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Real-time Processing of English Articles by Korean EFL Learners

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Abstract

Real-time Processing of English Articles by Korean EFL Learners

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The goal of this study is to investigate the role of starting age in Korean EFL learners' online article processing. The points of interest are two-fold. First, this study examines starting age effect in English article acquisition in an English as a foreign language (EFL) setting. Second, it provides a basis for article acquisition studies that observe online article processing by second language learners of English.

Although a wide range of studies have examined the difficulty that second language learners have in learning the English article system, not much work has focused on the influence of the learners' starting age (Song, 2014). Accordingly, the present study aims to evaluate the starting age effect in the acquisition of the English article system. Unlike previous studies, the present study uses the notion of "starting age" in an EFL setting, which has not been widely applied in earlier second language research studies (Larson-Hall, 2008). Moreover, in terms of measurement of second

language learners' performance, online tasks have been rarely used in the literature for examining the learners' article acquisition and understanding. By using a self-paced reading task, this study attempts to observe how Korean EFL learners process articles and understand semantic features of articles in real-time.

Both an offline acceptability judgment task and an online self-paced reading task were conducted to Korean EFL learners, whose English proficiency was at a highly advanced level. The participants were divided into two groups by their staring age: (a) the early group (starting age < 12), and (b) the late group (starting age ≥ 12). Following the framework primarily adopted from Huebner's semantic wheel (1983), five types of articles, from Type 1 to Type 5, were used for the experimental material. Each item was varied by the acceptability condition, "acceptable" or "unacceptable."

In the offline task, no significant difference was observed between the two starting age groups. Both groups made a clear distinction between the acceptable and the unacceptable condition for Type 1 to Type 4. For Type 5, there was a performance difference between the two groups as the early group successfully made a correct judgment between the two conditions while the late group did not. The performance gap deriving from the participants' starting age was limitedly observed. The results from the offline task, therefore, partially demonstrate the starting age effect in article acquisition by highly advanced Korean EFL learners of English.

Meanwhile in the online task, a statistically meaningful difference was observed between the two starting age groups. In the initial analysis, a significant interaction between the starting age condition and the acceptability condition was reported for most of the article types except for Type 3. The lack of interaction only for Type 3 can be explained by the subtle semantic feature that Type 3 has—a norming study in the present study demonstrated that even native speakers of English do not make a

clear-cut distinction between the two acceptability conditions for Type 3. Furthermore, the results showed that the two groups varied in the processability of English articles; the early group read faster than the late group, indicating a fluent processing of articles in real-time by the early group. Unexpected was a reverse effect by the late group, who read longer for the acceptable condition instead of the unacceptable condition. The reverse effect, which was only detected among the late group, is explained in the light of the starting age effect.

In short, while weak evidence in support of the starting age effect is provided by the offline task, the online task manifests a sturdy effect of starting age in Korean EFL learners' processing of English articles. Taken together, this study suggests that starting age is an influential factor that relates to online article processing by Korean EFL learners.

Keywords: second language acquisition, starting age, Korean EFL learners, English article system, real-time language comprehension

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Chapter 1 Introduction

1.1 Research Background

English articles are one of the most "notorious" grammatical features that pose difficulty for Korean learners of English. Even learners who are at an advanced level of English proficiency are reported to make errors in using articles (Butler, 2002; Murphy, 1997; Park, 2005). As such, it has been a challenge for second language learners of English to successfully learn and use English articles. With regard to such difficulty, previous studies have investigated several underlying causes as to why second language learners of English particularly have problems in learning English articles, and they have proposed five reasons: semantic complexity of articles (e.g., Larsen-Freeman, 1976), misconception or misjudgment of noun countability (e.g., Celce-Murcia & Larsen-Freeman, 1999), influence from learners' first language (e.g., Master, 1987), lack of perceptual saliency of articles (e.g., Burt & Dulay, 1978), and starting age of acquisition (e.g., DeKeyser, 2000).

Of particular focus in the current study is the impact of starting age on the acquisition of English articles by Korean EFL learners. As argued in a seminal study by DeKeyser (2000), the success of acquiring morphosyntactic features of English by second language learners can be determined by learners' starting age. His study demonstrated a high negative correlation between the starting age of acquisition and the score in a task that tested morphosyntactic knowledge. More importantly, he also found that English articles are one of the linguistic (morphosyntactic) features that have the greatest sensitivity to learners' starting age. A subsequent study that primarily focused on article acquisition by Korean EFL learners also demonstrated

a close relationship between the success of article acquisition and starting age (Song, 2014). She introduced five types of English articles (i.e., Type 1, Type 2, Type 3, Type 4, and Type 5), and observed how the second language learners would perform differently or similarly to each article type depending on their starting age of acquisition. A high negative correlation between the learners' starting age of acquisition and their performance was found for Type 3, Type 4, and Type 5. However, the learners' performance for Type 1, and Type 2 was not affected by their starting age. Based on the findings, she demonstrated an important role of second language learners' staring age in the success of acquiring certain types of English articles.

Meanwhile, in consideration of tasks used for examining second language learners' performance on English articles, three types of methods have been used. The first type is a method that analyzes qualitative data produced by second learners (e.g., Parrish, 1987). The second type is an offline task that obtains quantitative data (e.g., Butler, 2002). The third type is an online task that investigates learners' understanding and processing of articles at the instant moment (e.g., Kim & Lakshmanan, 2008). While an offline task may examine learners' explicit knowledge and allow extralinguistic knowledge to intervene, an online task captures learners' procedural competence and implicit knowledge as well as their explicit knowledge. Although each type of methodology has its benefit, an online task helps to learn how second language learners process the targeted language form in real-time and to measure their implicit knowledge. Despite its advantage, an online task have not been widely used in understanding second language learners' English article acquisition and use. Only a limited number of studies dealt with online processing

of articles by second language learners (a self-paced reading task (Kim & Lakshmanan, 2008; Snape, Hirakawa, Hirakawa, Hosoi, & Matthews, 2013); an eye-tracking experiment (Trenkic, Mirkovic, & Altmann, 2014)). Moreover, no known studies to date have examined second language learners' English article processing considering second language learners' starting age. Based on earlier studies that proposed a crucial role of starting age in the success of acquiring English articles, this study investigates how starting age is related to the performance of English articles by Korean EFL learners in an online task.

1.2 Research Questions

The objective of the current study is to examine the role of starting age in Korean EFL learners' processing of English articles in real-time. The following two research questions are addressed:

(1) Research Question 1

What is the role of starting age of acquisition in Korean EFL learners' online processing of English articles?

(2) Research Question 2

How do Korean EFL learners process different article types depending on their starting age of acquisition?

Two specific hypotheses are proposed for the research questions:

(1) Hypothesis 1

In line with earlier studies that demonstrated the role of starting age in the learners' performance on English articles, a behavioral difference is found in online article processing between the early and the late starting age group.

(2) Hypothesis 2

Similar to the finding in Song's (2014) offline task, behavioral performance is different for Type 3, Type 4, and Type 5 but not for Type 1 and Type 2, between the early and the late starting age group.

1.3 Organization of the Thesis

The organization of the thesis is as follows. Chapter 2 gives a review on the classification of the English article system, previous research on article acquisition by second language learners of English, an issue related to starting age, and methodologies used for research on article acquisition. Based on the literature, the chapter also provides the motivation and the aim of the current study. Chapter 3 deals with the methodology that was used for the present study. The selection of experimental materials and participants, and experimental procedure are introduced. Chapter 4 then presents the collected data from the experiment along with statistical analyses. Chapter 5 discusses major findings from the experiment and revisits the research questions. Chapter 6 finally concludes and provides some implications of the present study and makes suggestions for future research.

Chapter 2 Literature Review

2.1 Framework on the English Article System

There are two major approaches to the semantic classification of English articles regarding article acquisition by second language learners of English. One line of approach comes from the work of Huebner (1983, 1985). Huebner's classification consists of four categories, which are adopted from Bickerton's (1981) semantic wheel that organizes articles in two binary features of referentiality. The two binary features are [± Specific Referent] and [± Assumed Known to the Hearer]. If a referent is [+ Specific Referent], it is generally taken to mean that a referent can be specified and referred to in the provided context, whereas [- Specific Referent] indicates that no such referent can be assumed in the given situation. If a referent is [+ Assumed Known to the Hearer], the speaker assumes that that the hearer knows what is being denoted as the referential noun phrase, while a [- Assumed Known to the Hearer] feature indicates that the speaker assumes that the hearer does not. Based on the variation of these features, four article types are generated: Type 1 [- Specific Referent, + Assumed Known to the Hearer], Type 2 [+ Specific Referent, + Assumed Known to the Hearer], Type 3 [+ Specific Referent, - Assumed Known to the Hearer], and Type 4 [- Specific Referent, - Assumed Known to the Hearer]. Type 1 is known as "generics," where *a, the,* or *no article* can appear. Type 2 is used as "referential definites," where a noun phrase is marked with *the*. Type 3 indicates "referential indefinites," and takes either *a* or *no article*. Type 4 refers to "non-referentials," and is marked with either *a* or *no article.*

The classification proposed by Huebner (1983, 1985) was widely applied to the research of English article acquisition by second language learners of English

(Master, 1987; Parrish, 1987; Thomas, 1989) and was further extended by Murphy (1997), Butler (2002), and Park (2004). Based on the proposal made by Huebner (1983, 1985), Murphy (1997) specified subcategories in Type 1 and distinguished the use of *a(n)* from the use of *no article.* She also included proper nouns and idioms into Type 4, arguing that these nouns and expressions can also be systematically understood within the classification of the article system. Furthermore, adopting the work by Thomas (1989), she named the two binary features differently as [± Specific Referent] and [± Hearer Knowledge].

Butler (2002) later presented another semantic classification of the English article system. Several changes were made compared to the framework proposed by Murphy (1997). One difference can be found in the classification of Type 2, where subcategories were illustrated more in detail. Besides, "non-specific indefinites" were classified as Type 1 rather than as Type 4. In addition to these changes, idiomatic expressions and chunks, and proper nouns were removed from Type 4; instead, a new semantic environment that was named as Type 5 incorporated idioms and prefabricated patterns.

Based on previous work, Park (2004, 2005) suggested another categorization primarily following the framework given by Butler (2002). Table 2.1 presents the classification used and proposed by Park (2004, 2005). She outlined a more detailed classification for some subcategories compared to earlier studies. Moreover, claiming that idiomatic and prefabricated expressions cannot be considered within the binary feature framework, Park (2004) used the name "Conventional Use" instead of "Type 5."

Table 2.1 Park's (2004) classification of English articles

Type 1 [- SR, + HK] Generics: a(n), the, ø		
1	a(n)	[+ count] [+ sg] NP
2	the	[+ count] [+ sg] NP
3	ø	[+ count] [- sg] NP
4	ø	[- count] NP
Type 2 [+ SR, + HK] Referential definites: the		
5	the	Immediate situational use
6	the	Larger situational use
7	the	Anaphoric use
8	the	Associative anaphoric use
9	the	Usage with post-modifiers
10	the	Usage with superlative and unique adjectives
Type 3 [+ SR, - HK] Referential indefinites, first mention: a(n), ø		
11	a(n)	[+ count] [+ sg] NP
12	ø	[+ count] [- sg] NP
13	ø	[- count] NP
Type 4 [- SR, - HK] Nonreferentials: a(n), ø		
14	a(n)	Attributive indefinites: [+ count] [+ sg] NP
15	ø	Attributive indefinites: [+ count] [- sg] NP
16	ø	Attributive indefinites: [- count] NP
17	a(n)	Nonspecific indefinites: [+ count] [+ sg] NP
18	ø	Nonspecific indefinites: [+ count] [- sg] NP
19	ø	Nonspecific indefinites: [- count] NP
Conventional Use: the, ø		
20	ø	Institutions in society
21	ø	Sports
22	ø	Meals
23	the	Geographical and place names
24	ø	Geographical and place names
25	the	Names of buildings and institutions
26	ø	Names of buildings and institutions

Note. SR = Specific Referent. HK = Hearer Knowledge. The "*ø*" indicates *no article.*

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[1] Park (2004) specified *no article* into two categories: *zero article* and *null article.* Although the two types of *no article* are differentiated in her work, they are both categorized as *no article,* and are marked as "*ø*" in the current study.

Another line of approach to categorize the English article system comes from the work of Ionin (2003, 2006). In her study, Ionin explained that the article system can be understood by two universal semantic features, namely *definiteness* and *specificity*. If a determiner phrase is [+ definite], "then the speaker and hearer presuppose the existence of a unique individual in the set denoted by the NP" (Ionin, Ko, & Wexler, 2004, p. 5), and if it is [+ specific], "then the speaker intends to refer to a unique individual in the set denoted by the NP and considers this individual to possess some noteworthy property" (Ionin et al., 2004, p. 5). It was argued that in case of English, a determiner phrase should take *the* if a determiner phrase is [+ definite] while it should take *a(n)* if it is [- definite]. The selection of articles in English is determined by *definiteness*, and irrespective of *specificity*. Based on her proposal, Ionin argued that article use errors observed among second language learner come from the incorrect mapping of article use and the two universal features. Korean learners of English, for example, would wrongly match *the* with [+ specific] (situations), and *a* with [- specific] (situations).

Although the approach made by Ionin (2003, 2006) gives an insight to the issue of article acquisition by second language learners, it overlooked cases of generics. It should nevertheless be noted that article use errors are often derived from a misunderstanding or a lack of knowledge of generics by second language learners (Butler, 2002; Huebner, 1983, 1985; Park, 2004). Hence, if Ionin's framework is used, second language learners' knowledge of the English article system may not be thoroughly measured. Moreover, her framework only deals with contexts where articles are obligatory. Yet, it is not always the case that noun phrases are accompanied by an article; there are situations with no articles. Cases where there

are no articles should not be neglected, considering that omission of articles largely attributes to the article use error by second language learners. For these reasons, the current study used a framework adopted from Park (2004), which is in line with the proposal made in Huebner (1983, 1985), instead of the one proposed by Ionin (2003, 2006).

The categorization of English articles used in the current study is presented in Table 2.2. Although Park (2004) revised Type 5 from Butler (2002) by dubbing the article type as "Conventional Use," this article type is referred to as "Type 5" in the present work. Additional changes were made in Type 5. A category of weak definites were included as subtypes for Type 5. Weak definites include noun phrases that are expressed with *the* but do not indicate a specific entity (e.g., "read the newspaper").[2] As the use of *the* in weak definites are as much as a formulaic expression, *the* in these noun phrases were categorized as article Type 5. Examples for weak definites in Type 5 include *the television* in *turn on the television*, *the radio* in *listen to the radio*, and *the calendar* in *check the calendar*.

Table 2.2 Classification of English articles in the current study

Type 1 [- SR, + HK] Generics: *a(n), the, ø*			
Type 1a	*a(n)*	[+ count] [+ sg] NP	Hannah thought that <u>a model</u> has to be slim.
Type 1b	*the*	[+ count] [+ sg] NP	Astronauts said that <u>the telescope</u> is a marvelous tool.
Type 1c	*ø*	[+ count] [- sg] NP	Fred heard that <u>elephants</u> can lift seven hundred pounds.
Type 1d	*ø*	[- count] NP	Bart learned that <u>salt</u> helps muscles function better.

[2] Carlson and Sussman (2005) categorized weak definites as a separate type of categories and defined them as indefinite definites.

Type 2 [+ SR, + HK] Referential definites: *the*			
Type 2a	*the*	Immediate situational use	Pedestrians waited for the light to change. You should push the button to cross the road.
Type 2b	*the*	Larger situational use	The last train departs in thirty minutes. Jason rushed to the station with his three sons.
Type 2c	*the*	Anaphoric use	A car suddenly stopped on the road. Sean noticed that the car had a flat tire.
Type 2d	*the*	Associative anaphoric use	An American movie was awarded best prize. Newspapers wrote that the director shed tears of happiness.
Type 2e	*the*	Usage with post-modifiers	Doctor Lee reported the state of the woman's health.
Type 2f	*the*	Usage with superlative and unique adjectives	Amy Green was the best teacher in our village.
Type 3 [+ SR, - HK] Referential indefinites, first mention: *a(n), ø*			
Type 3a	*a(n)*	[+ count] [+ sg] NP	Yesterday there was a girl screaming and shouting crazily.
Type 3b	*ø*	[+ count] [- sg] NP	Judy gladly received presents from her close friends.
Type 3c	*ø*	[- count] NP	Clumsy Kaylee spilled milk over her favorite sofa.
Type 4 [- SR, - HK] Nonreferentials: *a(n), ø*			
Type 4a	*a(n)*	Attributive indefinites: [+ count] [+ sg] NP	Olivia has been a nurse most of her life.
Type 4b	*ø*	Attributive indefinites: [+ count] [- sg] NP	Tyler's sons were boxers but are both retired now.
Type 4c	*ø*	Attributive indefinites: [- count] NP	The powder was flour but looked like something else.
Type 4d	*a(n)*	Nonspecific indefinites: [+ count] [+ sg] NP	Arnold looked for a pen to get an autograph.
Type 4e	*ø*	Nonspecific indefinites: [+ count] [- sg] NP	Jacob always wears hats regardless of the weather.
Type 4f	*ø*	Nonspecific indefinites: [- count] NP	Having chicken and beer is what Koreans enjoy.
Type 5 Conventional Use: *the, ø*			
Type 5a	*ø*	Meals or institution	Mark always eats breakfast while listening to music.
Type 5b	*the/ø*	Geographical place name	Luke walked along the Mississippi River for twelve days.
Type 5c	*the/ø*	Building names	Charlie stayed at the Plaza Hotel with his girlfriend.
Type 5d	*the*	Weak definites	Bobby will read the newspaper

			once he finishes work.

Note. SR = Specific Referent. HK = Hearer Knowledge. The "*ø*" indicates *no article.*

2.2 English Article Acquisition by Second Language Learners

The difficulty that second language learners face when they learn English articles has constantly been reported in the literature (Butler, 2002; Hawkins & Chan, 1997; Jarvis, 2002; H.-Y. Lee, 1996; Liu & Gleason, 2002; Mizuno, 1985; Parrish, 1987; Takahashi, 1997; Tarone, 1985; Yoon, 1993; Young, 1996). A common finding from earlier studies is *the*-flooding of learners at a beginner level (Chaudron & Parker, 1990; Huebner, 1983; Master, 1990; Young, 1996). This *the*-flooding refers to the overuse of *the* where either *a(n)* or *no article* is contextually grammatical and suitable. Considering that *the* is exclusively used in [+/- Specific Referent, + Hearer Knowledge] contexts, some researchers explained that *the*-flooding is due to learners' tendency to connect [+ Hearer Knowledge] to *the* (Huebner, 1983, 1985; Master, 1987). This case can be understood as the flooding phenomenon detected in using Type 1. In another perspective, some mentioned that *the*-flooding is due to an incorrect association of [+ Specific Reference] feature to *the* (Chaudron & Parker, 1990; Parrish, 1987; Tarone & Parrish, 1988; Thomas, 1989). This case can be understood as the flooding phenomenon observed in using Type 3.

Further studies investigated the use of articles by second language learners throughout the acquisition stages. It has been widely accepted that *the* is the easiest to learn while an indefinite article, *a(n),* is the most challenging for learners (Master, 1994; Yamada & Matsuura, 1982). In relation to the classification of English articles discussed in the previous chapter, Butler (2002) reported that while [+ Specific

Referent] is easily captured even at a lower level of proficiency, correctly connecting [+ Hearer Knowledge] to article use is demanding regardless of the level of proficiency. A similar tendency was reported in other studies where learners showed poor performance for Type 3 and Type 4, which are both [- Hearer Knowledge] (Park & Song, 2008; Song, 2014). Subsequent studies also reported that Type 5 or Conventional Use is also difficult to be learned by second language learners (Butler, 2002; Park & Song, 2008; Song, 2014).

As to why learners have these difficulties, and as to why certain types in particular are comparatively more problematic, five major causes have been discussed. One possible reason rests on the semantic complexity that English articles have (Goldschneider & DeKeyser, 2001; Larsen-Freeman, 1976). Learning articles is difficult for second language learners because the learners should understand complex semantic concepts such as genericity (Butler, 2002; Ionin, Montrul, Kim, & Philippov, 2011; Ionin, Montrul, & Santos, 2011; Murphy, 1997; Park, 2005), specificity and definiteness (T. Chung, 2009; Ionin, 2006; Ionin et al., 2004), and presuppositionality (Ko, Ionin, & Wexler, 2010). The difficulty of learning and using articles in indefinite contexts can be explained by the hardship of reflecting [+ Hearer Knowledge] to article use (Chaudron & Parker, 1990; Lardiere, 2005; Master, 1987).

