188	
	LA08	1517	-0.670	
	LA09	1650	-0.540	
	LA10	3233	1.001	
E22	LA01	2455	0.243	2298
	LA02	1704	-0.488	
	LA03	3625	1.382	
	LA04	4994	2.715 (Outlier)	
	LA05	2456	0.244	
	LA06	2288	0.081	
	LA07	1787	-0.407	
	LA08	3557	1.316	
	LA09	1353	-0.829	
	LA10	1453	-0.732	

E23	LA01	2187	-0.017	2597
	LA02	3166	0.935	
	LA03	8178	Cut-off Outlier	
	LA04	2006	-0.194	
	LA05	4196	1.938	
	LA06	1530	-0.657	
	LA07	2086	-0.116	
	LA08	3861	1.612	
	LA09	2156	-0.048	
	LA10	2182	-0.022	
E24	LA01	1556	-0.632	2094
	LA02	2317	0.109	
	LA03	2851	0.629	
	LA04	973	-1.199	
	LA05	1819	-0.376	
	LA06	1922	-0.275	
	LA07	1690	-0.501	
	LA08	2971	0.746	
	LA09	1789	-0.405	
	LA10	3051	0.823	
E25	LA01	1173	-1.004	1719
	LA02	1455	-0.730	
	LA03	2417	0.206	
	LA04	688	-1.476	
	LA05	1855	-0.341	
	LA06	1026	-1.147	
	LA07	875	-1.294	
	LA08	2971	0.746	
	LA09	1630	-0.560	
	LA10	3099	0.870	
E26	LA01	1831	-0.364	1847
	LA02	1210	-0.968	
	LA03	3181	0.950	
	LA04	1697	-0.494	
	LA05	2033	-0.167	
	LA06	1576	-0.612	
	LA07	1566	-0.622	
	LA08	1180	-0.998	
	LA09	2532	0.318	
	LA10	1664	-0.527	

E27	LA01	2072	-0.129	2495
	LA02	2237	0.031	
	LA03	2286	0.079	
	LA04	3373	1.137	
	LA05	2787	0.566	
	LA06	5137	2.854 (Outlier)	
	LA07	1922	-0.275	
	LA08	3819	1.571	
	LA09	1460	-0.725	
	LA10	6351	Cut-off Outlier	
E28	LA01	1702	-0.490	2395
	LA02	1921	-0.276	
	LA03	2681	0.463	
	LA04	5663	3.366 (Outlier)	
	LA05	2919	0.695	
	LA06	8021	Cut-off Outlier	
	LA07	1003	-1.170	
	LA08	2971	0.746	
	LA09	1621	-0.568	
	LA10	4339	2.077	
E29	LA01	894	-1.276	2235
	LA02	1905	-0.292	
	LA03	2157	-0.047	
	LA04	2444	0.233	
	LA05	2457	0.245	
	LA06	1844	-0.351	
	LA07	1394	-0.789	
	LA08	3289	1.055	
	LA09	1476	-0.709	
	LA10	4488	2.222	
E30	LA01	1756	-0.437	2467
	LA02	3053	0.825	
	LA03	4267	2.007	
	LA04	4938	2.660 (Outlier)	
	LA05	5570	3.275 (Outlier)	
	LA06	1488	-0.698	
	LA07	1507	-0.679	
	LA08	3719	1.474	
	LA09	1591	-0.598	
	LA10	2353	0.144	

E31	LA01	11573	Cut-off Outlier	2213
	LA02	1802	-0.392	
	LA03	6896	Cut-off Outlier	
	LA04	3955	1.703	
	LA05	1534	-0.653	
	LA06	2908	0.684	
	LA07	1657	-0.533	
	LA08	1822	-0.373	
	LA09	1842	-0.353	
	LA10	2187	-0.017	
E32	LA01	1638	-0.552	2021
	LA02	3021	0.794	
	LA03	1995	-0.204	
	LA04	3085	0.857	
	LA05	1352	-0.830	
	LA06	1214	-0.964	
	LA07	2266	0.059	
	LA08	2094	-0.108	
	LA09	1053	-1.121	
	LA10	2496	0.283	

Table 5. Data Analysis Sheet of the Control Group (Study 2)

Participants	Target Items	Reaction Time (ms)	Outliers (z > 2.58)	Aggregate Means (without outlier)
C01	GA01	919	-1.097	1965
	GA02	2133	-0.016	
	GA03	1971	-0.160	
	GA04	1228	-0.822	
	GA05	1570	-0.517	
	GA06	4970	2.510	
	GA07	1340	-0.722	
	GA08	8418	Cut-off Outlier	
	GA09	1075	-0.958	
	GA10	2479	0.292	
C02	GA01	1600	-0.490	2535
	GA02	2485	0.298	
	GA03	5793	3.243 (Outlier)	
	GA04	2099	-0.046	
	GA05	5274	2.780 (Outlier)	
	GA06	2150	-0.001	
	GA07	2085	-0.059	
	GA08	6928	Cut-off Outlier	
	GA09	4591	2.172	
	GA10	2734	0.519	
C03	GA01	2372	0.197	2654
	GA02	1690	-0.410	
	GA03	2785	0.565	
	GA04	2669	0.461	
	GA05	4187	1.813	
	GA06	3766	1.438	
	GA07	2004	-0.131	
	GA08	3821	1.487	
	GA09	1040	-0.989	
	GA10	2202	0.046	
C04	GA01	1438	-0.635	2412
	GA02	1804	-0.309	
	GA03	5162	2.681 (Outlier)	
	GA04	2330	0.160	
	GA05	1089	-0.945	
	GA06	3178	0.914	
	GA07	4705	2.274	
	GA08	3794	1.463	
	GA09	1276	-0.779	
	GA10	2096	-0.049	

C05	GA01	976	-1.046	1939
	GA02	1496	-0.583	
	GA03	5125	2.648 (Outlier)	
	GA04	874	-1.137	
	GA05	3607	1.296	
	GA06	4123	1.756	
	GA07	872	-1.138	
	GA08	2210	0.053	
	GA09	1023	-1.004	
	GA10	2271	0.107	
C06	GA01	1125	-0.913	1588
	GA02	2058	-0.083	
	GA03	1839	-0.278	
	GA04	948	-1.071	
	GA05	1304	-0.754	
	GA06	1089	-0.945	
	GA07	2524	0.332	
	GA08	2307	0.139	
	GA09	1007	-1.018	
	GA10	1674	-0.424	
C07	GA01	3223	0.955	1805
	GA02	1926	-0.200	
	GA03	2306	0.138	
	GA04	1574	-0.514	
	GA05	2124	-0.024	
	GA06	993	-1.031	
	GA07	1627	-0.466	
	GA08	1908	-0.216	
	GA09	658	-1.329	
	GA10	1709	-0.393	
C08	GA01	972	-1.049	1421
	GA02	1672	-0.426	
	GA03	1849	-0.269	
	GA04	739	-1.257	
	GA05	1189	-0.856	
	GA06	955	-1.065	
	GA07	720	-1.274	
	GA08	1877	-0.244	
	GA09	1071	-0.961	
	GA10	3169	0.906	

C09	GA01	2602	0.402	2491
	GA02	3084	0.831	
	GA03	4201	1.825	
	GA04	1086	-0.948	
	GA05	2485	0.298	
	GA06	3385	1.099	
	GA07	1271	-0.783	
	GA08	3624	1.312	
	GA09	1255	-0.798	
	GA10	1921	-0.205	
C10	GA01	1622	-0.471	2311
	GA02	1840	-0.277	
	GA03	2492	0.304	
	GA04	1522	-0.560	
	GA05	2476	0.290	
	GA06	1508	-0.572	
	GA07	2724	0.510	
	GA08	5257	2.765 (Outlier)	
	GA09	2690	0.480	
	GA10	3921	1.576	
C11	GA01	1180	-0.864	1453
	GA02	1996	-0.138	
	GA03	1643	-0.452	
	GA04	1881	-0.240	
	GA05	1673	-0.425	
	GA06	5779	3.230 (Outlier)	
	GA07	473	-1.494	
	GA08	2077	-0.066	
	GA09	593	-1.387	
	GA10	1557	-0.529	
C12	GA01	2687	0.477	2219
	GA02	2572	0.375	
	GA03	2420	0.240	
	GA04	1259	-0.794	
	GA05	2206	0.049	
	GA06	1407	-0.662	
	GA07	2421	0.241	
	GA08	3152	0.891	
	GA09	1259	-0.794	
	GA10	2805	0.582	

