[PRE-DEFENSE DRAFT]

INTERPRETING SCOPE AMBIGUITY
IN FIRST AND SECOND LANGUAGE PROCESSING:
UNIVERSAL QUANTIFIER AND NEGATION

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CHAPTER 1
INTRODUCTION

In recent years, there has been an extensive body of research concerning scope interaction of negation and quantified noun phrases in the child language literature (Musolino, 1998; Krämer, 2000; Musolino et al, 2000; Lidz & Musolino, 2002; Gualmini, 2003, Musolino & Lidz, 2003; Sue, 2003; Musolino & Lidz, 2006, and many others). These studies of language development have been mostly concerned with children’s semantic knowledge, focusing, for example, on whether children show different interpretive preferences from those of adults, and why the differences, if any, emerge, etc. In order to capture a complete picture of the phenomena, we need to integrate the study of language acquisition with the study of sentence processing, since the latter can help to specify how the limitations of grammatical knowledge unfold in parsing procedures. Unfortunately, few studies have attempted to do this, at least within the confines of scope interpretations.

As a starting point, this dissertation takes up the issues of scope relations from an adult processing perspective, particularly addressing the question of how scope ambiguity is resolved during the process of building an interpretation of a sentence. More specifically, the current work explores this question with scopally ambiguous sentences containing a universal quantifier and negation by studying native English speakers, native Korean speakers and native Korean-speaking second language learners of English.
The sparse processing research that exists on scope relations has been concerned mostly with doubly quantified affirmative sentences in English such as the *a...every* or *every...a* pattern, and what is lacking almost entirely are studies of other types of scope ambiguity and cross-linguistic data from other languages. This motivated the present study to investigate whether the arguments in the literature can extend to a different sort of scope ambiguity involving a quantifier and negation. In addition, empirical evidence from typological variation such as English and Korean will provide a richer understanding of this phenomenon. In fact, to the best of my knowledge, no systematic study has delved into this particular scope phenomenon from a processing perspective, and the current work will represent the first documentation of these two languages regarding interpretive processing on this target construction.

Moreover, only a few studies have examined the processing of scope ambiguity by non-native speakers, and the extent to which L1 and L2 processing differ with respect to the resolution of scopal ambiguity remains open. Given that there exist interesting differences in scope interpretations between English and Korean, the topic offers an opportunity to investigate whether non-native speakers transfer semantic processing mechanisms from their first language or whether they can acquire the processing mechanisms used by native speakers of the target language.

The global aim of this dissertation is therefore twofold: (i) to determine how native speakers of English and Korean process scopally ambiguous sentences involving a universal quantifier and negation and (ii) to investigate whether non-native speakers resolve scope ambiguity in the same manner as native speakers.
In order to better understand what is happening in the processing and the acquisition of scope interpretation under investigation, two tasks were used— an off-line preference-choice task, and an on-line truth-value judgment task combined with a self-paced reading technique. Consequently, the results yielded by these methods will help not only to identify a reader’s particular scope preference in ambiguous sentences, but also to observe the locus of processing difficulty in the time course of scope ambiguity resolution.

The findings will be examined within the general theoretical framework outlined by O’Grady et al. (2008), who proposes that the nature and acquisition of scopal contrasts are best understood with reference to the operation of an efficiency-based processor. We return to the details of this approach in Chapter 2.

The structure of this dissertation is as follows. After the introduction (chapter 1), the first part will present the necessary theoretical and empirical background leading up to the current study. Chapter 2 will discuss basic scope facts in English and Korean which I will be concerned with. Then, two theoretical analyses of scope interpretation will be discussed—structure-based theory and efficiency-based processing theory. Chapter 3 will review studies on the interpretation of sentences involving negation and universally quantification, focusing on adults’ data. Chapter 4 will address general research questions.

The second part of the dissertation presents the details of the current study. A set of nine experiments will be reported in order: three off-line experiments and six on-line experiments involving three groups of subjects (native speakers of Korean, native speakers of English and non-native speakers of English). Chapter 5 will report three off-
line experiments. Chapter 6 and Chapter 7 will each present three experiments whose target construction contains a universal quantifier in subject position and object position, respectively. Finally, Chapter 8 will provide the general discussion of the results presented in previous chapters, examining what implications the current dissertation has for the investigation of scope interpretation in L1 and L2 research. Chapter 9 will conclude the dissertation.
CHAPTER 2
THEORETICAL FOUNDATIONS

This chapter provides the theoretical foundations necessary to understand the following chapters in the dissertation. It first presents the crucial aspects of scope interactions, and in particular, of scope ambiguity between negation and a universal quantifier in English. Following the discussion of English, it then describes the basic strategies for expressing sentential negation in Korean, their distributional properties and the scope facts involving negation and quantification that contrast with those of English. Next, it discusses two scope accounts in linguistic theory.

2.1 Scope facts

2.1.1 English

When a sentence includes two quantifiers or operators, it often creates scope ambiguity (Jackendoff, 1972; May, 1977; Horn, 1989, among others). To illustrate this, consider how a universal quantifier in subject position is interpreted with respect to sentential negation in (1).

(1) Every kid didn’t feed the doves in the park.
   a. $\forall x \ [\text{kid} (x) \rightarrow \neg \text{fed the doves in the park} (x)]$ (= none of the kids fed)
   b. $\neg \forall x \ [\text{kid} (x) \rightarrow \text{fed the doves in the park} (x)]$ (= not every kid fed)
According to the reading where the universally quantified noun phrase (QNP) is interpreted outside the scope of negation (every > not), the sentence means that *every kid is such that she didn’t feed the doves in the park* (1a). According to the alternative reading where the universally QNP is interpreted within the scope of negation (not > every), the sentence can be paraphrased as *not every kid fed the doves in the park* (1b).

In the traditional linguistic literature, interpretation (1a) has been named the ‘surface scope’ or ‘isomorphic’ interpretation of (1), while (1b) is referred to as the ‘inverse scope’ or ‘non-isomorphic’ interpretation of (1). This is because the scope interpretation of the elements, such as *every* and *not* in (1a), corresponds to their surface syntactic position, whereas in (1b) they are interpreted in the opposite order. In my dissertation, for expository purposes, the terms ‘full set’ interpretation and ‘partitioned set’ interpretation, which are neutral and transparent in their intended meanings, will be used to refer to the cases in (1a) and (1b) respectively.¹

Crucially, when a universally quantified NP in direct object position interacts with negation as in (2), the ambiguity seems to disappear. Here, the most natural interpretation is the partitioned set reading with negation taking scope over the quantified NP (not>every), that is, *not all the candles were lit by Cindy last night* as in (2a).

(2) Cindy didn’t light every candle last night.

a. \( \neg \forall x [candle(x) \Rightarrow Cindy\ lit(x)] \) (= Cindy lit only some candles)

¹ These two terms were borrowed from O’Grady (2008).
In this case, however, notice that the full set interpretation is also permissible given an inference referred to as a *scalar implicature* (Horn, 1989). A scalar implicature is an extension of Grice’s theory of conversational implicature, an account of how communicators are expected to conduct conversational exchanges which are cooperative, informative and relevant to the purposes of the conversation (Grice, 1989). Implicatures occur when a speaker’s use of a weak term such as *some* allows the listener to understand that the speaker has chosen not to express a stronger term such as *all*.

Let us consider in this regard example (2) above. If Cindy lit none of the candles, it follows that not all candles were lit by Cindy. Of course, the converse is not true: if Cindy lit only some of the candles, it does not follow that none of the candles were lit by her. This is because the ‘none’ reading is a subset of the ‘not every’ reading. The entailment relation between the two readings can be explained in terms of scalar implicatures. When a speaker uses a weaker interpretation (not > every), a listener is entitled to infer that a stronger reading (every > not) is not intended. This is because the listener understands that the speaker communicates as informatively as possible, by virtue of Grice’s maxim of quantity. Thus, although both interpretations are compatible with the context, the partitioned set reading is preferred because it leads to the inference that the full set reading does not hold (Musolino & Lidz, 2006).\(^2\) In fact, the every > not reading in (2) can be encoded more readily as either *Cindy didn’t light any of the candles* or *Cindy lit none of the candles*, and will be expressed as such.
To sum up, in English, when a universal quantifier interacting with negation appears in subject position, it gives rise to two possible scope assignments leading to a full set or a partitioned set interpretation. On the other hand, when a universal quantifier occurs in object position, even though the two scope interpretations are in principle possible, the partitioned set reading is pragmatically more natural. In the following section, some basic facts about Korean negation and its scope interaction with a universal quantifier will be discussed.

2.1.2 Korean

2.1.2.1 Properties of negation

Korean is syntactically a head-final language, and its basic word order for a transitive sentence is Subject-Object-Verb. Morphologically, Korean is a typical agglutinative language. As in English, two general types of negation have been discussed in the literature (Sohn, 1999): sentential negation and constituent negation. In my dissertation I am concerned only with sentential negation, which is the most common type of Korean negation. Three negative markers, an ‘don’t,’ mos ‘can’t,’ and mal ‘stop’ are used for sentential negation. I will focus only on the form of an, which generally negates an action or a state.

Interestingly, there are even certain cases in which the full set interpretation is preferred over the partitioned set reading as in the sentence, Max didn’t consider all the people who would be inconvenienced by this decision (cited in O’Grady et al. 2008s, and the example was brought by Kevin Gregg).

3 Constituent negation or lexical negation is a case where negative features are inherently contained within the constituents. For example, the forms of constituent negation for iss-ta ‘exist’ and al-ta ‘know’ are ep-ta ‘not exist’ and mola-ta ‘not know’ respectively. Also, there are some verbs which can take negative morphemes of Chinese origin such as pi, pul, mu, mol and mi, which are similar to English affixes such as im, in, dis, and de etc.
There are two distinct ways of forming sentential negation with *an* in Korean. According to researchers’ linguistic viewpoints, the two ways of forming sentential negation have been given many names such as short vs. long (Martin, 1969), pre-verbal vs. post-verbal (Cho, 1975), type I vs. type II (Yang, 1976), and simple vs. complex (Song, 1988) etc. In the current study, I simply call them short-form negation (SFN) and long-form negation (LFN). In SFN, the negative morpheme *an* is placed right before the verb, that is, preverbally, while in LFN, the nominalizer *ci* is suffixed to the verb and the negative morpheme *an*, accompanied by the auxiliary verb *ha-ta* appropriately inflected, follows it, that is, postverbally.\(^4\) For an affirmative sentence (3), two negation forms are possible as illustrated in (4) and (5).

(3) sonyen-i kwuki-lul mek-ess-ta
    boy -NOM cookie-ACC eat-PAST-DECL
    ‘The boy ate the cookie.’

(4) sonyen-i kwuki-lul an-mek-ess-ta
    boy -NOM cookie-ACC NEG-eat-PAST-DECL
    ‘The boy didn’t eat the cookie.’

(5) sonyen-i kwuki-lul mek- ci anh-ass-ta
    boy -NOM cookie-ACC eat-CI NEG do-PAST-DECL
    ‘The boy didn’t eat the cookie.’

There are distributional differences between the two types of sentence negation with respect to their compatibility with predicates (Kim 1996). An examination of these

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\(^4\) Some researchers use the *ani ha*-form of LFN, but this form is archaic. A contracted form *anh-* is more natural and commonly used in daily life. I will use the contracted form in this dissertation.
distributional differences is important in preparation for developing the experimental materials in Korean which I describe in later chapters.

A first difference involves the syllable structure of native Korean adjectival verbs with which the negative marker combines. Adjectival verbs are words that take on syntactic properties associated with both verbs and adjectives. Thus, they can occur with tense/aspect markers, as verbs do, and with degree words, as adjectives do (O’Grady 2005). It is generally agreed that all native Korean adjectival verbs can take long form negation. Short form negation, however, sounds unnatural with the adjectival verbs containing three or more syllables in the stem (Kim-Renaud, 1986; Song, 1988).

Table 1 lists some examples.

<table>
<thead>
<tr>
<th>One Syllable</th>
<th>Two Syllables</th>
<th>Three or more Syllables</th>
</tr>
</thead>
<tbody>
<tr>
<td>an chwup-ta</td>
<td>an pissa-ta</td>
<td>*an alumtap-ta</td>
</tr>
<tr>
<td>‘not cold’</td>
<td>‘not expensive’</td>
<td>‘not beautiful’</td>
</tr>
<tr>
<td>an coh-ta</td>
<td>an mukep-ta</td>
<td>*an hwullywungha-ta</td>
</tr>
<tr>
<td>‘not good’</td>
<td>‘not heavy’</td>
<td>‘not splendid’</td>
</tr>
<tr>
<td>an khu-ta</td>
<td>an telep-ta</td>
<td>*an chimchakha-ta</td>
</tr>
<tr>
<td>‘not big’</td>
<td>‘not dirty’</td>
<td>‘not calm/composed’</td>
</tr>
<tr>
<td>an cak-ta</td>
<td>an tewup-ta</td>
<td>*an pucilenha-ta</td>
</tr>
<tr>
<td>‘not small’</td>
<td>‘not warm’</td>
<td>‘not industrious’</td>
</tr>
<tr>
<td>an palk-ta</td>
<td>an etwup-ta</td>
<td>*an tachaylop-ta</td>
</tr>
<tr>
<td>‘not bright’</td>
<td>‘not dark’</td>
<td>‘not colorful’</td>
</tr>
</tbody>
</table>
In contrast to short form negation, all the predicates containing three or more syllables in their stem can naturally occur with long form negation.\(^5\)

(6) Long syllable predicates with long form negation

a. alumtap-ci anh-ta ‘not beautiful’  
b. hwullywungha-ci anh-ta ‘not splendid’  
c. chimchakha-ci-anh-ta ‘not calm/composed’  
d. pucilenha-ci-anh-ta ‘not industrious’  
e. tachaylop-ci-anh-ta ‘not colorful’  

Second, Sino-Korean verbs can always take long form negation, but short form negation is irregular when it appears before these verbs. Sino-Korean verbs are derived by attaching the auxiliary verb *ha-ta* ‘do’ to nouns of Chinese origin. Some examples are provided in the following table.

\(^5\) It is argued that some native adjectival verbs containing long syllables can allow short form negation when they are used in a contrastive environment (Kim 1996). One example is given as follows:

Ku yeca-ka alumtap-ni, an alumtap-ni?  
That-girl-NOM pretty-INT neg-pretty-INT
Table 2.
Sino-Korean Verbs with Negation Forms

<table>
<thead>
<tr>
<th>Sino-Korean Verbs</th>
<th>Short-Form Negation</th>
<th>Long-Form Negation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kongpwu-hata ‘study’</td>
<td>*an kongpwu ha-ta</td>
<td>kongpwu ha ci anh-ta</td>
</tr>
<tr>
<td>eyonsup-hata ‘practice’</td>
<td>*an-eyonsup-hata</td>
<td>eyonsup-ha ci-anh-ta</td>
</tr>
<tr>
<td>chungcen-hata ‘charge’</td>
<td>*an-chungcen-hata</td>
<td>chungcen- ha ci-anh-ta</td>
</tr>
<tr>
<td>swusen-hata ‘repair’</td>
<td>*an-swusen-hata</td>
<td>swusen- ha ci-anh-ta</td>
</tr>
<tr>
<td>cocel-hata ‘control,</td>
<td>*an-cocel-hata</td>
<td>cocel- ha ci-anh-ta</td>
</tr>
<tr>
<td>kumci-hata ‘prohibit’</td>
<td>*an-kumci-hata</td>
<td>kumci- ha ci-anh-ta</td>
</tr>
<tr>
<td><strong>TYPE II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>phikon-hata ‘be tired’</td>
<td>an-phikon-hata</td>
<td>phikon- ha ci-anh-ta</td>
</tr>
<tr>
<td>hayngpok-hata ‘be happy’</td>
<td>an-hayngpok-hata</td>
<td>hayngpok- ha ci-anh-ta</td>
</tr>
<tr>
<td>sayong-hata ‘use’</td>
<td>an-sayong-hata</td>
<td>sayong- ha ci-anh-ta</td>
</tr>
</tbody>
</table>

All the verbs in Type I and Type II are Sino-Korean verbs, but the verbs in Type I take only long form negation. A couple of Sino-Korean verbs can be used with short-form negation as shown in Type II. It has been suggested that their frequency of use in daily life is very high, and thus they behave like native Korean verbs (Kim 1996).