A second explanation is related to the learners' incorrect notion of nouns (Celce-Murcia & Larsen-Freeman, 1999). In particular, second language learners' understanding or knowledge of noun countability has been suggested to be influential in the acquisition of English articles (Butler, 2002; T. Chung, 2009; Master, 1990; Park & Song, 2008; Snape, 2008; Yoon, 1993). Researchers have argued that a fixed or an incorrect notion of noun countability makes learners omit

or overuse articles. Learners would make a one-to-one mapping from their notion of countability and the use of articles. Any nouns that are considered countable are always headed with an article while those that are thought uncountable are not used with an article. This is due to learners' misconception that the use of English articles can be directly selected by noun countability.

A third potential cause for the difficulty that some researchers propose derives from first language (Ionin & Montrul, 2010; Ionin, Zubizarreta, & Maldonado, 2008). A number of studies demonstrated a negative influence from the first language of a second language learner, and further proposed that article acquisition can become harder when the first language lacks an article system (Hakuta, 1976; Jarvis, 2002; Liu & Gleason, 2002; Master, 1990; Robertson, 2000; Rutherford, 2014; Tarone & Parrish, 1988; Thomas, 1989; Young, 1996).

A fourth probable factor that explains the difficulty of learning English articles by second language learners can be understood from a phonological aspect (Burt & Dulay, 1978; Goldschneider & DeKeyser, 2001). Due to their monosyllabic and unstressed feature, English articles are not perceptually salient. A weak perceptual saliency accordingly makes it difficult for second language learners to be aware of and be sensitive to articles and their use (Goldschneider & DeKeyser, 2001).

Last but not least, second language learners' starting age of learning English has been suggested to be responsible for the difficulty (DeKeyser, 2000; Song, 2014). A high negative correlation between the success of morphosyntactic features of English and starting age of English acquisition showed that the younger one's starting age is, the more successful a learner is in learning the English article system. It is explained that as articles are a part of morphological aspect of English, which

are successfully learned through an implicit learning process during the early childhood (DeKeyser, 2008; N. C. Ellis & Larsen-Freeman, 2006), English articles are not successfully learned by second language learners who started to learn English comparatively late.

Implicit learning, although the word cannot be easily defined, is (the process of) "learning without awareness of what is being learned" (DeKeyser, 2008, p. 314). Implicit learning is opposed to the apprehension of language that involves conscious, selective, and strategic process. Owing to an unselective and subconscious learning process where learners are unaware of the targeted language feature, implicit learning is closely linked to a learning process during the early childhood in a naturalistic situation. This characteristic of implicit learning indicates that the period of time when a language is learned influences the type of learning.

More specifically, it is argued that language is learned, stored, and processed in a different way before and after puberty (Ullman, 2001a, 2001b, 2004). In relation to second language acquisition, findings showed that morphosyntactic features, including auxiliary verbs, inversion in questions, subject-verb number agreement, and articles, cannot be easily mastered when they are learned at a late age (DeKeyser, 2005; Jiang, 2004 (for subject-verb number agreement)). These arguments and findings substantiate the stance that starting age of acquisition is another influential factor to determine the performance of second language learners' English article acquisition.

Nonetheless, only a few studies have investigated the role of starting age in the success of English article acquisition by second language learners of English. In addition to the scarce number of work done, results from previous studies mostly

come from tasks that measured learners' offline performance. Therefore, further investigations are needed (i) to evaluate the influence of second language learners' starting age on English article acquisition, and (ii) particularly to examine the role of starting age in the learners' article processing in real-time.

An overview of the starting age effect on article acquisition by second language learners, and some perspectives on the notion of starting age are elaborated in the following section.

2.3 The Role of Starting Age in Second Language Acquisition

The effect of starting age on the ultimate attainment in second language acquisition has been a controversial and critical issue in second language acquisition (SLA) research. An argument that there is a window of opportunity for a successful language acquisition derives from an early proposal by Lenneberg (1967). A hypothesis he formed, now popularly known as the critical period hypothesis, postulates a time threshold—arguably to be around puberty—beyond which a language learner would not be able to reach an ultimate level of the targeted language. Linking the idea of this critical period, studies in SLA research have attempted to compare performance of second language learners who learned the targeted language before or after their adolescence. Diverging stances on the role of age on second language acquisition have been proposed considering whether an ultimate attainment is predictable by an age factor.

From one perspective, it is argued that there is an overwhelming age effect on the acquisition of the target language. A number of studies have showed a steep decline of performance by second language learners after a certain time threshold,

namely the critical period (DeKeyser, 2000; DeKeyser, Alfi-Shabtay, & Ravid, 2010; Flege, Yeni-Komshian, & Liu, 1999 (for accent); Harley & Hart, 1997, 2002; Johnson, 1992; Johnson & Newport, 1989, 1991; Larson-Hall, 2008; D. Lee & Schachter, 1997; Patkowski, 1980; Pfenninger, 2011; Schachter, 1990). The reported results suggested that there is a maturational effect that determines the success of attaining a native-like level. Based on the findings, the researchers claimed that second language learners who started after a certain period of time may not be able to show a native-like performance.

Such claim has been substantiated by neurolinguistics evidence, from a functional Magnetic Resonance Imaging (fMRI) study in particular. Ullman (2001b, 2004) proposed that language learned before and after puberty takes a fundamentally different learning mechanism. Brain regions activated in different areas for before and after puberty supported this claim. Further studies with fMRI evidence corroborated that once second language learners pass a maturational threshold, knowledge of a second language, an L2 syntax, for instance, is represented separately from where first language is activated in the brain (Clahsen & Felser, 2006; Paradis, 2004). In short, these researchers speculate that performance by second language learners is greatly or even solely affected by the time the learners are exposed to the target language.

On the contrary, an opposite stance denies the determining impact of age factor on the performance and success of second language learners. It is argued that it is not impossible for late second language learners to reach a native-like level in the target language (Bialystok, 1997; Bialystok & Hakuta, 1999; Bialystok & Miller, 1999; Birdsong, 1992, 2004, 2006; Birdsong & Molis, 2001; Bongaerts, Van

Summeren, Planken, & Schils, 1997; Hakuta, Bialystok, & Wiley, 2003; Ioup, Boustagui, El Tigi, & Moselle, 1994; Reichle, 2010; Van Boxtel, Bongaerts, & Coppen, 2005; Wiley, Bialystok, & Hakuta, 2005). This stance is also supported by work of White and Genesee (1996) and Montrul and Slabakova (2003), although they showed a reserved attitude by acknowledging the possibility that critical period may exist for some linguistic structures or language domains.

Further accounts that deny age effect in second language acquisition have been upheld by some neurolinguistics work. Green (2003) argued for a convergence of language system in the brain even for second language learners. This was to say that no significant difference can found between native speakers and (late) second language learners in their brain activation. Abutalebi and Green (2007) also mentioned that the neural representations of second language learners and native speakers are indistinguishable. All in all, reports from these studies gave credence to the view that the time period that language acquisition starts has no significant impact on the ultimate attainment by second language learners.

As can be seen from these earlier studies, whether starting age is a determining factor in the ultimate level of success has been a contentious issue. It would thus be of interest to learn how influential second language learners' starting age can be in article acquisition and performance.

On top of some age issues, working concepts of starting age are introduced. Stevens (2004, 2006) presented a detailed description on starting age and its related terms: age of onset (AO), the age of time that language acquisition begins; age at arrival (AA), the age of immigration in critical period studies; length of residence (LoR), the period of time after the age of arrival; age at testing (AT), the sum of AA

and LOR. As claimed by some researchers (DeKeyser et al., 2010; Stevens, 2004, 2006), it is important to clarify among a number of definitions in conducting a research what starting age means to avoid confounding effects from the mixed use of the concepts.

Of particular focus in the present research is the age of first exposure (AoE) in Pfenninger (2011), also referred to as the age of onset (AO) (Stevens, 2004, 2006). Nevertheless, the term used in the current study is different from the one used in previous critical period studies. Studies that examined critical period were mostly conducted in a target language country and recruited immigrants and participants. Unlike these critical period studies, the role of starting age in second language learners' success in learning English is investigated in an English as a Foreign Language (EFL) environment in the current study. Although the context is different from earlier critical period studies, using the term, "starting age," in an EFL environment and examining its role in it is not new.

Larson-Hall (2008) examined whether a younger starting age is beneficial to learners in a situation with minimal exposure to an instructed foreign language. Japanese college students who learned English not as an immigrant but as a foreign language learner were tested on their phonemic discrimination and grammaticality judgment. The participants' scores indicated that when a substantial amount of input of English is provided, there is an evident age effect even when there is minimal amount of exposure to foreign language. Her study implies that measuring the effect of starting age provides ground for discussing whether younger starting age is advantageous to second language learners' successful language acquisition even in an EFL situation.

The application of starting age in an EFL situation can also be found in a study by Jo and Lim (2013). The participants in their study were Korean college students who learned English in an EFL context. The researchers divided the students into two groups based on the learners' age of first exposure to English and examined their performance in a number of different grammatical structures. The results showed that the success of having implicit knowledge of the structures is influenced by the learners' starting age and the learners' prior experience to learn English. This study demonstrated the validity of applying the concept of starting age in an EFL context, along with Larson-Hall's (2008) study.

In the present study, the idea of starting age or age of first exposure is adopted although the study was not undertaken within an environment where English is used as a daily means of communication. Instead, similar to the aforementioned two studies, what is referred to as "starting age" in the current study is to refer to learners' first time at which they were exposed to English input.

2.4 Methodology Used for Article Acquisition Research

In terms of conducting research on article acquisition by second language learners of English, a variety of methods have been implemented. Methodologies most widely used for investigating article acquisition can be grouped into three types.

The first type of method collects data that are qualitative in nature. This method includes (longitudinal) case studies (Y.-C. Chung, 2009; Huebner, 1983, 1985; Parrish, 1987), in which a small number of learners are observed how they learn English articles throughout their developmental and learning stages. The method also incorporates data analysis of a spoken narrative (Murphy, 1997; Parrish, 1987;

Thomas, 1989) or a review of written samples (Mizuno, 1985; Murphy, 1997). At times, researchers would proceed a follow-up questionnaire or an (follow-up) interview (Butler, 2002; Master, 1987; Park & Song, 2008) to collect additional information about learners' comprehension of articles and their use. Although this type of method provides researchers with a large sample of natural speech and writing, it has limitations in that the method cannot capture unpronounced instances of errors or correct responses of the participants. For instance, if a participant thinks it difficult to use *a(n),* (s)he may (strategically) avoid using articles or circumvent by selecting a noun that does not require a strict article selection. Observations made by this method can thus overlook cases of article use that were not detected during the task.

The second type of method takes a quantitative approach. Tasks in this type of method are systematically designed so that researchers can evaluate participants' understanding of a certain article type or a specific contextual environment that they aim to test. Among many types of measurement, there are a cloze-test (Butler, 2002; Mizuno, 1985; Murphy, 1997; Park, 2005; Park & Song, 2008; Song, 2006, 2008, 2014; Yamada & Matsuura, 1982), a grammaticality judgment test (Mizuno, 1985), an editing test (Mizuno, 1985), a forced-choice elicitation task (Snape, 2008), and an acceptability judgment task (Ionin et al., 2004; Ionin, Montrul, Kim, et al., 2011; Kim & Lakshmanan, 2008; Snape, 2008, 2013; Snape, García-Mayo, & Gürel, 2013; Snape, Hirakawa, et al., 2013). With these tasks, researchers can obtain data on learners' general tendency in article use, and collect quantifiable result that can be statistically analyzed and interpreted. Even so, these methods become inappropriate if a researcher attempts to identify learners' instant response to the targeted language

feature (R. Ellis, 2004, 2005) and tries to measure learners' implicit knowledge rather than explicit knowledge of the English article system (Norris & Ortega, 2000).

Granted, the distinction between implicit knowledge and explicit knowledge in second language acquisition studies can be made based on several criteria (R. Ellis, 2005). Particularly salient features can be characterized by the term of awareness, accessibility, and learnability. First, awareness matters. Implicit knowledge taps into an intuitive awareness of language rules. For instance, child L1 learners whose language has a gender agreement show a preference for one over the other type of article of a different gender. Such intuitive awareness of gender concord can be understood as the existence of implicit knowledge (and distinction from explicit knowledge) (Karmiloff-Smith, 1979). In contrast, explicit knowledge makes learners to be consciously aware of linguistic forms or grammatical rules more explicitly. Learners can have the potential to make metalinguistic analysis with explicit knowledge. In short, explicit knowledge is viewed as a type of knowledge that learners are consciously aware of, while implicit is not and instead tacit in nature. Secondly, implicit knowledge can be distinguished from explicit knowledge by the learner's accessibility to knowledge. Usually accessibility is measured by a task with time pressure. Implicit knowledge is accessible during one's automatic language processing and in situations that do not require time for further monitoring (R. Ellis, 2005; Erlam, 2006). A generally accepted idea is that implicit knowledge rather than explicit knowledge is used when participants are given a limited amount of time. Thirdly, the period when language is learned matters. Following Rod Ellis' (2005) distinction, there is a certain period time that affects language learning and the type of knowledge to be stored. Based on the idea of learnability, it is suggested that

implicit knowledge can only be obtained during and before the critical period of time. Unlike implicit knowledge, explicit knowledge is understood to be manifested at any period of time.

Considering the characteristics of implicit knowledge and explicit knowledge, the suggested offline tasks mentioned earlier may not be suitable when a researcher aims to measure learners' implicit knowledge of the targeted language feature. Trenkic (2008) explains that it is highly likely that the aforementioned methodologies chosen to test second language learners' performance in English articles would measure learners' extralinguistic strategies to handle problems with English articles instead of their implicit knowledge of the English article system. As such, when extralinguistic strategies can intervene and chances that explicit knowledge is measured in the task grows, it becomes difficult to examine the learners' linguistic knowledge of the English article system.

Given the background, a third task type that can be used to examine a second language learner's performance in English articles is an online task. This type of task is similar to the second type in that it deals with data that are quantitative in nature. Yet, it is different from both the first and the second type as it measures learners' language use that takes place in real-time. Unlike an offline task, which refers to a task type that evaluates one's terminated language performance in production or comprehension, an online task measures one's language use that takes place in real-time. An online task enables to examine learners' language procedural competence and underlying mechanism in language processing. In order to have a comprehensive understanding of language ability of second language learners, it should not only be explicit knowledge but also implicit knowledge and their mechanism for processing

language in-real time that should be evaluated. Thus, researchers can benefit from using an online task to understand second language learners' article acquisition.

Compared to an offline task, an online task allows researchers to measure implicit knowledge of the task participants. This is because the key of measuring implicit knowledge is (the degree of) the awareness of a learner on the tested language feature (Gass, Behney, & Plonsky, 2013), and this type of task prevents participants from being aware of conscious of the target language feature. As learners' spontaneous behavioral reaction and psychological response to the targeted feature can be observed with an online task, the result from an online task would further tell about the learners' language ability.

Indeed, it should be noted that this study is not to argue that only an online task allows to measure implicit knowledge. As noted in R. Ellis (2005), implicit knowledge can be evaluated if the task is given under time pressure. A time grammatical judgment task, in contrast to an untimed grammatical judgment task, for instance, enables to assess one's implicit knowledge of the given linguistic features although it is not an online task. The reason to use an online task in the present study is to focus and observe how learners would process articles in real-time. As previously mentioned, the real-time comprehension of articles has not been discussed enough in earlier work.

The most commonly used method to capture second language learners' online processing of grammatical features is a self-paced reading task (e.g., Jiang, 2004). In a self-paced reading task, participants read sentences in their own pace, from which the task name derives. Words in a sentence are presented one-by-one, and participants should comprehend each word every time it appears. Owing to the way

that words are presented, participants' immediate response and instant understanding of the articles can be captured. A number of studies verified that a self-paced reading task is a suitable measurement to assess second language learners' implicit knowledge of the targeted language feature (Jiang, 2007; Suzuki & DeKeyser, 2015). Nonetheless, only few studies have attempted to use a self-paced reading task to examine second language learners' online processing of English articles (Jung & Park, 2013; Kim & Lakshmanan, 2008; Snape, Hirakawa, et al., 2013). No known studies have investigated article processing in relation to learners' starting age.

In addition to a self-paced reading task, an eye-tracking experiment can be used for investigating second language learners' article acquisition. Similar to a self-paced reading task, an eye-tracker captures the participants' behavioral response to the linguistic input. Yet, different from the reading task, an eye-tracking experiment traces the participant's eye movement. One type of tracking is to observe how the participant reads the given text presented on the screen. Another type of tracking is known as a visual-world paradigm, where the participants' eye movement and gaze on the presented pictures are observed. In this case, not a text but a number of pictures or a single picture with a number of different objects is presented on a screen. By observing eye movement and gaze, researchers can understand how people react and respond to the given linguistic output. One known study used a visual-word paradigm to examine second language learners' understanding of English articles (Trenkic et al., 2014). The eye gaze result demonstrated that the learners do not simply (overly) rely on pragmatic situations but successfully respond and process

the given noun phrases with articles by considering the semantic features of articles.[3]

In sum, online tasks (i) enable researchers to gain quantitative data of targeted article types, (ii) prevent learners from using metalinguistic strategies, and (iii) assess learners' implicit knowledge of English articles while avoiding intervention of explicit knowledge. As Bialystok (1981) asserted in her paper, task selection is critical in measuring second language learners' performance since different knowledge types can be accessed depending on the task type. This indicates that a task should be chosen with caution considering the research goal and the knowledge type to be measured. Since the goal of the present study is to examine second language learners' implicit knowledge of English article related to the starting age effect, an appropriate method would be an online task that observes one's real-time processing of articles. In order to investigate how second language learners comprehend English articles at the instant moment and to measure their implicit

[3] The participants heard either one of the sentences, "The pirate will put the cube inside the can," or "The pirate will put the cube inside a can." In the picture, there was a pirate, a cube, and two cans. In one type of picture, both cans were open, where a cube may be put inside. In the other type of picture, only one can was open. If an article is correctly understood and processed, a faster behavioral response is expected for [*the can*, one possible referent] condition and [*a can*, two possible referents] condition. However, if pragmatic contexts strongly affects the participants' interpretation on the given noun phrase, a longer time is predicted for the picture with two possible referents regardless of the given article type. Both native speaker of English and L2 learners of English behaved as the first prediction, where the choice of a corresponding referent to the given noun phrases was made based on semantic features of an article but not pragmatic contexts.

knowledge of English articles, the present study chose a self-paced reading task as a measurement.

2.5 Research Motivation

In a seminal study on the acquisition of morphosyntactic features by second language learners of English, DeKeyser (2000) showed that learners' starting age is crucial for learners' success in second language acquisition. He compared second language learners' performance in ten different morphosyntactic categories. The learners were grouped by their starting age of English; one group consisted of learners whose starting age was below 16 while the other was composed of those above 16. Performance on certain linguistic categories did not differ across the learner group. By contrast, a different performance was observed across the groups regarding English articles. Learners in the younger starting age group scored better than the late starting age group. A high negative correlation between starting age and the task score supported the claim that the success of acquiring some morphosyntactic features is greatly dependent on learners' starting age. Among all types of morphosyntactic features, English articles showed a high sensitivity to the learners' starting age. The study showed a significant influence of starting age on the success of article acquisition.

Nevertheless, article types in his study were not categorized in detail, and there were only seven testing items. English articles were simply grouped by "determiners omitted in obligatory context," and "determiners used with abstract nouns." Each

article category contained three and four items, respectively.[4] Therefore, while learners' performance in morphosyntactic features related to starting age was examined in general, further investigations were needed to observe learners' performance on different types of articles.

Based on DeKeyser's (2000) work, Song (2014) categorized article types into five types and examined the impact of starting age on learners' performance and acquisition of English articles. A total of 34 Korean EFL learners of English were recruited for the study, and they were divided into two groups according to their

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[4] The following items are the tested article categories used in DeKeyser (2000):

Determiners omitted in obligatory context

(1a) *Tom is reading book in the bathtub.

(1b) Tom is reading a book in the bathtub.

(2a) *Mrs. Johnson went to library yesterday.

(2b) Mrs. Johnson went to the library yesterday.

(3a) *The boy is helping the man build house.

(3b) The boy is helping the man build a house.

Determiners used with abstract nouns

(4a) *The beauty is something that lasts forever.