C13	GA01	1210	-0.838	2434
	GA02	3288	1.012	
	GA03	4641	2.217	
	GA04	1944	-0.184	
	GA05	2724	0.510	
	GA06	1120	-0.918	
	GA07	1456	-0.619	
	GA08	3499	1.200	
	GA09	1248	-0.804	
	GA10	3207	0.940	
C14	GA01	1529	-0.554	2283
	GA02	2517	0.326	
	GA03	3117	0.860	
	GA04	1338	-0.724	
	GA05	3201	0.935	
	GA06	1211	-0.837	
	GA07	2182	0.028	
	GA08	2766	0.548	
	GA09	1831	-0.285	
	GA10	3135	0.876	
C15	GA01	1209	-0.838	1815
	GA02	2529	0.337	
	GA03	2378	0.202	
	GA04	1459	-0.616	
	GA05	2128	-0.020	
	GA06	1138	-0.902	
	GA07	2580	0.382	
	GA08	1627	-0.466	
	GA09	1075	-0.958	
	GA10	2027	-0.110	
C16	GA01	1599	-0.491	1742
	GA02	1448	-0.626	
	GA03	1515	-0.566	
	GA04	1774	-0.335	
	GA05	1414	-0.656	
	GA06	2386	0.209	
	GA07	1431	-0.641	
	GA08	1831	-0.285	
	GA09	2219	0.061	
	GA10	1800	-0.312	

C17	GA01	1248	-0.804	2809
	GA02	2930	0.694	
	GA03	3800	1.468	
	GA04	2600	0.400	
	GA05	3534	1.231	
	GA06	4551	2.137	
	GA07	4035	1.677	
	GA08	2608	0.407	
	GA09	1279	-0.776	
	GA10	1507	-0.573	
C18	GA01	1488	-0.590	1869
	GA02	1347	-0.716	
	GA03	2635	0.431	
	GA04	3205	0.939	
	GA05	1507	-0.573	
	GA06	1020	-1.007	
	GA07	1671	-0.427	
	GA08	2690	0.480	
	GA09	923	-1.093	
	GA10	2205	0.048	
C19	GA01	1267	-0.787	1531
	GA02	2681	0.472	
	GA03	2050	-0.090	
	GA04	1016	-1.010	
	GA05	1677	-0.422	
	GA06	950	-1.069	
	GA07	1286	-0.770	
	GA08	1715	-0.388	
	GA09	980	-1.042	
	GA10	1683	-0.416	
C20	GA01	2240	0.079	1410
	GA02	1643	-0.452	
	GA03	3088	0.834	
	GA04	923	-1.093	
	GA05	1657	-0.440	
	GA06	1040	-0.989	
	GA07	808	-1.195	
	GA08	792	-1.210	
	GA09	661	-1.326	
	GA10	1243	-0.808	

C21	GA01	1095	-0.940	2136
	GA02	4506	2.097	
	GA03	2338	0.167	
	GA04	1065	-0.967	
	GA05	2996	0.752	
	GA06	1033	-0.995	
	GA07	1919	-0.206	
	GA08	10145	Cut-off Outlier	
	GA09	19028	Cut-off Outlier	
	GA10	8010	Cut-off Outlier	
C22	GA01	1270	-0.784	2030
	GA02	2506	0.316	
	GA03	3458	1.164	
	GA04	1305	-0.753	
	GA05	1356	-0.708	
	GA06	1220	-0.829	
	GA07	1209	-0.838	
	GA08	3009	0.764	
	GA09	5106	2.631 (Outlier)	
	GA10	2940	0.703	
C23	GA01	2506	0.316	2734
	GA02	3374	1.089	
	GA03	5021	2.555	
	GA04	3139	0.880	
	GA05	2818	0.594	
	GA06	2668	0.460	
	GA07	1741	-0.365	
	GA08	2162	0.010	
	GA09	1403	-0.666	
	GA10	2506	0.316	
C24	GA01	1291	-0.765	2496
	GA02	4389	1.993	
	GA03	3271	0.997	
	GA04	1589	-0.500	
	GA05	1960	-0.170	
	GA06	2709	0.497	
	GA07	2109	-0.037	
	GA08	3409	1.120	
	GA09	1310	-0.749	
	GA10	2927	0.691	

C25	GA01	1011	-1.015	1624
	GA02	2173	0.020	
	GA03	2407	0.228	
	GA04	2389	0.212	
	GA05	1654	-0.442	
	GA06	1541	-0.543	
	GA07	1003	-1.022	
	GA08	1540	-0.544	
	GA09	909	-1.106	
	GA10	1610	-0.481	
C26	GA01	1242	-0.809	1524
	GA02	2295	0.128	
	GA03	5503	2.984 (Outlier)	
	GA04	874	-1.137	
	GA05	1943	-0.185	
	GA06	892	-1.121	
	GA07	1058	-0.973	
	GA08	1191	-0.854	
	GA09	1226	-0.823	
	GA10	2997	0.753	
C27	GA01	1753	-0.354	1940
	GA02	2758	0.541	
	GA03	4017	1.661	
	GA04	1751	-0.356	
	GA05	1489	-0.589	
	GA06	1173	-0.871	
	GA07	1353	-0.710	
	GA08	1940	-0.188	
	GA09	1008	-1.017	
	GA10	2153	0.002	
C28	GA01	5341	2.840 (Outlier)	2445
	GA02	5281	2.787 (Outlier)	
	GA03	3555	1.250	
	GA04	2327	0.157	
	GA05	2335	0.164	
	GA06	1762	-0.346	
	GA07	1311	-0.748	
	GA08	2969	0.728	
	GA09	3361	1.077	
	GA10	1943	-0.185	

C29	GA01	1071	-0.961	1335
	GA02	2479	0.292	
	GA03	826	-1.179	
	GA04	1517	-0.564	
	GA05	1087	-0.947	
	GA06	1370	-0.695	
	GA07	1418	-0.652	
	GA08	688	-1.302	
	GA09	840	-1.167	
	GA10	2054	-0.086	
C30	GA01	1894	-0.229	2012
	GA02	3691	1.371	
	GA03	5819	3.266 (Outlier)	
	GA04	1576	-0.512	
	GA05	2447	0.264	
	GA06	1543	-0.541	
	GA07	2279	0.114	
	GA08	1974	-0.157	
	GA09	1293	-0.764	
	GA10	1414	-0.656	

Table 6. Data Analysis Sheet for Independent T-test (Study 2)

Aggregate Means of Experimental Group		Aggregate Means of Control Group	
Participants	**Means of Reaction Time**	**Participants**	**Means of Reaction Time**
E01	3193	C01	1965
E02	1886	C02	2535
E03	1574	C03	2654
E04	2697	C04	2412
E05	1949	C05	1939
E06	1688	C06	1588
E07	1672	C07	1805
E08	1694	C08	1421
E09	2309	C09	2491
E10	2091	C10	2311
E11	1731	C11	1453
E12	1834	C12	2219
E13	1634	C13	2434
E14	2661	C14	2283
E15	1994	C15	1815
E16	2893	C16	1742
E17	2095	C17	2809
E18	2299	C18	1869
E19	1992	C19	1531
E20	1607	C20	1410
E21	1880	C21	2136
E22	2298	C22	2030
E23	2597	C23	2734
E24	2094	C24	2496
E25	1719	C25	1624
E26	1847	C26	1524
E27	2495	C27	1940
E28	2395	C28	2445
E29	2235	C29	1335
E30	2467	C30	2012
E31	2213		
E32	2021		

C. Data of Study 3 (Self-paced Reading Task)

Codes:

S01 : Participants of the third study on the effect of syntactic proficiency by chronological order.

D201 : Display 2 of Relative Clause stimulus sentences by chronological order.