In sum, I have described two different forms of sentential negation in Korean (i.e., short vs. long form negation) and noted that these two negative forms show distributional differences. In general, long form negation can accommodate all the predicates while short form negation has some irregularities and restrictions. In the following section, the scope facts regarding the two forms of negation in Korean will be examined.

‘Is the girl pretty or not?'
2.1.2.2 Scope Judgments

Although the study of negation has been one of the most widely discussed topics among Korean syntacticians and semanticists, and those who have studied negation in Korean have paid much attention to its scope interaction with quantifiers, there are still unsolved issues. One controversy is whether the two negative forms are different in terms of scope. Some researchers claim that the two forms are synonymous, while others argue that they are not synonymous but semantically distinct, revealing different scope effects. The debate gets even more complicated when it comes to the grammatical position of the relevant quantifiers: subject vs. direct object.

One general agreement from the findings among researchers is that the quantifiers can take wide scope over negation regardless of the form of negation or the position of the quantifiers. However, the question of where negation takes wide scope over quantifiers seems unsettled, depending on the types of negation and/or the position of the quantifiers. Let us consider the examples which contain a universal quantifier motun ‘every’ and the two different forms of negation when the universal quantifier is in either subject or direct object position.6

(7) Universally QNP in Subject Position

a. motun sonyen-i khwukhi-lul an mek ess ta SFN
every boy-Nom cookie-Acc NEG-eat-PAST-DECL
‘Every boy didn’t eat cookies.’

---

6 Sometimes every and all are interchangeably translated to denote the universal quantifier in the literature. In this dissertation, I translate motun as every. Also, it is noted that most of Korean speakers, in colloquial speech, feel more comfortable with postnominally floating adverbial quantifiers such as ta or motwu.
One group of researchers, including Song (1982), Lee (1993), Baek (1998) and Kim (2000), among others, argue that the two types of negation behave alike in terms of scope ambiguities when the negation interacts either with a quantifier in subject position or in object position. That is, the sentences in (7) and (8) can allow both the full set interpretation and the partitioned set interpretation (SFN and LFN: every > not and not > every).

Yet, another group of researchers including Cho (1975), Han (1989), Hagstrom (2000) and Kim (2001), among others, claims that the two negation forms are not identical with respect to scope ambiguities when each interacts with a quantifier. They claim that the short negation form is not ambiguous, allowing only the full set interpretation where the quantifier has wide scope over negation (SFN: every > not), while the long negation form is ambiguous, allowing two interpretations (LFN: every > not and not > every).

However, the dissertation covers only the preominantly universal quantifier such as motun which forms a
Finally, it has been proposed that the two types of negation show different scope ambiguities with respect to the position of the quantifier. Suh (1989) argues that in the case of the short negation form interacting with a universal quantifier, the sentence is not ambiguous regardless of the position of the quantifier, allowing only the full set reading (SFN: every > not). However, in the case of long negation, the scope effects differ depending on the position of the quantifier: with a universally QNP occurring in subject position, the sentence is not ambiguous, whereas the sentence is ambiguous with a universally QNP in object position (subject QNP with LFN: every > not but object QNP with LFN: every > not and not > every). The conflicting scope judgments in the literature so far are summarized in table 3 and table 4.

Table 3.
Negation Type Effect on Scope Judgments

<table>
<thead>
<tr>
<th>Group</th>
<th>Short Form Negation (SFN)</th>
<th>Long Form Negation (LFN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Set</td>
<td>Partitioned Set</td>
</tr>
<tr>
<td></td>
<td>(every &gt; not)</td>
<td>(not &gt; every)</td>
</tr>
<tr>
<td>Group I (SFN = LFN)</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Group II (SFN ≠ LFN)</td>
<td>√</td>
<td>*</td>
</tr>
</tbody>
</table>

Group II: Cho (1975), Han (1989), Hagstrom (2000) and Kim (2001)

constituent with the noun it modifies like *every* in English.
Table 4. Negation Type Effect and Position Effect on Scope judgments (Suh 1989)

<table>
<thead>
<tr>
<th>Position of Quantifier</th>
<th>Short Form Negation (SFN)</th>
<th>Long Form Negation (LFN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Set (every &gt; not)</td>
<td>Partitioned Set (not &gt; every)</td>
</tr>
<tr>
<td>Subject</td>
<td>√</td>
<td>*</td>
</tr>
<tr>
<td>Direct Object</td>
<td>√</td>
<td>*</td>
</tr>
</tbody>
</table>

Why does this disagreement arise? Most of the research on negation and scope has focused on whether the two different forms of negation in Korean derive from a single underlying structure or from double underlying structures. The exact proposal of each linguist about the derivational structure of each negation form is beyond the scope of my dissertation. It suffices to observe that such disagreements exist. Researchers who are working on structural analyses sometimes use data based on the intuitions of a few informants. In addition, those sentences are usually presented not in discourse context but in isolation, and they are often taken from unfamiliar, formal written sources. In this respect, it is necessary to provide empirical evidence based on systematic experiments in order to draw firm conclusions regarding scope judgments in Korean.
2.2 Scope theories

This section presents a summary of two linguistic theories which account for the scope relations involving a universal quantifier and negation. The standard derivational theory by Aoun & Li (1989, 1993) is presented first. It provides the foundation on which subsequent structure-related accounts have been developed, although it addresses our target scope phenomenon only in English. Then, the processing-based theory put forward by O’Grady et al. (2008) will be discussed. This account proposes that the nature and acquisition of scopal contrasts are best understood with reference to the operation of an efficiency-based processor.

2.2.1 Structure-based Approach

The classic derivational analysis of scope ambiguity presented here is formulated within the theory of quantifier scope developed by Aoun & Li (1989, 1993). This account is set firmly within the Government and Binding (Chomsky 1981) and Barriers (Chomsky 1986) frameworks. As discussed in the previous section, sentences of English containing two or more QNPs can give rise to scope ambiguity. Consider the following example (9).

(9) A professor loves every student.
   a. \([\text{IP } a \text{ professor} \backslash \text{IP every student} \backslash \text{IP t loves t}])\]

   There is a particular professor who loves every student.
For every student, there is a different professor who loves her.

Following the standard view in generative grammar, scope is structurally defined in terms of c-command between two operators.\(^7\) Sentence (9) is ambiguous between two scope interpretations. The scope ambiguity has been attributed to movement at Logical Form (hereafter, LF) according to May (1977, 1985). The abstract LF of quantified sentences such as (9) is derived through obligatory quantifier raising (QR) (Chomsky 1976, May 1977, 1985). That is, as represented in (9a) and (9b), operators are covertly raised at LF and are adjoined to the immediate left of clausal boundaries, i.e. IP, leaving a variable in the original position.

In order to explain scope ambiguity between quantifiers, Aoun & Li propose the Scope Principle, following May (1985).

(10) The Scope Principle (Aoun & Li, 1993:88)

An operator A may have scope over an operator B iff A c-commands a member of the chain containing B.

---

\(^7\) Prior to Aoun & Li, May (1977, 1985) are considered seminal works to first argue that quantifiers mandatorily undergo covert quantifier-raising (QR) to generate the distinct scope readings of quantifiers at the level of LF. Unfortunately, May does not address the scope issue of negation in his discussion.

\(^8\) The relation of c-command is defined as follows (Chomsky, 1981):

- x c-commands y if,
  - a. the first branching node dominating x also dominates y
  - b. x does not dominate y
  - c. x \(\neq\) y
In addition, it is noted that the core cases of scope ambiguity in their proposal are explained using a chain-based theory. Chains contain the operator itself, the intermediate traces in A’-position coindexed with the operator, the variable bound by the operator, and NP-traces coindexed with the operator. This chain-based account also assumes the VP-internal subject hypothesis (Koopman & Sportiche, 1991, among others).

To see how the Scope Principle applies to scope ambiguity in a sentence containing a universal quantifier and a negator, let us consider the LF representation of the pattern in which every appears in subject position.

(11) **Every** boy did **not** eat cookies.

LF form: \([iP\ Every\ boy\ i [iP\ x\ i \ did [NegP\ not [VP\ t\ i\ eat\ cookies]]]]\)

In (11), the subject has moved from its VP internal position to a case position. In one LF, *every boy* c-commands *not*, which results in a wide scope for the universal quantifier (*every > not*), meaning that *every boy is such that he did not eat any cookies*, that is, *none of the boys ate any cookies*. In the other LF form, in contrast, *not* c-commands the NP-trace *t*, which is a member of the chain containing *every boy*, yielding a wide scope of negation (*not > every*), giving the meaning that *not every boy ate a cookie*. According to the Scope Principle (10), therefore, either the universal quantifier or the negator can take scope over the other, creating ambiguity in the sentence.
In contrast, when the universal quantifier appears in object position, the construction does not create scope ambiguity, as illustrated in (12).\(^9\)

(12) The boys did not eat every cookie.

\[
\begin{array}{c}
\text{LF form: } \\
[\text{IP The boys} \quad [\text{IP t}_i \quad \text{did} \quad [\text{NegP not} \quad [\text{VP every cookie} \quad [\text{VP t}_j \quad \text{eat} \quad t_j]]]]]
\end{array}
\]

Aoun & Li (1993) assume that the negation heads its own phrase (NegP), and that a negative operator occupies the Spec of the Neg position (Pollock, 1989; Ouhalla, 1990; Chomsky, 1991). According to their accounts, the object QNP is not raised to a position higher than the negation, due to the blocking effect of negation by the Locality Requirement. Thus, the only available interpretation in this proposal involves negation c-commanding every cookie, meaning that not every cookie was eaten by the boys (not \(\geq\) every).

Critically, the analysis used to block the quantifier wide scope reading (every \(\geq\) not) in the object QNP pattern is somewhat provisional, in the sense that not all sentences receive a fully adequate explanation. Given the right context, a full set interpretation is sometimes favored (see footnote 2 in section 2.1.1.1). In addition, as noted previously, there are situations where both not \(\geq\) every and every \(\geq\) not interpretations are possible, with respect to scalar implicature and an entailment relation (Musolino & Lidz 2006).

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\(^9\)The specific sentence which Aoun & Li illustrate to discuss the interaction of quantifiers with negation is
2.2.2 Efficiency-based Processing Approach

The key idea underlying O’Grady’s processing-based approach to scope is simply that less accessible interpretations create a heavier burden on working memory as the processor works its way through a sentence that it is attempting to interpret. Following O’Grady & Lee (2008) and O’Grady et al. (2008), I adopt two assumptions about the operations of the processor:

i. As the processor works its way through a sentence, it immediately assigns each NP an interpretation, based on available clues such as position, determiner type, case marker, context, and so forth.

ii. The revision of a previously assigned interpretation is costly since it disrupts the normal linear operation of the processor, which forms and interprets sentences in real time under conditions that value quickness.

To see the relevance of these assumptions, let us consider how O’Grady’s idea can apply to the scope interaction with which we are concerned. The example sentence with the universal quantifier every appearing in subject position is repeated here.

(13) **Every** boy didn’t eat cookies.

   a. \( \forall x \ [\text{boy}(x) \rightarrow \neg \text{ate cookies}(x)] \) (every > not)

   b. \( \neg \forall x \ [\text{boy}(x) \rightarrow \text{ate cookies}(x)] \) (not > every)

_Someone does not love everyone._
It has been recognized that the sentence yields two possible scope assignments. According to the reading where every is interpreted outside the scope of negation as in (13a), the sentence can be paraphrased as meaning none of the boys ate cookies. This corresponds to a full set interpretation. On the other hand, according to the interpretation where every is interpreted inside the scope of negation as in (13b), the sentence can mean that not every boy ate cookies. This is a partitioned set interpretation.

In O’Grady’s framework, these two interpretations have different processing cost. In the first case, the default full set interpretation is activated for every boy as soon as it is encountered. This interpretation is maintained while processing the subsequent elements of the sentence.

(14) The full set interpretation (subject-every pattern in English)

First step

Every boy

Later step

Every boy didn’t eat cookies
In the case of the partitioned set interpretation, in contrast, the full set interpretation that is initially assigned to every boy is modified after the negative not is encountered, giving the partitioned set interpretation associated with negation wide scope. O’Grady suggests that this revision of the quantified NP’s initial interpretation increases the burden on working memory since it requires the processor not only to retrieve an NP that had already been assigned an interpretation, but to dramatically modify that interpretation.10

(15) Partitioned set interpretation (subject-every pattern in English)

First step

Every boy

Later step

Every boy didn’t eat cookies

Some boys ate cookies

Other boys didn’t eat cookies

---

10 This sort of processing-based explanation is in the same spirit as the reanalysis-based account by Fodor (1982). In a sentence such as John showed a book to every student, Fodor argues that readers experience processing difficulty because they initially assign wide scope to the first quantifier a but must reanalyze the interpretation on encountering every student, realizing that their initial analysis is incongruent with
Now consider patterns such as (16), in which the universal quantifier occurs in object position.

(16) The boys didn’t eat every cookie.

Because not precedes the direct object in English, the possibility of negation wide scope (the partitioned set interpretation) is available at the point where the processor encounters the quantified NP. In contrast with what happens in the case of a negated sentence with a universally quantified subject (see above), there is no need to revise a previously assigned interpretation and there is no added processing cost.

(17) Partitioned set interpretation (object-

The boy didn’t eat every cookie

Some cookies were eaten.

Other cookies were not eaten.

Interestingly, the full set interpretation can also be derived without the need to revise a previously assigned interpretation. This is because processing-related considerations do not require the processor to assign a partitioned set interpretation to the universally quantified direct object of a negated verb—nothing prevents the assignment subsequent information.
of the full set interpretation associated with this sort of quantified phrase in other sentences.

(18) Full set interpretation (object-every pattern in English)

The boys didn’t eat every cookie.

Of course, this does not mean that the partitioned set interpretation is not preferred in this sort of pattern—it clearly is. The point is simply that it is not preferred for processing-based reasons. Rather, it is arguably favored simply because there are alternative, non-ambiguous ways to express the full set interpretation—The boys ate no cookies and The boys didn’t eat any cookies. Moreover, as noted earlier, the full set interpretation is perfectly acceptable in certain situations, including the question pattern below (brought to my attention by William O’Grady).