(4b) Beauty is something that lasts forever.

(5a) *After a life like that he will go straight to the hell.

(5b) After a life like that he will go straight to hell.

(6a) *The red is a beautiful color.

(6b) Red is a beautiful color.

(7a) *The men played the basketball in the backyard.

(7b) The men played basketball in the backyard.

starting age; the starting age of one group was below 12 while the other group was above 12.[5] Song (2014) adopted Park's (2004) framework on English articles, primarily taken from Huebner's (1983, 1985) classification of English articles. Five types of articles were tested: Type 1, Type 2, Type 3, Type 4, and Type 5.[6] Type 3, Type 4, and Type 5 were found to be sensitive to starting age. Song (2014) attributed the result to the characteristic of these article types. The three article types that were found to be sensitive to starting age are item-based but not rule-based, which were explained to be acquired easily through implicit learning. She explained that the early starting age group performed particularly better in certain types as they implicitly learned the targeted language feature as a young learner. Based on the findings of her study, Song (2014) proposed that Type 3, Type 4, and Type 5 are age-sensitive.

Meanwhile, as noted in the previous section, most of the earlier studies on the acquisition of English articles were undertaken with offline task measurement. Despite its advantage, little work has been done using online measurement concerning second language learners' acquisition and use of English articles (Jung & Park, 2013; Kim & Lakshmanan, 2008; Snape, Hirakawa, et al., 2013).

Kim and Lakshmanan (2008) investigated how Korean learners of English

[5] The data analyzed in Song (2014) originally comes from her earlier work (Song, 2006), where 82 participants were recruited in total. The selection of the age of 12 in her study was to reflect proposals made in earlier studies that reported the maturational effect in second language acquisition—the cut-off age known to be the critical period to successfully acquire an additional language was 12.

[6] What Song (2014) referred to as Conventional Use is named as Type 5 in the current study.

interpret semantic features of English articles in real-time. Both a sentence acceptability rating task and a self-paced reading task were conducted. A self-paced reading task particularly allowed the researchers to measure and assess learners' implicit knowledge and their processing of the targeted language form in real time. The participants consisted of the native control group, the intermediate second language learner group, and the advanced learner group. In the offline task, the advanced learner group performed the same as the native group. In the online task, in contrast, the total reading time for the targeted sentences by the learner group was longer than the native control group irrespective of the learners' level of proficiency. Concerning the different result between the offline task and the online task, the explanation they made primarily lied on the characteristic of an online task. They commented that the offline task seemed to tap into the learners' conscious knowledge of the targeted form; the online task may have made the learners reflect their underlying implicit knowledge of English articles.

While the study was the first to explore online processing of English articles by second language learners of English, a number of limitations remain. Several conditions for conducting a self-paced reading task have not been strictly controlled. First of all, the number of words/regions used in the target sentences were not consistent across experimental items. The variation in the number of words/regions makes it difficult to compare the reading time spent within and across items. The way the data was analyzed was also problematic. Reading times of the whole sentence rather than of each region were measured. If a total reading time instead of a reading time spent at each region is analyzed, what it only shows is the participants' reading fluency. In other words, if the reading time spent for the whole sentence is

used for the analysis, it is impossible to analyze the participants' reading time cost particularly for processing articles.

Moreover, no known studies to date have examined the relationship between starting age and second language learners' online processing of English articles. Therefore, it would be interesting to investigate whether the second language learners in the current study process English articles differently depending on their starting age of acquisition.

Furthermore, previous studies that used an online task for article acquisition adopted the framework suggested by Ionin (2003, 2006). As previously mentioned, however, we adopt the classification that is primarily based on Huebner's (1983, 1985) proposal. The rationale behind this decision is that Huebner's (1983, 1985) framework allows to observe learners' understanding of English articles that appear in a *no article* environment. The materials in the current study include cases where having no articles is grammatical and acceptable. Hence, unlike the *definiteness* and *specificity* framework, which requires an environment to have an article, whether learners are aware of the presence or the absence of articles in a context can be measured by using this framework. It should be the first study to examine second language learners' online processing of *no articles* as well as the selection of either *a(n)* or *the*.

The current study strictly controlled the participants' level of English proficiency. Previous studies on second language learners' article acquisition and use have mostly concentrated on the different performance observed during the developmental learning stages. Some researchers observed how learners at a beginning level would use English articles (Parrish, 1987). Others examined how the

beginners would improve as they learn English (Huebner, 1983, 1985; Master, 1987, 1990). In some cases, article use by intermediate and advanced second language learners was compared (Jung & Park, 2013; Liu & Gleason, 2002; Namkung, 2015; Snape, 2008; Yamada & Matsuura, 1982). Unlike these studies, the focus of the current study is not on the developmental process of learning English articles but on learners' processing of English articles in real-time.

It is important to control the level of English proficiency to be the most advanced state in order to prevent the result being confounded with the learners' language proficiency. In this regard, the recruited second language learners should be at a highly advanced level of English proficiency so that any effect from the lack of knowledge of English articles due to low level of proficiency is safely excluded. A high level of proficiency guarantees that the task distinctively examines the effect of starting age on the second language learners' ability to use English articles in real-time. There have been several studies that recruited advanced second language learners as participants (e.g., Snape, Hirakawa, et al., 2013) but few studies have targeted highly-advanced learners of English (Park, 2004, 2005; Park & Song, 2008). In addition, no study has systematically examined highly-advanced EFL learners' online processing of English articles. An initial screening of participants was thus conducted for the current study (e.g., Abrahamsson & Hyltenstam, 2009), and only learners at a highly-advanced level of English proficiency were recruited.

In short, considering previous studies that demonstrated a negative correlation between starting age and the success of article acquisition, it would be interesting to investigate how performance in online tasks would be different depending on the learners' starting age of English. The current study thus aims to examine the role of

starting age in processing English articles online by second language learners of English, particularly those at a highly advanced level of English proficiency.

Chapter 3 Methodology

3.1 Norming Study

A norming study was conducted to guarantee the validity of the sentences used as the experimental items. The condition was varied by “acceptable” and “unacceptable” for each sentence. The norming study tested whether sentences are judged “acceptable” for acceptable conditions and “unacceptable” for unacceptable conditions. The results of the study were used to assure that the (un)acceptability conditions of the sentences were properly manipulated and were evaluated differently.

3.1.1 Participants

Twenty-five native speakers of English (18 females and 7 males) participated in the norming task (mean age = 24.08). Even in cases that a participant knew additional languages, all participants spoke English most fluently compared to any other languages. The native speaker group was recruited from Amazon Mechanical Turk, and the participants were compensated $0.80 for their participation.

3.1.2 Materials

Each item consisted of two sentences (Table 3.1). The first sentence was a context sentence, and the second sentence was a target sentence. The context sentence provided contextual information of the two sentences. This context sentence was followed by a target sentence, which contained a noun phrase that was varied by different types of articles.

Table 3.1 A sample set of materials

Condition	Context sentence	Target sentence
Type1 [-SR, + HK] Generics: *a(n), the, ø*		
Acceptable	There may be some stereotypes on careers.	Hannah thinks that a model has to be slim.
Unacceptable	There may be some stereotypes on careers.	Hannah thinks that model has to be slim.
Type 2 [+SR, +HK] Referential definites: *the*		
Acceptable	A woman suddenly fainted on the road.	Doctor Lee reported the state of the woman's health.
Unacceptable	A woman suddenly fainted on the road.	Doctor Lee reported a state of the woman's health.
Type 3 [+SR, -HK] Referential indefinites, first mentions: *a(n), ø*		
Acceptable	Graduation ceremonies were held in February.	Judy gladly received presents from her close friends.
Unacceptable	Graduation ceremonies were held in February.	Judy gladly received the presents from her close friends.
Type 4 [-SR, -HK] Nonreferentials: *a(n), ø*		
Acceptable	Some people find joy by helping others.	Olivia has been a nurse most of her life.
Unacceptable	Some people find joy by helping others.	Olivia has been the nurse most of her life.
Type 5 Conventional use: *the, ø*		
Acceptable	There are famous hotels in New York.	Charlie stayed at the Plaza Hotel with his girlfriend.
Unacceptable	There are famous hotels in New York.	Charlie stayed at Plaza Hotel with his girlfriend.

The type of articles used for the noun phrase in the target sentence was chosen according to the categorization of the English article system selected for the current study (see Chapter 2.1). The types of articles are Type 1, Type 2, Type 3, Type 4, and Type 5.

Each article type item was varied by the acceptability condition. The acceptability condition was manipulated by changing the article used in the noun phrase in the target sentence. For instance, one of the target sentences used for Type 2 was *Doctor Lee reported* ***the state*** *of the woman's health.* This sentence becomes

unacceptable when *the* in *the state* is replaced by *a; Doctor Lee reported* ***a state*** *of the woman's health.* Similarly, in Type 4, the acceptable target sentence, *Olivia has been* ***a nurse*** *most of her life,* becomes unacceptable when *a* is replaced by *the;* the unacceptable target sentence is *Olivia has been* ***the nurse*** *most of her life.*

Yet, the variation was made in a different way for some article types. In the case of Type 1, the selection of either *a* or *the* could not vary the acceptability condition as both choices can make the target sentence acceptable. This was due to the characteristic of the article. For instance, consider the case of generics in Type 1. *A model* in "Hannah though that a model has to be slim," or *the telescope* in "Astronauts said that the telescope is a marvelous tool" are both acceptable although one noun phrase is headed by *a* and the other type by *the.* To compensate for such cases, the variation of the acceptability condition was made by the presence or the absence of an article instead of selecting either *a* or *the* (Table 3.1). Furthermore, when it comes to plurals in Type 3, no articles were used because noun phrases with a plural form, *presents,* for instance, could not be headed by *a*. In this case, the acceptability condition was also controlled by the absence or the presence of articles: *presents,* or *the presents.* Similar the case was in Type 5, which was varied by the absence or the presence of articles such as *the Plaza Hotel,* or *Plaza Hotel.*

In addition to the variation on articles to change the acceptability condition, noun countability was also considered. All nouns used for the target sentences were [+ count] except for the subtypes that were categorized as [- count] at initial design Table 2.2). The countability control was to exclude any confounding effects from the learners' incorrect notion of noun countability that affects their understanding and use of English articles.

The five article types had 23 subtypes in total, and each subtype had three items. A total of 69 sets (= 23 subtypes x 3 items) were prepared for the norming study. Target sentences in each item were varied by the acceptability condition, generating 138 sentences (= 69 sentences x 2 conditions). A context sentence was the same for both acceptability conditions. All in all, 207 unique sentences (= 69 context sentences + 138 target sentences) were used for the norming study (see Appendix A for a full list of the experimental material).

3.1.3 Procedure

The responses for the norming study were collected with Google Form. The norming study was done on-line, so participants conducted the experiment at their own environmental settings with their laptop or PC. Participants were given items, which contained both a context sentence and a target sentence. Participants were told that the first sentence functions as a context sentence and constitutes a single context with the second sentence. They were instructed to give scores for the second sentence by the degree of contextual acceptability. Participants had to rate from 1 (‘Unacceptable’) to 6 (‘Ungrammatical’) with a question that asked, “How contextually grammatical/acceptable is the second sentence?” The participants gave scores for each item based on their judgment with a six-point Likert scale.

3.1.4 Results

The results of the norming study are given in Table 3.2 (mean score = 4.00). A non-parametric test was used as the rating score was obtained from a Likert scale. A Wilcoxon Rank Sum Test was conducted by using the wilcox.test() function

implemented in the stats library in R (R Development Core Team, 2016). The analysis showed that the score of the acceptable condition was significantly higher than that of the unacceptable condition overall ($p < .001$). The score difference between the two acceptability conditions was also found for all five article types (*ps* < .001).

Table 3.2 Mean rating score in the norming study

	Acceptable	Unacceptable
Type 1	4.57 (0.07)	3.43 (0.08)
Type 2	4.53 (0.06)	3.75 (0.06)
Type 3	4.35 (0.09)	4.06 (0.09)
Type 4	4.47 (0.06)	3.72 (0.06)
Type 5	4.65 (0.07)	3.86 (0.08)

A statistically significant difference between two acceptability conditions overall and for each article type indicated that the condition variation affected native speakers' judgment on the (contextual) acceptability. The norming study result justified the validity of the variation made for the acceptability condition. Hence, the context and target sentences that were tested in the norming study were also used in the main experiment.

3.2 Main Experiment

In order to examine how Korean EFL learners process English articles in real-time, a self-paced reading task was used. By comparing reading times spent for each region, how the targeted words are processed differently according to the semantic feature of articles and to the condition variation can be tested. As mentioned in Chapter 2.4, a self-paced reading task will help researchers to have a better

understanding on learners' implicit knowledge of English articles by observing their automatic processing of the targeted language feature.

3.2.1 Participants

Fifty Korean EFL learners of English were initially recruited for the main experiment. The Korean participants included undergraduate/graduate students at Seoul National University and graduate students at Ewha Womans University. The Korean learner group was compensated ₩8,000 for participation.

Participants from the Korean learner group had to fulfill two conditions in order to participate in the task. First, Korean should be their first language. This condition indicated that the Korean participants were native speakers of Korean, and that they spoke Korean better or comparable to English. The qualification on language enabled to exclude Koreans who know and have learned Korean but are more fluent in English or other languages than Korean.

Second, Korean EFL learners had to have an official record of an internet-based test of English as a foreign language (iBT TOEFL) with an overall score of 110 or above—the maximum score in iBT TOEFL is 120. The iBT TOEFL measures the test takers' English ability to perform well in an (academic) university setting and evaluates one's performance in four sections of academic tasks: reading, listening, speaking, and writing. The score for each section ranges from 0 to 30. Based on the score scale provided by Educational Testing Service, which provides TOEFL, the score range to be at the highest level for each section is as follows: reading: 22-30; listening: 22-30; speaking: 26-30; writing: 24-30 (Educational Testing Service, 2017). Based on this criterion, one with a total score of 94 (= 22 + 22 + 26 +24) or

above can be regarded to be at an advanced level in English. The recruitment of participants with a total score of 110 or above thus justifies that they are at a highly advanced state of language proficiency.

TOEFL was chosen as it not only evaluates comprehension skill but also production skill. TOEFL is different from other official tests such as The Test of English for International Communication (TOEIC) and The Test of English Proficiency developed by Seoul National University (TEPS), which measure one's comprehension but not production skill. As previously mentioned, erroneous article use has been broadly observed from EFL leaners' production. As TOEFL measures test takers' production skill, it was suitable to use its score as a qualification for the level of English proficiency.

The recruited participants were to elaborate on their experience related to learning English. A language background questionnaire was provided to obtain information on the participants' experience in an English-speaking country, the amount of English input they received, and the age to start learning English. The language background questionnaire had two versions. One version (Appendix B) was targeted to participants who had experience living abroad in an English-speaking country more than a year before the age of 18. An English-speaking country included not only countries where people use English as their first language (e.g., U.S., Canada, and UK) but also countries where people use English as an official language (e.g., Singapore, the Philippines, and Hong Kong). Participants who lived in a country where English was not a native nor an official language (e.g., Indonesia) but attended an international school where English is a medium of instruction also responded with this version of questionnaire. The other version (Appendix B) was

utilized for the rest of the participants who did not live abroad more than a year before 18. The questions included the age that participants started to learn English, methods they used to study English, and the amount of time they spent to learn English. The content of the two versions was different as the first version further included questions about the participants' experience to live and study abroad.

Based on the participation qualification and the information obtained from the language background questionnaire, six participants were excluded. Two participants were screened out due to the lack of information as they did not provide sufficient information on the amount of language exposure and on their starting age. The other four participants who moved to the U.S. during their adolescence and are currently residing abroad were also excluded as they do not have a similar language background compared to the rest of the participants.

After the screening process, a total of 44 participants (mean age = 24.82; 40 females and 4 males) were included for the final analysis (Table 3.3). The recruited participants were divided into two groups by their starting age (mean starting age = 9.50; median starting age = 11.50). This division was directly linked to the research question on the relationship between performance in English article processing and the starting age to learn English. The criterion of starting age division in the current study adopted the standard used in earlier work (Bongaerts, 1999; Flege et al., 1999; McDonald, 2006; Montrul & Slabakova, 2003; Van Boxtel et al., 2005; White & Genesee, 1996). These previous research used age 12 as a cut-off point. Hence, the participants in the present experiment were divided into "the early (starting age) group" (starting age < 12) and "the late (starting age) group" (starting age ≥ 12). As mentioned in Chapter 2.3, the definition of starting age in the current study is not

identical to the one that is generally used in second language acquisition studies. What is referred to as "starting age" in this study is the age of exposure to English, including a learning situation in an instructional setting.

The participants were divided by this notion of starting age. In order to be categorized as the first exposure to English, the type of language experience that participants reported had to fulfill two conditions. First, it was regarded as "exposure" only when the input was given in a way that a learner was actively involved in developing his/her English skill in either reading, writing, listening, or speaking. For instance, one participant responded that she began to study English when she was in her mother's womb; some replied as "I learned alphabets." Such cases were not considered as "exposure." Instead, what was included as "exposure" was experience as attending an English kindergarten in Korea, reading English books, regularly talking with a native speaker of English, going to a private institute, and studying with a home-visiting English teacher.

Second, only when there was at least a minimum amount of English input was the response considered as "exposure." A minimum amount of learning English was set as three hours a week (Larson-Hall, 2008).[7] This criterion meant that any language learning experience that was reported to be less than three hours was not counted as exposure.

Hours spent at school and for studying English were calculated by summing up the participants' response. Participants who studied abroad were calculated to have

[7] In her study, minimal input is defined as no more than four hours of instruction per week.

spent 1215 hours a year (= 6.75 hours x 5 days x 36 weeks).[8] This amount of hours were multiplied by the years of residence abroad. The exposure time in Korea was calculated based on the regular school course in Korea: (a) 3rd-4th grade: 30 hours (= 40 minutes x 45.3 lesson time); (b) 5th-6th grade: 45.3 hours (= 40 minutes x 68 lesson time); (c) middle school: 63.75 hours (= 45 minutes x 85 lesson time); (d) high school: 145.3 hours (= 50 minutes x 175 lesson time); foreign language high school: 175 hours (= 50 minutes x 210 lesson time). For English kindergarten in Korea, it was calculated as 900 hours (= 5 hours x 5 days x 36 weeks). Additional hours that participants spent to study English were also added in the total amount of exposure to English. Based on the two criteria and the calculation of time of exposure, a full set of background information of the participants was collected (Table 3.3).

Table 3.3 Background information of the participants

	Early group (*n* = 22) (starting age < 12)	Late group (*n* = 22) (starting age ≥ 12)
Mean age (years)[9]	24.73	24.91
Sex (female)	18	22[10]
Mean starting age (years)	6.36 (range: 1-11)	12.64 (range: 12-14)
iBT TOEFL score	114.59	114.09
Mean length of residence abroad (years)	2.81	1.71
Mean amount of total input (hours)	4717.83	4450.50

[8] The time is calculated based on the school curriculum in the U.S.

[9] "Mean age" refers to the "age at testing" in age-related second language acquisition studies.

[10] It has been reported that second language learners' sex does make a significant difference in their performance (Jo & Lim, 2013).

Language profiles that may influence the participants' performance were compared. First, the mean iBT TOEFL score did not differ between the two starting age groups (p = .539). The statistical analysis was to verify that the level of English proficiency was not of an influential factor in their performance to be measured. Second, with regard to the length of residence abroad, Welch's t-test showed that the difference did not show any significant difference (p = .215). Third, the total amount of English input also did not differ between the two groups (p = .681). Fourth, the starting age between the groups, in contrast, was found to be statistically different (p < .001). A comparable profile in the iBT TOEFL score, the mean length of residence abroad, and the mean amount of total input, but a different language background only in the starting age of English guaranteed that the participants' performance on article processing was tested only by their starting age and not by other linguistic factors.

3.2.2 Materials

Sentences that were scored in the norming study were used in the main task. As the same in the norming study, a single item comprised of a context sentence and a target sentence. Target sentences were varied by the acceptability condition. The noun phrase of interest had different articles according to the article type classification. A total of 138 items (= 69 items x 2 conditions) were used for the main experimental sentences (Appendix A).