D301 : Display 3 of Relative Clause stimulus sentences by chronological order.

Table 7. SPR Task Data Analysis Sheet of Display 2 (Study 3)

Participants	Target Items	Reaction Time (ms)	Outliers (z > 2.58)	Aggregate Means (without outlier)
S01	D201	2115	0.123	1584
	D202	1655	-0.390	
	D203	1396	-0.679	
	D204	1321	-0.763	
	D205	1068	-1.046	
	D206	1383	-0.694	
	D207	1767	-0.265	
	D208	2062	0.064	
	D209	2033	0.032	
	D210	1037	-1.080	
S02	D201	2131	0.141	1782
	D202	1278	-0.811	
	D203	2097	0.103	
	D204	1371	-0.707	
	D205	1036	-1.082	
	D206	1771	-0.261	
	D207	1957	-0.053	
	D208	5495	3.898 (Outlier)	
	D209	2729	0.809	
	D210	1667	-0.377	

S03	D201	3241	1.381	1784
	D202	3793	1.997	
	D203	1610	-0.441	
	D204	1143	-0.962	
	D205	975	-1.150	
	D206	1177	-0.924	
	D207	1742	-0.293	
	D208	1193	-0.906	
	D209	1358	-0.722	
	D210	1610	-0.441	
S04	D201	2093	0.099	1756
	D202	1800	-0.228	
	D203	2391	0.432	
	D204	1076	-1.037	
	D205	1238	-0.856	
	D206	1933	-0.080	
	D207	1527	-0.533	
	D208	2832	0.924	
	D209	1368	-0.711	
	D210	1301	-0.786	
S05	D201	2322	0.355	2013
	D202	1537	-0.522	
	D203	1754	-0.280	
	D204	1537	-0.522	
	D205	1604	-0.447	
	D206	2238	0.261	
	D207	2054	0.055	
	D208	3290	1.436	
	D209	1922	-0.092	
	D210	1870	-0.150	
S06	D201	1832	-0.193	1605
	D202	1184	-0.916	
	D203	1446	-0.624	
	D204	1667	-0.377	
	D205	1078	-1.035	
	D206	1632	-0.416	
	D207	2432	0.477	
	D208	1765	-0.267	
	D209	1578	-0.476	
	D210	1434	-0.637	

S07	D201	2785	0.872	2058
	D202	2535	0.593	
	D203	1785	-0.245	
	D204	1329	-0.754	
	D205	1409	-0.665	
	D206	4348	2.617 (Outlier)	
	D207	1956	-0.054	
	D208	3158	1.288	
	D209	1877	-0.142	
	D210	1691	-0.350	
S08	D201	1907	-0.109	2480
	D202	1542	-0.516	
	D203	4007	2.236	
	D204	1476	-0.590	
	D205	2160	0.174	
	D206	2107	0.115	
	D207	5107	3.465 (Outlier)	
	D208	3071	1.191	
	D209	2324	0.357	
	D210	3722	1.918	
S09	D201	2251	0.275	2511
	D202	1688	-0.353	
	D203	2874	0.971	
	D204	2344	0.379	
	D205	2126	0.136	
	D206	3251	1.392	
	D207	3845	2.055	
	D208	8157	Cut-off Outlier	
	D209	2688	0.763	
	D210	1532	-0.528	
S10	D201	1738	-0.298	1313
	D202	1008	-1.113	
	D203	2159	0.173	
	D204	1244	-0.849	
	D205	1227	-0.868	
	D206	1077	-1.036	
	D207	977	-1.147	
	D208	910	-1.222	
	D209	1010	-1.111	
	D210	1777	-0.254	

S11	D201	1471	-0.596	1316
	D202	1339	-0.743	
	D203	1583	-0.471	
	D204	1708	-0.331	
	D205	889	-1.246	
	D206	1286	-0.802	
	D207	1221	-0.875	
	D208	854	-1.285	
	D209	1338	-0.744	
	D210	1471	-0.596	
S12	D201	2502	0.556	1593
	D202	1455	-0.614	
	D203	2084	0.089	
	D204	1321	-0.763	
	D205	1004	-1.117	
	D206	1389	-0.687	
	D207	1136	-0.970	
	D208	1467	-0.600	
	D209	1585	-0.468	
	D210	1988	-0.018	
S13	D201	1719	-0.319	1323
	D202	1095	-1.016	
	D203	1162	-0.941	
	D204	1001	-1.121	
	D205	938	-1.191	
	D206	1157	-0.946	
	D207	1375	-0.703	
	D208	2095	0.101	
	D209	1376	-0.702	
	D210	1314	-0.771	
S14	D201	6677	Cut-off Outlier	2053
	D202	2482	0.533	
	D203	2891	0.990	
	D204	1640	-0.407	
	D205	1706	-0.333	
	D206	1844	-0.179	
	D207	1234	-0.860	
	D208	2267	0.293	
	D209	2721	0.800	
	D210	1690	-0.351	

S15	D201	2247	0.271	2125
	D202	2284	0.312	
	D203	2438	0.484	
	D204	2166	0.180	
	D205	1517	-0.544	
	D206	1808	-0.219	
	D207	1948	-0.063	
	D208	3044	1.161	
	D209	2028	0.026	
	D210	1770	-0.262	
S16	D201	2117	0.126	2264
	D202	2288	0.317	
	D203	1783	-0.247	
	D204	1420	-0.653	
	D205	1616	-0.434	
	D206	1646	-0.400	
	D207	3102	1.226	
	D208	3567	1.745	
	D209	4651	2.956 (Outlier)	
	D210	2837	0.930	
S17	D201	2953	1.059	2139
	D202	1605	-0.446	
	D203	2299	0.329	
	D204	2255	0.280	
	D205	1005	-1.116	
	D206	1353	-0.728	
	D207	2754	0.837	
	D208	1887	-0.131	
	D209	1636	-0.411	
	D210	3637	1.823	
S18	D201	4893	3.226 (Outlier)	1509
	D202	1757	-0.276	
	D203	1790	-0.239	
	D204	1557	-0.500	
	D205	1124	-0.983	
	D206	1391	-0.685	
	D207	1675	-0.368	
	D208	1891	-0.127	
	D209	1273	-0.817	
	D210	1127	-0.980	

S19	D201	2373	0.412	1895
	D202	1484	-0.581	
	D203	1799	-0.229	
	D204	1494	-0.570	
	D205	776	-1.372	
	D206	1796	-0.233	
	D207	2048	0.049	
	D208	4944	3.283 (Outlier)	
	D209	4040	2.273	
	D210	1241	-0.853	
S20	D201	1688	-0.353	2141
	D202	2001	-0.004	
	D203	3280	1.425	
	D204	1594	-0.458	
	D205	1594	-0.458	
	D206	2501	0.555	
	D207	2282	0.310	
	D208	2219	0.240	
	D209	2845	0.939	
	D210	1407	-0.667	
S21	D201	1820	-0.206	2164
	D202	1564	-0.492	
	D203	1135	-0.971	
	D204	2936	1.040	
	D205	889	-1.246	
	D206	2468	0.518	
	D207	2270	0.297	
	D208	2686	0.761	
	D209	3634	1.820	
	D210	2236	0.259	
S22	D201	2733	0.814	2290
	D202	1734	-0.302	
	D203	1816	-0.210	
	D204	1533	-0.526	
	D205	2633	0.702	
	D206	4266	2.526	
	D207	1867	-0.153	
	D208	1867	-0.153	
	D209	2967	1.075	
	D210	1483	-0.582	