(19) Didn’t the boys eat every cookie?

(≠ Didn’t the boys eat any cookies? or Did the boys eat no cookies?)

Here only the full set interpretation is permitted and, crucially, this interpretation cannot be expressed by any or no – removing the usual competition for the full set reading.
Let us consider how this processing theory works with Korean. Regardless of the syntactic position of a universal quantifier, since Korean is a verb final language and negation is adjacent to the verb, the universal quantifier precedes the negative in linear order. Although there are two different types of negation (short vs. long form negation) in Korean, and there have been disagreements among linguists in regards to the scope judgments as discussed in section 2.1 of this chapter, I focus only on long form negation interacting with a universal quantifier for expository purposes. The following examples are repeated.

(20) Universal quantifier in Subject Position

\[
\text{motun} \text{ sonyen} \text{ kwukhi-lul} \text{ mek- ci} \text{ anh- ass-ta} \\
\text{every} \text{ boy} \text{-NOM} \text{ cookie-ACC} \text{ eat-CI NEG do-PAST-DECL} \\
\text{‘Every boy didn’t eat cookies.’}
\]

(21) Universal quantifier in Object Position

\[
\text{sonyen-i} \text{ motun} \text{ kwukhi-lul} \text{ mek- ci} \text{ anh- ass-ta} \\
\text{boy-Nom} \text{ every} \text{ cookie-Acc} \text{ eat-CI NEG do-PAST-DECL} \\
\text{‘The boy didn’t eat every cookie.’}
\]

In both sentences, like English, the full set interpretation where the universal quantifier takes a wide scope over negation (every > not) can be computed without any kind of backtracking. That is, whether in subject or object position, a universally quantified NP receives the default full set interpretation, which can then be maintained at no extra cost through the rest of the sentence. Although the diagrams in (22) show the computational routines for subject-\textit{motun} pattern, those for object-\textit{motun} pattern can be understood in the same manner.
(22) The full set interpretation (subject-*motun* pattern in Korean)

First step

**motun sonyen – i**
every boy

Later step

**motun sonyen-i kwukhi-lul mek-ci anh-ass-ta**
every boy -NOM cookie-ACC eat-CI NEG do-PAST-DECL

In order to derive a partitioned set interpretation where negation takes wide scope over the universal quantifier (not > every), in contrast, the previously computed full set of the interpretation for the quantified noun must be revised when the negative is encountered. This is illustrated in the following.
(24) Partitioned set interpretation (subject-*motun* pattern in Korean)

First step

\[ \text{*motun sonyen-i every boy} \]

Later step

\[ \text{*motun sonyen-i kwukhi-lul mek-ci anh-ass-ta every boy -NOM cookie-ACC eat-CI NEG do-PAST-DECL} \]

Given the efficiency assumptions, the processing based approach predicts that the full set interpretation will be easier than the partitioned set interpretation when the quantified NP precedes the negative operator, as invariably happens in Korean, and as happens in the case of universally quantified subject NPs in English.
CHAPTER 3
EMPIRICAL FOUNDATIONS

This chapter reviews some of the previous studies on L1 and L2 scope interpretation of sentences involving a universal quantifier and negation. I present the major findings for English and Korean, which are particularly relevant to our concern.

3.1 Scope interpretations in L1 acquisition

In a pioneering study, Musolino (1998) examined the acquisition of scope interpretation involving the interaction of quantifiers and negation in English, using a Truth Value Judgment Task (Crain and Thornton 1998; TVJT). The basic idea of the TVJT is that the participants make a bipolar judgment about whether a statement is true or not, based on prior context. In the typical TVJT, one experimenter performs a short story with the help of well-known toys and props, and the second experimenter animates a puppet who carefully watches the story. At the end of the story, the puppet makes a statement to describe what happened in the story, and then the participants evaluate the truth value of the statement. This method has been widely used in other acquisition research in recent years because, by providing a rich context, it can decrease the role of performance factors in accessing participants’ judgments.

Musolino tested sentences containing negation and universally quantified NPs like (1) and (2).
(1) Every horse didn’t jump over the fence.
   a. ∀x [horse (x) → ¬ jump (x, over the fence)]  (= full set interpretation)
   b. ¬∀x [horse (x) → jump (x, over the fence)]  (= partitioned set interpretation)

(2) The Smurf didn’t buy every orange.
   a. ¬∀x [orange (x) → buy (smurf, x)]  (= partitioned set interpretation)

As we have discussed in the previous chapter, sentences like (1) where a universally quantified NP occurs in the subject position of a negated clause, are scopally ambiguous between a full set and a partitioned set reading (1a and 1b, respectively). By contrast, sentences like (2) where a universally quantified NP occurs in the direct object position of a negated clause have a partitioned set interpretation as the dominant reading.

A group of university students was tested on the basis of a videotaped version of the stories. The basic plot in the trials was that out of a total of three objects (three horses in (1) and three oranges in (2)), only two were affected by the action while the remaining one was unaffected. Thus, this context should yield a value of true for the partitioned set interpretation and false for the full set interpretation.

It was found that the adult subjects could readily access both the full set and the partitioned set interpretations in (1) and the partitioned set interpretation for sentences like (2). Since this study focused on children’s comprehension of scope, adults’ data were not discussed further. In fact, there were no precise reports about how exactly adults performed in each condition, except that they accepted the partitioned set interpretation of sentences like (1) 100% of the time (ibid: 116). Moreover, we have seen that,
according to the entailment relations between the full set and the partitioned set interpretation, the sentences where universally quantified nouns appear in object position such as (2) are ambiguous (see Chapter 2). However, this study assumed that the sentences in the object-every condition are not scopally ambiguous and the quantified NP every orange must be interpreted within the scope of negation. In other words, the study considered a partitioned set reading as the “only” available interpretation, not allowing any possibility of a full set interpretation in that pattern.

Subsequent studies such as Musolino et al. (2000) and Musolino et al. (2006) also argue that adults easily have access to both the full set and the partitioned set interpretation in scopally ambiguous sentences like (1) in English. In addition, they report that adults have a strong preference for the partitioned set interpretation between the two readings in this subject-every pattern. In Musolino et al. (2000: 16), 15 adults were interviewed regarding the meanings of a sentence such as every horse didn’t jump over the fence. To 12 out of 15 it meant that not all the horses jumped over the fence; only two adults interpreted the sentence as meaning that none of the horses jumped over the fence.

Musolino et al. (2006: 841-842) reported that sentences of the form every NP didn’t VP are used to indicate the partitioned set interpretation far more than the full set interpretation in spontaneous speech, providing observations from an informal corpus study. Some of the sentences which they use to illustrate to show the ‘not all’ interpretation are presented in the following.
(3) Everybody doesn’t pay the same rent (landlords)
(4) Everyone doesn’t love a parade in the city (in the media)

However, it should be noted that many such can also be true on the full set interpretation (every > not) as well. For instance, a sentence such as everyone didn’t get on the bus can mean either that no one got on the bus or that only some of the people got on the bus. Without any clear information about the preceding or the subsequent discourse, it doesn’t seem to be conclusive that the sentences are interpreted with one particular reading. In fact, there are examples which can be understood more readily as a full set interpretation. Consider the following sentences which were found on the web.

(5) Everybody doesn’t hate you, it just feels like it.
(kemmeyer.typepad.com/less_clutter_noise/2007/09/everybody-doesn.html)

(6) What happens if everybody can’t pay back their Credit Card? Will banks stop providing credit cards?
(answers.yahoo.com/question/index?qid=20080915135604AAvlmBh)

Moving on to sentences where universally quantified nouns occur in the direct object position, Musolino et al. (2000) didn’t collect adults’ data as a control to compare with children’s data. It was found that children in their study systematically assigned sentences like Smurf didn’t buy every orange a partitioned set interpretation, 85% of the time, and Musolino et al. concluded that these findings comported well with the literature.
It seems that Musolino et al., like Musolino (1998) assumed that with this type of sentence only the partitioned set interpretation is possible, as Musolino (1998) did.

However, Musolino et al. (2006) further investigated whether the participants know that sentences involving negation and universal quantified NPs in object position can be true in a full set context, in accordance with the entailment relations. Recall that the full set interpretation (‘none’ reading) entails the partitioned set interpretation (‘not every’ reading), suggesting that the full set context satisfies the truth conditions of the partitioned set context (Horn, 1989).

Musolino et al. implemented the TVJT with a technique developed by Chierchia et al. (1998) to test the participants’ interpretation of sentences such as The Smurf didn’t buy every orange. The idea in this task is that statements are presented either as a description or as a prediction. Then, participants are asked whether the statement is correctly either described or predicted. Note that in context where the Smurf bought none of the oranges (i.e., full set context), the statement such as The Smurf didn’t buy every orange is considered to be a bad description. This is so because ‘not every’ expression is infelicitous in describing the context that satisfies the felicity conditions of ‘none’ expression. In contrast, the use of ‘not every’ in the prediction mode such as The Smurf won’t buy every orange can still be consistent within a context in which none of the oranges are purchased.

Twenty adults participated in the task. In the description mode, they rejected the test statements, 80% of the time, while in the prediction mode, they accepted the statements 82.5 % of the time. The findings thus confirm that adult native speakers of
English are sensitive to the implicature relations licensed in the two readings, and that the preferred interpretation is naturally obtained from a pragmatic point of view.

To sum up so far, the results we have reviewed invite two observations about scope interpretation in English. First, in sentences containing negation and a universal quantifier in subject position, the partitioned set interpretation is preferred (Musolino et al., 2000; Musolino et al., 2006), although both the full set and the partitioned set interpretations are readily accessible to adult comprehenders (Musolino, 1998). Second, when it comes to sentences containing negation and a universal quantifier in object position, adults strongly resort to a partitioned set interpretation, not because that is the only possible reading from a semantic point of view, but because it has pragmatic advantages over the other reading (Musolino et al., 2006).

Interestingly, a recent study by Conroy (2008) refutes the previous findings, particularly regarding sentences containing a universally quantified subject and negation. Conroy conducted a series of experiments using various tasks such as the Incremental Verification Task (IVT), the speeded force choice task etc., and interpreted the results as evidence that adults prefer the full set interpretation in the pattern.

The IVT was designed to test how a subject can evaluate her scope interpretation as a situation unfolds in case where four pictures are each hidden underneath a cup. In figure 1, when you interpret a sentence like *every dog wasn’t wearing a hat*, full set interpretation (*every > not*) requires you to wait to the last cup. In contrast, the partitioned set interpretation (*not > every*) can be verified on the first cup. On the other hand, in figure 2 full set interpretation (*every > not*) is false on the second picture where you see a
dog wearing a hat; partitioned set interpretation (not > every) is verified on the first picture again.

Figure 1. TRUE for the full set interpretation in every dog wasn't wearing a hat.

Figure 2. FALSE for the full set interpretation in every dog wasn't wearing a hat.

Conroy found that adults largely adopted the full set interpretation whereas the partitioned set interpretation was chosen only 22.9% of the time. 14 out of 22 subjects chose the full set interpretations on all trials.

\bibliographystyle{apa}

\bibliography{references}

\footnote{Conroy (2008) didn’t examine sentences containing a universally quantified noun and negation.}
A speeded force choice task yielded similar findings. One example target is provided in the following.

The farmer has pink spray paint. There is a barn that the cow lives in, and a barn that the pig lives in. It looks like the red and blue dwarves spray painted the cow’s barn, but not the green dwarf. It doesn’t look like any of the dwarves spray painted the pigs barn, so the farmer finished the job.

![Figure 3. Example of Speed Force Choice Task](image)

The participants’ task was to complete an incomplete sentence by selecting an item for either scope interpretation after they saw a picture accompanied by an auditory explanation. For example, in a sentence like Every dwarf didn’t spray paint the barn that belongs to the _______, if you follow the full set interpretation, that is, none of dwarves spray painted it, you select the picture of the pig’s barn. On the other hand, selecting the picture of the cow’s barn means that you interpret the sentence according to a partitioned set reading, that is, not every dwarf spray painted it. The task had two conditions: a speeded choice and a non-speeded choice. The responses were significantly different.
between the two conditions: participants showed the full set interpretation on 82.5% of the total trials in the speeded condition and 60% in the non-speeded condition. The most intriguing result in this experiment is that, as in IVT, the full set reading was selected more frequently than the partitioned set reading.

Taking stock, one immediate question arises. Why do Conroy’s results differ from those obtained by other studies which are concerned with the pattern of sentences involving a universally quantified noun and negation? It is generally agreed that for English-speaking adults, a sentence such as *every NP didn’t VP* is ambiguous. One line of research has come to the conclusion that the partitioned set interpretation is preferred, while other research presents experimental data whose results challenge that conclusion.

Among various factors that could be responsible for these conflicting findings, there is one crucial possibility. In the previous studies adopting the TVJT method (Musolino1998; Musolino et al. 2002 and Musolino et al. 2006), the context is configured so that the partitioned set interpretation is true. It has been noted that adults seek out an interpretation that fits into a true statement by virtue of the Principle of Charity (Grice 1975). Therefore, it is possible that a preference for the partitioned set interpretation is due to the effect of the Principle of Charity applied to this sort of task (Musolino & Lidz 2003).

In contrast, techniques such as the IVT and the speeded force choice task developed by Conroy (2008) have provided an opportunity for participants to evaluate the two interpretations in parallel, and then choose the genuinely preferred interpretation. Both tasks have shown that adults have more access to the full set interpretation.
However, the validity of these methods has not been fully established. More empirical data therefore should be provided to reach a firm conclusion about the preference issue in sentences containing a universally quantified noun and negation in English.

Turning to Korean, as discussed previously, depending on the negation type and grammatical position of a universally quantified NP, conflicting scope judgments among theoretical linguists have been reported in the literature.\textsuperscript{12} Experimental data on Korean native speakers’ scope interpretation is quite scarce. Han et al. (2007) is one of the few empirical studies.

Han et al. used the TVJT to investigate scope judgments regarding a universally quantified noun and negation in Korean. 160 adult speakers were presented a videotaped version of stories testing three factors, including scope interpretation (full set vs. partitioned set), negation type (short vs. long) and syntactic position of a universally quantified noun (subject vs. object). Twenty subjects were assigned to each of eight different conditions because the conditions were treated as a between-subjects factor.

It was found that participants accepted the full set interpretation more frequently than the partitioned set interpretation, regardless of the negation type or grammatical function of the universally quantified noun. The acceptance proportions for each condition are summarized in table 5.
Table 5
Mean Percentage of ‘True’ responses by condition (%) (Han et al. 2007:30)

<table>
<thead>
<tr>
<th>Quantifier position</th>
<th>Scope</th>
<th>Short negation</th>
<th>Long negation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>Full set (every&gt;not)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Partitioned set (not&gt;every)</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Object</td>
<td>Full set (every&gt;not)</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>Partitioned set (not&gt;every)</td>
<td>37</td>
<td>46</td>
</tr>
</tbody>
</table>

The full set interpretation is strongly preferred over the other across all conditions by most of the participants. Recall that leaving aside the confounding findings in the pattern where a universally quantified subject NP interacts with negation in English, native speakers of English exhibited a strong preference for the partitioned set interpretation in sentences where universally quantified NP occurs in object position. The experimental plot manipulated in English was identical with the one in Korean. Namely, in sentences like The Smurf didn’t buy every orange, the Smurf ended up buying only one out of three oranges. However, the preferred interpretation by native speakers of each language was manifested in the opposite way.