Different from the norming study, where sentences were presented as a whole, the targeted words appeared one-by-one in the main task (Table 3.4). Each word in a sentence was assigned to a separate region. The number of regions of the context

sentences ranged from six to seven. With regard to the target sentences, there were either eight or nine regions. In order to exclude a wrap-up effect, the noun phrase (e.g., *a nurse* or *the nurse*) that was aimed to be tested was never placed at the ultimate or at the penultimate region. A wrap-up effect indicates a typical tendency of longer reading times being cost at the final region when people read sentences online (Gibson, Desmet, Grodner, Watson, & Ko, 2005). For this reason, the noun phrase of interest in the target sentences was always placed to begin at region 4. The noun phrase appeared in region 4 for Type 1, Type 2, Type 3, and Type 4; the noun phrase appeared in region 4 and region 5 for Type 5.

Table 3.4 Region division for the self-paced reading task

	Region 1	Region 2	Region 3	Region 4
Context	Some	people	find	joy
Target A (Acceptable)	Olivia	has	been	**a nurse**
Target B (Unacceptable)	Olivia	has	been	**the nurse**
	Region 5	Region 6	Region 7	Region 8
Context	by	helping	others.	
Target A (Acceptable)	most	of	her	life.
Target B (Unacceptable)	most	of	her	life.

Note. The targeted noun phrases are bold-faced.

Furthermore, the noun phrase that included the article of interest was chunked and was presented in a single phrase (e.g., Region 4 in Table 3.4). This was different from other regions where articles or particles were allocated in separate regions. Such phrase-by-phrase presentation, instead of word-by-word presentation, is advantageous in research dealing with highly frequent but short words such as

articles and prepositions. It is because some participants read or press buttons fast, even faster than their normal reading speed for frequently appeared words (Jiang, 2012). A phrase-by-phrase presentation was thus chosen at regions that contained articles to be tested.

In addition to the main experimental sentences, filler sentences were also prepared. Filler sentences were used in order to disguise the participants from noticing the purpose of the main task. Intervention of filler sentences allows the participants read and respond to main task items without being aware of the target items. Filler items were designed in the same way the main experimental items were. The filler items consisted of a context sentence and a target sentence, and their conditions were varied by grammaticality. Filler items included sentences with anaphoric expressions, reflexive pronouns, PP attachment, and past-tense structures. The first two types of filler items were highly context-dependent. The appearance of these types of items helped participants be more aware of the first sentence, the context sentence, throughout the experiment. The last two types of items were less context-dependent, making the participants also focus on the grammaticality or acceptability of the second sentence, the target sentence. No difference was made concerning the selection of articles in filler items. A total of 144 sentences were used as filler items. In sum, a total of 282 items (= 138 main items + 144 filler items) were pseudo-randomly presented using Ibex Farm software (Drummond, 2013).

3.2.3 Procedure

First, a language background questionnaire was done, which served as the basis for qualifying participation (see Chapter 3.2.1). The questionnaire was then followed

by a self-paced reading task. A self-paced reading task had an embedded acceptability judgment task for each item. The judgment task was an offline task as no time constraint was imposed. The experiment took about 40 minutes.

The self-paced reading task was designed under Ibex Farm software (Drummond, 2013). Each item was displayed in two lines, where a context sentence was in the first line and a target sentence in the second line. The sentences were presented word-by-word. An Arial in a 24-point font size was used. Each region was veiled behind a series of dash marks, "---," and the marks displayed word length and position (Figure 3.1). Whenever the participants pressed the spacebar, the dashes revealed their hidden words in a non-cumulative moving-window fashion. The reading times spent at each region were recorded.

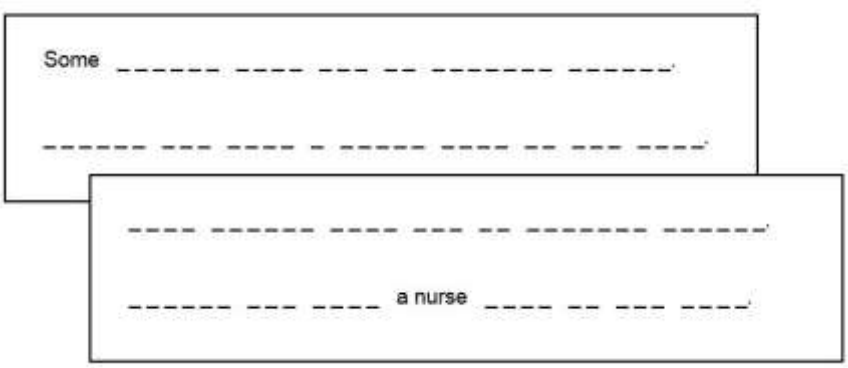

Figure 3.1 An example trial for the self-paced reading task

A number of studies showed that longer reading times in a self-paced reading task indicate additional processing. For instance, it will take longer to read if a participant thinks the presented word (phrase) is ungrammatical or unacceptable. Or, even when the sentence is grammatical, a participant may read slowly if further

analysis is required due to, for instance, a complex or an ambiguous structure, retrieval of previous entities, or a process of linking and matching with world-knowledge or contextual information (Pearlmutter, Garnsey, & Bock, 1999). Thus, longer reading times demonstrate that *there is something going on* during language processing.

An acceptability judgment task followed after each self-paced reading task item. A question that asked, "How contextually grammatical or acceptable is the second sentence?" appeared on the screen, and the participants were asked to give scores based on their judgment. Similar to the method in the norming study, a six-point Likert scale was used, where '1' indicated 'Ungrammatical/Unacceptable,' and '6' denoted 'Grammatical/Acceptable.' The participants were instructed to consider the two presented sentences ensemble as a single context. The next experimental item appeared after the participants gave scores for the acceptability judgment question. The acceptability judgment task was included in order to test the participants' explicit knowledge of English articles.

Since both groups of the participants are highly advanced learners of English, both groups may successfully distinguish the two acceptability conditions. However, if starting age matters considerably, the group difference would be widely observed in most article types. Based on the rationales, two predictions were made concerning the reading time result:

(1) Prediction 1 (from Hypothesis 1)

Considering the reported effect of starting age on the success in second language learners' article acquisition, the early group will read longer for

the unacceptable condition and faster for the acceptable condition overall than will the late group.

(2) Prediction 2 (from Hypothesis 2)

Based on the work by Song (2014) that second language learners' performance for Type 3, Type 4, and Type 5 is particularly sensitive to starting age, the early group will read longer for the unacceptable condition and faster for the acceptable condition for Type 3, Type 4, and Type5. There will be no significant difference between the two groups for processing Type 1 and Type 2 since performance in these types were reported not to be as significantly as affected by learners' starting age.

Chapter 4 Results

4.1 Acceptability Rating Score

The mean rating scores in the acceptability judgment task are summarized in Table 4.1. Since the score was given in a Likert scale, the result was analyzed with a non-parametric test. A Wilcoxon Rank Sum Test was used in an R environment (R Development Core Team, 2016) to analyze the data.

As presented in Table 4.1, the acceptable condition was scored significantly higher than the unacceptable condition for both the early group and the late group (*ps* < .001). Moreover, both the early and the late group rated article types differently depending on the acceptability condition except for Type 5. For Type 5, the mean rating score for the two conditions did not differ in the late group ($p = 0.64$).

The mean scores within condition and between groups were also compared. For the acceptable condition, there was no significant difference between the two groups in any of the article types except for Type 4 (Type 1, $p = .205$; Type 2, $p = .721$; Type 3, $p = .395$; Type 4, $p < .01$; Type 5, $p = .485$). For the unacceptable condition, there was a significant difference between the two groups for all article types (Type 1, $p < .001$; Type 2, $p < .001$; Type 3, $p = 0.017$; Type 4, $p < .001$; Type 5, $p < .001$).

Table 4.1 Mean rating score in the acceptability judgment task

		Acceptable	Unacceptable	*p*
Type 1	Early	4.60 (0.05)	3.61 (0.05)	<.001
	Late	4.71 (0.04)	4.02 (0.05)	<.001
Type 2	Early	5.08 (0.03)	3.73 (0.05)	<.001
	Late	5.01 (0.03)	3.98 (0.05)	<.001
Type 3	Early	4.80 (0.05)	4.22 (0.06)	<.001

	Late	4.68 (0.05)	4.43 (0.05)	<.001
Type 4	Early	4.58 (0.04)	3.48 (0.04)	<.001
	Late	4.76 (0.04)	3.74 (0.05)	<.001
Type 5	Early	4.64 (0.05)	4.10 (0.05)	<.001
	Late	4.56 (0.05)	4.60 (0.05)	*n.s.*

Note. Mean (standard error) score. It is marked as *n.s.* for no statistical significance.

First, the analyzed results indicate that both the early and the late group made a correct judgment on the acceptability condition. Second, the insignificant difference for Type 5 by the late group demonstrates that the late group learners were not as much sensitive as the early group to the difference between the acceptable and unacceptable condition. Third, while there was no significant difference between the groups in the acceptable condition, there was a statistically meaningful difference in the unacceptable condition. The late group gave higher scores for the unacceptable condition in general. Fourth, only for Type 4 was there a statistical difference between the two groups for the acceptable condition. Implications from these results are discussed in the Discussion section (Chapter 5).

4.2 Reading Time

Reading time data from each region were collected. Instead of using the measured data, the reading times were corrected by word length. This was to reflect reading time difference caused by word length. As a noun phrase with a longer word length is susceptible to reading cost, a correction was required to exclude influence deriving from word length. For instance, a longer reading time is expected for reading *a ballerina* than reading *a pen*. However, it is difficult to make a conclusion from this result about article processing as a longer reading time for *a ballerina* may not indicate a processing difference due to some article characteristics, but simply

show a reading burden caused by word length. For this reason, calculated reading times, called as "residual reading times," were used for the main analysis.[11] The residual reading times fix any reading time differences caused by the length variation of a sentence or a word (Ferreira & Clifton, 1986).

In addition to using residual reading times, data points that exceeded 3 standard deviation from the overall mean were removed (Jiang, 2012). This procedure was to eliminate influential data points.

Reading times spent for each region are presented in Figure 4.1 (see Appendix C for all residual reading times). The figure shows the mean residual reading time. The plotted error bars are the standard error. The Y-axis is in milliseconds. Particularly noticeable is a steep increase of reading times at region 4. After a longer reading time at region 5, the reading time decreases as the region proceeds to region 6. On top of the reading time difference among regions, a different reading time tendency can be observed between the acceptability conditions. A reading time difference between the two groups is also observable.

[11] The name "residual" comes from the way the reading times are calculated. A regression model that has word length as a fixed factor is constructed. The residuals from this model are obtained, which are the corrected reading times by word length: the residual reading times.

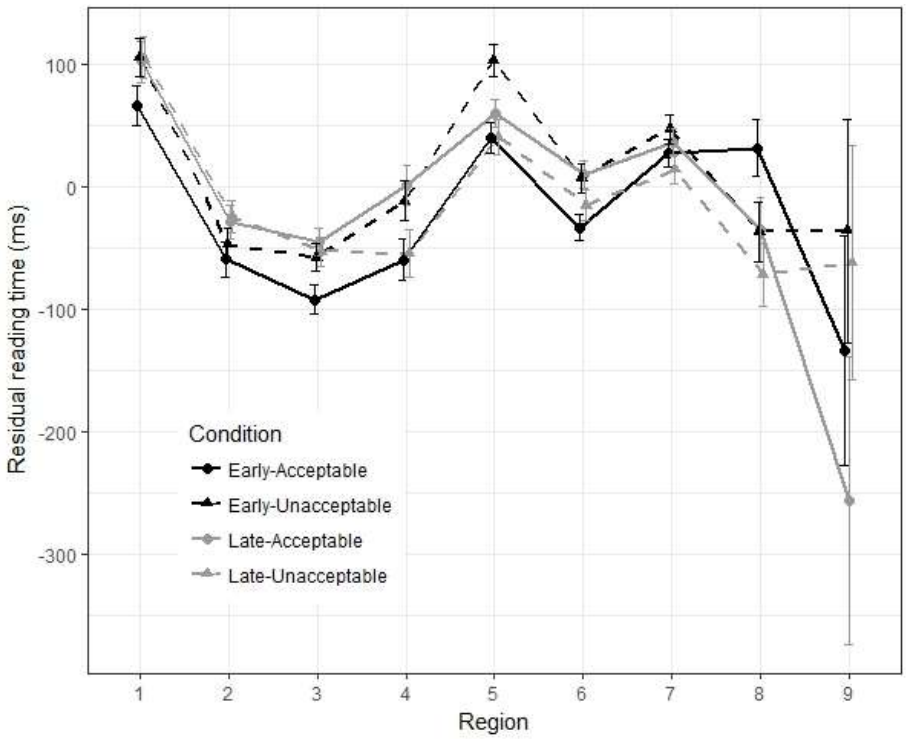

Figure 4.1 A visual summary of residual reading times at all regions

As the research goal was to examine participants' article processing, only regions that were related to processing articles were selected for the main analysis: the regions of interest (ROIs). The selected ROIs were as follows: the critical region, where the targeted noun phrase appeared; the spill-over 1 region, the next region after the critical region; the spill-over 2 region, the next region after the spill-over 1 region. The assignment of the spill-over regions was to reflect a widely recognized characteristic in a self-paced reading task that reading time difference for different conditions may not be detected at the targeted position alone (Bertram, Hyönä, & Laine, 2000). It has been reported that language parsers would continue to analyze the targeted language feature even after they move on from the critical region. The ongoing processing in the regions subsequent to the critical region is thus essential

in a self-paced reading task. Considering the importance of the spill-over regions, the current study accordingly assigned the two regions that follow the critical region as the spill-over regions.

The assignment of the ROIs is exemplified below (Table 4.2). Region 4 is the critical region; region 5 is the spill-over 1 region; region 6 is the spill-over 2 region. The designation of the ROIs was slightly different for Type 5c. As the targeted noun phrase for Type 5c appeared in region 4 and 5, the two regions were collapsed into the critical region. The following two regions were then assigned as the spill-over 1 region, and spill-over 2 region, respectively (Table 4.2).

Table 4.2 Region division for the self-paced reading task

An example set of Type 4d						
		Critical	Spill-over 1	Spill-over 2		
	Region 1-3	Region 4	Region 5	Region 6	Region 7	Region 8
Target (Acceptable)	…	**a nurse**	most	of	her	life.
Target (Unacceptable)	…	**the nurse**	most	of	her	life.
An example set of Type 5c						
		Critical	Critical	Spill-over 1	Spill-over 2	
	Region 1-3	Region 4	Region 5	Region 6	Region 7	Region 8
Target (Acceptable)	…	**the Plaza**	**Hotel**	with	his	girlfriend.
Target (Unacceptable)	…	**Plaza**	**Hotel**	with	his	girlfriend.

For the initial analysis, data points at the ROIs were combined into one: the region of interest (ROI)—note the absence of the plural *–s*. The data for the ROI is

the sum of the reading time data at the critical region, spill-over 1 region, and spill-over 2 region. In short, the sum of the reading times at the ROIs equals the reading times at the ROI.

Residual reading times at the ROI by the acceptability condition and the exposure condition are summarized in Table 4.3. Statistical analyses were conducted to compare article processing between the two starting age groups.

Table 4.3 Residual reading times at the ROI

		Acceptable	Unacceptable
All types	Early	-23.63 (7.53)	2.77 (7.86)
	Late	18.53 (7.46)	-18.47 (8.92)
Type 1	Early	-8.67 (18.80)	35.40 (18.96)
	Late	38.37 (18.24)	-18.89 (20.61)
Type 2	Early	-34.39 (13.64)	5.10 (16.33)
	Late	23.26 (13.54)	-15.68 (16.88)
Type 3	Early	13.33 (22.19)	21.80 (24.14)
	Late	-16.76 (24.05)	-7.34 (27.24)
Type 4	Early	-32.98 (15.48)	28.02 (14.57)
	Late	-2.72 (14.87)	-17.87 (18.51)
Type 5	Early	-33.91 (17.17)	26.69 (17.16)
	Late	47.12 (16.30)	-29.46 (19.92)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

In order to analyze the data, a Linear Mixed Effects Regression (LMER) analysis (Baayen, Davidson, & Bates, 2008; Cunnings, 2012) was built by using an lme4 R package (Bates, Mächler, Bolker, & Walker, 2014). While analysis of variance (ANOVA) has been a popular way to analyze quantitative data in second language acquisition research, statistical models called as the LMER model are used in the present study. The choice to use regression models was to consider the following two separate analyses at the same time: by-subject analysis from the data averaged over participants (F_1), and by-item analysis from the data averaged over

items (F_2). Although the significance of main effects can be observed by F_1 x F_2 criterion in ANOVA, the analysis (i) falls short of dealing with cases where either type of analysis does not reach a statistically significant level, and (ii) cannot handle random variance of subjects and that of items at the same time. An alternative to ANOVA is the LMER model, where the two types of variance can be captured ensemble. The random variance in ANOVA is comparable to the "random effects" in the LMER model; what are known as the main effects are named as "fixed effects" in this regression model (Cunnings, 2012).

The LMER model was applied to the analysis. The effects that were aimed to be observed were selected as fixed effects: the acceptability condition, the exposure condition. The interaction of the two conditions were also examined. Subjects and items were selected as random effects. The models produced coefficients, standard errors, and *t*-values for the selected effects. First, the coefficients are the slope of the model. The slope describes the degree to which the measured values are predictable by the given variables. In the current study, the slope is the predictability of the selected fixed effects to the reading times. Second, the standard error shows the certainty of the coefficient estimates. The smaller the standard error is, the smaller the confidence intervals are, indicating the sureness of the coefficient estimates. Third, the *t*-values tell the statistical significance of the coefficients. The *t*-values are the output of the coefficient divided by the standard error. The coefficients were considered statistically significant if the absolute value of *t* exceeded 2 (Baayen, 2008).

In addition to the regression analysis, a planned contrast of pair-wise comparison of means was conducted. The comparison was to observe further reading

time differences within each condition. The Tukey test was used with a multcomp package in R (Hothorn, Bretz, & Westfall, 2008).

For the data that included reading times from all article types, there was a main effect of the exposure condition (*estimate* = 41.162, *se* = 11.235, *t* = 3.753) as well as the acceptability condition (*estimate* = 46.387, *se* = 11.262, *t* = 4.119). A statistically meaningful interaction between the two factors were also found (*estimate* = -83.387, *se* = 15.913, *t* = -5.240). Additionally, a planned Tukey pairwise contrast demonstrated a significant reading time difference between the early and the late group for the acceptable condition (*estimate* = 42.162, *se* = 11.235, *z* = 3.753, $p < .001$). A reading time difference between the two groups was also found for the unacceptable condition (*estimate* = -41.225, *se* = 11.270, *z* = -3.658, $p = .001$). A significant reading time difference between the acceptability conditions was found in the late group (*estimate* = -37.000, *se* = 11.243, *z* = -3.291, $p < .01$) as well as in the early group (*estimate* = 46.387, *se* = 11.262, *z* = 4.119, $p < .001$).

The main analyses demonstrate that the unacceptable condition was read slower in general, that longer reading times were cost for the late group, and that the reading time for the unacceptable condition was mitigated by the exposure condition, where the late group read faster than the early group. The results from the Tukey contrast showed that the unacceptable condition took longer reading time for the early group. A reverse trend was observed in the late group, where longer reading times were spent for the acceptable condition. The reveres effect and reported findings are discussed in Chapter 5.

On top of the analysis on the full data set, statistical analyses were run for each article type (Table 4.4). The leftmost column presents the fixed effects: main

effects—the exposure condition and the acceptability condition—and the interaction. "Exposure" and "Acceptability" refers to the exposure condition and acceptability condition, respectively. "Exposure:Acceptability" refers to the interaction between the exposure condition and the acceptability condition.

Table 4.4 Linear Mixed Effect Regression results for reading time at the ROI

	Coefficient	SE	*t*
Type 1			
(Intercept)	-8.669	19.345	-0.448
Exposure	47.072	27.426	1.716
Acceptability	44.082	27.035	1.631
Exposure:Acceptability	-101.378	38.294	-2.647*
Type 2			
(Intercept)	-33.92	17.19	-1.973
Exposure	56.73	24.48	2.318*
Acceptability	38.03	21.48	1.770
Exposure:Acceptability	-74.85	30.29	-2.471*
Type 3			
(Intercept)	13.874	26.042	0.533
Exposure	-31.134	35.953	-0.866
Acceptability	7.401	34.887	0.212
Exposure:Acceptability	2.929	49.249	0.060
Type 4			
(Intercept)	-32.98	16.16	-2.041
Exposure	30.26	22.47	1.347
Acceptability	61.00	22.47	2.715*
Exposure:Acceptability	-76.15	31.75	-2.398*
Type 5			
(Intercept)	-33.91	18.05	-1.879
Exposure	81.01	25.40	3.189*
Acceptability	60.56	25.00	2.422*
Exposure:Acceptability	-137.06	35.33	-3.880*

Note. A coefficient was considered to be a significant level if $|t| > 2$. The statistical significance is marked with an asterisk.