S23	D201	1637	-0.410	1917
	D202	1186	-0.914	
	D203	4842	3.169 (Outlier)	
	D204	2122	0.131	
	D205	1003	-1.118	
	D206	1571	-0.484	
	D207	1838	-0.186	
	D208	2538	0.596	
	D209	2221	0.242	
	D210	3140	1.268	
S24	D201	4163	2.411	2722
	D202	4489	2.775 (Outlier)	
	D203	2427	0.472	
	D204	1834	-0.190	
	D205	1380	-0.697	
	D206	3220	1.358	
	D207	2133	0.144	
	D208	5143	3.505 (Outlier)	
	D209	3228	1.366	
	D210	3387	1.544	
S25	D201	1670	-0.374	2318
	D202	1656	-0.389	
	D203	4250	2.508	
	D204	1920	-0.094	
	D205	1471	-0.596	
	D206	3101	1.225	
	D207	2606	0.672	
	D208	2469	0.519	
	D209	4467	2.750 (Outlier)	
	D210	1720	-0.318	
S26	D201	1055	-1.060	1838
	D202	1125	-0.982	
	D203	2403	0.445	
	D204	1919	-0.095	
	D205	742	-1.410	
	D206	1421	-0.652	
	D207	1088	-1.023	
	D208	1937	-0.075	
	D209	3369	1.524	
	D210	3325	1.475	

S27	D201	5921	4.374 (Outlier)	1627
	D202	1424	-0.648	
	D203	1718	-0.320	
	D204	1506	-0.557	
	D205	1086	-1.026	
	D206	1403	-0.672	
	D207	2038	0.037	
	D208	1954	-0.056	
	D209	1922	-0.092	
	D210	1591	-0.462	
S28	D201	1453	-0.616	1585
	D202	2389	0.429	
	D203	1567	-0.489	
	D204	1121	-0.987	
	D205	1256	-0.836	
	D206	2652	0.723	
	D207	1521	-0.540	
	D208	1154	-0.950	
	D209	1654	-0.391	
	D210	1087	-1.025	
S29	D201	1203	-0.895	1186
	D202	1186	-0.914	
	D203	1805	-0.223	
	D204	1203	-0.895	
	D205	853	-1.286	
	D206	2004	0.000	
	D207	1052	-1.064	
	D208	1236	-0.858	
	D209	869	-1.268	
	D210	452	-1.734	
S30	D201	3848	2.059	2306
	D202	3005	1.117	
	D203	3688	1.880	
	D204	1249	-0.844	
	D205	928	-1.202	
	D206	1114	-0.994	
	D207	2867	0.963	
	D208	1582	-0.472	
	D209	1815	-0.212	
	D210	2966	1.074	

S31	D201	1469	-0.598	1708
	D202	985	-1.138	
	D203	1519	-0.542	
	D204	1966	-0.043	
	D205	868	-1.269	
	D206	2050	0.051	
	D207	2235	0.257	
	D208	1884	-0.135	
	D209	2517	0.572	
	D210	1585	-0.468	
S32	D201	2137	0.148	2237
	D202	2590	0.654	
	D203	2068	0.071	
	D204	2371	0.409	
	D205	1221	-0.875	
	D206	3734	1.932	
	D207	1821	-0.205	
	D208	2422	0.466	
	D209	1919	-0.095	
	D210	2088	0.093	
S33	D201	1740	-0.295	1841
	D202	1493	-0.571	
	D203	2302	0.332	
	D204	1742	-0.293	
	D205	1294	-0.793	
	D206	2225	0.246	
	D207	2092	0.098	
	D208	2207	0.226	
	D209	1974	-0.034	
	D210	1342	-0.740	
S34	D201	2333	0.367	1924
	D202	1288	-0.800	
	D203	3879	2.093	
	D204	1735	-0.301	
	D205	1402	-0.673	
	D206	1616	-0.434	
	D207	2866	0.962	
	D208	2397	0.438	
	D209	875	-1.261	
	D210	852	-1.287	

S35	D201	1905	-0.111	1965
	D202	1307	-0.779	
	D203	1901	-0.116	
	D204	1303	-0.783	
	D205	1356	-0.724	
	D206	1554	-0.503	
	D207	2070	0.073	
	D208	1319	-0.765	
	D209	4306	2.570	
	D210	2624	0.692	
S36	D201	1380	-0.697	1752
	D202	1488	-0.577	
	D203	2349	0.385	
	D204	1805	-0.223	
	D205	1023	-1.096	
	D206	1669	-0.375	
	D207	1821	-0.205	
	D208	2451	0.499	
	D209	2185	0.202	
	D210	1353	-0.728	
S37	D201	2422	0.466	2496
	D202	3191	1.325	
	D203	4309	2.574	
	D204	2268	0.294	
	D205	2329	0.362	
	D206	1925	-0.089	
	D207	2519	0.575	
	D208	2351	0.387	
	D209	1664	-0.380	
	D210	1980	-0.027	

Table 8. SPR Task Data Analysis Sheet of Display 3 (Study 3)

Participants	Target Items	Reaction Time (ms)	Outliers (z > 2.58)	Aggregate Means (without outlier)
S01	D301	4660	2.368	2138
	D302	1866	-0.445	
	D303	1249	-1.066	
	D304	1220	-1.095	
	D305	2245	-0.063	
	D306	2412	0.105	
	D307	2250	-0.058	
	D308	1461	-0.852	
	D309	1966	-0.344	
	D310	2049	-0.260	
S02	D301	4035	1.739	2394
	D302	1316	-0.998	
	D303	1150	-1.166	
	D304	1205	-1.110	
	D305	2530	0.224	
	D306	3072	0.770	
	D307	2966	0.663	
	D308	2769	0.464	
	D309	1964	-0.346	
	D310	2933	0.630	
S03	D301	1658	-0.654	1674
	D302	1158	-1.158	
	D303	1359	-0.955	
	D304	1391	-0.923	
	D305	1725	-0.587	
	D306	1707	-0.605	
	D307	1644	-0.668	
	D308	1825	-0.486	
	D309	2226	-0.082	
	D310	2042	-0.267	
S04	D301	3540	1.241	2721
	D302	2160	-0.149	
	D303	2233	-0.075	
	D304	7980	Cut-off Outlier	
	D305	3284	0.983	
	D306	5485	3.199 (Outlier)	
	D307	2387	0.080	
	D308	2675	0.370	
	D309	2567	0.261	
	D310	2924	0.621	

S05	D301	1403	-0.911	2108
	D302	1670	-0.642	
	D303	3157	0.855	
	D304	1454	-0.860	
	D305	2472	0.165	
	D306	2673	0.368	
	D307	1420	-0.894	
	D308	1671	-0.641	
	D309	2237	-0.071	
	D310	2923	0.620	
S06	D301	4581	2.289	2424
	D302	1216	-1.099	
	D303	1298	-1.017	
	D304	2470	0.163	
	D305	2744	0.439	
	D306	2332	0.024	
	D307	1466	-0.847	
	D308	2932	0.629	
	D309	1564	-0.749	
	D310	3632	1.333	
S07	D301	2472	0.165	2623
	D302	2816	0.512	
	D303	2004	-0.306	
	D304	1972	-0.338	
	D305	4129	1.834	
	D306	1254	-1.061	
	D307	1860	-0.451	
	D308	2160	-0.149	
	D309	4503	2.210	
	D310	3064	0.762	
S08	D301	3838	1.541	2967
	D302	1924	-0.386	
	D303	3575	1.276	
	D304	2228	-0.080	
	D305	3623	1.324	
	D306	2307	-0.001	
	D307	2708	0.403	
	D308	2989	0.686	
	D309	2869	0.565	
	D310	3604	1.305	

S09	D301	3157	0.855	2516
	D302	1813	-0.498	
	D303	3126	0.824	
	D304	2219	-0.089	
	D305	5001	2.712 (Outlier)	
	D306	2251	-0.057	
	D307	2063	-0.246	
	D308	5751	3.467 (Outlier)	
	D309	3657	1.359	
	D310	1844	-0.467	
S10	D301	1421	-0.893	1171
	D302	1177	-1.138	
	D303	1232	-1.083	
	D304	1059	-1.257	
	D305	1382	-0.932	
	D306	1277	-1.038	
	D307	1166	-1.149	
	D308	860	-1.458	
	D309	1093	-1.223	
	D310	1043	-1.273	
S11	D301	2919	0.616	2068
	D302	2154	-0.155	
	D303	1354	-0.960	
	D304	1387	-0.927	
	D305	1587	-0.726	
	D306	1636	-0.676	
	D307	3566	1.267	
	D308	2187	-0.121	
	D309	1836	-0.475	
	D310	2059	-0.250	
S12	D301	2852	0.548	1762
	D302	1720	-0.592	
	D303	1953	-0.357	
	D304	1088	-1.228	
	D305	1987	-0.323	
	D306	1519	-0.794	
	D307	1322	-0.992	
	D308	1271	-1.044	
	D309	2103	-0.206	
	D310	1803	-0.508	