This contrast in judgment raises an intriguing typological question and offers us a chance to test how scope interpretation is acquired by second language learners. In the

12 Consequently, various structure-based analyses have been proposed depending on the researcher’s linguistic position. An in depth discussion about each of the different analyses would deviate from the purpose of this dissertation (for further discussion, see Kim (2001)).
next section, one experimental study which investigated this issue will be discussed, along with other general considerations in second language acquisition.

3.2 Scope interpretations in L2 acquisition

In spite of the considerable expansion of research on children’s (and adults’) interpretation of sentences containing a universally quantified NP and negation in L1 acquisition, very few studies have attempted to examine the same phenomenon in the field of second language acquisition (but see Marsden (2004), which examined the interaction between a universally quantified NP and an existentially quantified one, as in someone criticized everyone).

O’Grady et al. (2008) is one of the few quantitative, empirical studies to investigate an area that has received little attention in L2 acquisition research. Working with Korean speakers learning English as a second language, O’Grady et al. tested English sentences containing the universal quantifier all in direct object position and negation such as Tom didn’t fix all the computers. As noted in the previous section, L1 research has shown that native English speakers and native Korean speakers differ with respect to their scope preferences in the above sentence: the former preferred the partitioned set interpretation while the latter favored the full set interpretation. These crosslinguistically opposing preferences present an interesting scenario in L2 acquisition.

Forty-two native speakers of Korean, who were at the high-intermediate level for English, took part in a TVJT format. In this task, participants were simultaneously given an oral and written English version of stories that encouraged either a full set...
interpretation or a partitioned set interpretation. The stories were accompanied by a picture at the end, which summarized the entire story. Participants were then asked to judge the truth-value of the sentence within ten seconds. A Korean version of the text was administered a week after the English version. Table 6 summarizes the results.

Table 6.
Mean Percentage of ‘True’ responses in Korean and in English by native speakers of Korean: O’Grady et al. (2008)

<table>
<thead>
<tr>
<th></th>
<th>Full set interpretation</th>
<th>Partitioned set interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korean (L1)</td>
<td>97%</td>
<td>21%</td>
</tr>
<tr>
<td>English (L2)</td>
<td>93%</td>
<td>28%</td>
</tr>
</tbody>
</table>

In both Korean and English, the participants showed a strong preference for the full set interpretation over the partitioned set interpretation. For these Korean speakers who are learning English as a second language, the preferred interpretation in their L1 seems to be transferred to the second language. O’Grady et al. explain their results with reference to processing considerations.

As discussed in chapter 2, in sentences containing a universally quantified object NP and negation in Korean, the full set interpretation is processed with less cost than the

\[13\] O’Grady et al. are in the process of conducting the same sort of experiment with native speakers of English learning Korean. In their pilot study whose participants included four advanced English-speaking learners of Korean as a second language, it was found that none of the participants exhibited a preference for the partitioned set reading (not > all) in the Korean version although that reading is strongly preferred in English: two participants accepted both not > all and all > not readings, and the remaining two accepted
partitioned set interpretation. Recall that the universally quantified NP precedes negation in Korean. Thus to derive the all > not interpretation, the processing routine begins with the full set interpretation associated with the all NP, and that interpretation is maintained through the negation to the end of sentence. By contrast, the not > all interpretation requires revision of the full set interpretation upon encountering negation. In the case of English, negation precedes the all NP and thus the partitioned set interpretation of a direct object NP does not require the revision of a previously assigned interpretation. The full set interpretation in English also has a comparably low processing cost because nothing prevents the assignment of the full set interpretation associated with the all NP. Thus the results from the L2 learners suggest that the preferred interpretation in the L1 (Korean) is carried over to the L2 (English) since it has a low cost in their second language.

From a methodological point of view, this study is carefully controlled, particularly in that both a pre-made oral recording and written versions of the task were simultaneously given to the participants (English version only), unlike other existing TVJT formats. Although there has been little in-depth discussion of the effects of prosody in the field of acquisition (but see Jackendoff 1972; Horn 1989), caution should be exercised to eliminate any plausible influence of prosody in the research design. In this regard, the effects of intonation in the materials in O’Grady et al. were kept constant.

A potential problem in O’Grady’s experimental design, however, is that only a one-week interval between the two versions of the two languages was given to the same

only the all > not reading. This finding is indicative, albeit not conclusive, that the transfer per se is not a satisfactory account in this case (see further discussion in O’Grady et al. 2008).
group of participants. They first conducted the English version and then after one week, the Korean version. This is indeed an important consideration, since it reduces any contaminating possibility of L1 influence. Nevertheless, it can’t completely exclude the possibility that the test items presented in English in the prior experiment may have remained in the participants’ short-term memory within the one-week period. This may result in facilitating the processing of those test items in subsequent experiment or perhaps encourage participants consciously to stick to their prior responses. It is of course not certain that the test materials may have caused priming effects across the two tasks in O’Grady et al.’s study. However, use of a design like this becomes problematic, particularly when the number of materials including both test and filler items is relatively small.

Another problem concerns their assumption that the learners in this study are at an intermediate or a high intermediate level of proficiency. It is unclear how the assumption can be justified, given that there is no report about how the proficiency was measured and how subjects were grouped into that one proficiency level. In L2 research, of key interest is whether the learners at different levels of proficiency behave differently with respect to various phenomena.14 This study, consisting of only one level of proficiency therefore leaves open the question as to whether the observed pattern can be generalized across proficiency levels.

14 Particularly many L2 studies based on Universal Grammar (UG) are concerned with the acquisition of certain constructions across proficiency levels. The constructions are assumed to be undermined by input, by L1 knowledge and by classroom instruction. One well-known working hypothesis within the UG program is the Full transfer /Full access model (FTFA) (Schwartz and Sprouse, 1996). According to the FTFA, the initial state of L2 acquisition (i.e., low proficiency level) is constrained by the full L1 grammar (full transfer) while the final state of L2 acquisition (i.e., advanced proficiency level) is guided by UG in its entirety.
In considering these methodological concerns in my L2 experiments, although the same group of subjects participates in two versions of language (English vs. Korean) as in the O’Grady et al.’ study, the interval between the tasks will be about one month long so that it should reduce priming effects. In addition, the L2 group will be divided into more than two levels by means of an independent proficiency assessment so that comparison among different proficiency levels would be possible.

So far, the studies of scope interaction between a universal quantifier and negation in L1 and L2 acquisition have been discussed. The next chapter addresses the general research questions in the current study.
CHAPTER 4

RESEARCH QUESTIONS

As stated in the introduction, the topic of this dissertation was originally inspired by the substantial number of investigations into the acquisition of scope interpretation in L1. However, I also attempt to incorporate insights from work on processing. It is clear that the data from two lines of psycholinguistic research—language acquisition and sentence processing—can broaden the empirical basis for generalizations about scope interpretation. Unfortunately, very few studies have integrated the two, despite an increasing awareness that they have wrongly been studied independently of each other (Fodor, 1998).

My dissertation implements a self-paced reading task along with a truth-value judgment task as experimental methodology. The former technique is mostly used in the field of sentence processing and the latter in language acquisition research. By adopting the two tasks simultaneously, we can obtain a more precise picture not only of what interpretation is preferred if any, but also of how or when that interpretation is processed in real time.

In an attempt to investigate these issues, the following two general research questions are considered in the dissertation.
I. What principle guides readers in determining the preferred interpretation in scopally ambiguous sentences containing a universal quantifier (in subject position vs. object position) and negation in their native language?

II. At what points does the resolution of scope ambiguity occur in real time processing with respect to the preferred scope interpretation in a reader’s native language?

Since so little is known concerning native speakers’ processing of the scope, data from native speakers will be reported in detail. Then, using the results from native speakers as baseline data, the same questions will be explored with respect to L2 learners in order to determine whether they manifest different processing patterns from native speakers in interpreting scope. With this in mind, we now turn to the second part of this dissertation, the main experiments. Alongside these general research questions just raised, more specific research questions will be presented for each experiment.
CHAPTER 5
OFF-LINE STUDY

This chapter presents a detailed description of my off-line study, which involves three experiments by three groups of participants: native speakers of Korean (Experiment 1), native speakers of English (Experiment 2) and Korean speakers learning English as a foreign language (Experiment 3). Due to the possibility that the various individual differences may invalidate the cross-experiment comparisons particularly in L2 processing, the same group of Korean subjects took part in both the English and the Korean versions (Experiments 1 and 3). To avoid any possible priming effect of language, an interval of about four weeks separated the two experiments. Due to restrictions on the verbs which can be negated with the two types of negation in Korean, the materials were developed first in Korean and then they were modified in English by changing proper names or places, etc., so that native speakers of English would feel comfortable in understanding the contexts. The experiment involving native speakers of Korean will be reported first and the results will provide a native language baseline for assessing L2 learners’ processing behavior in Experiment 3.

15 It would be ideal for the same participants to have taken part in both offline and online experiments to see the big picture of semantic processing. However, since the materials used in off and online tasks were very similar, and it was not easy for the researcher to control two tasks with the same subjects, offline and online experiments were conducted with different participants. Nonetheless, the same group of Korean subjects participated in both the Korean and the corresponding English versions separately in offline and online experiments.
5.1 Experiment 1: Native Speakers of Korean

The following research questions are addressed in Experiment 1.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier and negation in off-line L1 Korean processing?

2. If so, does the preferred interpretation of ambiguous sentences involving a universal quantifier and negation differ with respect to the negation type (short vs. long) in off-line L1 Korean processing?

3. Does the preferred interpretation of ambiguous sentences involving a universal quantifier and negation differ with respect to the grammatical position of a universal quantifier (subject vs. object) in off-line L1 Korean processing?

Experiment 1, a questionnaire task, was designed to measure the baseline for Korean speakers’ preferred interpretation in the absence of supportive context for either scope interpretation.

5.1.1 Method

5.1.1.1 Participants

Eighty six native Korean speakers (KOR) participated in the experiment. All were undergraduate or graduate students at a university in Korea. They received either course credit or monetary compensation for their participation. Among these participants, two
were removed because their accuracy rate on filler items was below 80%, leaving eighty-four native speakers of Korean for the data analysis. Their biographic information is given in Table 7.

Table 7.
Background Information for the KOR Group (Off-line)

<table>
<thead>
<tr>
<th>KOR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( N )</td>
<td>84</td>
</tr>
<tr>
<td>( M ) Age</td>
<td>22.5</td>
</tr>
<tr>
<td>( SD )</td>
<td>2.35</td>
</tr>
<tr>
<td>Male</td>
<td>33</td>
</tr>
<tr>
<td>Female</td>
<td>51</td>
</tr>
</tbody>
</table>

5.1.1.2 Stimuli

The materials in Experiment 1 were created by carefully considering the distributional differences between the two negation forms in Korean described in chapter 2. The verbs which combined with negation were all native Korean action verbs, most of which contained one or two syllables in the stem. Accordingly, the verbs sounded natural with both short and long form negation. Four native speakers of Korean including the researcher carefully checked the naturalness of the verbs when they were negated with both short and long form negative markers.

In order to investigate the research questions addressed at the beginning of this section, four different types of sentences were tested in Experiment 1: i) universal quantifier in subject position with short negation, ii) universal quantifier in subject
position with long negation, iii) universal quantifier in object position with short negation, and iv) universal quantifier in object position with long negation. Each type of sentence was followed by two paraphrases – one implying the full set interpretation (every > not), and the other implying the partitioned set interpretation (not > every). A set of representative sentences follows:

(1) Universal Quantifier in Subject Position with Long Negation

hwacangsil-eyse motun haksaying-i son-ul ssis-ci anh-ess-ta.
restroom-at every student-Nom hand-Acc wash-CI Neg do PST-DECL
‘Every student didn’t wash her hands in the restroom.’

a. Full Set Interpretation Paraphrase (every > not)

hwacangsil-eyse amwu-to son-ul ssis-ci anh-ess-ta.
restroom-at any-TO hand-Acc wash-CI Neg do –PST-DECL
‘No students washed their hands in the restroom.’

b. Partitioned Set Interpretation Paraphrase (not > every)

hwacangsil-eyse myechmyeng-uy haksaying-man son-ul ssis-ess-ta
restroom-at some-GEN student-only hand-ACC wash
‘Only some students washed their hands in the restroom.’

(2) Universal Quantifier in Subject Position with Short Negation

hwacangsil-eyse motun haksaying-i son-ul an ssis-ess-ta.
restroom-at every student-Nom hand-Acc NEG wash–PST-DECL
‘Every female student did not wash her hands in the restroom.’
a. Full Set Interpretation Paraphrase (every > not)

hwacangsil-eyse amwu-to son-ul an ssis-ess-ta.
restroom-at any-TO hand-Acc NEG wash-PST-DECL
‘No students washed their hands in the restroom.’

b. Partitioned Set Interpretation Paraphrase (not > every)

hwacangsil-eyse myechmyeng-uy haksayng-man son-ul ssis-ess-ta
restroom-at some-GEN student-only hand-ACC wash
‘Only some students washed their hands in the restroom.’

(3) **Universal Quantifier in Object Position with Long Negation**

ecey pam Sohee-ka motun chospwul-ul khey-ci anh-ass-ta
last night Sohee-NOM every candle-ACC light-CI Neg-PST-DECL
‘Sohee did not light every candle last night’

a. Full Set Interpretation Paraphrase (every > not)

ecey pam Sohee-ka chospwul-ul han kay-TO khey-ci anh-ass-ta
last night Sohee-NOM candle-ACC one-CL-TO light-CI Neg-PST-DECL
‘Sohee did not light any candle last night.’

b. Partitioned Set Interpretation Paraphrase (not > every)

ecey pam Sohee-ka meykay-uy chospwul-man khey-ss-ta
last night Sohee-NOM some-GEN candle-only light-PST-DECL
‘Sohee lit only some candles last night.’

(4) **Universal Quantifier in Object Position with Short Negation**

ecey pam Sohee-ka motun chospwul-ul an khey-ss-ta
last night Sohee-NOM every candle-ACC NEG light-PST-DECL
‘Sohee did not light every candle last night’
In addition to the 24 ambiguous experimental items, there were 48 filler items. Each filler item also required participants to select either one of two paraphrases or one of two conflicting descriptions. The fillers consisted of 12 ambiguous sentences which showed different types of ambiguity from the experimental target items, and 36 unambiguous sentences. The 36 unambiguous sentences consisted of 12 sentences containing only negation, 12 sentences containing only a universal quantifier, and 12 sentences with neither negation nor a universal quantifier. They are illustrated in English translation in the following.

Sample of filler items

(5) Ambiguous sentence

Tony trusted Bruce more than Peter about the matter.

a. Tony trusted Bruce more than Peter trusted Bruce about the matter.

b. Tony trusted Bruce more than Tony trusted Peter about the matter.
(6) Unambiguous sentence containing only negation
Sarah never knew that the grandmother was comfortable with herself in the countryside.

a. The grandmother felt comfortable with herself in the countryside.
b. The grandmother felt comfortable with Sarah in the countryside.