For Type 1, a statistically meaningful interaction between the two main effects was found. Longer reading times were spent for the unacceptable condition by the early group compared to the late group. This indicates that the reading time

difference due to the acceptability condition in Type 1 is influenced by the exposure condition.

For Type 2, a main effect of the exposure condition was observed. This main effect of the exposure condition demonstrates a delayed processing of articles by the late group. Moreover, there was an interaction between the two fixed effect factors. The interaction suggests that the reading time difference caused by the acceptability condition was affected by the exposure condition.

For Type 3, the coefficients did not reach a significant level for any of the factors. The absence of statistical significance implies that the two conditions were not processed differently. It also shows that the exposure condition was not of an influence on the learners' article processing.

For Type 4, it took longer reading times for both learner groups to process the unacceptable condition; yet, no significant reading time difference was found between the two groups. Nonetheless, there was a statistically meaningful interaction between the two factors, where the late group spent less reading time for the unacceptable condition compared to the early group. A post-hoc Tukey contrast demonstrated that the early group spent longer reading times for the unacceptable condition than for the acceptable condition (*estimate* = 61.00, *se* = 22.47, $z = 2.715$, $p < .05$). These statistical analyses imply that the two starting age groups process acceptability conditions differently, and the early group particularly has a better sensitivity to the acceptability condition.

For Type 5, both groups took longer to process the unacceptable condition. The late group spent more time in processing articles than the early group. The analysis demonstrated that the late group read the unacceptable condition faster compared to

the early group. Meanwhile, interestingly, a post-hoc Tukey pair-wise contrast showed that the late group read the acceptable faster than the unacceptable condition (*estimate* = -76. 505, *se* = 24.959, *z* = -3.065, *p* = .012). This is a reverse effect in that more time was needed for the late learners to process the acceptable condition than the unacceptable condition.

In short, the analyses can be summarized in three points. One, a main effect of the acceptability condition was found in Type 4, and Type 5. Two, a main effect of the exposure condition was found in Type 2, and Type 5. Three, there was an interaction between the exposure and the acceptability condition for Type 1, Type 2, Type 4, and Type 5.

For further analyses, the reading times at the ROIs were analyzed. Different from the ROI, the data of the ROIs provide reading time data spent at the critical region, spill-over 1 region, and spill-over 2 region separately. The region-by-region observation allowed to examine the participants' processing of articles more in detail.

Similar to the main analysis, an LMER model (Baayen et al., 2008; Cunnings, 2012) was used under an lme4 R package (Bates et al., 2014). The data of the two exposure groups were separately analyzed. Only the acceptability condition was included as the fixed effect. Item and subject factor were both included as the random effect. The models produced estimates, standard errors, and *t*-values. Following Baayen (2008), the coefficients were considered to reach a statistically significant level when the absolute *t*-value exceeded 2.

Table 4.5 summarizes the residual reading times at the ROIs for all types.

Table 4.5 Residual reading times at the ROIs (All types)

		Acceptable	Unacceptable
Critical	Early	-45.68 (15.41)	0.32 (14.76)
	Late	24.32 (14.57)	-41.07 (17.49)
Spill-over 1	Early	22.58 (11.49)	92.67 (12.37)
	Late	38.10 (11.34)	35.76 (13.58)
Spill-over 2	Early	-44.01 (10.89)	-18.67 (12.84)
	Late	-6.57 (12.06)	-44.56 (14.06)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

Figure 4.2 shows that there is a reading time difference between the two conditions. A larger reading time gap between the conditions can be more clearly seen in the early group.

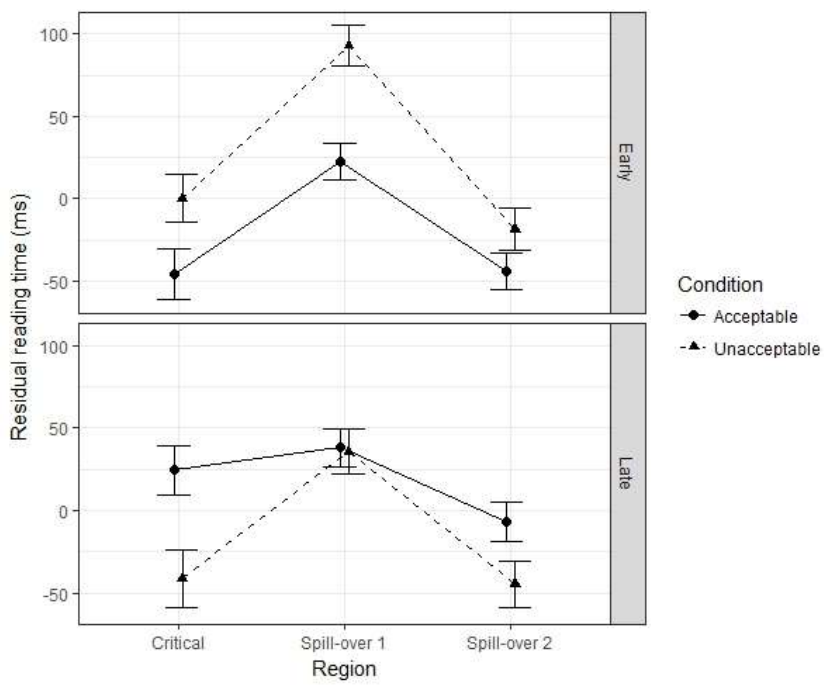

Figure 4.2 Residual reading times at the ROIs (All types)

Regression models demonstrated a main effect of the acceptability condition at the critical region for both the early (*estimate* = 45.32, *se* = 21.31, *t* = 2.13) and the

late group (*estimate* = -65.84, *se* = 22.64, *t* = 2.91). The main effect was also observed at the following region and the spill-over 1 region for the early group (*estimate* = 70.13, *se* = 19.01, *t* = 3.69). At the spill-over 2 region, the late group showed a reading time difference between the two acceptability conditions (*estimate* = -37.85, *se* = 18.76, *t* = 2.02). Interesting was a reverse effect of the main effect, where the late group spent longer time for the acceptable condition than the unacceptable condition. This trend is in contrast with the processing by the early group learners, who took longer reading time for the unacceptable condition than the acceptable condition.

Table 4.6 shows the residual reading times at the ROIs for Type 1.

Table 4.6 Residual reading times at the ROIs (Type 1)

		Acceptable	Unacceptable
Critical	Early	-21.29 (39.85)	-1.99 (30.67)
	Late	33.79 (37.16)	-10.18 (34.56)
Spill-over 1	Early	34.16 (26.63)	114.96 (30.71)
	Late	58.21 (26.01)	44.30 (32.74)
Spill-over 2	Early	-39.06 (29.88)	-3.12 (35.78)
	Late	23.46 (30.80)	-87.42 (38.54)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

Figure 4.3 is a line graph of the residual reading times spent at each region. What is salient is the reading time increase at the spill-over 1 region for the early group. Moreover, the early group read the unacceptable condition slowly compared to the acceptable condition. Nevertheless, this was not the case for the late group. The late group spent longer reading time for the acceptable condition.

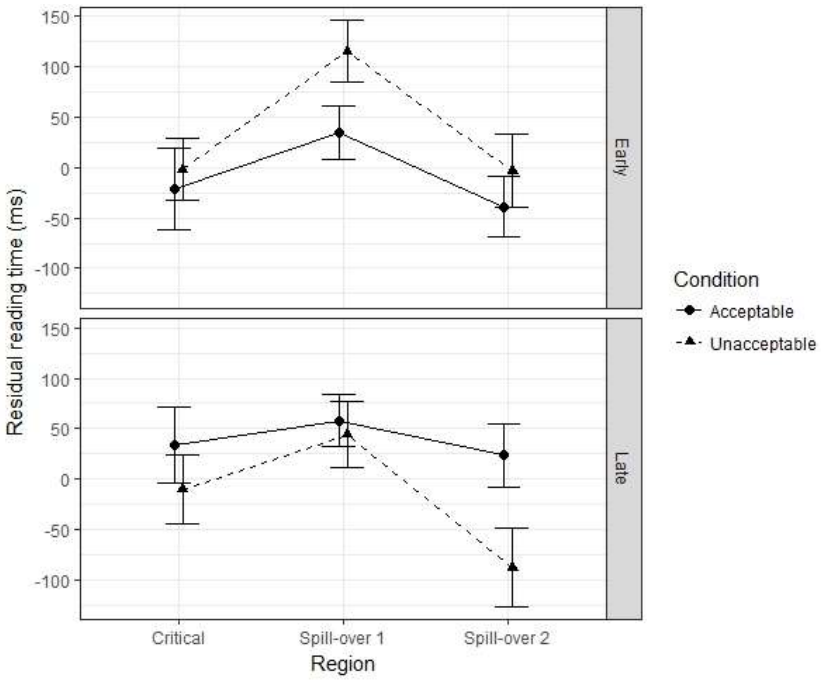

Figure 4.3 Residual reading times at the ROIs (Type 1)

The regression models demonstrated a main effect of acceptability condition at the spill-over 1 region for the early group (*estimate* = 80.87, *se* = 40.32, *t* = 2.01), and at the spill-over 2 region for the late group (*estimate* = -112.14, *se* = 52.23, *t* = -2.03). However, the article processing of the two groups was different in that the unacceptable condition was read slower by the early group while faster by the late group.

Residual reading time data for Type 2 are presented in Table 4.7.

Table 4.7 Residual reading times at the ROIs (Type 2)

		Acceptable	Unacceptable
Critical	Early	-38.78 (29.00)	-14.80 (29.61)
	Late	28.14 (24.88)	-71.83 (35.11)
Spill-over 1	Early	0.41 (20.61)	70.01 (26.02)
	Late	58.20 (21.74)	56.82 (24.81)

Spill-over 2	Early	-61.16 (19.35)	-30.59 (27.98)
	Late	-12.06 (23.01)	-20.48 (24.50)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

Figure 4.4 plots the residual reading times for Type 2. There is a steep rise of the reading time at the spill-over 1 region for both language groups. Notable is the similar reading time tendency for the acceptable and the unacceptable condition at the two spill-over regions for the late group.

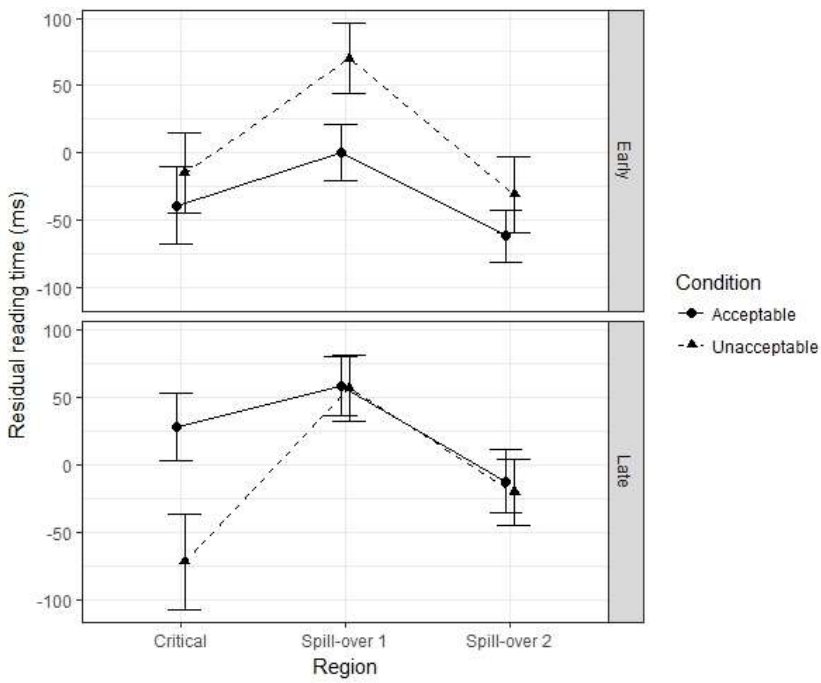

Figure 4.4 Residual reading times at the ROIs (Type 2)

The statistical analyses of the observed data shows that a main effect of acceptability condition was found at the spill-over 1 region for the early group (*estimate* = 71.31, *se* = 35.79, *t* = 2.00), and at the critical region for the late group (*estimate* = -96.56, *se* = 46.95, *t* = -2.06). The analyses further indicate that while the

early group spent longer reading times for the unacceptable condition, the late group read slower for the acceptable condition.

Residual reading times for Type 3 are given in Table 4.8.

Table 4.8 Residual reading times at the ROIs (Type 3)

		Acceptable	Unacceptable
Critical	Early	-20.99 (51.39)	-20.47 (50.99)
	Late	7.85 (51.75)	-16.96 (58.09)
Spill-over 1	Early	64.40 (32.02)	148.35 (37.05)
	Late	-7.11 (39.64)	67.19 (35.68)
Spill-over 2	Early	-3.43 (27.45)	-58.87 (33.12)
	Late	-51.01 (31.19)	-68.58 (43.89)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

Figure 4.5 provides a visual summary of the residual reading times. A reading time increase is detected at the spill-over 1 region. The figure presents a similar tendency between the two groups, with longer reading time spent for the unacceptable condition.

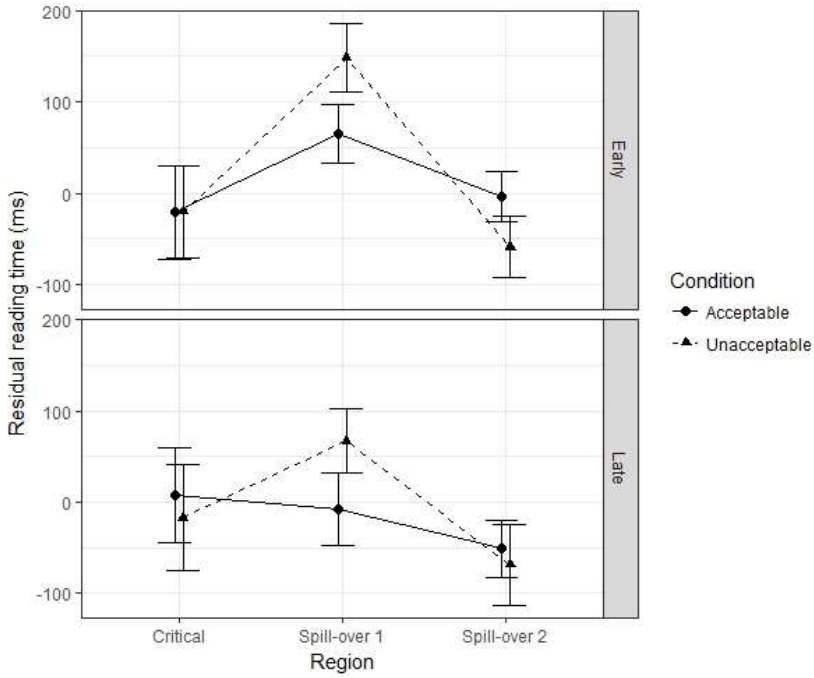

Figure 4.5 Residual reading times at the ROIs (Type 3)

Despite the trend shown in the figure, regression models for reading time data for Type 3 showed that no statistical significance was found between the two conditions within neither the early group nor the late group at any of the regions.

Table 4.9 demonstrates the residual reading times for Type 4.

Table 4.9 Residual reading times at the ROIs (Type 4)

		Acceptable	Unacceptable
Critical	Early	-77.01 (31.61)	15.08 (30.81)
	Late	-33.33 (30.72)	-31.93 (38.63)
Spill-over 1	Early	34.78 (23.85)	82.12 (21.68)
	Late	34.85 (21.69)	37.95 (28.91)
Spill-over 2	Early	-57.45 (22.93)	-13.45 (21.21)
	Late	-9.86 (23.61)	-61.33 (26.81)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

Residual reading times are visually presented in Figure 4.6. The reading time

difference between the conditions seems smaller for the late group. A reading time increase is detected at the spill-over 1 region for both groups.

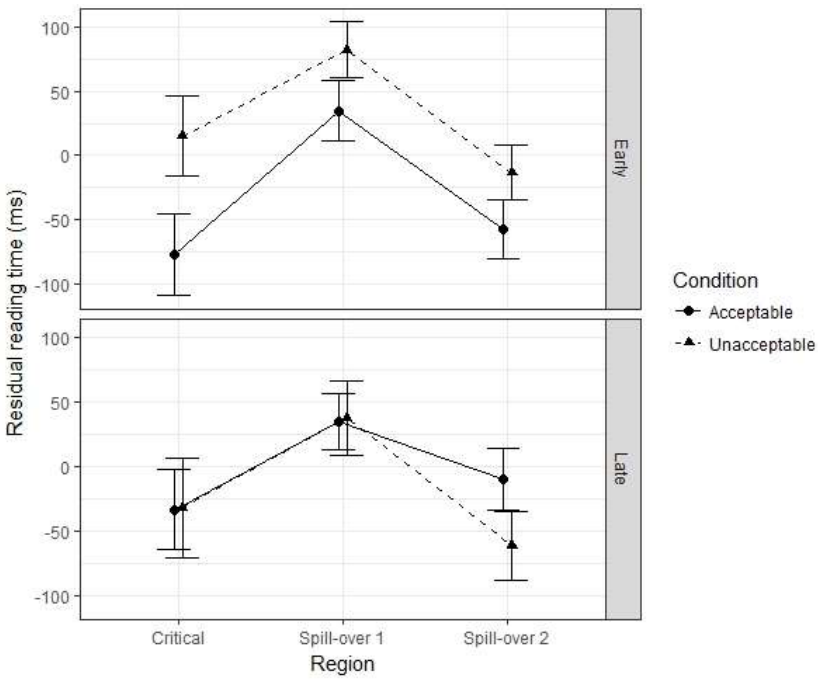

Figure 4.6 Residual reading times at the ROIs (Type 4)

A main effect of the acceptability condition was observed from the early group at the critical region (*estimate* = -92.10, *se* = 44.14, *t* = 2.09).

Residual reading times at the ROIs for Type 5 are shown in Table 4.10.

Table 4.10 Residual reading times at the ROIs (Type 5)

		Acceptable	Unacceptable
Critical	Early	-50.04 (30.92)	11.96 (29.66)
	Late	81.31 (28.32)	-50.54 (35.53)
Spill-over 1	Early	-8.42 (29.00)	70.85 (27.97)
	Late	31.33 (22.07)	-30.01 (31.17)
Spill-over 2	Early	-32.79 (24.38)	7.25 (28.46)
	Late	10.29 (29.56)	2.49 (31.53)

Note. Mean (standard error) residual reading time. The numbers are in milliseconds.

Figure 4.7 plots the residual reading times. For the early group, longer reading times are detected for the unacceptable condition compared to the acceptable condition. A steep incline of the reading time by the early group at the spill-over 1 region is also found. In contrast, a reverse reading time tendency is observed for the late group. The acceptable condition cost the late group longer reading time.

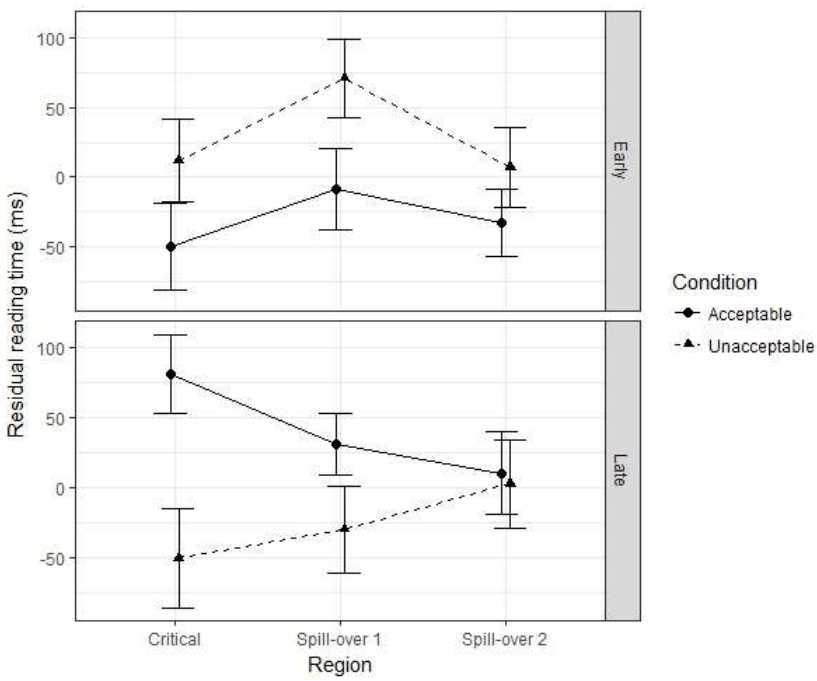

Figure 4.7 Residual reading times at the ROIs (Type 5)

The regression models from Type 5 data showed that there was a statistically meaningful difference between the two acceptable conditions at the critical region for the late group (*estimate* = -131.45, *se* = 45.02, *t* = -2.92).