S13	D301	2876	0.572	1891
	D302	1345	-0.969	
	D303	1664	-0.648	
	D304	2125	-0.184	
	D305	1595	-0.718	
	D306	1251	-1.064	
	D307	2220	-0.088	
	D308	1657	-0.655	
	D309	1907	-0.403	
	D310	2271	-0.037	
S14	D301	3991	1.695	2512
	D302	2858	0.554	
	D303	2014	-0.296	
	D304	1891	-0.420	
	D305	10864	Cut-off Outlier	
	D306	2265	-0.043	
	D307	1642	-0.670	
	D308	2923	0.620	
	D309	8133	Cut-off Outlier	
	D310	6792	Cut-off Outlier	
S15	D301	1960	-0.350	2294
	D302	1946	-0.364	
	D303	1412	-0.902	
	D304	2717	0.412	
	D305	2628	0.323	
	D306	1895	-0.416	
	D307	3165	0.863	
	D308	2471	0.164	
	D309	2175	-0.134	
	D310	2575	0.269	
S16	D301	4317	2.023	2642
	D302	1794	-0.517	
	D303	2297	-0.011	
	D304	1586	-0.727	
	D305	3599	1.300	
	D306	6502	Cut-off Outlier	
	D307	2262	-0.046	
	D308	2364	0.057	
	D309	5284	2.997 (Outlier)	
	D310	2918	0.615	

S17	D301	2788	0.484	2023
	D302	1703	-0.609	
	D303	1303	-1.012	
	D304	1423	-0.891	
	D305	2373	0.066	
	D306	1573	-0.740	
	D307	1506	-0.807	
	D308	1618	-0.694	
	D309	2938	0.635	
	D310	3008	0.705	
S18	D301	2908	0.604	2516
	D302	2859	0.555	
	D303	1690	-0.622	
	D304	2224	-0.084	
	D305	3742	1.444	
	D306	1773	-0.538	
	D307	2876	0.572	
	D308	2024	-0.286	
	D309	2023	-0.287	
	D310	3038	0.735	
S19	D301	2208	-0.100	2199
	D302	1824	-0.487	
	D303	1898	-0.412	
	D304	441	-1.879	
	D305	2356	0.049	
	D306	1610	-0.702	
	D307	3000	0.697	
	D308	1505	-0.808	
	D309	4860	2.570	
	D310	2289	-0.019	
S20	D301	1532	-0.781	2157
	D302	2313	0.005	
	D303	1657	-0.655	
	D304	2032	-0.278	
	D305	2063	-0.246	
	D306	3376	1.076	
	D307	2532	0.226	
	D308	2126	-0.183	
	D309	1907	-0.403	
	D310	2032	-0.278	

S21	D301	1836	-0.475	2159
	D302	1538	-0.775	
	D303	1903	-0.407	
	D304	1178	-1.137	
	D305	2352	0.045	
	D306	3486	1.186	
	D307	2471	0.164	
	D308	1201	-1.114	
	D309	3487	1.187	
	D310	2135	-0.174	
S22	D301	2250	-0.058	2522
	D302	2483	0.177	
	D303	2099	-0.210	
	D304	2449	0.142	
	D305	3216	0.915	
	D306	5950	3.667 (Outlier)	
	D307	2167	-0.142	
	D308	2017	-0.293	
	D309	2783	0.479	
	D310	3233	0.932	
S23	D301	4392	2.099	3069
	D302	1670	-0.642	
	D303	2555	0.249	
	D304	2588	0.282	
	D305	4676	2.385	
	D306	4843	2.553	
	D307	2205	-0.103	
	D308	9385	Cut-off Outlier	
	D309	2556	0.250	
	D310	2138	-0.171	
S24	D301	2809	0.505	2794
	D302	2073	-0.236	
	D303	2073	-0.236	
	D304	1855	-0.456	
	D305	5660	3.375 (Outlier)	
	D306	2610	0.304	
	D307	3774	1.476	
	D308	4348	2.054	
	D309	2662	0.357	
	D310	2938	0.635	

S25	D301	5966	3.683 (Outlier)	2474
	D302	3619	1.320	
	D303	1902	-0.408	
	D304	1573	-0.740	
	D305	4170	1.875	
	D306	2002	-0.308	
	D307	2119	-0.190	
	D308	2237	-0.071	
	D309	8151	Cut-off Outlier	
	D310	2170	-0.139	
S26	D301	1583	-0.730	1388
	D302	970	-1.347	
	D303	1185	-1.130	
	D304	1511	-0.802	
	D305	1965	-0.345	
	D306	1371	-0.943	
	D307	1072	-1.244	
	D308	1237	-1.078	
	D309	1430	-0.884	
	D310	1551	-0.762	
S27	D301	1250	-1.065	1825
	D302	2256	-0.052	
	D303	1573	-0.740	
	D304	1676	-0.636	
	D305	2171	-0.138	
	D306	2055	-0.254	
	D307	1823	-0.488	
	D308	2000	-0.310	
	D309	2054	-0.255	
	D310	1388	-0.926	
S28	D301	1703	-0.609	1982
	D302	2036	-0.274	
	D303	2354	0.047	
	D304	1541	-0.772	
	D305	1019	-1.298	
	D306	2420	0.113	
	D307	3322	1.021	
	D308	952	-1.365	
	D309	3402	1.102	
	D310	1071	-1.245	

S29	D301	1821	-0.490	1347
	D302	1520	-0.793	
	D303	1420	-0.894	
	D304	1102	-1.214	
	D305	1454	-0.860	
	D306	1904	-0.406	
	D307	1570	-0.743	
	D308	1571	-0.742	
	D309	803	-1.515	
	D310	302	-2.019	
S30	D301	2213	-0.095	2345
	D302	2396	0.089	
	D303	2532	0.226	
	D304	1851	-0.460	
	D305	2494	0.188	
	D306	1631	-0.681	
	D307	2666	0.361	
	D308	3217	0.916	
	D309	1216	-1.099	
	D310	3233	0.932	
S31	D301	3400	1.100	2108
	D302	1416	-0.898	
	D303	5268	2.981 (Outlier)	
	D304	1833	-0.478	
	D305	1466	-0.847	
	D306	2234	-0.074	
	D307	3418	1.118	
	D308	1235	-1.080	
	D309	2685	0.380	
	D310	1284	-1.031	
S32	D301	2868	0.564	2864
	D302	2752	0.447	
	D303	1837	-0.474	
	D304	4022	1.726	
	D305	3819	1.522	
	D306	2487	0.181	
	D307	3105	0.803	
	D308	1586	-0.727	
	D309	4167	1.872	
	D310	1996	-0.314	

S33	D301	1807	-0.504	2078
	D302	1324	-0.990	
	D303	1941	-0.369	
	D304	1262	-1.053	
	D305	2273	-0.035	
	D306	1424	-0.890	
	D307	2292	-0.016	
	D308	3040	0.737	
	D309	1889	-0.422	
	D310	3524	1.225	
S34	D301	2181	-0.128	2122
	D302	1231	-1.084	
	D303	3773	1.475	
	D304	13109	Cut-off Outlier	
	D305	2598	0.292	
	D306	3314	1.013	
	D307	1635	-0.677	
	D308	1864	-0.447	
	D309	1349	-0.965	
	D310	1150	-1.166	
S35	D301	4837	2.547	2481
	D302	1971	-0.339	
	D303	1302	-1.013	
	D304	1205	-1.110	
	D305	2104	-0.205	
	D306	5404	3.118 (Outlier)	
	D307	1918	-0.392	
	D308	2752	0.447	
	D309	4705	2.414	
	D310	1537	-0.776	
S36	D301	2213	-0.095	2054
	D302	1503	-0.810	
	D303	4237	1.943	
	D304	2155	-0.154	
	D305	1518	-0.795	
	D306	1953	-0.357	
	D307	1404	-0.910	
	D308	2083	-0.226	
	D309	2186	-0.123	
	D310	1286	-1.029	