(7) Unambiguous sentence containing only a universal quantifier
The detective investigated every salesman that was surfing the internet at the moment.

a. The detective was surfing the internet at the moment.
b. The salesmen were investigated by the detective.

(8) Unambiguous sentence with neither negation nor a universal quantifier
The cook heard that the grandfather who relaxed by walking a dog was very picky about food.

a. It was the grandfather who relaxed by walking a dog.
b. It was heard that the cook was very picky about food.

The order of the stimuli within the list was pseudo-randomized, and the order of presentation of the two alternative paraphrases was counterbalanced across the lists.

5.1.1.3 Procedure
The materials were printed as paper questionnaires. Participants were asked to mark one of the two options that either paraphrased or described the preceding sentence. The task was not timed. However, participants were instructed to answer spontaneously,
and to avoid deliberating too long over the answer. Also, they were requested to complete the test without interruption to the extent possible. In other words, once they had begun, they were not supposed to go back to any page that they had already answered, except at the very end in order to check that they had responded to all the questions in the test. It took no more than twenty minutes for the participants to complete the questionnaire.

5.1.1.4 Data Analysis

First, data analyses were conducted on participants’ response accuracy for the thirty six filler items which were not ambiguous. All data from participants whose comprehension task accuracy was below 80% were discarded. The following results are based on the remaining 84 participants. Their overall mean accuracy calculated from the fillers items was 87.76% (SD = 4.48), ranging from 80.5% to 94.4%. The average correct response percentage to fillers did not differ significantly across the four test lists.

5.1.2 Results

The dependent measure in Experiment 1 was the percentage of responses for either the full set interpretation or the partitioned set interpretation. As shown in table 13 and figure 4, the participants preferred the paraphrase corresponding to the full set interpretation across all four conditions.
Table 8.
Responses to Scope Interpretation (%)

<table>
<thead>
<tr>
<th></th>
<th>Subject-every</th>
<th>Object-every</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td>Full Set Interpretation</td>
<td>70.23 (19.34)</td>
<td>71.56 (20.20)</td>
</tr>
<tr>
<td>Partitioned Set Interpretation</td>
<td>29.77</td>
<td>28.44</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Figure 4. Responses to Scope Interpretation (%)

The percentage of full-set interpretation by each condition was analyzed by conducting one-sample t-tests (2-tailed) to see whether performance on the specific interpretation was significantly above the chance level of 50%, which is the established chance percentage, given that the participants had to choose between two answers. The
results indicate that the full set interpretation in the four conditions was selected above chance (t1(83)=9.87, t2(23)=11.89, p<0.0005 for Subject-every SFN condition, t1(83)=9.90, t2(23)=10.88, p<0.0005 for Subject-every LFN condition, t1(83)=5.75, t2(23)=5.71, p<0.0005 for Object-every SFN condition, and t1(83)=5.38, t2(23)=5.99, p<0.0005 for Object-every LFN condition). Six participants selected the full set interpretation above 90% for all of the items across conditions.

The proportion of the full set interpretation was entered into a repeated measures ANOVA with within-subjects factors ‘position of the universal quantifier’ (Subject vs. Object) and ‘the negation type’ (Long vs. Short). No statistical difference was found (Fs < 1).

5.1.3 Discussion

The results in Experiment 1 show that when no supporting discourse contexts were provided to facilitate the scope interpretations, the sentences containing the universal quantifier motun and negation are indeed ambiguous to native speakers of Korean, in that both the full set interpretation and the partitioned set interpretation were accessible to them. However, the full set interpretation is more readily available than the partitioned set interpretation. This may reflect that the partitioned set interpretation is simply hard to get, being consistent with a general agreement among researchers in the literature that the universal quantifier takes wide scope over negation in Korean. Although some previous studies claim that scope interpretation may differ with respect to the syntactic position of the universal quantifier (subject vs. object) or negation type
(short form vs. long form), the results don’t reveal any difference at least with this sort of a binary-scale judgment task. Rather we find a similar pattern, that is, a significantly higher preference for the full set interpretation over the partitioned set interpretation across conditions.
5.2 EXPERIMENT 2: Native Speakers of English

Experiment 2 was designed to measure a baseline for English speakers’ preferred interpretation in the absence of supportive context for either scope interpretation. The findings will be used as control data for comparison with the L2 judgments in Experiment 3. The following research questions are addressed in Experiment 2.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier and negation in off-line L1 English processing?
2. If so, how does the preferred interpretation differ with respect to the syntactic position of a universal quantifier (subject vs. object) in off-line L1 English processing?

5.2.1 Method

5.2.1.1 Participants

Thirty native speakers of English (ENG), all undergraduate or graduate students at a university in Hawaii participated in Experiment 2. The participants received either course credit or monetary compensation. None of the graduate students were linguistics students and some of undergraduate students were taking 400-level linguistics courses. Two participants who didn’t complete the questionnaires and two participants whose accuracy rate on filler items was below 80% were dropped, leaving twenty six native
speakers of English for the final data analysis in the off-line task. These participants’ biographic information is given in Table 9.

Table 9
Background Information of the ENG Group (Off-line)

<table>
<thead>
<tr>
<th></th>
<th>ENG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>26</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td><em>M</em></td>
<td>21.57</td>
</tr>
<tr>
<td><em>SD</em></td>
<td>2.02</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>11</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>Have you studied linguistics?</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
</tr>
<tr>
<td><strong>Cloze test score</strong></td>
<td></td>
</tr>
<tr>
<td><em>M</em></td>
<td>45.76</td>
</tr>
<tr>
<td><em>SD</em></td>
<td>1.79</td>
</tr>
<tr>
<td><strong>Score range</strong></td>
<td>43-49</td>
</tr>
</tbody>
</table>

*Note.* The maximum score of the cloze test was 50.

5.2.1.2 Stimuli

The stimuli in Experiment 2 were the English equivalents of the sentences from the Korean version of Experiment 1. Unlike Experiment 1, which tested the effect of both the syntactic position of the universal quantifier and the negation type in Korean, only the syntactic position of the universal quantifier was tested, resulting in two different types of test sentences: i) universal quantifier in subject position of a negated verb and ii) universal quantifier in object position of a negated verb. Each type of sentence was followed by two paraphrases, one corresponding to the full set interpretation and the
other corresponding to the partitioned set interpretation. A sample set of experimental items is provided in the following (see Appendix A for a complete list).

(1) **Universal Quantifier in Subject Position**

Every student didn’t read the books in the library.

a. Only some students read the books in the library.

b. None of the students read the books in the library.

(2) **Universal Quantifier in Object Position**

Tom didn’t solve every puzzle in the classroom.

a. Tom solved only some of the puzzles in the classroom.

b. Tom solved none of the puzzles in the classroom.

As in Experiment 1, 24 stimuli items were arranged in pseudo-random order, such that no two items of the same condition were placed adjacent to each other. They were intermixed with 48 filler items from Experiment 1. The order of presentation of the two possible answers was counterbalanced across the items.

**5.2.1.3 Procedure**

Participants first filled out a background questionnaire in which they specified their age, gender, and language background, etc. Then, participants were given paper questionnaires containing the stimuli. Participants were asked to indicate one of the two options that either paraphrased or described the preceding sentence. As in Experiment 1,
although there was no time limit, they were instructed not to take very long to answer the questionnaire. It took approximately fifteen to twenty minutes to complete the questionnaires. After the judgment task, they completed a cloze test, which took approximately fifteen minutes. The cloze test was administered in order to compare scores of the English native speakers with those of the L2 learners in Experiment 3. Thus, in this Experiment 2, the English native speakers’ cloze test scores are not further discussed, although the overall data are presented in Table 14. The cloze test and the answer key are given in the Appendix.

5.2.1.4 Data Analysis

All data from participants whose response accuracy for filler items was below 80% were discarded. In what follows, the results are based on twenty six participants. Their overall mean accuracy, calculated from the fillers items, was 91.35% (SD = 3.79), ranging from 86.1% to 97.2%. The average correct response percentage did not differ significantly across the lists.

5.2.2 Results

Table 10 shows participants’ responses (either the full set or the partitioned set interpretation) in the two different syntactic positions for the universal quantifier. In the object-every condition, readers preferred the paraphrases corresponding to the partitioned set interpretation (t1(25)=6.81, t2(23)=13.43, p<0.0005).
Table 10.
Responses to Scope Interpretation (%)

<table>
<thead>
<tr>
<th></th>
<th>Subject-every</th>
<th>Object-every</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Set Interpretation</td>
<td>55.77 (25.58)</td>
<td>6.42 (8.27)</td>
</tr>
<tr>
<td>Partitioned Set Interpretation</td>
<td>44.23</td>
<td>93.58</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Figures 5 and 6 present participants’ performance in each condition.

Figure 5. Responses to Scope Interpretation (%): subject-every condition
Figure 6. Responses to Scope Interpretation (%): object-\textit{every} condition

In the case where \textit{every} in subject position interacts with negation, the native speakers of English didn’t show any preference for either scope interpretation: the participants chose the full set interpretation 56\% of the time and chose the partitioned set interpretation 44\% of the time. Among participants, one chose the partitioned set interpretation for all of the items and two chose the full set interpretation for all of the items.

When \textit{every} appears in object position, the participants nearly always chose the partitioned set interpretation: it was selected 94\% of the time compared to only 6\% for the full set interpretation. Thirteen participants selected the partitioned set paraphrase for all of the items and fourteen items received a partitioned set interpretation from all participants. In the pattern where \textit{every} is in object position, a one-sample t-test of the
responses for the partitioned set interpretation to the expected value of 50% was significant ($t_1(25)=26.87$, $p<0.0005$; $t_2(23)=21.23$, $p=0.0005$), but not in subject-every pattern (all $p$’s > 0.1).

5.2.3 Discussion

It is important to recall that as noted in Chapter 2, the scope interaction between a universal quantifier and negation differs with respect to the grammatical position of the universal quantifier in English. When the universal quantifier every is placed in object position such as *The boy didn’t eat every cookie*, the strongly dominant interpretation is one of which the boy ate only some of the cookies, but not all of them (i.e., partitioned set interpretation: not > every).

In contrast, when the universal quantifier every appears in subject position such as *Every boy didn’t eat cookies*, the sentence is perceived to be ambiguous, allowing both the full set and the partitioned set interpretation. The question of a scope preference in this latter pattern was complicated. Some studies reported that adult speakers of English prefer the partitioned set interpretation, *not every boy is such that they eat cookies* (e.g., Musolino et al., 2000 and Musolino and Lidz, 2006). By contrast, other line of studies argued that the full set interpretation, *all of the boys failed to eat cookies*, is preferred by adult speakers of English (Conroy, 2008).

Turning back to the results of Experiment 2, for a universal quantifier in object position, adult native speakers of English had a very strong aversion to the full set interpretation but they strongly preferred the partitioned set interpretation. This result
converges with reports in the literature. However, in the case of a universal quantifier in subject position there was no bimodal distribution and the participants didn’t reveal any preference for either scope interpretation. Instead, the results make it clear that such sentences are indeed ambiguous to native speakers of English. This finding is interesting, considering the conflicting findings regarding adult scope preference for the pattern of English in the literature.

It should be noted that native English listeners expect the speaker to disambiguate through prosody, that is, by resorting to stress and intonation in order to direct the listener to the intended meaning (Jackendoff 1972; Horn 1989). However, when limited to only a written text as in the case of this experiment, a native English speaker would find it so difficult to determine the intention of the writer that he or she would require the statement to be reworded. For instance, there are clearly two alternative ways to express the two different scope interpretations for an ambiguous sentence such as every boy didn’t eat cookies: for the full set interpretation, none of the boys ate cookies and for the partitioned set interpretation, not every boy ate cookies). Native English speakers would require the original ambiguous statement to be expressed in one of these two clarifying forms. This dilemma may be reflected in the findings which do not show any consistent preference.
5.3 EXPERIMENT 3 (Korean L2 learners of English)

Experiment 3 was designed to measure the interpretive preferences for ambiguous sentences involving a universal quantifier and negation in the absence of contextual information by Korean L2 learners of English. All the methods and materials are the same as in Experiment 2. The research questions addressed in this experiment are stated below.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier and negation in off-line L2 English processing? If so, how does it differ with respect to L2 learners’ proficiency?
2. Does the preferred interpretation (if any) differ with respect to the syntactic position of the universal quantifier (subject vs. object) in off-line L2 English processing? Does it differ with respect to L2 learners’ proficiency?

5.3.1 Method

5.3.1.1 Participants

As stated in the introduction of this chapter, the same subjects participated in both Experiment 1 in Korean and Experiment 3 in English, with an interval of about four weeks between the two tasks. Ninety two Korean speakers learning English participated in the experiment. In exchange for taking part in the experiments, subjects received course credit or monetary compensation. Among these participants, five were removed because their accuracy rate on filler items was below 80%. An additional three were
removed because they didn’t complete their cloze test (Brown 1980). In total, eight subjects were omitted from the original data, leaving eighty-four subjects for the data analysis.

In Experiment 3, the L2 learner’s English proficiency was independently evaluated by using a cloze test developed by Brown (1980). Since this test has been employed by many researchers, it is considered a valid and reliable measure of English proficiency that comprehensively assesses the L2 learners' morphosyntactic and lexical knowledge.

The cloze test consists of a reading passage about the progress of mankind, with every seventh word omitted throughout the passage. The participants were asked to fill in a word for each blank and their scores were measured based on the answer key which provided all possible answers. The maximum number of correct responses on the test was 50. According to their scores, the 84 participants were grouped into three equal-sized proficiency levels: high level (High-L2), intermediate level (Inter-L2), and low level (Low-L2). The participants’ biographic information and the cloze test scores for each of the groups are given in Table 11. The data for each individual participant appears in Appendix G.
As can be seen in Table 16, most of the L2 learners started to learn English between 10 to 13 years of age, when they regularly received a couple of hours of English instruction per week at school in Korea. Table 16 also shows that more participants in the High-L2 group have studied linguistics, compared to those in the other two groups, and one of the possible reasons comes from the fact that most of these high-level participants were majoring in English language and literature at their university, which offers general linguistics classes such as syntax and semantics etc. Therefore, if the performance of the high-level L2 learners shows a native-like pattern in the resolution of scope ambiguity under investigation but the other lower two groups do not, one might conjecture that the
linguistic classes contributed to the knowledge of these high level L2 learners. However, due to the lack of any information about whether there was actually any formal instruction about scope interpretation in English, we cannot draw any conclusion at this point.

Moreover, it should be noted that the participants in the high-level group spent more time in an English environment than did the participants in the lower two proficiency groups, although there is a great deal of variation in this regard (as indicated by the high standard deviations).

5.3.1.2 Stimuli

The materials used in Experiment 3 were identical to those used in Experiment 2. Samples of the 24 experimental sentences in Experiment 2 are repeated below as (1) and (2). The 24 stimuli items were counter-balanced across two lists and interspersed between filler items, which were of the same type as in Experiment 2. The experimental sentences were pseudo-randomized (see Appendix A for a complete list).

(1) Universal Quantifier in Subject Position (Subject-every)

Every student didn’t read the books in the library.

a. Only some students read the books in the library.

b. None of the students read the books in the library.
(2) **Universal Quantifier in Object Position (Object-every)**

Tom didn’t solve every puzzle in the classroom.

a. Tom solved only some of the puzzles in the classroom.

b. Tom solved none of the puzzles in the classroom.