Taken together, the results demonstrate that the early and the late group show

a different way of processing English articles in a number of ways. Interpretation on the results and major findings are followed in the Discussion section.

Chapter 5 Discussion

5.1 Discussion on the Analyzed Data

The goal of the current study was to examine the role of starting age of Korean EFL learners in English article processing in real-time. Of another interest was to investigate how the early and the late starting age group process the five article types—Type 1, Type 2, Type 3, Type 4, and Type 5. Based on earlier findings with an offline task, it was predicted that a different processing will be detected particularly for Type 3, Type 4, and Type 5. As these article types were reported to be age-sensitive, the early group was expected to be more sensitive to the acceptability condition for these article types. In relation to these research questions and predictions, some major findings are discussed.

First, the starting age effect was weak in the offline acceptability judgment task. The rating score between the two acceptability conditions was significantly different regardless of the group. The result indicates that the distinction between the acceptable and the unacceptable condition was clearly made by both groups. An outstanding performance in English articles is surprising given the previous studies that reported the notoriousness of acquiring the English article system by second language learners of English (Butler, 2002; Murphy, 1997). What was different from those earlier studies in the current research was the strict control of the learners' level of English proficiency. As noted, the participants were guaranteed to be at a highly advanced level. In this vein, a plausible explanation on the learners' outstanding performance can be attributed to the level of English proficiency. Higher the learners' English proficiency is, expected is a better performance (Kim & Lakshmanan, 2008;

Namkung, 2015). This result suggests that the highly advanced Korean EFL learners have successfully built (explicit) knowledge of English articles in the instructional learning environment. The learners in the current study thus made distinctions between the conditions despite the difficult nature of English article acquisition by the learners.

Nonetheless, the starting age effect on the success of English article acquisition cannot be flatly denied. When the score was analyzed within the acceptability condition, a different tendency was observed. For the unacceptable condition, the mean rating score of the late group was higher than that of the early group for all article types of the unacceptable condition. For example, the mean rating score for the unacceptable condition for Type 2 was 3.73 (the early group) and 3.98 (the late group), respectively. The statistical analysis demonstrated that such score difference reached a significant level. Such higher rating score for the unacceptable condition by the late group indicates that the late starting age learners were more generous for the unacceptable condition. These rating score differences imply that the starting age may yield some influence on the learners' understanding and comprehension of English articles. The result resonates with the argument made in earlier work that demonstrated an important role of starting age (DeKeyser, 2000; Song, 2014).

Although the rating score difference was detected in the unacceptable condition, it should be noted that no significant difference between the groups was observed concerning the acceptable condition. For instance, the mean rating score for the acceptable condition in Type 2 was 5.08 (the early group) and 5.01 (the late group). The score was not statistically different. Except for Type 4, there was no significant difference in the acceptable condition between the two groups. This indicates that

both groups made a similar judgment on the acceptable condition. Some may attribute the insignificant difference in the acceptable condition to a ceiling effect rather than a comparable performance by the two groups. A ceiling effect refers to people's tendency to be conservative in giving extreme scores. For instance, people tend to avoid giving score 1 or 6 in a 6-point Likert scale (MacIntyre & Gardner, 1989). In this respect, a similar rating score for the acceptable condition by the two groups may be understood as a ceiling effect rather than learners' comparable judgment on the acceptable condition. Yet, the explanation does not seem plausible given that the score given in the acceptability judgment task was similar to that of the mean score for the acceptable condition in the norming study, where native speakers of English participated. Thus, it cannot be strongly argued that starting age is a determining factor for the success of learning English articles when it comes to offline tasks.

Second, in addition to the finding related to the participants' offline task performance, another finding comes from the participants' online task performance. Despite a comparatively weak impact of starting age on the learners' offline performance, the analyses showed that the learners' starting age plays a significant role in real-time comprehension of English articles. The result from the self-paced reading task suggests that articles are processed differently according to learners' starting age.

The results from the regression models constructed for all article types can be understood as follows. First, longer reading times spent by the late group imply that the early group learners process articles more fluently and automatically. Second, the observed interaction shows that the late group learners have a weaker sensitivity

to the acceptability condition in article use. Such a weaker sensitivity to the semantic feature of the articles by the late group further shows the role of starting age in article processing. Third, the critical role of the starting age is ensured by the results from a pair-wise contrast that showed a statistical difference between the groups for both conditions.

On top of the reading time data for all types, analyses on the reading time performance by the two groups for each article type also presents some meaningful findings. In the following, (i) the main effect of the exposure condition, (ii) the main effect of the acceptability condition, and (iii) the interaction between the exposure and the acceptability condition are discussed.

First, a main effect of the exposure condition was found in Type 2 and Type 5 from the ROI data. For Type 2, it was ensured in the acceptability judgment task that both learner groups clearly knew the difference between the acceptable and the unacceptable semantic features of article Type 2. As both reading groups showed the sensitivity to the acceptability condition in the offline task, a main effect of the exposure condition in the online task was unexpected. In order to understand why a processing difference in the self-paced reading task between the two groups was found in Type 2, the characteristic of article Type 2 should be revisited.

As previously mentioned in Chapter 2.1, the semantic feature of Type 2 is [+ Specific Referent, + Hearer Knowledge] and the articles used for this type are referential definites, marked with *the*. This means that article Type 2 is highly context-dependent compared to the other article types. For instance, an example item of Type 2 used in the experiment was, "[Context sentence] A car suddenly stopped on the road. [Target sentence] Sean noticed that the car had a flat tire." In this case,

the car in the second sentence appears as ***the*** *car* but not ***a*** *car*, as it should refer to the *car* presented in the context sentence—recall that the participants were instructed to consider the two sentences as a single context. When it comes to processing a noun phrase headed by *the* in *the car*, participants should retrieve from their memory what [the NP] refers to. A co-referring process is involved during this stage, where (s)he should correctly make a connection between the entities appeared in the context sentence and the other presented in the target sentence.

Concerning the co-referring process in real-time, it has been widely reported that there is processing cost to link the [the NP] to a previously mentioned noun phrase (e.g., Gordon, Hendrick, & Johnson, 2001). Processing cost can be indicated by a longer reading time in a behavioral experiment such as a self-paced reading task. Longer reading times can thus be taken as a processing burden due to a retrieval process, in which [the NP] form should be associated with the noun mentioned earlier. In this respect, statistically longer reading times by the late group compared to the early group demonstrate that the co-referring process is more taxing for the late group than the early group. Therefore, the result suggests that the late group is less skilled in linking the entity to a previously mentioned noun in the given context.

For Type 5, longer reading times cost by the late group compared to the early group show that the feature of Type 5 affects the late group's processing of articles. Type 5 is different from other article types in that it does not have a specified semantic feature to characterize itself. Instead, Type 5 is used as a chunk or a formulaic expression. Due to such item-based characteristic, the amount of exposure or the familiarity to the word used with article Type 5 becomes an important factor in the success of acquiring and using Type 5 (Song, 2014). In this perspective, it is

understandable why a main effect of exposure was detected for Type 5, and why the early group learners were faster than the late group to process this type of article. The result indicates that the early group benefited from their earlier exposure to English in acquiring article Type 5. The result is in line with the argument that the learnability of articles like Type 5 is highly influenced by learners' starting age. The result further shows that the starting age effect bears out in online processing of English articles.

In short, the different processing performance between the early and the late group for article Type 2 and Type 5 reveals an important role of learners' starting age in English article processing. It suggests that the earlier the starting age is, the more fluent are the learners in processing English articles.

The second finding relates to the main effect of the acceptability condition. Data analyses from the ROI data showed that only for article Type 4 and Type 5 was there a statistically meaningful effect of the acceptability condition. More importantly, post-hoc analyses demonstrated that only the early group showed a "plausibly expected performance"—spending longer reading time for the unacceptable condition, and shorter reading time for the acceptable condition—for these two article types. An evident main effect of the acceptability condition by the early group for Type 4 and Type 5 gives an insight on the different processing of the two exposure groups.

For Type 4, both the early and the late group demonstrated the learners' sturdy sensitivity to the acceptability condition in the offline task. However, when it comes to the online task, only the early group but not the late group exhibited a sensitivity to the acceptability condition. The performance gap can be explained by the learners'

knowledge of semantic features of Type 4, noun countability in specific. As discussed earlier, choosing either *a(n)* or *no article* in article Type 4 is highly dependent on the notion of countability of the following noun. This is because Type 4 is specified with an underlying countability feature, [± count]. It is thus important to have a correct concept of noun countability to correctly use and understand the usage of article Type 4. This leads to a conjecture that the mitigated awareness of the acceptability condition in the online task by the late group is due to their uncertainty of noun countability at the instant moment. The finding that the notion of noun countability is influential in the selection of the article is not new. It has been widely reported from offline studies that a misconception or an untidy notion of noun countability is an influential factor that affects the degree of the success for second language learners of English to learn English article system (Butler, 2002; Celce-Murcia & Larsen-Freeman, 1999; T. Chung, 2009; Master, 1990; Park & Song, 2008; Snape, 2008; Yoon, 1993).

In addition to assuring the importance of a correct notion of noun countability for successful article acquisition, the current study demonstrates how this notion is differently activated and applied in article processing in real-time. The present finding particularly showed the notion difference between the early and the late group. This finding is in line with Song (2014)'s study that Korean EFL learners benefit from an early starting age for English article acquisition particularly for Type 4. It further demonstrated that the early group is more sensitive to the notion of noun countability, and thus, is more successful in processing English articles in real-time. Hence, on top of the earlier studies, the present finding demonstrates the different storing between the early and the late group through an online task of knowledge on

noun countability.

Type 5, along with Type 4, is a type of article where a statistically meaningful main effect of acceptability condition was found. More importantly, the early group but not the late group showed a longer reading time for the unacceptable condition compared to the acceptable condition. The reason that this type of article was highly influenced by starting age can be understood by the characteristic of Type 5. Type 5 is categorized as "Conventional Use", and it was explained that this type of article is item-based (Song, 2014). The observation that an item-based linguistic form is processed differently depending on the age of exposure aligns with Ullman's (2001a, 2001b, 2004) earlier account that the way language is learned before and after puberty is different. Besides, a weak sensitivity to the acceptability condition by the late group for Type 5 was already detected in the offline task. In the acceptability judgment task, no significant difference was yielded in Type 5 between the two conditions within the late group (Acceptable condition = 4.56; Unacceptable condition = 4.60). The finding is in line with a previous study by Song (2014), which reported a high negative correlation between learners' starting age and the success of performance for article Type 5. Given the data obtained from the online and the offline task, the finding collaboratively supports the suggestion that Type 5 is an article type that is highly sensitive to the age of exposure to English by Korean EFL learners.

There was also a main effect of the acceptability condition in the analyses from the data from the ROIs for Type 1 and Type 2. A statistically meaningful reading time difference was observed at the spill-over 1 region for the early group. The difference was observed in a plausibly expected way, where longer reading times

were detected for the unacceptable condition. A different reading times for the two acceptability conditions were also captured for the late group at the ROIs. A reading time difference was shown at the spill-over 2 region for Type 1 and at the critical region for Type 2. However, contrary to the early group, the statistical reading time difference was observed in a way that the acceptable condition was read longer and the unacceptable condition was read faster. Such a reverse effect by the late group calls for an explanation as it was an unexpected reading performance and an opposite behavior from the early group.

A third finding with regard to the participants' article processing concerns the interaction between the exposure group and the acceptability condition. The analyses on the reading times showed a meanigful interaction between the acceptability condition and the exposure group concerning Type 1, Type 2, Type 4, and Type 5. The interaction at first glance seems to indicate that the age of exposure affects how the participants process articles of the two acceptability conditions differently. In other words, the results show that the sensitivity to the acceptability condition is modulated by the exposure condition. This interaction effect, however, should be interpreted with caution. Since a reverse effect was observed throughout the items, the statistical analysis cannot be simply interpreted as the starting age effect. As was presented in the plotted figures in Chapter 4.2, the late group read longer for the acceptable condition. Given this reverse effect, the interaction effect cannot be simply considered as conclusive evidence for supporting the starting age effect on article processing by Korean EFL learners.

5.2 A Reverse Effect and Processability of English Articles

What is referred to as the “reverse effect” is a reading performance, in which longer reading times are cost for the acceptable condition rather than for the unacceptable condition. The effect is the opposite from the plausibly expected reading performance, where it takes longer reading time for the unacceptable condition and shorter for the acceptable condition.

As can be seen in a number of plotted figures in Chapter 4.2, a reverse effect was demonstrated among the late group. Statistical analyses on the ROIs showed that longer reading times were spent for the acceptable condition at the spill-over 2 region for Type 1, at the critical region for Type 2, and at the critical region for Type 5. At the ROI for Type 5, a post-hoc analysis also demonstrated that more reading times were spent by the late group for the acceptable condition than the unacceptable condition. Two possible accounts for this reverse effect are discussed.

One reason relates to the perception of the English article system that the late group has. Indeed, it can be assumed that a different reading performance between the two exposure groups would be accounted for by the late group’s insensitivity to English articles at the instant moment. It would be explained that the late group was not sensitive to the characteristics that articles have, and thus, may have performed differently from the early group. Nevertheless, if the performance difference was solely due to the lack of reading awareness of the article characteristic in real-time, reading times between both acceptability conditions should not have shown a statistical difference. The result in turn shows that this was not the case; instead, a reverse effect was observed. Thus, a weak sensitivity to the article characteristics by the late group cannot be born out.

Instead, a careful examination on the material used for the experiment provides an insight why a reverse effect was detected: the presence of articles. For a better understanding, the commonality between the materials of the acceptable condition is presented. A salient similarity of the acceptably conditioned items for Type 1 and Type 5 is that they have articles preceding the noun phrase. For instance, the acceptable condition for Type 1 noun phrase is *a model* and the unacceptable condition is *model* (Table 5.1). This is also the case for Type 5, where the acceptable condition is *the Plaza Hotel,* whereas the unacceptable condition is *Plaza Hotel.* The difference between the two acceptability conditions in both article types is the presence or absence of English articles. While the acceptable condition has an article preceding the noun phrase, the unacceptable condition does not. Interestingly, the reverse effect found among the late group was a reading performance where longer reading times were spent for the acceptable condition compared to the unacceptable condition. Aligning the reported reading time result from the late group with the commonality of the acceptable condition, it can be speculated that the reverse effect is highly contingent on the presence of articles in the acceptable condition. The conjecture leads to a suggestion that the reverse effect can be interpreted as a penalty that occurs when an article is present: the "article presence penalty." The penalty indicates that the presence of an article, either *a(n)* or *the*, makes the late starting age group learners spend longer reading time for the acceptable condition.

Table 5.1 A sample set of materials (Only with the target sentence)

Condition	Target sentence
Type 1 [-SR, + HK]	
Acceptable	Hannah thinks that <u>a model</u> has to be slim.

Unacceptable	Hannah thinks that model has to be slim.
Type 2 [+SR, +HK]	
Acceptable	Doctor Lee reported the state of the woman's health.
Unacceptable	Doctor Lee reported a state of the woman's health.
Type 3 [+SR, -HK]	
Acceptable	Judy gladly received presents from her close friends.
Unacceptable	Judy gladly received the presents from her close friends.
Type 4 [-SR, -HK]	
Acceptable	Olivia has been a nurse most of her life.
Unacceptable	Olivia has been the nurse most of her life.
Type 5 Conventional use	
Acceptable	Charlie stayed at the Plaza Hotel with his girlfriend.
Unacceptable	Charlie stayed at Plaza Hotel with his girlfriend.

A possible reason for the article presence penalty majorly lies in the characteristic of Korean, the participants' first language. As Korean is a language that lacks an article system, it is unlikely that an L1-transfer was in play for these Korean participants (e.g., Ionin, 2006).[12] Yet, the absence of an article system itself can be of cause and cannot be neglected as one of the factors that yields a reverse effect. As an article is a hard and an unfamiliar linguistic feature that is absent in the participants' first language, the presence of an article itself could generate a processing burden. The presence would matter in the processability of articles regardless of the acceptability condition. For instance, just as the participant encounters the article in the given item and even before moving on to the region

[12] Influence from an L1-transer would matter in a case where the tested L2 learners' first language has an article system but not when the first language lacks an article system. A performance comparison between L1-Spanish speakers, whose L1 has an article system, and L1-Russian speakers, whose L1 does not have an article system, demonstrates this observation (Ionin et al., 2008).

subsequent to the critical region where the noun phrase appears, (s)he would spend more time incorporating the unexpected linguistic feature due to the unfamiliar nature of the English article system. The “unexpectancy” and difficulty appears in a form of a penalty, which results in a reverse effect.

As was observed in the reported result, this penalty particularly applies (stronger) for the late group rather than the early group. It is then questionable why the late group but not the early group was under the influence of the article presence penalty. Given the level of English proficiency and the result from the offline acceptability judgment task, it was guaranteed that the linguistic knowledge that both groups have is comparable with regard to the English article system. Hence, the different application of the penalty can be explained by the difference between the two exposure groups. The early group consisted of Korean EFL learners whose age of exposure was comparatively early, below the age of 12. Unlike the early group, the late group was exposed to a substantial amount of input after the age of 12. The language background between the two groups was comparable in the amount of input, the length of residence abroad, and the level of English proficiency. This indicates that only different between the two groups is starting age. What can be learned from here is that knowledge on English articles are learned and stored in a different way or a different types of knowledge by the two exposure groups. The early group learners would have formed an implicit type of knowledge on English articles. The findings indicate that they are fluent in processing English articles although an article system is not present in their first language. In the meantime, the late group has explicit knowledge on the English article system. It would thus be difficult for the late group learners to apply their knowledge to article processing as automatically as

the early group learners. The presence of the article makes the late group learners spend longer time when they approach an article. The penalty particularly applies to the late but not the early group due to the difference in starting age.

The other potential cause concerns the participants' incorrect one-to-one mapping of article use and articles. In an instructional setting, Korean EFL learners are told to use *the* when a noun phrase has already been introduced in the context. The article use is taught as a one-to-one mapping that "if a noun phrase appears for the second time, use *the*." Although this rule-like explanation works well in a wide range of contexts, it has limitations in that the convention cannot apply to all cases with [the NP] form. The instructed rule can then be wrongly understood as, "if a noun is headed with *the,* the noun has at least once been introduced in the context." The simplistic but in a sense incorrect mapping is also applied to using *a(n)*. Article *a(n)* is defined just as a complementary linguistic tool for *the,* with an explanation that goes as the following: "If a noun phrase appears for the first time, use *a(n)*." The explanation on when to use *a(n)* goes further enough to misanalyse the use of *a(n)* for Korean EFL learners, positing that "if a noun is headed with *a(n),* the noun is introduced in the context for the very first time."

Although the explanations on *the* and *a(n)* provide an easy and simply applicable rule for using articles in a noun phrase, they may lead the learners to misunderstand the use of English articles. To be precise, the instructed rules can be mistakenly understood as the following: (i) "if a noun phrases is headed by *a(n),* the entity is new and uninformed to the reader or the listener, and should be considered as a purely new entity" and (ii) "if a noun phrase is headed by *the*, this is something that has already been introduced in the context, and that the reader or the listener is

cognizant of the referred entity." These misinterpretations may lead to an erroneous link between the use and the environment where articles appear.

Due to the erroneous link between the use and environment where *the* is used, Korean EFL learners would try to search for a noun phrase that was introduced in the provided context. Whenever they encounter [the NP], the learners would look for or try to recall a corresponding entity. In this respect, a longer reading time for the acceptable condition by the late group is understandable as it would be due to a searching process for a noun phrase that corefers to the [the NP], although it may have not been presented in the context material sentence.