S37	D301	3373	1.073	2485
	D302	2335	0.028	
	D303	4045	1.749	
	D304	2311	0.003	
	D305	2427	0.120	
	D306	3177	0.875	
	D307	1707	-0.605	
	D308	1853	-0.458	
	D309	1903	-0.407	
	D310	1722	-0.590	

Table 9. Data Analysis Sheet for Regression Test (Study 3)

Participants	Syntactic Proficiency Score	Aggregate Means of Display 2	Aggregate Means of Display 3
S01	37	1584	2138
S02	17	1782	2394
S03	28	1784	1674
S04	25	1756	2721
S05	29	2013	2108
S06	33	1605	2424
S07	32	2058	2623
S08	23	2480	2967
S09	30	2511	2516
S10	35	1313	1171
S11	23	1316	2068
S12	23	1593	1762
S13	27	1323	1891
S14	28	2053	2512
S15	24	2125	2294
S16	25	2264	2642
S17	29	2139	2023
S18	28	1509	2516
S19	19	1895	2199
S20	30	2141	2157
S21	22	2164	2159
S22	30	2290	2522
S23	26	1917	3069
S24	30	2722	2794
S25	24	2318	2474
S26	39	1838	1388
S27	29	1627	1825
S28	28	1585	1982
S29	37	1186	1347
S30	26	2306	2345
S31	30	1708	2108
S32	29	2237	2864
S33	26	1841	2078
S34	32	1924	2122
S35	25	1965	2481

S36	35	1752	2054
S37	28	2496	2485

APPENDIX 4
STATISTICAL ANALYSIS

A. Reliability and Validity Analysis of Judgement Task

1. KR-20 Reliability Analysis (SPSS Output)

Table 10. Reliability Analysis

KR-20	KR-20 Based on Standardized Items	N of Items
0.835	0.837	20

Table 11. Item-Total Statistics

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	KR-20 if Item Deleted
Item1	4.98	17.092	0.102	0.841
Item2	5.04	16.406	0.369	0.830
Item3	4.82	15.744	0.419	0.828
Item4	4.95	16.127	0.373	0.830
Item5	5.04	16.406	0.369	0.830
Item6	4.87	15.965	0.379	0.830
Item7	5.02	15.870	0.533	0.823
Item8	4.98	15.944	0.462	0.826
Item9	5.07	16.439	0.415	0.829
Item10	4.91	15.269	0.605	0.818
Item11	4.75	15.490	0.471	0.825
Item12	4.78	15.581	0.454	0.826
Item13	4.62	15.722	0.409	0.829
Item14	4.98	15.981	0.450	0.826
Item15	4.76	15.480	0.477	0.825
Item16	4.93	15.958	0.411	0.828
Item17	5.02	16.129	0.443	0.827
Item18	4.96	16.702	0.211	0.837
Item19	4.96	16.184	0.369	0.830
Item20	5.02	15.870	0.533	0.823

2. Factor Analysis using FACTOR (Ferrando & Lorenzo-Seva, 2017)

Table 12. Adequacy of the Correlation Matrix

Bartlett's statistic	391.0 (df = 190; P = 0.000010)
Kaiser-Meyer-Olkin (KMO) test	0.666
BC Bootstrap 95% CI of KMO	[0.672, 0.733]

Table 13. Explained Variance Based on Eigenvalues

Variable	Eigenvalue	Proportion of Variance	Cumulative Proportion of Variance
1	5.061	0.253	0.253
2	2.269	0.113	0.366
3	1.805	0.090	
4	1.463	0.073	
5	1.315	0.066	
6	1.186	0.059	
7	1.040	0.052	
8	0.983	0.049	
9	0.796	0.040	
10	0.663	0.033	
11	0.616	0.031	
12	0.492	0.025	
13	0.482	0.024	
14	0.415	0.021	
15	0.323	0.016	
16	0.269	0.013	
17	0.253	0.013	
18	0.228	0.011	
19	0.197	0.010	
20	0.146	0.007	

Table 14. Parallel Analysis (PA) Based on Minimum Rank Factor Analysis (Timmerman & Lorenzo-Seva, 2011)

Variable	Real-data % of variance	Mean of random % of variance	95 percentiles of random % of variance
1	27.023*	12.494	13.856
2	12.121*	10.999	11.978
3	9.720	9.777	10.636
4	7.317	8.811	9.512
5	6.949	7.976	8.672
6	5.937	7.229	7.829
7	5.298	6.515	7.067
8	4.613	5.887	6.401
9	3.861	5.270	5.800
10	3.310	4.695	5.144
11	3.171	4.147	4.577
12	2.397	3.659	4.157
13	1.933	3.164	3.608
14	1.815	2.688	3.081
15	1.310	2.239	2.640
16	1.271	1.797	2.256
17	1.180	1.344	1.779
18	0.679	0.875	1.339
19	0.093	0.437	0.846

*Advised number of dimensions: 2

Table 15. Closeness to Unidimensionality Assessment

(Ferrando & Lorenzo-Seva, 2018)

Variable	I-ECV	BC Bootstrap 95% CI
1	0.227	[0.003, 0.999]
2	0.769	[0.153, 1.000]
3	0.502	[0.001, 0.896]
4	0.571	[0.001, 0.975]
5	0.696	[0.022, 0.999]
6	0.939	[0.485, 1.000]
7	0.920	[0.526, 1.000]
8	0.877	[0.377, 1.000]
9	0.994	[0.959, 1.000]
10	0.862	[0.313, 0.997]
11	0.626	[0.052, 0.995]
12	0.523	[0.002, 0.961]
13	0.455	[0.002, 0.938]
14	0.998	[0.992, 1.000]
15	0.893	[0.302, 1.000]
16	0.494	[0.020, 0.988]
17	0.632	[0.067, 0.978]
18	0.333	[0.000, 0.991]
19	0.852	[0.123, 1.000]
20	0.990	[0.902, 1.000]

Overall Assessment

ECV = 0.706, 95% CI [0.644, 0.796]

Table 16. Construct Replicability: Generalized H (G-H) Index

(Ferrando & Lorenzo-Seva, 2018)

Factor	H-Latent	BC Bootstrap 95% CI
F1	0.932	[0.923, 0.923]
GF	0.945	[0.878, 0.878]

B. Analysis of Study 1 (Judgement Task)

1. Descriptive Statistics

Table 17. Descriptive Statistics of Judgement Task Data (SPSS Output)

RC Attachment Strategy				Statistic	Std. Error
Number of Selections Made for Respective RC Attachment Strategy	Early Closure Strategy	Mean		14.80	0.563
		95% Confidence Interval for Mean	Lower Bound	13.67	
			Upper Bound	15.93	
		5% Trimmed Mean		15.11	
		Median		16.00	
		Variance		17.459	
		Std. Deviation		4.178	
		Minimum		2	
		Maximum		20	
		Range		18	
		Interquartile Range		6	
		Skewness		-0.894	0.322
		Kurtosis		0.686	0.634
	Late Closure Strategy	Mean		5.20	0.563
		95% Confidence Interval for Mean	Lower Bound	4.07	
			Upper Bound	6.33	
		5% Trimmed Mean		4.89	
		Median		4.00	
		Variance		17.459	
		Std. Deviation		4.178	
		Minimum		0	
		Maximum		18	
		Range		18	
		Interquartile Range		6	
		Skewness		0.894	0.322
		Kurtosis		0.686	0.634

2. Test Assumptions

Paired-samples T-test requires the assumptions of normality and independence of the distributions. The assumption of independence was met by design when the data were collected. Meanwhile the assumption of normality was observed by calculating the *z*-scores of skewness and kurtosis as well as the P-P plots.