5.3.1.3 **Procedure**

The procedure was also identical to that of Experiment 2. The only difference is that Experiment 3 was conducted in Korea. It was informally reported that it took about 20 to 30 minutes for the L2 learners to complete the questionnaire.

5.3.2 **Data Analysis**

As in the previous two experiments, all data from participants whose comprehension task accuracy was below 80% were discarded. The remaining 84 participants’ overall mean accuracy, calculated from the fillers items, was 85.48% (SD = 4.00), ranging from 80.6% to 94.4%, which seems quite similar to the native speakers’ performance, 91.35% (SD = 3.79), ranging from 86.1% to 97.2%. The difference in the comprehension accuracy between the three proficiency group means was not statistically significant \( F(2, 81) = 2.42, p > .05 \), although the accuracy rate tended to improve slightly as proficiency levels increased. The mean for High-L2 was 86.50% \( (SD = 4.26) \), the mean for Intermediate-L2 was 85.71% \( (SD = 3.75) \), and the mean for Low-L2 was 84.22% \( (SD = 3.78) \). A repeated measures ANOVA with syntactic position of a universal quantifier (subject vs. object) as the within-subject variable and English proficiency
(Low-L2 vs. Intermediate-L2 vs. High-L2 vs. ENG control) as the between-subject variable was conducted on the responses from each subject.

5.3.3 Results

Table 1 summarizes the responses of each proficiency group on the two conditions, compared to the results by native the English control group.

Table 12.
Responses to Scope Interpretation (%): L2 groups and ENG group

<table>
<thead>
<tr>
<th>Subject-every</th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2</td>
<td>79</td>
<td>21</td>
</tr>
<tr>
<td>Inter-L2</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>High-L2</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>ENG</td>
<td>56</td>
<td>44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object-every</th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Inter-L2</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>High-L2</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>ENG</td>
<td>6</td>
<td>94</td>
</tr>
</tbody>
</table>

Figures 7 and 8 graphically present the differences between the four groups in the subject quantified condition and the object quantified condition respectively.
Figure 7. Responses to Scope Interpretation (%): subject-every condition

Figure 8. Responses to Scope Interpretation (%): object-every condition
A repeated measures ANOVA computed for participants’ responses revealed a significant main effect of syntactic position of a universal quantifier (F(1, 106) = 47.05, p< 0.0005), with all the groups selecting a full set interpretation in subject-*every* condition more often than in object-*every* condition. A significant effect of English proficiency and a significant interaction between syntactic position of *every* and group were also found (proficiency group: F(3, 106)=94.7, p< 0.0005 ; proficiency group x syntactic position of *every* (F(3, 1060=13.06, p< 0.0005). The interaction effect seems to be largely due to the native speakers, who show a strong aversion to the full set interpretation especially in the object-*every* condition (only 6% of participants selected the interpretation), compared to the three L2 learner groups (75%, 65% and 30% for Lw-L2 group, Inter-L2 group, High-L2 group respectively in the same condition). In fact, when the repeated measures ANOVA was conducted on the data from the three L2 groups only, there was a significant main effect of syntactic position of *every* (F(1, 81) = 10.367, p = 0.002) and proficiency level (F(2, 81)= 68.68, p < 0.0005), but the interaction between the syntactic position of *every* and proficiency level was not significant (F(2, 81) = 2.34, p = 0.103). Since the performance among proficiency groups differed, a Tukey’s HSD post-hoc analysis was conducted and the differences between all groups were found to be significant (all p’s < .05).

What we are more concerned about is how the proficiency groups differ from native speakers of English separately for the subject-*every* condition and the object-*every* condition. First, in the subject-*every* condition, the percentage of full-set interpretation by each group was analyzed by conducting one-sample t-tests (2-tailed) to see whether
performance on that interpretation was significantly above the chance level of 50%. This analysis had been done in the previous experiments as well, and 50% is once again the expected chance level, given that one of two answers had to be selected. L2 learners in the Low-L2 group and the Inter-L2 group performed significantly above chance level on the full-set interpretation of the subject-*every* condition (Low-L2 group: t1(27) = 8.749, p < .0005; t2(23) = 9.800, p < .001; Inter-L2 t1(27) = 5.496, p < .0005; t2(23) = 6.334, p < .0005), indicating that the Low-L2 group and the Inter-L2 group behave alike despite the differences in strength of effect, but that they behave differently from the High-L2 group as well as from the native speakers.

To compare the rate of full-set interpretation by the four levels of English proficiency, a one-way ANOVA was conducted, showing a significant effect of group (F(3,106) = 22.770, p < .0005). Table 13 shows p values for each pairwise comparison, indicating that differences between the Low-L2 group and the High-L2 group, between Low-L2 group and the English native speakers group, between the Inter-L2 group and the High-L2 group, and between the Inter-L2 and the English native speakers group were all significant. In contrast, the differences between the Low-L2 group and the Inter-L2 group, and between the High-L2 group and the English native speakers group were not significant.
Table 13.
Tukey’s HSD Post-Hoc Analyses on the Participants’ Percent Rates on Full-set Interpretation (Subject-every condition)

<table>
<thead>
<tr>
<th>Comparison</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2 - Inter-L2</td>
<td>.116</td>
</tr>
<tr>
<td>Low-L2 - High-L2</td>
<td>.000*</td>
</tr>
<tr>
<td>Low-L2 - Native Speakers</td>
<td>.000*</td>
</tr>
<tr>
<td>Inter-L2 - High-L2</td>
<td>.000*</td>
</tr>
<tr>
<td>Inter-L2 - Native Speakers</td>
<td>.000*</td>
</tr>
<tr>
<td>High-L2 - Native Speakers</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Turning to the object-every condition, the same analyses were conducted based on the rate of partitioned-set interpretation in each group. One-sample t-tests (2-tailed) showed that L2 learners in the High-L2 group and the native speakers of English group performed significantly above chance level on the partitioned-set interpretation of the object-every condition (High-L2 group: t1(27) = 6.112, p < .0005; t2(23) = 7.995, p < .0005; ENG group: t1(25) = 26.879, p < .0005; t2(23) = 21.228, p < .0005). As in the subject-every condition, overall responses for the High-L2 group was similar to those of the English control group, but differed from those of the other two groups. To compare the rate of the full-set interpretation for the four levels of English proficiency, a one-way ANOVA was conducted and there was a significant effect of group (F(3,106) = 118.129, p < .0005). Tukey’s HSD post-hoc analysis on each group indicated that except for the difference between the Low-L2 group and the Inter-L2 group, other group differences were all significant. The following table shows p values for each comparison.
Table 14.

Tukey’s HSD Post-Hoc Analyses on the Participants’ Percent Rates on the Partitioned-set Interpretation (Object-*every* condition)

<table>
<thead>
<tr>
<th>Partitioned Set Interpretation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2 - Inter-L2</td>
<td>.091</td>
</tr>
<tr>
<td>Low-L2 - High-L2</td>
<td>.000*</td>
</tr>
<tr>
<td>Low-L2 – ENG</td>
<td>.000*</td>
</tr>
<tr>
<td>Inter-L2 - High-L2</td>
<td>.000*</td>
</tr>
<tr>
<td>Inter-L2 – ENG</td>
<td>.000*</td>
</tr>
<tr>
<td>High-L2 – ENG</td>
<td>.000*</td>
</tr>
</tbody>
</table>

5.3.3 Discussion

Experiment 3 was designed to investigate how L2 learners interpret English sentences containing negation and a universal quantifier *every* in either subject position or object position when they have to choose between two possible paraphrases of the sentence without any supporting context.

Overall, L2 learners differed from native speakers of English. In the case where *every* in subject position interacts with negation, L2 learners in both the Low-L2 group and the Inter-L2 group selected the full set interpretation more often than the partitioned set interpretation, suggesting that they prefer that interpretation in the absence of contextual information. In contrast, both the High-L2 group and the native speakers of English failed to show a preferred interpretation statistically, although the full set interpretation was chosen more often than the partitioned set interpretation by the native speakers of English group, while the High-L2 group selected the partitioned set interpretation numerically more than the full set interpretation.
Matters are more interesting in the case where negation interacts with *every* in object position. Compared to the native speakers of English, who nearly always chose a partitioned set interpretation, the participants in the Low-L2 group and the Inter-L2 group showed a preference for the full-set interpretation. In contrast, the High-L2 group preferred the partitioned set interpretation, just as the native speakers of English did, although this preference was weaker in the case of the High-L2 group.

Two comments are in order here. First, the participants in the Low-L2 and the Inter-L2 who selected the full-set interpretation more often than the partitioned set interpretation, regardless of the position of *every*, seem to be transferring the preference from their L1, Korean. Recall that in Experiment 1, which was conducted in Korean with native speakers of Korean (virtually the same subjects as in Experiment 3), the full-set interpretation was chosen significantly more often than the partitioned set interpretation in both subject-*every* and object-*every* conditions. Second, the participants in the High-L2 group seem to behave in a native-like fashion in general. They didn’t show any scope preference in the subject-*every* pattern, similar to native English speakers. Moreover, in the object-*every* pattern, they preferred the partitioned set interpretation as native English speakers did. However, in the latter case, the degree of preference for this interpretation between the two groups was different, showing that native English speakers favored the interpretation more strongly than learners in the High-L2 group.

We now turn to the experiments, which were designed to explore the interpretive mechanism in real time, using a self-paced reading task combined a truth-value judgment
task. The tasks will yield online reaction time measures, which provide a precise record of a participant’s scope interpretation.
CHAPTER 6

On-line Study:
Universally Quantified Noun Phrase in Subject Position

This chapter examines the on-line comprehension of ambiguous sentences containing negation and a universal quantifier in subject position. The on-line experiments presented discourse contexts which favored either a full set interpretation or a partitioned set reading. After each context, the participants were asked to read a target sentence containing a negated verb with a universally quantified subject noun phrase, and judge whether it adequately describes the context or not. Participants’ response indicates whether they are capable of accessing the relevant interpretation. Moreover, since the reading times are measured for each ambiguous sentence, it is possible to compare reading times for the partitioned set interpreted sentences against those for the full set interpreted sentences.

Three experiments are reported in order: native speakers of Korean (Experiment 4), native speakers of English (Experiment 5), and Korean speakers learning English as a foreign language (Experiment 6). As in the off-line experiments, the same group of Korean subjects was asked to participate in both the English and the Korean versions (Experiments 4 and 6), and an interval of about four weeks separated the two experiments. What follows is the experiment with native Korean speakers.
6.1 Experiment 4: Native Speakers of Korean

As discussed in Chapter 2, it has been reported that scope interaction may vary depending on negation type in Korean. Experiment 4 systematically investigates whether there are any processing differences between the short and the long negation forms in terms of scope interpretation, all things being equal. The following research questions are addressed.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier in subject position and negation in on-line L1 Korean processing?
2. If so, how does the preferred interpretation differ with respect to the negation type (short vs. long) in on-line L1 Korean processing?
3. At what points is the potential scope ambiguity resolved in on-line L1 Korean processing?

6.1.1 Method

6.1.1.1 Participants

Forty-two native Korean subjects (KOR) participated in Experiment 4. Among these participants, two were excluded because their accuracy rate on filler items was below 80%. An additional three were excluded because they didn’t complete their cloze test. The data analysis will focus on the remaining subset of forty participants.
Their biographical information is given in Table 15.

Table 15.
Background Information for the KOR Group: Experiment 4

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>40</td>
</tr>
<tr>
<td>Age M</td>
<td>23.1</td>
</tr>
<tr>
<td>Age SD</td>
<td>2.18</td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
</tr>
</tbody>
</table>

6.1.1.2 Stimuli

Twenty-four sets of four conditions each were used in the experiment, in a 2 x 2 design, which manipulated the negation type (short vs. long) and the supporting context (full set vs. partitioned set). The basic construction of the stimulus is similar to that of the materials used in Experiment 1. However, in Experiment 4 the stimulus items were followed by contexts that supported either the full set interpretation or the partitioned set interpretation. In addition, since the current experiment measures participants’ reaction times to the target sentence, two modifications were made due to methodological considerations. First, a postpositional phrase preceded the universally quantified subject NP. Second, each of target sentences was embedded in a matrix clause in order to ensure that the potentially critical region containing negation would not overlap with the final

---

16 These two participants were omitted due to low accuracy rates on fillers in English (58.3% and 55.5%, respectively) but their comprehension accuracy for fillers in Korean was relatively low, compared to other participants (80.5% and 77.7%, respectively).
position in a sentence. Note that Korean is an SOV language with negation incorporated with the verb. The universally quantified subject NP therefore always precedes the negative operator.

The ambiguous sentences thus consisted of a postpositional phrase (Region 1), a universal quantifier (Region 2), a subject (Region 3), an object (Region 4), a negated verb (Region 5), a matrix subject (Region 6) and a matrix verb (Region 7), creating seven regions. A sample set of experimental conditions is shown in (1)-(2). The slashes here indicates the segmentation of the test items used in the presentation. A full set of materials for this experiment is provided in the Appendix.

(1) **Full set context: Every > Neg**

Three students, Suhee, Younghee and Jinhee, came into the classroom after playing outside. They looked very dirty. The teacher asked the students to wash their hands in the restroom. However, they didn’t go to the restroom, but, rather to the playground again. The teacher recorded the students’ behavior.

a. **Sentence with long form negation**

```
hwacangsil-eyse / motun / haksayng-i / son-ul / ssis ci anh-ass-ta-ko / in the restroom every student-Nom hand-Acc wash CI Neg do-PST-DECL-Comp sensayngnim-un / kirokhayssta
```

```
R1  R2  R3  R4  R5
```

teacher-Top recorded

‘The teacher recorded that every student did not wash her hands in the restroom.’

---

17 It is a well-known phenomenon that an increase in reading time occurs at the end of sentences, the so-called “wrap-up” effect (Just & Carpenter, 1980).
b. **Sentence Short form negation**

 hwacangsil-eyse / motun / haksayng-i / son-ul / an ssis-ess-ta-ko /  
 R1 R2 R3 R4 R5  
in the restroom every student hand Acc Neg wash PST DECL Comp  
sensayngnim-un / kilokhayssta  
R6 R7  
teacher Top recorded  

‘The teacher recorded that every student did not wash her hands in the restroom.’

(2) **Partitioned set context: Neg > Every** (English translation)

Three students, Suhee, Younghee and Jinhee, came into the classroom after playing outside. They looked very dirty. The teacher asked the students to wash their hands in the restroom. Suhee and Younghee went to the restroom and washed their hands, but Jinhee did not stop by the restroom, going directly to the playground again instead. The teacher recorded the students’ behavior.

a. The test sentence is the same as in (1a).

b. The test sentence is the same as in (1b).

The twenty-four sets of items were distributed among four lists in a Latin Square design. Each participant saw exactly one of the lists intermixed with forty-eight filler items in a pseudo-random order. The filler items were identical with those used in Experiment 1, except that they too were presented along with a context paragraph in Experiment 4.

**6.1.1.3 Procedure**

The experiment was administered using the psycholinguistic experiment software, SuperLab 4.0 with an RB-834 response pad (www.cedrus.com). The experimental
paradigm involved self-paced reading in a moving-window format (Just, Carpenter & Woolley, 1982) combined with a truth value judgment task.