The fallacious mapping of articles particularly explains well for the late group's performance for Type 2. While an article precedes a noun phrase in Type 2 for both the acceptability conditions, the acceptable condition is headed by *the* while the unacceptable condition is headed by *a(n)* (Table 5.1). The reading time analysis for Type 2 showed an early and instant reaction to the article by the late group, indicating that the presence of either *the* or *a(n)* affected how the late group processed articles. Relating to the erroneous mapping of articles, it can be interpreted that the late group started to search for a plausible entity that would link the [the NP] as they encountered *the.* In this sense, a longer reading time for the acceptable condition by the late group may be due to an instructed perception on *the* and *a(n).*

In short, two probable explanations on the reverse effect have been discussed. One was the article presence penalty. When the participants in the late group approach an article while reading sentence in real-time, they spend longer time to retrieve and further think about the English article system. As Korean does not have an article system as English does, the presence of an article itself can be burdensome

in processing. The other possible reason for the reverse effect was grounded on the environmental setting where the participants learned English. The English article system is taught in a one-to-one mapping in an instructional setting, where *the* refers to an already introduced discourse entity while *a(n)* indicates a new entity introduced in the discourse for the first time. Given this learning situation, it is high likely that the participants would try to seek for an entity that matches with [the NP] since *the*, in their knowledge, has to relate to another noun phrase that was presented earlier. Such mapping would have led to longer reading time even for the acceptable condition. Although both groups were instructed English in an EFL context, the effect was detected particularly among the late group. Provided that the only different between the two groups was starting age, starting age explains such performance different—the reverse effect is predominantly found among the late group.

In addition to the issue on the reverse effect, a further point of interest is the absence of main effects found for Type 3. The insignificance of the acceptability condition indicates that neither the late nor the early group was sensitive to the acceptability condition for article Type 3. Not even an interaction nor a main effect of the exposure condition was found. As to why no statistical effect was found for Type 3, second language learners' strong dependence on (their assumption of) contextual or discourse information can be of cause (Demirci, 2000).[13] Learners would rely on the contextual information rather than strictly following the semantic

[13] Although this study was not about second language learners' interpretation on English articles, it was proposed that the learners are highly dependent on discourse information when they understand the targeted language.

features of the given morphosyntacitc form.

For instance, a material used for Type 3 is as the following: "[Context sentence] Graduation ceremonies were held in February. [Target sentence] Judy gladly received presents from her close friends." The targeted noun phrase is *presents.* If this item is conditioned "unacceptable," the noun phrase in the target sentence, *presents,* should be replaced by ***the*** *presents:* "Judy gladly received the presents from her close friend." Yet, even though *the presents* is unacceptable given that the context sentence and the target sentence should function as a single context, the learners would erroneously consider *the presents* as acceptable. As "graduation ceremonies" appeared in the context sentence, the learners would assume a large context where someone gave and received some presents at the ceremony. Their over-assumption of the contextual information leads to an incorrect judgment that *the presents* is acceptable in the given item. Heavy reliance on the contextual information is not restricted to the late group; the early group is also affected by the context information just as the late group. This processing tendency was revealed by the absence of the main effect of the acceptability condition and the interaction between the acceptability and exposure condition for Type 3. Therefore, it can be interpreted that both groups depended more on their wrong interpretation of the given contextual information rather than the semantic features of the articles for Type 3.

Some might ask why the learners should be more sensitive to contextual information particularly for Type 3 and not for other types of articles. The reason can be found in the subtle semantic feature of Type 3. The subtleness is well attested in the norming study where even native speakers of English did not show a

significant contrast between the judgment on the acceptable and the unacceptable condition (Acceptable = 4.35; Unacceptable = 4.06). The lack of statistical difference between the rating scores between the two conditions implies that it is more difficult to make a clear-cut distinction for the acceptability condition for Type 3 than any other article types. Given the weak distinction made between the two conditions even among native speakers of English, it is not surprising to observe an absence of the main effect of the acceptability condition from the Korean EFL learner group for processing Type 3 articles. The lack of distinction between the two conditions resonates with early studies, which demonstrated that Type 3 is a type of article which second language learners of English have difficulty mastering (Park, 2005; Park & Song, 2008; Song, 2014). Provided the current and earlier findings, a subtle semantic feature explains the different main effect observed only for Type 3.

5.3 Performance Difference Between the Tasks

So far, both the offline and online task performance for English articles by Korean EFL learners were observed, and the findings were discussed. No prominent effect of starting age was detected in the offline task. In the online task, however, a number of analyses demonstrated that there does exist a processing difference between the two groups, and that starting age plays a critical role in Korean EFL learners' online processing of English articles. Given the results from both the offline and the online task, it is questionable why a performance difference was captured between the two tasks. There are two possible reasons.

First, the observed gap between an offline task and an online task can be

explained by Processing Deficit Approach (Jiang, 2004).[14] The approach demonstrates how performance difference was detected between two tasks within the late group but not the early group. Processing Deficit Approach posits that second language learners have an intact knowledge of the targeted language, and that they do not fail to have a full representation on the morphology. Returning to the results of the current study, the performance from the offline acceptability judgment task guarantees that the learners were fully aware of the differences between the two conditions of article use. It justifies that the learners had a sturdy representation of semantic features and linguistic environments of English articles. Although the result from the judgment task assured a full representation by the learner group, a weak sensitivity to the acceptability condition in the self-paced reading task demonstrated the learners' lack of processing ability.

The observation aligns with the argument made in Processing Deficit Approach. An insensitivity to the acceptability condition found in the online task can be understood to have derived from the learners' processing difficulty and from the failure to activate and apply their intact representation in real-time. Accordingly, the learners' different processing in the online task compared to the offline task can be attributed to the learners' "clumsy" processing, rather than a representational deficit (cf. Trenkic, 2007). In other words, the performance gap can be accounted for not by

[14] Processing Deficit Approach is also widely known as the Missing Surface Inflectional Hypothesis (Prévost & White, 2000). The approach claims that the difficulty of acquiring and using morphology by second language learners is attributed not to the deficit representation but to the unsuccessful or impossible mapping of representation to the morphology.

the failure to have a correct linguistic representation but by a processing deficit. This study explains the processing deficit by the starting age effect.

Second, from another perspective, the performance difference between the acceptability judgment task and the self-paced reading task can be explained by a task effect. While an offline task is a measurement that captures more of explicit knowledge, an online task is known to access and examine one's implicit knowledge (Gass et al., 2013). It is thus high likely that a different type of knowledge was measured from each type of task. A different performance caused by the type of the task is not new. In their study of the acquisition and use of English articles by Korean learners of English, Kim and Lakshmanan (2008) reported a different performance between an offline acceptability rating task and an online self-paced reading task. They explained that a different field of knowledge was activated in the two tasks, and that the degree of awareness was different across the tasks. Although the reason for the performance difference cannot be conclusively identified by these two explanations, either explanation demonstrates that English articles are processed and understood in a different way by Korean learners of English in an offline task and in an online task.

5.4 Summary of the Findings

In summary, the findings from the current study are as follows. First, in an offline task, starting age does not play a significant role when the learners are at a highly advanced level of English proficiency. Yet, as long as Type 5 is concerned, the group with late exposure to English would be less sensitive to the use and semantic features of English articles. Second, the starting age effect bears out in real-

time article processing. A higher sensitivity to the acceptability condition and faster reading times by the early group demonstrate that starting age is influential in the learners' online article processing. The interaction between the two conditions found in most article type further illustrates a tight relationship between starting age and the learners' online article processing.

Two interesting observations were also made. One was the reverse effect detected among the late group, where longer reading times were spent for the acceptable condition. The reverse effect was explained by (a) the article presence penalty, and (b) the learners' one-to-one mapping of articles and contextual situation which they were taught in an instructional learning setting. Another observation was the performance difference between the offline and the online task. The gap was explained by (a) Processing Deficit Approach, and (b) the task effect that activates different types of knowledge. Taken together, the findings suggest that starting age plays a crucial role in Korean EFL learners' online article processing.

Chapter 6 Conclusion

The present study aimed to answer two research questions. One goal was to examine the role of starting age of acquisition in Korean EFL learners' online processing of English articles. It was shown that the early group performed and processed English articles better compared to the late group. The current study demonstrates that learners' starting age of acquisition is a determining factor in their online article processing. Another objective of the study was to investigate how Korean EFL learners process five different types of articles depending on their starting age of acquisition. In contrast to the prediction that the starting age effect will be observed only for Type 3, Type 4, and Type 5, the effect was observed in all article types except for Type 3. Given that the absence of the starting age effect on Type 3 was due to the inherently subtle semantic feature of Type 3, the study suggests that starting age is influential in online processing of English articles.

Some implications can be drawn from the findings. First, the study verified the validity of using "starting age" in second language research conducted in an EFL context. As previously mentioned, "starting age" in the current study was different from the conventionally used meaning, which is applied to an immigrant situation. The present study used "starting age" in an instructional setting and observed its effect on processing English articles in real-time. Even so, a clear division of processing difference between the early and the late group was found. The current study verifies the validity to use "starting age" in second language acquisition research targeted to an EFL environment.

Secondly, the study presents the importance of task selection to understand

second language learners' language ability. Starting age was shown to have a weak impact on the success of acquiring English articles in the acceptability judgment task. In contrast, it was found that starting age of acquisition is influential on the processing of English articles online. The different outcome implies that different types of knowledge can be measured depending on the task. The present study demonstrates that online tasks can lead to a different observation, and that diverse aspects of the learners' language ability may be captured. Based on the findings, it is recommended to researchers to select a task that best suits the research question.

This was the first study to conduct an online task to examine the effect of second language learners' starting age on English article acquisition. Therefore, it would be interesting to observe what other previous language background affects second language learners' article processing in real-time. Moreover, using other experimental tools such as an eye-tracker will provide further insights on the role of starting age in English article acquisition and processing. As this study presented the validity of using "starting age" in an EFL context and conducted an online article processing task, the study gives a direction to future research regarding the role of starting age on the acquisition and processing of English articles by second language learners.

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Appendices

Appendix A

Materials used for the norming study and the main task

"Acc" indicates the acceptable condition; "UnAcc" indicates the unacceptable condition.

Type	Condition	Context	Target
1a	Acc	There may be some stereotypes on careers.	Hannah thinks that a model has to be slim.
1a	UnAcc	There may be some stereotypes on careers.	Hannah thinks that model has to be slim.
1a	Acc	There was a hot debate today.	Sophia said that a tomato is certainly a vegetable.
1a	UnAcc	There was a hot debate today.	Sophia said that tomato is certainly a vegetable.
1a	Acc	People have different minimum amount of calories.	Emma heard that a swimmer eats ten thousand calories.
1a	UnAcc	People have different minimum amount of calories.	Emma heard that swimmer eats ten thousand calories.
1b	Acc	We should learn more about the universe.	Astronauts say that the telescope is a marvelous tool.
1b	UnAcc	We should learn more about the universe.	Astronauts say that telescope is a marvelous tool.
1b	Acc	It is important to save endangered animals.	Rachel read that the whale is deadly dying out.
1b	UnAcc	It is important to save endangered animals.	Rachel read that whale is deadly dying out.
1b	Acc	The development of technology changed the world.	Technicians agree that the smartphone made our lives easier.
1b	UnAcc	The development of technology changed the world.	Technicians agree that smartphone made our lives easier.
1c	Acc	Most people are afraid of reptiles.	Zach trusts that snakes are easy to care for.
1c	UnAcc	Most people are afraid of reptiles.	Zach trusts that snake is easy to care for.
1c	Acc	You can learn about animals from books.	Fred read that elephants can lift seven hundred pounds.
1c	UnAcc	You can learn about animals from books.	Fred read that elephant can lift seven hundred pounds.
1c	Acc	Some wild animals are specialized at racing.	Zoologists reported that cheetahs run sixty miles per hour.
1c	UnAcc	Some wild animals are specialized at racing.	Zoologists reported that cheetah runs sixty miles per hour.

1d	Acc	Some food helps you concentrate better.	Researchers found that sugar makes the brain work.
1d	UnAcc	Some food helps you concentrate better.	Researchers found that a sugar makes the brain work.
1d	Acc	Boosting your metabolism helps you lose weight.	Experts proved that caffeine speeds up our metabolism.
1d	UnAcc	Boosting your metabolism helps you lose weight.	Experts proved that a caffeine speeds up our metabolism.
1d	Acc	A talk was given by a nutritionist yesterday.	Bart learned that salt helps muscles function better.
1d	UnAcc	A talk was given by a nutritionist yesterday.	Bart learned that a salt helps muscles function better.
2a	Acc	A lady was entering the garden.	Anna kindly opened the gate for the lady.
2a	UnAcc	A lady was entering the garden.	Anna kindly opened a gate for the lady.
2a	Acc	A gunshot heard from the neighborhood.	Arwen repeatedly knocked the door until someone came out.
2a	UnAcc	A gunshot heard from the neighborhood.	Arwen repeatedly knocked a door until someone came out.
2a	Acc	Pedestrians waited for the light to change.	You should push the button to cross the road.
2a	UnAcc	Pedestrians waited for the light to change.	You should push a button to cross the road.
2b	Acc	The last train departs in thirty minutes.	Jason rushed to the station with his three sons.
2b	UnAcc	The last train departs in thirty minutes.	Jason rushed to a station with his three sons.
2b	Acc	International flights take long to check-in.	Tina arrived at the airport three hours before departure.
2b	UnAcc	International flights take long to check-in.	Tina arrived at an airport three hours before departure.
2b	Acc	The street was already full of cars.	Kenneth headed to the garage to park his car.
2b	UnAcc	The street was already full of cars.	Kenneth headed to a garage to park his car.
2c	Acc	A red purse was on a bench.	Eva picked up the purse and looked around her.
2c	UnAcc	A red purse was on a bench.	Eva picked up a purse and looked around her.
2c	Acc	A car suddenly stopped on the road.	Sean noticed that the car had a flat tire.
2c	UnAcc	A car suddenly stopped on the road.	Sean noticed that a car had a flat tire.
2c	Acc	A boy was crying in the museum.	Tom talked to the boy to find his mother.
2c	UnAcc	A boy was crying in the museum.	Tom talked to a boy to find his mother.
2d	Acc	My family had an excellent vacation.	We agreed that the hotel had virtually flawless service.
2d	UnAcc	My family had an excellent vacation.	We agreed that a hotel had virtually flawless service.

2d	Acc	A flower shop was caught in fire.	Witnesses said that the florist lit up a candle.
2d	UnAcc	A flower shop was caught in fire.	Witnesses said that a florist lit up a candle.
2d	Acc	An American movie was awarded best prize.	Newspapers wrote that the director shed tears of happiness.
2d	UnAcc	An American movie was awarded best prize.	Newspapers wrote that a director shed tears of happiness.
2e	Acc	It is difficult to remember everything.	Thomas unfortunately forgot the number of the emergency call.
2e	UnAcc	It is difficult to remember everything.	Thomas unfortunately forgot a number of the emergency call.
2e	Acc	A woman suddenly fainted on the road.	Doctor Lee reported the state of the woman's health.
2e	UnAcc	A woman suddenly fainted on the road.	Doctor Lee reported a state of the woman's health.
2e	Acc	Meeting someone popular is not that easy.	Noah luckily met the composer of Vienna Philharmonic yesterday.
2e	UnAcc	Meeting someone popular is not that easy.	Noah luckily met a composer of Vienna Philharmonic yesterday.
2f	Acc	Students in our village love school.	Admittedly Green was the best teacher in our village.
2f	UnAcc	Students in our village love school.	Admittedly Green was a best teacher in our village.
2f	Acc	You can see Burj Khalifa in Dubai.	Burj Khalifa is the highest building in our history.
2f	UnAcc	You can see Burj Khalifa in Dubai.	Burj Khalifa is a highest building in our history.
2f	Acc	Usually a basketball player is very tall.	Harry Bates was the tallest athlete for the past decades.
2f	UnAcc	Usually a basketball player is very tall.	Harry Bates was a tallest athlete for the past decades.
3a	Acc	Tim could not sleep well last night.	Yesterday there was a girl screaming and shouting crazily.
3a	UnAcc	Tim could not sleep well last night.	Yesterday there was the girl screaming and shouting crazily.
3a	Acc	You should always handle glass safely.	Helen slowly placed a vase on her dining table.
3a	UnAcc	You should always handle glass safely.	Helen slowly placed the vase on her dining table.
3a	Acc	Professor Brown is leaving school next week.	The faculty prepared a necktie as a goodbye gift.
3a	UnAcc	Professor Brown is leaving school next week.	The faculty prepared the necktie as a goodbye gift.
3b	Acc	Graduation ceremonies were held in February.	Judy gladly received presents from her close friends.
3b	UnAcc	Graduation ceremonies were held in February.	Judy gladly received the presents from her close friends.
3b	Acc	Moving to a new place takes work.	Blair even installed cables at the living room.
3b	UnAcc	Moving to a new place takes work.	Blair even installed the cables at the living room.

3b	Acc	People sell used goods at garage sales.	Justin recently bought toys at the garage sale.
3b	UnAcc	People sell used goods at garage sales.	Justin recently bought the toys at the garage sale.
3c	Acc	Be careful when you drink something.	Clumsy Kaylee spilled milk over her favorite sofa.
3c	UnAcc	Be careful when you drink something.	Clumsy Kaylee spilled the milk over her favorite sofa.
3c	Acc	Students are busy during the semester.	Amy quickly had sandwich and headed for class.
3c	UnAcc	Students are busy during the semester.	Amy quickly had the sandwich and headed for class.
3c	Acc	You might panic if your car stops.	John called for help when his car stopped.
3c	UnAcc	You might panic if your car stops.	John called for the help when his car stopped.
4a	Acc	People find jobs that fit their personality.	Cindy's son was a lawyer in a law firm.
4a	UnAcc	People find jobs that fit their personality.	Cindy's son was the lawyer in a law firm.
4a	Acc	There was a dance audition in Paris.	Aiden's mother was a ballerina when she was little.
4a	UnAcc	There was a dance audition in Paris.	Aiden's mother was the ballerina when she was little.
4a	Acc	Some people find joy by helping others.	Olivia has been a nurse most of her life.
4a	UnAcc	Some people find joy by helping others.	Olivia has been the nurse most of her life.
4b	Acc	Richard and Ted are twin brothers.	The two are professors and both teach Spanish.
4b	UnAcc	Richard and Ted are twin brothers.	The two are the professors and both teach Spanish.
4b	Acc	Getting into college is becoming more competitive.	Judith's cousins are students at a prestigious university.
4b	UnAcc	Getting into college is becoming more competitive.	Judith's cousins are the students at a prestigious university.
4b	Acc	Some sports make athletes risk their lives.	Tyler's sons were boxers but are both hospitalized.
4b	UnAcc	Some sports make athletes risk their lives.	Tyler's sons were the boxers but are both hospitalized.
4c	Acc	A powder splattered on the ground.	The powder was flour but looked like cocaine.
4c	UnAcc	A powder splattered on the ground.	The powder was the flour but looked like cocaine.
4c	Acc	The police found an unlabeled spray.	The spray was poison that was extremely dangerous.
4c	UnAcc	The police found an unlabeled spray.	The spray was the poison that was extremely dangerous.
4c	Acc	A blogger posted the wrong recipe.	Sadly it was sugar instead of salt originally.
4c	UnAcc	A blogger posted the wrong recipe.	Sadly it was the sugar instead of salt originally.

4d	Acc	A famous actor was passing by.	Arnold looked for a pen to get an autograph.
4d	UnAcc	A famous actor was passing by.	Arnold looked for the pen to get an autograph.
4d	Acc	Try to check your mailbox every day.	Interestingly Jimmy uses a fork to open a letter.
4d	UnAcc	Try to check your mailbox every day.	Interestingly Jimmy uses the fork to open a letter.
4d	Acc	Taking notes can improve your memory.	Students must bring a notebook especially for history class.
4d	UnAcc	Taking notes can improve your memory.	Students must bring the notebook especially for history class.
4e	Acc	Many people love reading books for pleasure.	Ron will borrow books from the public library.
4e	UnAcc	Many people love reading books for pleasure.	Ron will borrow the books from the public library.
4e	Acc	Spending time with friends makes you happy.	Clare always watches movies after lunch with friends.
4e	UnAcc	Spending time with friends makes you happy.	Clare always watches the movies after lunch with friends.
4e	Acc	Some people have their own fashion style.	Jacob always wears hats regardless of the weather.
4e	UnAcc	Some people have their own fashion style.	Jacob always wears the hats regardless of the weather.
4f	Acc	Drinking alcohol can make you excited.	People love drinking wine when they party out.
4f	UnAcc	Drinking alcohol can make you excited.	People love drinking the wine when they party out.
4f	Acc	There are some fantastic food pairings.	Having chicken and beer is what Koreans enjoy.
4f	UnAcc	There are some fantastic food pairings.	Having chicken and the beer is what Koreans enjoy.
4f	Acc	Adding some ingredients makes foods savory.	Jessica often uses butter to make steak tasty.
4f	UnAcc	Adding some ingredients makes foods savory.	Jessica often uses the butter to make steak tasty.
5a	Acc	Everybody has their own daily routine.	Mark always eats breakfast while listening to music.
5a	UnAcc	Everybody has their own daily routine.	Mark always eats the breakfast while listening to music.
5a	Acc	Doing things constantly is not easy.	Steve goes to church every day including holidays.
5a	UnAcc	Doing things constantly is not easy.	Steve goes to the church every day including holidays.
5a	Acc	A follow-up appointment is very important.	Hailey goes to hospital after having a surgery.
5a	UnAcc	A follow-up appointment is very important.	Hailey goes to the hospital after having a surgery.
5b	Acc	Bring your camera when you travel.	Maggie drove to Lake Saint-Louis to take pictures.
5b	UnAcc	Bring your camera when you travel.	Maggie drove to the Lake Saint-Louis to take pictures.