Early Closure Strategy

$$Z_{\text{skewness}} = \frac{S - 0}{SE_{skewness}} = \frac{-0.894 - 0}{0.322} = -2.78$$

$$Z_{\text{kurtosis}} = \frac{K - 0}{SE_{kurtosis}} = \frac{0.686 - 0}{0.634} = 1.08$$

Late Closure Strategy

$$Z_{\text{skewness}} = \frac{S - 0}{SE_{skewness}} = \frac{0.894 - 0}{0.322} = 2.78$$

$$Z_{\text{kurtosis}} = \frac{K - 0}{SE_{kurtosis}} = \frac{0.686 - 0}{0.634} = 1.08$$

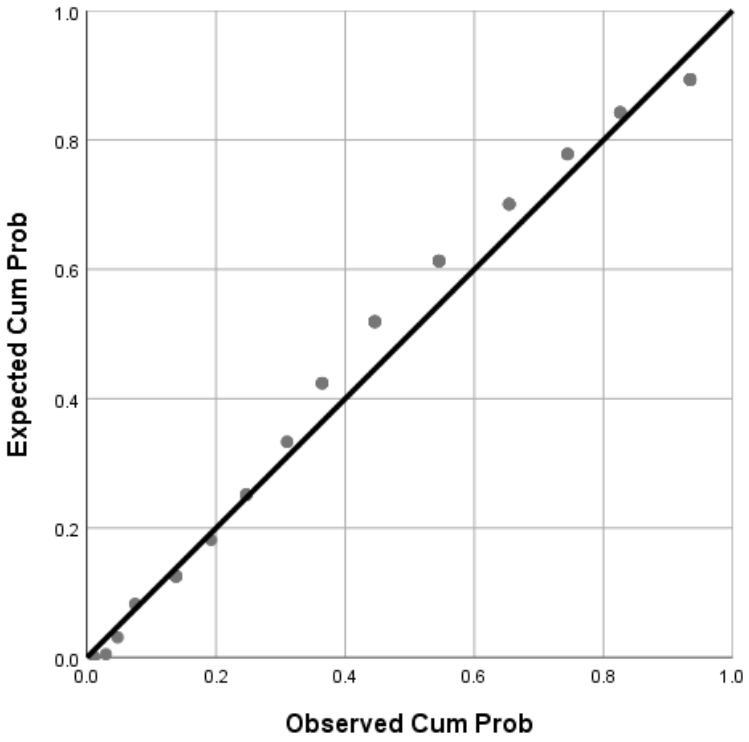

Figure 1. Normal P-P Plot of Number of Selections for Early Closure Strategy (SPSS Output)

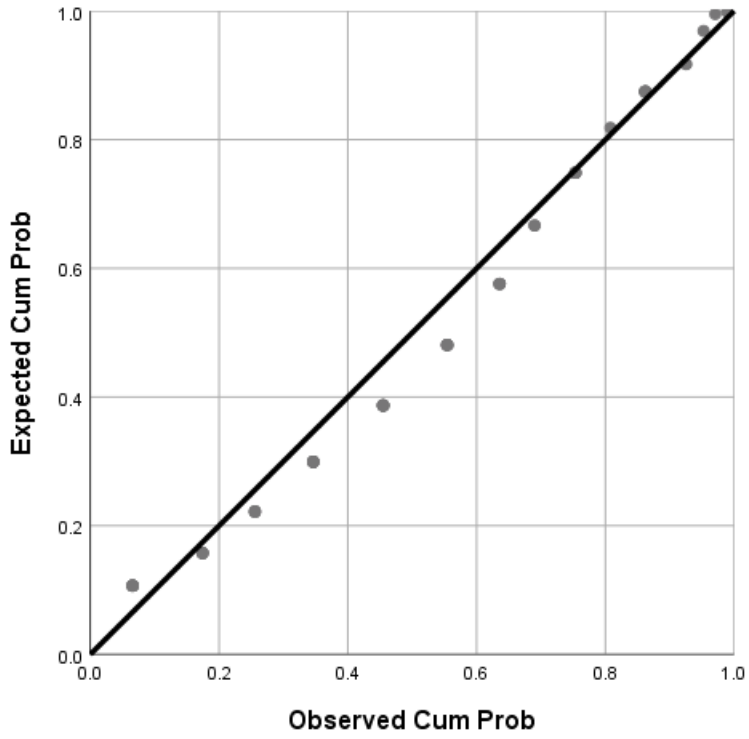

Figure 2. Normal P-P Plot of Number of Selections for Late Closure Strategy (SPSS Output)

3. Paired-Samples T-test

Table 18. Paired-Samples Statistics (SPSS Output)

		Mean	N	Std. Deviation	Std. Error Mean
Pair	Number of Selections for Early Closure Strategy	14.80	55	4.178	0.563
	Number of Selections for Late Closure Strategy	5.20	55	4.178	0.563

Table 19. Paired-Samples T-test Results (SPSS Output)

			Pair
			Number of Selections for Early Closure Strategy - Number of Selections for Late Closure Strategy
Paired Differences	Mean		9.600
	Std. Deviation		8.357
	Std. Error Mean		1.127
	95% Confidence Interval of the Difference	Lower	7.341
		Upper	11.859
t			8.519
df			54
Sig. (2-tailed)			0.000

Effect size was observed using Cohens' *d*

$$d = \frac{\bar{x}_{\text{EC strategy}} - \bar{x}_{\text{LC strategy}}}{s_{\text{LC strategy}}} = \frac{14.80 - 5.20}{4.18} = 2.30 \text{ (large)}$$

C. Analysis of SPR Experiment (Study 2)

1. Descriptive Statistics

Table 20. Descriptive Statistics of SPR Experiment Data (SPSS Output)

Group of Participants				Statistic	Std. Error
Aggregate Means of Reaction Time	Control Group	Mean		2032.07	79.588
		95% Confidence Interval for Mean	Lower Bound	1869.29	
			Upper Bound	2194.84	
		5% Trimmed Mean		2027.63	
		Median		1988.50	
		Variance		190028.133	
		Std. Deviation		435.922	
		Minimum		1335	
		Maximum		2809	
		Range		1474	
		Interquartile Range		822	
		Skewness		0.066	0.427
		Kurtosis		-1.169	0.833
	Experi-mental group	Mean		2117.31	71.563
		95% Confidence Interval for Mean	Lower Bound	1971.36	
			Upper Bound	2263.27	
		5% Trimmed Mean		2093.30	
		Median		2056.00	
		Variance		163879.899	
		Std. Deviation		404.821	
		Minimum		1574	
		Maximum		3193	
		Range		1619	
		Interquartile Range		617	
		Skewness		0.762	0.414
		Kurtosis		0.157	0.809

2. Test Assumptions

Independent Samples T-test requires the assumptions of normality, homogeneity, and independence. For the assumption of normality, the *z*-scores of skewness and kurtosis as well as the P-P plots were observed. Meanwhile Levene's statistic was consulted for the assumption of homogeneity of variance. The assumption of independence was met by design as the data were collected.

Control Group

$$Z_{\text{skewness}} = \frac{S - 0}{SE_{skewness}} = \frac{0.066 - 0}{0.427} = 0.15$$

$$Z_{\text{kurtosis}} = \frac{K - 0}{SE_{kurtosis}} = \frac{-1.169 - 0}{0.833} = -1.40$$

Experimental Group

$$Z_{\text{skewness}} = \frac{S - 0}{SE_{skewness}} = \frac{0.762 - 0}{0.414} = 1.84$$

$$Z_{\text{kurtosis}} = \frac{K - 0}{SE_{kurtosis}} = \frac{0.157 - 0}{0.809} = 0.19$$