Participants first read a short story which favored either a full set interpretation or a partitioned set interpretation, as illustrated in the previous section. The story was presented as a single chunk in the center of the computer monitor. Participants were asked to take sufficient time to understand the story. Then, a test statement appeared in a phrase-by-phrase fashion. All regions except for the one that was currently being read were covered by dashes. Participants pressed a button on the response pad to reveal each region of the statement at their own space. After finishing the end of the statement, they were told to enter their response after the prompt “Is it True or False?” appeared on the screen. They entered an answer by pressing the appropriate response key (T or F). The rationale of self-paced reading paradigm is that increased processing effect can be detected locally in slower reading times on a critical segment compared to the same segment in a counterpart condition. The judgments of truth or falsity show whether the ambiguous sentence is interpreted as indicating that the participant can access an interpretation that makes the sentence true in the context under consideration.

Before the actual experiment, a practice session with five trials was conducted with careful instructions from the researcher. When it was clear that subject understood the procedure, the actual experiment began. The participants were tested individually in a quiet room. The entire experiment lasted approximately 30 minutes.
6.1.1.4 Data Analysis

Data analysis was conducted on participants’ accuracy on filler items. Among the forty participants included in the analysis, the average comprehension accuracy was 86.45% (SD = 2.89), ranging from 80.5% to 91.6%. The average percentage of correct responses did not differ significantly across the four lists. Reading times that were more than 3 standard deviations from the mean were replaced by the mean value plus 3 times the standard deviation. This procedure was done for the ambiguous sentences and for the times needed for the interpretive judgments separately, affecting 3.4% and 3.9% of the data respectively. Then, all raw reading times for a target sentence before the truth-value judgment were transformed into residual reading times.

Raw reading times may show some noise due to the differences in subjects’ reading rates or the differences in word length within a condition. Differences in word lengths can also lead to variance in individual reading rates. In other words, it is not easy to understand factual differences between conditions if word length differs. Thus, it allows for better understanding of the data if one calculates corrected reading times after adjusting raw reading times based on word length.

Estimating residual reading times is one of the best ways to factor out the effect of length (Ferreira & Clifton, 1986). Residual reading times are calculated using a deviation from predicted scores, providing individually corrected estimates of participants’ expected reading times for the words or phrases that differ in length. A word read at average reading rate would have a residual reading time of about 0 ms, while a word that is read fast would have a negative residual reading time. A positive residual reading time
indicates that the word is read more slowly than expected.

The dependent measures included the subject’s response of true or false, the times spent for the truth-value judgment, and reading times in the course of reading the test items. A 2x2 repeated-measures ANOVA with context and negation type as within-subjects factors was performed. The data was analyzed in two ways, by subject and by item.

6.1.2 Results

Truth-value judgments

Beginning with the participants’ judgments of the ambiguous statements, the analysis revealed a significant main effect of interpretation (F1(1, 39) = 403.064, p < 0.0005; F2(1, 23) = 229.364, p < 0.0005), indicating that native Korean subjects were more likely to accept the full set reading than the partitioned set reading. There was no statistical difference between negation types (Fs < 1), and an interaction between interpretation and negation type was not significant (Fs < 1). Table 16 summarizes the proportions of the truth-value judgments by native Korean speakers.
Table 16
Mean percentages (%) of True or False responses by KOR group: Experiment 4

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td>True</td>
<td>95.00 (8.61)</td>
<td>94.17 (12.83)</td>
</tr>
<tr>
<td>False</td>
<td>5.00 (14.83)</td>
<td>5.83 (12.83)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Judgment times for the truth-value judgments

Turning to the time needed for the truth value judgment, there was a main effect of interpretation ($F_1(1, 39) = 78.169, p < 0.0005; F_2(1, 23) = 65.135, p < 0.0005$). This finding suggests that it took longer for participants to reach a judgment regarding the truth of the partitioned set interpretation (that is, they were quicker to judge the truth of the full set reading). There was no main effect of negation type ($F$s < 1), and no interaction of interpretation and negation type ($F$s < 1). See Table 17.

Table 17
Judgment times (ms) for the truth-value judgments by KOR group: Experiment 4

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td>Judgment times (ms)</td>
<td>1359 (290.39)</td>
<td>1393 (350.07)</td>
</tr>
<tr>
<td></td>
<td>2666 (1075.75)</td>
<td>2652 (821.28)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.
Note that Table 17 presents participants’ judgment times across four conditions, regardless of their actual judgment. Crucially, when the judgment times associated with the full set interpretation were compared against those for the partitioned set interpretation, the subset analysis showed a main effect of context ($F_1(1, 37) = 57.785, p < 0.0005$; $F_2(1, 19) = 61.548, p < 0.0005$). For such comparisons, there was no main effect of negation type ($F_s < 1$), and no interaction of context and negation type ($F_s < 1$). See Table 18 for judgment times contingent on only a “true” response for each condition by native Korean speakers.

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td>True</td>
<td>1317</td>
<td>1314</td>
</tr>
<tr>
<td></td>
<td>(325.76)</td>
<td>(293.48)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

**Residual reading times**

Finally, the residual reading time analysis yielded the following results. Figure 8 shows participants’ reading time profiles over the time course of the four conditions.

---

18 As shown in Table 16, the number of T responses in partitioned set readings was relatively small, as compared to that of T responses for full set interpretations. Thus this subset analysis was based on enough T responses in each condition to show a good estimate per subject and item. For subject analysis, two subjects were excluded because they rejected the partitioned set interpretations in over 80% of the trials. For item analysis, four items were excluded because the number of observations per item with T responses was too small. This exclusion procedure applied to subset analysis for the residual reading times shown in Table 19.
At all regions prior to the fifth region (i.e., negated verb), there were no significant differences among reading times across conditions (all Fs < 1). At the negated verb (Region 5), there was a significant main effect of context (F1(1, 39) = 10.27, p = 0.003; F2(1, 23) = 12.04, p = 0.002). That is, native Korean speakers read the negated verb more slowly when they assigned it the partitioned set interpretation than when they assigned it the full set interpretation. There was no significant main effect of negation type (Fs < 1). The interaction of context and negation type was not significant (Fs < 1).

A significant main effect of context was also found in the sixth region (F1(1, 39) = 43.890, p < 0.005; F2(1, 23) = 48.435, p < 0.005), and in the seventh region (F1(1, 39) = 74.587, p < 0.005; F2(1, 23) = 17.430, p < 0.005). This is presumably due to spill-over
from the slow down at the previous region. There were no other observed significant effects at the two final regions.

As in judgment times, subset analysis for residual reading times was also conducted with respect to test items that were judged to be “true” in each condition. Particularly relevant to my concern is the negated verb where participants showed a significant main effect of context above. The graph given below (Table 19) shows the mean residual reading times for the negated verb in the four conditions.

Table 19
Residual reading times (ms) for “TRUE” responses in negated verb (R5): Experiment 4

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5 (True responses)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Neg</td>
<td>61</td>
<td>188</td>
</tr>
<tr>
<td>Long Neg</td>
<td>35 (200.82)</td>
<td>137 (379.58)</td>
</tr>
<tr>
<td></td>
<td>Short Neg</td>
<td>Long Neg</td>
</tr>
<tr>
<td></td>
<td>188 (263.69)</td>
<td>137 (379.58)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Crucially, there was a main effect of context at the negated verb (F1(1, 37) = 6.103, p < 0.018; F2(1, 23) = 5.922, p < 0.025), indicating that native Korean speakers showed slower reading times in this region of sentences when the partitioned set reading is derived. No other significant effects were found.
6.1.3 Discussion

In Experiment 4, native Korean speakers were asked to judge the truth of ambiguous sentences involving the universal quantifier motun in subject position and negation. The target sentences were presented with the two supporting contexts—those that favored a full set interpretation and those that favored a partitioned set reading.

The results show that Korean subjects strongly preferred the full set interpretation, accepting the target sentence over 94% of trials in contexts that supported it. By contrast, the truth of the target sentence was accepted only around 40% of the time in context supporting the partitioned set reading. The high rates of rejection (i.e., 60%) for the partitioned set interpretation indicate that such interpretation is hard to assign despite the supporting context, as compared to the full set interpretation.

Recall that in the off-line judgment task in the previous chapter, the native Korean speakers showed a strong tendency to assign the full set interpretation to the target sentences in the absence of helpful context. In Experiment 4 where participants were given a rich discourse context, the same pattern of results was also found. Nevertheless, particularly relevant here is the fact that discourse didn’t profoundly mitigate the difficulty of the partitioned set interpretation in the on-line procedure. Rather, the difficulty of this interpretation was confirmed through the slower judgment times needed to assign the interpretation, compared to judgment times needed to assign the full set reading.

Moreover, the residual reading times for the ambiguous sentence showed that the native Korean speakers read the target sentence more slowly, particularly at the negated
verb when they assigned it the partitioned set interpretation. The slow down at this point suggests that subjects start to integrate the partitioned set interpretation upon encountering the negated verb.

One final note to mention is that none of the above effects involving scope judgments and reading times for the ambiguous sentence differed with respect to the two negation forms (i.e., short vs. long). Such findings replicate the results of the off-line task, suggesting that any variation of scope judgments regarding the two types of negation in the literature may derive from the artifact of data collection and need to be reconsidered.

Taken together, the results in Experiment 4 demonstrate that the on-line truth value judgment and comprehension of an ambiguous sentence containing a universally quantified subject NP and negation in Korean give rise to processing difficulty in the partitioned set interpretation rather than in the full set interpretation. The point where the dispreferred partitioned set interpretation is calculated against the preceding context was the negated verb, i.e., the second operator in the target sentence, which is marked with slow reading times.
6.2 Experiment 5: Native Speakers of English

Experiment 5 investigated native English speakers’ scope interpretation in real time. As in Experiment 4, an ambiguous sentence containing a universally quantified NP in subject position and negation was presented after a context that favored either the full set interpretation or the partitioned set interpretation. The findings will be used as control data to compare with the L2 data in Experiment 6. The following research questions are addressed in Experiment 5.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier in subject position and negation in on-line L1 English processing?
2. At what points is the potential scope ambiguity resolved in on-line L1 English processing?

6.2.1 Method

6.2.1.1 Participants

Twenty-seven native speakers of English (ENG), all undergraduate students at a university in Hawaii participated in Experiment 5. The participants received either course credit or monetary compensation. Three participants whose accuracy rate on filler items was below 80% were removed, leaving twenty-four native speakers of English for the final data analysis. These participants’ biographical information is given in Table 20.
Table 20
Background Information for the ENG Group: Experiment 5

<table>
<thead>
<tr>
<th></th>
<th>ENG</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 21.41</td>
</tr>
<tr>
<td></td>
<td>SD 1.88</td>
</tr>
<tr>
<td>Male</td>
<td>9</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
</tr>
<tr>
<td>Have you studied linguistics?</td>
<td>Yes 19</td>
</tr>
<tr>
<td></td>
<td>No  5</td>
</tr>
<tr>
<td>Cloze test score</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 45.58</td>
</tr>
<tr>
<td></td>
<td>SD 1.64</td>
</tr>
<tr>
<td>Score range</td>
<td>43-48</td>
</tr>
</tbody>
</table>

*Note.* The maximum score for the cloze test was 50.

6.2.1.2 Stimuli

The stimulus in Experiment 5 was mostly the same as in Experiment 4, except that test items and contexts appeared in English. Another difference was that Experiment 5 manipulated only context (full set vs. partitioned set). The experiment thus created two conditions, each condition testing for the full set interpretation or the partitioned set reading in sentences containing a universally quantified subject NP and negation. The test items were divided into six regions: a prepositional phrase (Region 1), a universal quantifier *every* (Region 2), subject NP (Region 3), negated verb (Region 4), object NP (Region 5) and a prepositional phrase (Region 6). A sample set of experimental conditions is shown in (1) and (2). The slashes in the ambiguous sentence indicate the segmentation used in the presentation. A full set of materials for this experiment is provided in Appendix B.
(1) **Full set context: Every > Neg**

Mrs. Keenan and her three kids were enjoying the beautiful sunset while taking a walk in the park. Suddenly many doves flocked to the park. Since the kids were afraid to come near them, they stepped back and watched other people feeding the doves from a distance.

(2) **Partitioned set context: Neg > Every**

Mrs. Keenan and her three kids were enjoying the beautiful sunset while taking a walk in the park. Suddenly many doves flocked to the park. Joy and Martina were afraid to come near them and they stepped back. However, Alfred remained there to feed bread crumbs to the doves.

**Sentence:** According to the story, / every / kid / didn’t feed / the doves / in the park.

R1  R2  R3  R4  R5  R6

The twenty-four sets of two conditions each were distributed in a Latin Square design, creating two lists intermixed with forty-eight filler items in a pseudo-random order. The fillers were the English equivalents of those from the Korean version of Experiment 4.

6.2.1.3 Procedure

The self-paced reading procedure and the truth value judgment task were identical in format to those used in Experiment 4. After participants filled out a background questionnaire, they were individually tested in a quiet room. After the actual experiment, they completed a cloze test in order to compare their scores with those of the L2 learners in Experiment 6. The entire task including the cloze test lasted approximately 45 minutes.
6.2.1.4 Data Analysis

The data analysis was conducted in the same way as described in Experiment 4. Among the twenty-four participants included in the analysis, the average comprehension accuracy was 86.45% (SD = 2.89), ranging from 80.5% to 91.6%. The average rate of correct response rates didn’t differ significantly across the two conditions.

The dependent variables were truth value judgment by the subjects, the judgment response time, and reading times for the test sentences. Reading times that were more than 3 standard deviations from the mean were replaced by the mean value plus 3 times the standard deviation. This procedure was done for the ambiguous sentences and for the times needed for the judgment separately, affecting 3.43% and 3.99% of the data respectively. Then, all raw reading times for a target sentence before the truth-value judgment were transformed into residual reading times (see section 5.2.1.4). A paired t-test was performed to compare the means between the two conditions.

6.2.2 Results

Truth-value judgments

Table 21 summarizes the proportions of responses to the truth value judgment of the native English readers. Participants accepted the ambiguous sentences on around 71% of trials with a full set interpretation, but on only about 37% of trials involving a partitioned set interpretation. The difference between the two conditions was statistically significant (t1(23) = 4.949, p < 0.0005; t2(23) = 8.231, p < 0.0005).
Table 21
Mean percentages (%) of True or False responses by ENG group: Experiment 5

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>True</td>
<td>70.83 (16.48)</td>
<td>36.91 (22.38)</td>
</tr>
<tr>
<td>False</td>
<td>29.17</td>
<td>63.19</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

**Judgment times for the truth-value judgments**

The timing results for the truth-value judgments revealed that although judgment times for sentences with the partitioned set interpretation were somewhat slower (1582ms, compared to 1510ms for sentence with a partitioned set reading), there was no main effect of interpretation ($p$'s > 0.5).

However, when the judgment times assigned to the full set interpretation were compared against those assigned to the partitioned set interpretation, the subset analysis showed a main effect of context ($t_1(1, 22) = 2.597, p = 0.016; t_2(1, 22) = 2.383, p = 0.026$). That is, “true” judgment times were slower in sentences with a partitioned set interpretation than in sentences with a full set interpretation. Table 22 summarizes the judgment times for only true responses in the two conditions.