5b	Acc	The way animals live is astonishing.	Birds fly over the Atlantic Ocean during the migration.
5b	UnAcc	The way animals live is astonishing.	Birds fly over Atlantic Ocean during the migration.
5b	Acc	Hiking can be boring for some people.	Luke walked along the Mississippi River for twelve days.
5b	UnAcc	Hiking can be boring for some people.	Luke walked along Mississippi River for twelve days.
5c	Acc	You can enjoy art in Washington.	Becky occasionally visits the Kennedy Center to watch shows.
5c	UnAcc	You can enjoy art in Washington.	Becky occasionally visits Kennedy Center to watch shows.
5c	Acc	There are famous hotels in New York.	Charlie stayed at the Plaza Hotel with his girlfriend.
5c	UnAcc	There are famous hotels in New York.	Charlie stayed at Plaza Hotel with his girlfriend.
5c	Acc	Most airline labor unions are inactive.	The workers at Heathrow Airport are treated well.
5c	UnAcc	Most airline labor unions are inactive.	The workers at the Heathrow Airport are treated well.
5d	Acc	An empty home makes you feel lonely.	Alex turns on the television when he arrives home.
5d	UnAcc	An empty home makes you feel lonely.	Alex turns on television when he arrives home.
5d	Acc	You can get confused about the date.	Merlin quickly checked the calendar to verify the schedule.
5d	UnAcc	You can get confused about the date.	Merlin quickly checked calendar to verify the schedule.
5d	Acc	We should keep up with current events.	Bobby will read the newspaper once he finishes work.
5d	UnAcc	We should keep up with current events.	Bobby will read newspaper once he finishes work.

Appendix B

Questionnaire for language background information

만 19세 이전에 영어권 국가 (영어를 공용어를 사용하는 곳도 포함) 에서의 거주 경험이 <u>있는</u> 경우

1. 외국에서의 거주 경험을 아래와 같이 기재해 주세요. [예시] 8-11살, 필리핀, 외국인학교 (국제학교 영어사용) / 11-12살, 미국, 미국학교
2. 외국에 거주할 때 영어와 한국어의 사용 비중은 어떠했습니까? (영어: 한국어) [예시] 필리핀 - 영어 80: 한국어 20 / 미국 - 영어 60 : 한국어 40
3. 외국에 거주하는 동안 영어 능력 향상에 가장 도움을 준 요소는 무엇인가요? 다음의 항목을 참고하여 작성해 주세요 (예: 학교, 친구, 책, TV, 라디오, 영화, 신문). 모든 거주 경험에 대해 작성해 주세요. [예시] 필리핀: 학교에서 친구들과 대화, 수업 듣기, 영어 책 읽기 / 미국: 학교 수업, 신문 읽기
4. 한국에서는 영어 어떤 방식으로 일주일에 몇 시간씩 배웠나요? 다음의 항목을 참고하여 작성해 주세요 (예: 영어유치원, 학교수업, 학원, 인터넷강의, 학습지, 책, TV, 라디오, 영화, 신문). [예시] 8-9세: 학습지 / 9-11세: 학교 수업 (일주일에 두 번 각 50분씩), 원어민 영어학원 (일주일에 두 번 두 시간씩)
5. 본인의 현재 영어 능력을 가지는 데 가장 도움이 된 것은 무엇이었나요? [예시] 미국에서 학교 다닌 것, 원어민이 진행한 학원수업

만 19세 이전에 영어권 국가 (영어를 공용어를 사용하는 곳도 포함) 에서의 거주 경험이 <u>없는</u> 경우

1. 영어 학습을 시작한 시기 (나이)는 언제인가요? [예시] 8세
2. 영어를 어떤 방식으로 일주일에 몇 시간씩 배웠나요? (예: 영어유치원, 학교수업, 학원, 학습지, 책, TV, 라디오, 영화, 신문) [예시] 8-9세: 학습지 / 9-11세: 학교 수업 (일주일에 두 번 각 50분씩), 원어민 영어학원 (일주일에 두 번 두 시간씩)
3. 본인의 현재 영어 능력을 가지는 데 가장 도움이 된 것은 무엇이었나요? [예시] 어릴 때 다녔던 영어유치원

Appendix C

Residual reading times for all regions

"Acc" indicates the acceptable condition; "UnAcc" indicates the unacceptable condition. "RRT" refers to the residual reading times.

Type	Region	Condition	Exposure	RRT
1	1	Acc	Early	77.54 (41.90)
1	1	Acc	Late	80.66 (44.45)
1	1	UnAcc	Early	112.17 (38.78)
1	1	UnAcc	Late	109.72 (46.27)
1	2	Acc	Early	-42.22 (33.21)
1	2	Acc	Late	61.82 (31.66)
1	2	UnAcc	Early	-9.90 (29.40)
1	2	UnAcc	Late	21.25 (36.05)
1	3	Acc	Early	-62.20 (26.73)
1	3	Acc	Late	-47.66 (27.21)
1	3	UnAcc	Early	-56.96 (25.23)
1	3	UnAcc	Late	-72.46 (25.93)
1	4	Acc	Early	-24.76 (42.28)
1	4	Acc	Late	8.09 (42.49)
1	4	UnAcc	Early	-4.56 (31.02)
1	4	UnAcc	Late	-29.36 (37.84)
1	5	Acc	Early	55.72 (27.22)
1	5	Acc	Late	75.75 (26.83)
1	5	UnAcc	Early	93.12 (36.39)
1	5	UnAcc	Late	49.32 (33.23)
1	6	Acc	Early	-8.88 (28.76)
1	6	Acc	Late	54.37 (27.81)
1	6	UnAcc	Early	39.82 (29.19)
1	6	UnAcc	Late	-36.59 (31.49)
1	7	Acc	Early	42.56 (26.58)
1	7	Acc	Late	29.17 (28.33)
1	7	UnAcc	Early	12.74 (28.38)
1	7	UnAcc	Late	-8.10 (30.04)
1	8	Acc	Early	-28.46 (50.59)

1	8	Acc	Late	-89.56 (59.94)
1	8	UnAcc	Early	55.20 (48.87)
1	8	UnAcc	Late	-90.63 (54.42)
1	9	Acc	Early	-137.49 (100.67)
1	9	Acc	Late	-303.49 (135.96)
1	9	UnAcc	Early	-60.37 (99.63)
1	9	UnAcc	Late	-83.33 (111.16)
2	1	Acc	Early	43.09 (27.28)
2	1	Acc	Late	94.20 (31.86)
2	1	UnAcc	Early	88.49 (32.34)
2	1	UnAcc	Late	125.02 (33.56)
2	2	Acc	Early	-61.09 (27.49)
2	2	Acc	Late	-75.27 (26.18)
2	2	UnAcc	Early	-64.29 (27.90)
2	2	UnAcc	Late	-22.92 (28.20)
2	3	Acc	Early	-76.21 (21.02)
2	3	Acc	Late	-12.18 (19.51)
2	3	UnAcc	Early	-30.12 (21.33)
2	3	UnAcc	Late	-40.75 (22.70)
2	4	Acc	Early	-56.88 (30.58)
2	4	Acc	Late	6.30 (27.13)
2	4	UnAcc	Early	-29.61 (30.84)
2	4	UnAcc	Late	-82.29 (35.54)
2	5	Acc	Early	5.95 (21.05)
2	5	Acc	Late	61.50 (21.83)
2	5	UnAcc	Early	76.88 (26.30)
2	5	UnAcc	Late	49.94 (27.01)
2	6	Acc	Early	-56.34 (19.56)
2	6	Acc	Late	-1.18 (21.39)
2	6	UnAcc	Early	-7.03 (25.12)
2	6	UnAcc	Late	-13.44 (23.43)
2	7	Acc	Early	62.32 (22.28)
2	7	Acc	Late	87.86 (22.18)
2	7	UnAcc	Early	72.57 (24.27)
2	7	UnAcc	Late	5.67 (24.92)
2	8	Acc	Early	44.70 (42.49)
2	8	Acc	Late	-0.77 (53.72)
2	8	UnAcc	Early	-88.49 (51.93)
2	8	UnAcc	Late	9.49 (51.00)
2	9	Acc	Early	-124.80 (225.18)

2	9	Acc	Late	-102.97 (238.57)
2	9	UnAcc	Early	48.66 (225.59)
2	9	UnAcc	Late	-3.40 (195.50)
3	1	Acc	Early	141.95 (40.16)
3	1	Acc	Late	103.83 (45.43)
3	1	UnAcc	Early	55.70 (33.66)
3	1	UnAcc	Late	92.17 (39.70)
3	2	Acc	Early	-105.42 (43.79)
3	2	Acc	Late	-88.98 (37.75)
3	2	UnAcc	Early	-66.69 (37.20)
3	2	UnAcc	Late	-22.53 (29.50)
3	3	Acc	Early	-83.89 (40.60)
3	3	Acc	Late	-84.31 (37.62)
3	3	UnAcc	Early	-152.40 (34.52)
3	3	UnAcc	Late	-7.89 (41.38)
3	4	Acc	Early	-19.60 (51.77)
3	4	Acc	Late	5.68 (53.23)
3	4	UnAcc	Early	-34.83 (52.73)
3	4	UnAcc	Late	-19.11 (58.43)
3	5	Acc	Early	55.68 (36.99)
3	5	Acc	Late	-3.38 (40.02)
3	5	UnAcc	Early	165.65 (37.84)
3	5	UnAcc	Late	64.03 (37.85)
3	6	Acc	Early	4.39 (28.24)
3	6	Acc	Late	-35.60 (30.48)
3	6	UnAcc	Early	-24.68 (30.03)
3	6	UnAcc	Late	10.82 (31.40)
3	7	Acc	Early	43.94 (30.97)
3	7	Acc	Late	-10.20 (30.51)
3	7	UnAcc	Early	57.04 (29.78)
3	7	UnAcc	Late	52.24 (31.31)
3	8	Acc	Early	111.10 (66.18)
3	8	Acc	Late	-36.01 (71.74)
3	8	UnAcc	Early	-85.46 (62.90)
3	8	UnAcc	Late	7.12 (57.26)
4	1	Acc	Early	40.45 (35.17)
4	1	Acc	Late	101.31 (33.35)
4	1	UnAcc	Early	110.60 (31.22)
4	1	UnAcc	Late	64.97 (35.11)
4	2	Acc	Early	-1.52 (27.91)

4	2	Acc	Late	-44.01 (27.22)
4	2	UnAcc	Early	-48.97 (28.62)
4	2	UnAcc	Late	-23.59 (24.16)
4	3	Acc	Early	-98.72 (23.70)
4	3	Acc	Late	-71.11 (21.88)
4	3	UnAcc	Early	-47.56 (22.08)
4	3	UnAcc	Late	-60.04 (24.17)
4	4	Acc	Early	-74.83 (32.10)
4	4	Acc	Late	-34.32 (31.19)
4	4	UnAcc	Early	14.57 (31.38)
4	4	UnAcc	Late	-35.54 (40.05)
4	5	Acc	Early	34.26 (25.30)
4	5	Acc	Late	40.09 (22.06)
4	5	UnAcc	Early	84.08 (24.55)
4	5	UnAcc	Late	32.80 (32.25)
4	6	Acc	Early	-40.02 (22.29)
4	6	Acc	Late	2.95 (23.19)
4	6	UnAcc	Early	19.17 (20.78)
4	6	UnAcc	Late	-6.37 (22.40)
4	7	Acc	Early	0.79 (25.62)
4	7	Acc	Late	-0.98 (22.73)
4	7	UnAcc	Early	43.49 (24.20)
4	7	UnAcc	Late	13.83 (23.40)
4	8	Acc	Early	17.06 (50.95)
4	8	Acc	Late	-5.17 (49.65)
4	8	UnAcc	Early	-25.96 (47.74)
4	8	UnAcc	Late	-153.71 (56.13)
5	1	Acc	Early	72.09 (35.06)
5	1	Acc	Late	133.35 (37.33)
5	1	UnAcc	Early	153.97 (38.22)
5	1	UnAcc	Late	135.57 (34.40)
5	2	Acc	Early	-125.51 (29.30)
5	2	Acc	Late	17.95 (31.21)
5	2	UnAcc	Early	-43.65 (29.50)
5	2	UnAcc	Late	-76.16 (31.08)
5	3	Acc	Early	-138.95 (27.36)
5	3	Acc	Late	-24.27 (25.76)
5	3	UnAcc	Early	-47.62 (31.00)
5	3	UnAcc	Late	-72.52 (23.71)
5	4	Acc	Early	-106.44 (39.90)

5	4	Acc	Late	33.31 (38.29)
5	4	UnAcc	Early	-13.84 (39.27)
5	4	UnAcc	Late	-90.72 (48.62)
5	5	Acc	Early	66.43 (31.34)
5	5	Acc	Late	120.96 (24.87)
5	5	UnAcc	Early	126.92 (28.76)
5	5	UnAcc	Late	16.49 (32.30)
5	6	Acc	Early	-42.11 (26.24)
5	6	Acc	Late	24.70 (24.56)
5	6	UnAcc	Early	1.49 (26.84)
5	6	UnAcc	Late	-28.22 (33.39)
5	7	Acc	Early	-18.47 (24.87)
5	7	Acc	Late	52.46 (22.33)
5	7	UnAcc	Early	39.96 (26.49)
5	7	UnAcc	Late	20.81 (25.95)
5	8	Acc	Early	38.21 (56.36)
5	8	Acc	Late	-76.10 (65.26)
5	8	UnAcc	Early	-36.35 (63.69)
5	8	UnAcc	Late	-107.44 (63.57)

국문 초록

한국인 제2언어 학습자의 실시간 영어 관사 처리

본 연구는 한국어 제2언어 학습자들이 어떻게 영어 관사를 실시간으로 처리하는지 알아보고자 한다. 이 연구에 두 가지 의의가 있다. 첫째, 본 연구는 영어가 따로 교육되는 상황에서 학습자의 학습 시작 나이가 영어 관사 습득에 어떤 영향을 미치는지 관찰한다. 둘째, 관사 습득에 관한 연구 분야에 있어, 영어를 제2언어로 배우는 학습자들이 관사를 어떻게 실시간으로 처리하는지에 대한 학문적 토대를 제공한다.

많은 연구들이 제2언어 학습자들이 겪는 영어 관사 체계 학습의 어려움을 다루었지만, 학습자의 학습 시작 나이의 영향을 고려하여 분석한 연구는 많지 않다(Song, 2014). 이에 따라 본 연구는 영어 관사 체계를 학습에 미치는 학습 작 나이의 영향을 살펴보고자 한다. 본 연구에서 사용하는 “학습 시작 나이”의 개념은 여태까지 사용되었던 방식과는 다르다. 이전 연구와 달리, 본 연구에서는 “학습 시작 나이”를 영어가 외국어로 사용되는 환경 (EFL) 환경에 적용하였다(Larson-Hall, 2008). 이와 더불어 제2언어 학습자들의 수행 능력을 관찰하는 방법도 여태까지의 연구에서 사용된 방식과 다르다. 본 연구에서는 이전까지 거의 사용되지 않았던 실시간 반응 수행 과제를 주어 학습자들을 관찰한다. 자기 조절 읽기 과제(self-paced reading task)를 사용하여 한국인 제2언어 영어

학습자들이 영어 관사를 어떻게 이해하고 그 관사의 의미적 특성을 어떤 식으로 실시간 처리를 하는지 살펴보고자 한다.

한국어 제2언어 학습자를 대상으로 시간 제약 없는 타당도 평가 과제 (offline acceptability judgment task)와 시간 제약이 주어지는 자기 조절 읽기 과제 (online self-paced reading task)를 실시하였다. 피실험자는 모두 최상위급 수준의 영어 실력을 지닌 학습자들로만 선정하였다. 참가자들의 학습 시작 나이를 기준으로 두 집단으로 나누었다. 이른 집단(early group)은 학습 시작 나이가 12세 미만인 사람으로, 늦은 집단(late group)은 학습 시작 나이가 12세 이상인 사람으로 구성하였다. 실험에 사용되는 문장들은 다섯 가지 영어 관사 종류로 구성되었다. 다섯 가지 관사 종류는 Huebner(1983)의 의미 바퀴(semantic wheel)를 기반으로 한 영어 관사 체계를 차용하여 설정하였다. 각 문장은 적절성 조건에 따라 “적절함” 혹은 “부적절함”의 조건으로 나뉘었다.

시간 제약 없는 과제(offline task)에서는 두 학습 시작 시기 집단이 통계적으로 유의미한 반응 차이를 보이지 않았다. 관사 종류 1에서 4까지 해당하는 모든 관사 종류에 대해 두 집단 모두 적절한 문장과 부적절한 문장을 잘 구분하였다. 관사 종류 5에 관해서는 이른 집단은 두 조건의 차이점을 잘 구별하였으나 늦은 집단은 적절히 구별하지 못했다. 두 집단 간의 과제 수행 결과 차이는 제한적인 수준으로만 관찰되었다. 따라서, 시간 제약 없는 과제에서의 결과에서는 최상위급 수준의 한국인 제2언어 학습자들이 관사 습득을 하는 데에 학습 시작 나이의 영향을 오직

제한적으로만 볼 수 있었다.

이에 반해 시간 제약 제약이 주어지는 과제에서는 두 집단 사이에 통계적으로 유의미한 차이가 관찰되었다. 분석 결과에 따르면 관사 종류 3를 제외하고 다른 모든 관사 종류에 있어서, 학습자의 학습 시작 나이와 관사 사용의 적절도 사항 간의 교호작용이 있는 것으로 드러났다. 관사 종류 3에서만 교호작용이 발견되지 않은 것은 이 관사가 지니는 미묘한 의미적 특징 때문으로 해석 가능하다. 영어 원어민을 대상으로 한 사전 연구에서도 관사 종류 3에 관해서는 적절성 판단이 까다로워진다는 결과가 보고되었고, 이것은 관사 종류 3이 지니는 의미적 미묘함을 함께 보여준다.

위의 결과와 더불어, 두 집단이 영어 관사 처리 자체에서의 차이가 있다는 것이 제시되었다. 이른 집단이 늦은 집단에 비해 읽기 속도가 빨랐는데, 이는 이른 집단이 영어 관사를 처리함에 있어 더 능숙하다는 것을 보여준다. 이외의 관찰 사항 중 하나는 늦은 집단의 읽기 양상에서 보여졌다. 그것은 부적절한 문장에서 짧은 시간이 걸리고 적절한 문장에서는 오히려 긴 시간이 걸리는, 역전 현상이었다. 이와 같은 역전 현상은 오직 늦은 집단에서만 발견되었는데, 역전 현상의 원인은 학습 시작 시기와 연결지어 설명 가능하다.

요약하자면 다음과 같다. 시간 제약 없는 과제의 결과는 학습 시작 시기의 영향을 크게 보여주지 못하지만 시간 제약이 있는 과제의 결과는 학습 시작 시기가 한국인 제2언어 학습자의 실시간 관사 처리에 영향력이

있다는 것을 입증한다. 위와 같은 결과를 토대로 본 연구에서는 한국어 제2언어 학습자가 영어 관사를 실시간으로 처리함에 있어 학습 시작 나이가 영향력 있는 요소라는 것을 주장한다.

주요어: 제2언어습득, 학습 시작 나이, 한국인 제2언어 학습자, 영어 관사 체계, 실시간 언어 이해

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