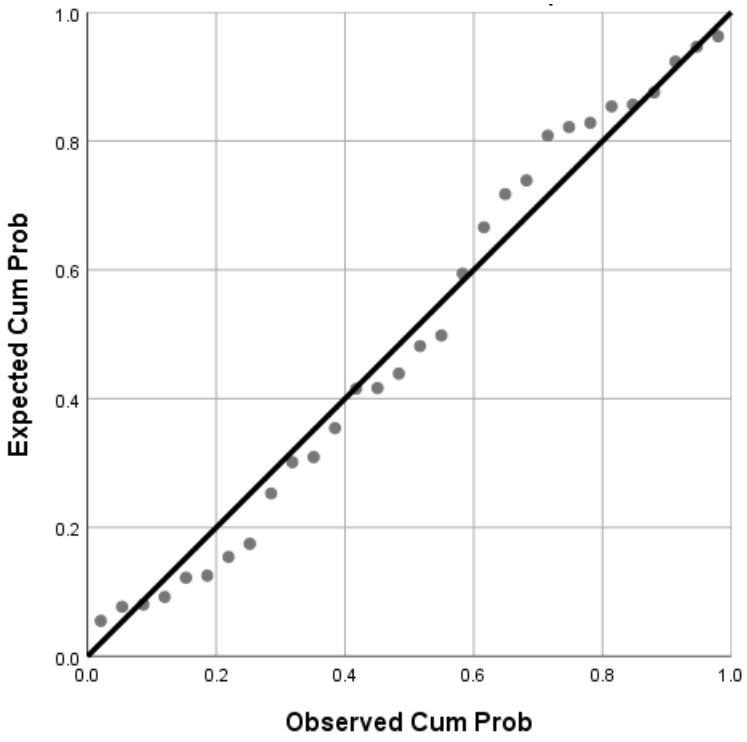

Figure 3. Normal P-P Plot of Control Group (SPSS Output)

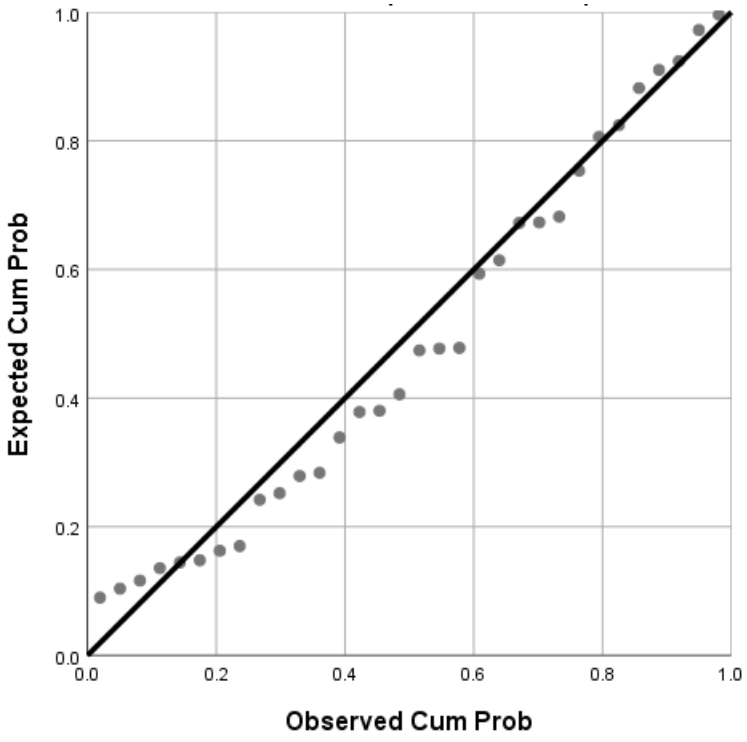

Figure 4. Normal P-P Plot of Experimental Group (SPSS Output)

Table 21. Test of Homogeneity of Variance of SPR Experiment Data

(SPSS Output)

		Levene Statistic	df1	df2	Sig.
Aggregate Means of Reaction Time	Based on Mean	0.552	1	60	0.460
	Based on Median	0.576	1	60	0.451
	Based on Median and with adjusted df	0.576	1	59.645	0.451
	Based on trimmed mean	0.634	1	60	0.429

3. Independent Samples T-test

Table 22. Group Statistics (SPSS Output)

		N	Mean	Std. Deviation	Std. Error Mean
Pair	Experimental Group	32	2117.31	404.821	71.563
	Control Group	30	2032.07	435.922	79.588

Table 23. Independent Samples T-test Results (SPSS Output)

			Aggregate Means of Reaction Time	
			Equal variances assumed	Equal variances not assumed
t-test for Equality of Means	t		0.798	0.796
	df		60	58.858
	Sig. (2-tailed)		0.428	0.429
	Mean Difference		85.246	85.246
	Std. Error Difference		106.771	107.030
	95% Confidence Interval of the Difference	Lower	-128.329	-128.932
		Upper	298.820	299.424

Effect size was assessed using Cohens' *d*

$$d = \frac{\bar{x}_{\text{Experimental Group}} - \bar{x}_{\text{Control Group}}}{s_{\text{Control Group}}} = \frac{2117.31 - 2032.07}{435.92} = 0.20 \text{ (small)}$$

D. Analysis of SPR Task (Study 3)

1. Descriptive Statistics

Table 24. Descriptive Statistics of SPR Task Data (SPSS Output)

			Statistic	Std. Error
Reaction Time of Display 2	Mean		1922.16	61.343
	95% Confidence Interval for Mean	Lower Bound	1797.75	
		Upper Bound	2046.57	
	5% Trimmed Mean		1920.77	
	Median		1917.00	
	Variance		139229.917	
	Std. Deviation		373.135	
	Minimum		1186	
	Maximum		2722	
	Range		1536	
	Interquartile Range		585	
	Skewness		0.021	0.388
	Kurtosis		-0.529	0.759
Reaction Time of Display 3	Mean		2240.46	71.394
	95% Confidence Interval for Mean	Lower Bound	2095.67	
		Upper Bound	2385.25	
	5% Trimmed Mean		2251.95	
	Median		2199.00	
	Variance		188591.866	
	Std. Deviation		434.272	
	Minimum		1171	
	Maximum		3069	
	Range		1898	
	Interquartile Range		478	
	Skewness		-0.459	0.388
	Kurtosis		0.253	0.759

Syntactic Proficiency Score	Mean		28.14	0.797
	95% Confidence Interval for Mean	Lower Bound	26.52	
		Upper Bound	29.75	
	5% Trimmed Mean		28.15	
	Median		28.00	
	Variance		23.509	
	Std. Deviation		4.849	
	Minimum		17	
	Maximum		39	
	Range		22	
	Interquartile Range		5	
	Skewness		0.140	0.388
	Kurtosis		0.211	0.759

2. Test Assumptions

Generalized linear model suits the model assumptions to the data instead of the other way around as in simple linear regression. For this reason, it does not require the assumptions of normality, linearity or homoscedasticity. Regardless, it was worth to confirm that there was no autocorrelation in the cases of the dependent variables, as observed using the runs test.

Table 25. Runs Test of SPR Task Dependent Variable Data (SPSS Output)

	Reaction Time of Display 2	**Reaction Time of Display 3**
Test Value*	1917	2199
Cases < Test Value	18	18
Cases >= Test Value	19	19
Total Cases	37	37
Number of Runs	15	18
Z	-1.330	-0.329
Asymp. Sig. (2-tailed)	0.183	0.742
*Median		

3. Generalized Linear Model (Gamma Regression)

Table 26. Parameter Estimates of Display 2 (SPSS Output)

		(Intercept)	Syntactic Proficiency Score	(Scale)
B		7.826	-0.009	.037*
Std. Error		0.1975	0.0069	
95% Wald Confidence Interval	Lower	7.438	-0.023	
	Upper	8.213	0.004	
Hypothesis Test	Wald Chi-Square	1569.610	1.852	
	df	1	1	
	Sig.	0.000	0.174	
Exp(B)		2503.822	0.991	
95% Wald Confidence Interval for Exp(B)	Lower	1700.084	0.977	
	Upper	3687.536	1.004	
Dependent Variable: Reaction Time of Display 2 Model: (Intercept), Syntactic Proficiency Score				
*Computed based on the Pearson chi-square.				

Table 27. Parameter Estimates of Display 3 (SPSS Output)

		(Intercept)	Syntactic Proficiency Score	(Scale)
B		8.215	-0.018	0.035*
Std. Error		0.1923	0.0067	
95% Wald Confidence Interval	Lower	7.838	-0.031	
	Upper	8.592	-0.005	
Hypothesis Test	Wald Chi-Square	1825.123	7.047	
	df	1	1	
	Sig.	0.000	0.008	
Exp(B)		3696.404	0.982	
95% Wald Confidence Interval for Exp(B)	Lower	2535.699	0.969	
	Upper	5388.415	0.995	
Dependent Variable: Reaction Time of Display 3 Model: (Intercept), Syntactic Proficiency Score				
*Computed based on the Pearson chi-square.				