---

19 One subject and one item were excluded in this subset analysis due to the small number of true responses per subject and item. This exclusion procedure applied to subset analysis for residual reading times shown in Table 23.
Table 22.
Judgment times (ms) for TRUE by ENG group: Experiment 5

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>“True” responses</td>
<td>1393 (636.81)</td>
<td>1837 (993.57)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Residual reading times

Figure 10 shows the residual reading times in sentences with the two scope interpretations. At all regions prior to the fifth region, there were no significant differences between residual reading times (all p’s > 0.5).

![Graph showing residual reading times](image)

Figure 10. Residual reading times for ENG group: Experiment 4 (PP1, Every2, sub-NP3, Neg-Verb4, obj-NP5, PP6)

At the direct object NP (Region 5) which corresponds to the first region after the region containing the negative, a significant effect of context was found (t1(23)=2.1, 98
p=0.049; t2(23)=2.5, p=0.021). A significant main effect of context was also found in the sixth region in the subject analysis (t1(23)=2.314, p=0.03), possibly due to spill-over or wrap-up effects, but not in the item analysis (t2(23)=1.707, p=0.101).

The subset analysis for reading times for “true” responses at the object NP (R5) in the two conditions revealed a significant main effect of context (t1(1, 22) = 2.28, p = 0.033; t2(1, 22) = 2.084, p = 0.049). Reading times at the object NP (R5) are shown in Table 23.

Table 23.
Residual reading times (ms) at object NP (R5) for “TRUE” responses: Experiment 5

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5 (True responses)</td>
<td>104 (157.73)</td>
<td>222 (248.17)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

6.2.3 Discussion

The first finding in this experiment is that English speakers show a preference for the full set interpretation over the partitioned set reading in sentences containing a universally quantified subject NP and negation. Moreover, when the judgment times needed to assign the former interpretation were compared to those needed to assign the latter reading, English speakers spent a longer time accepting the partitioned set interpretation. This suggests that the full set interpretation was more easily computed compared to the partitioned set interpretation.
Recall that previous studies have reported conflicting results with respect to the scope preference for the ambiguous sentences we are looking at in the experiment (see Chapter 2). One line of research has claimed that despite the availability of both readings, adult English speakers arrive at the partitioned set interpretation more often, whereas other research has argued that the full set interpretation is favored. My findings in the current experiment support the latter contention.

In Experiment 2 where the native English speakers were asked to select an interpretation without discourse context, no preference for either reading was found. In the current experiment, where the ambiguous sentences were accompanied by a supportive context, the full set interpretation was more often accepted than the partitioned set reading. This suggests that of the two interpretations, the full set interpretation is more contextually plausible and easier to access than the partitioned set reading, at least in real time where the processing burden is expected to be greater than in an off-line experiment.

The second objective of this experiment was to investigate at which point the potential scope ambiguity is resolved. The analysis of reading times reveals that the object NP (corresponding to the first region after the negative in the ambiguous sentence) was read more slowly in contexts favoring the partitioned set interpretation. This suggests that the native English readers start to evaluate the relevant scope interpretation at this point by revising the interpretation previously assigned to the quantified NP.
6.3 Experiment 6: Korean EFL learners

In Experiment 4 and Experiment 5, native Korean speakers and native English speakers dispreferred the partitioned set interpretation of sentences containing a universally quantified subject NP and negation. This was manifested in the low rate of acceptance of the sentences presented in the partitioned set interpretation, slow judgment times needed to accept the interpretation and signs of increased reading times in sentences with contexts supporting the partitioned set interpretation, compared to those in contexts favoring the full set interpretation.

Experiment 6 investigates on-line processing with Korean L2 learners of English. The research questions for this experiment are as follows.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier in subject position and negation in on-line L2 English processing? If so, does it vary with respect to L2 learners’ proficiency?
2. At what points is the potential scope ambiguity resolved in on-line L2 English processing? Does it vary with respect to L2 learners’ proficiency?

6.3.1 Method
6.3.1.1 Participants

Forty nine subjects participated in Experiment 6. They were all recruited at a university in Korea. Among these participants, four were removed because their accuracy rate on filler items in the self-paced reading task was below 80%. An additional three were
omitted because they didn’t complete their cloze test. Another two who didn’t participate in the Korean version (Experiment 4) were excluded. The data analysis focuses on the remaining forty participants, who were divided into two groups according to their English proficiency measured by the cloze test: high level (High-L2) and low level (Low-L2). The participants’ biographical information and the cloze test scores are provided in Table 24. As noted previously, the same group of subjects participated in Experiment 4 (Korean version) and Experiment 6 (English version). The data for each individual participant appears in Appendix G.

Table 24.
Background Information of the L2 Learner Groups: Experiment 6

<table>
<thead>
<tr>
<th></th>
<th>KOR L2 learners of English</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High-L2</td>
<td>Low-L2</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>M</td>
<td>24.8</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.47</td>
<td>1.14</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Have you studied linguistics?</td>
<td>YES</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Age of first learning English</td>
<td>M</td>
<td>12.3</td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.30</td>
<td>0.92</td>
</tr>
<tr>
<td>Length of living in English-speaking countries (months)</td>
<td>M</td>
<td>8.25</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>11.05</td>
<td>3.30</td>
</tr>
<tr>
<td>Cloze test score</td>
<td>M</td>
<td>40.75</td>
<td>22.3</td>
</tr>
<tr>
<td>(max: 50)</td>
<td>SD</td>
<td>1.86</td>
<td>2.43</td>
</tr>
<tr>
<td></td>
<td><em>Score range</em></td>
<td>38-45</td>
<td>19-26</td>
</tr>
</tbody>
</table>

20 The cloze test used here was the same as the one used in off-line experiments.
As with the off-line L2 learners, Table 24 shows that in Experiment 6, the more advanced the English proficiency, the greater the likelihood that the subjects had studied linguistics. Moreover, the extent of participants’ exposure to an English-speaking community differed across the two groups.

6.3.1.2 Stimuli

The materials including experimental items and filler items in Experiment 6 were identical those used in Experiment 5 (see Appendix B for a complete list). An example of the experimental items is repeated below as (1)-(2).

(1) **Full set context: Every > Neg**

Mrs. Keenan and her three kids were enjoying the beautiful sunset while taking a walk in the park. Suddenly many doves flocked to the park. Since the kids were afraid to come near them, they stepped back and watched other people feeding the doves from a distance.

(2) **Partitioned set context: Neg > Every**

Mrs. Keenan and her three kids were enjoying the beautiful sunset while taking a walk in the park. Suddenly many doves flocked to the park. Joy and Martina were afraid to come near them and they stepped back. However, Alfred remained there to feed bread crumbs to the doves.

**Sentence (subject QNP)**

According to the story, / **every** / kid / didn’t feed / the doves / in the park.

R1 R2 R3 R4 R5 R6
6.3.1.3 Procedure

Experiment 6 adopted exactly the same procedure as that of Experiment 4. The experimental procedure involved a phrase-by-phrase, non-cumulative, moving-window self-paced reading task (Just, Carpenter, & Woolley, 1982), combined with a truth-value judgment task. After reading a context paragraph favoring either a full set interpretation or a partitioned set interpretation, subjects read a test sentence. Following the moving-window paradigm, each button press triggered removal of the current phrase and presentation of the next phrase. The time in milliseconds was recorded for each button press and these together served as the measurement of reading time per region. Subjects were then asked to judge the truth of the test sentence, and their responses and judgment timing were recorded. After the experiment, subjects completed a background questionnaire and a cloze test. The whole session took approximately one hour and a half.

6.3.1.4 Data Analysis

The data analysis method was conducted in the same way as described in Experiment 4. As in the previous two experiments, all data from participants whose comprehension task accuracy was below 80% were discarded. The remaining forty participants’ overall mean accuracy, calculated from the fillers items, was 86.87% (SD = 3.61), ranging from 80.6% to 94.4. The difference in the comprehension accuracy between the two group means was not statistically significant ($F(1, 38) = 1.678, p=0.203$).
As in the previous experiments, reading times that were more than 3 standard deviations from the mean were replaced by the mean value plus 3 times the standard deviation. This procedure was done for the ambiguous sentences and for the times needed for the judgment separately, affecting 4.35% and 3.54% of the data respectively. Following Ferreira & Clifton (1986), all raw reading times for a target sentence before the truth value judgment were transformed into the residual reading times. A repeated measures ANOVA was conducted with context (full set vs. partitioned set interpretation) as the within-subject variable and with English proficiency (Low-L2 vs. High-L2) as the between-subject variable. When needed, a t-test too was performed for pairwise comparisons. Again, the dependent variables were truth value judgment by the subjects, the judgment response times, and reading times for the test sentences.

6.3.2 Results

Truth-value judgments

Table 25 provides the results for the truth-value judgment rates of the two learner groups. Both the Low-L2 and the High-L2 groups accepted the full set interpretation more often (92% and 87.5% of the time, respectively), than the partitioned set interpretation (34% and 69% of the time, respectively). This difference was significant (Low-L2 group: t1(1, 19) = 21.708, p < 0.0005; t2(1, 23) = 12.124, p < 0.0005) and High-L2 group: t1(1, 19) = 3.854, p = 0.001; t2(1, 23) = 3.417, p = 0.002). However, in the partitioned set interpretation, the High-L2 group accepted the test items more often, than the Low-L2 group – 69% of the time vs. 34% and this difference was significant.
(t1(1, 38) = 7.736, p < 0.0005; t2(1, 46) = 7.565, p < 0.0005). Notably, in the High-L2 group, five subjects showed equal or higher acceptances of the partitioned set interpretation than of the full set reading, despite the apparent preference for the latter set interpretation in the group results.21

Table 25.
Mean percentages (%) of True or False responses by KOR-L2 group: Experiment 5

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2</td>
<td>True</td>
<td>92.08</td>
</tr>
<tr>
<td></td>
<td>(6.37)</td>
<td>(12.65)</td>
</tr>
<tr>
<td></td>
<td>False</td>
<td>7.92</td>
</tr>
<tr>
<td>High-L2</td>
<td>True</td>
<td>87.5</td>
</tr>
<tr>
<td></td>
<td>(13.17)</td>
<td>(15.79)</td>
</tr>
<tr>
<td></td>
<td>False</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

The proportions of “true” responses to the test items were entered into a repeated measures ANOVA. The analysis revealed a significant main effect of context (F1(1, 38) = 211.885, p < 0.0005; F2(1, 46) = 119.343, p < 0.0005) and a significant interaction between context and English proficiency (F1(1, 38) = 57.101, p < 0.0005; F2(1, 46) = 36.506, p < 0.0005).

21 Individual data for the Low-L2 group showed that all the subjects chose the full set interpretation more
Judgment times for the truth-value judgments

Table 26 summarizes judgment times for the truth value judgments of the two L2 learner groups. As can be seen in the table, the L2 learners in this experiment took longer to judge the truth value of sentences in contexts that favored the partitioned set interpretation. There was a significant main effect of context \((F1(1, 38) = 26.890, p < 0.0005; F2(1, 46) = 40.984, p < 0.0005)\), but no other significant effects were found.

Table 26. Judgment times (ms) for the truth-value judgment by KOR-L2 group: Experiment 6

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>Full Set</th>
<th>Partitioned Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2</td>
<td>1880</td>
<td>2724</td>
</tr>
<tr>
<td>(261)</td>
<td></td>
<td>(914)</td>
</tr>
<tr>
<td>High-L2</td>
<td>1698</td>
<td>2259</td>
</tr>
<tr>
<td>(397)</td>
<td></td>
<td>(859)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

A subset analysis of judgment times dependent upon “true” responses was conducted only for the High-L2 learners because the Low-L2 learners rejected the partitioned set interpretation most of time and thus the number of T responses for this interpretation was too small. Recall that in the results for the truth value judgment portion in Table 25, the High-L2 group commonly accepted both the full set interpretation and the partitioned set reading (87.5% and 69%, respectively), although they showed a reliably strong preference for the full set interpretation. This high acceptance rate in each condition can give us a good estimate with which to compare the participants’ judgment often than the partitioned set reading.
times when they assign the matching interpretation to the ambiguous sentence. As can be seen in Table 26, the times needed to accept the partitioned set interpretation as true are numerically longer than those for the full set reading. This difference was statically significant ($t_1(1, 19) = 4.441, p < 0.0005; t_2(1, 23) = 4.461, p < 0.0005$).

Table 26.
Judgment times (ms) for TRUE by the High-L2 group: Experiment 6

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-L2</td>
<td>1629 (959)</td>
<td>2387 (1750)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

**Residual reading times**

The residual reading time profiles for the two L2 groups are shown in Figure 11. Reading time comparisons at each region between the two learner groups are not meaningful because the Low-L2 group produced longer reading times at all positions in the string than the High L2-group, as shown in Figure 11. Of more interesting is how each group is engaged in processing during the time courses of scope interpretation.
Figure 11. Residual reading times for the KOR-L2 group: Experiment 6
(PP₁, Every₂, sub-NP₃, Neg-Verb₄, obj-NP₅, PP₆)

With the Low L2 group no reading-time differences reached significance at any region prior to the fifth region. At the direct object NP (Region 5) the Low L2 learners read significantly slower with a context favoring the partitioned set interpretation, compared to a context with the full set reading (t₁(1, 19) = 6.021, p > 0.0005; t₂(1, 23) = 3.914, p = 0.001). At the sixth region, the main effect of context was only marginally significant in the item analysis (t₁(1, 19) = 1.530, p = 0.143; t₂(1, 23) = 1.939, p = 0.065). With the High-L2 group the observed patterns were similar to those with the Low-L2 group. Until the fifth region, there were no significant differences between reading times in the two scope interpretations. At the direct object NP (Region 5) there was a main
effect of context ($t_1(19) = 2.747, p = 0.013; t_2(23) = 2.487, p = 0.021$). No other contrasts reached significance for the advanced learners.

A subset analysis was conducted for reading times contingent on “true” responses at the object NP (R5) for the High-L2 group, which accepted the sentence to be true with a context in either the full set interpretation (87.5%) or the partitioned set reading (69%). There was a significant main effect of context ($t_1(19) = 2.243, p = 0.037; t_2(23) = 2.985, p = 0.007$). Reading times at the object NP (R5) are shown in Table 27.

Table 27.
Residual reading times (ms) at object NP (R5) for “TRUE” responses by the High-L2 group: Experiment 6

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5 (True responses)</td>
<td>85</td>
<td>212</td>
</tr>
<tr>
<td></td>
<td>(189.62)</td>
<td>(177.65)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

6.3.2 Discussion

Experiment 6 tested how L1 Korean speakers process ambiguous sentences containing negation and a universally quantified subject NP in English. Of particular interest was the question of whether proficiency level (Low vs. High) affects the time course of interpreting scope.

First, recall that the native English speakers (Experiment 5) were more likely to accept the full set interpretation than the partitioned set reading. The native respondents generated longer judgment times when they assigned the partitioned set interpretation.
Moreover, they showed increased reading times at the direct object NP for the partitioned set interpretation, that is, in the first region after the region containing the negative. The slowdown at the object NP position for the partitioned set reading suggests that the effects of scope ambiguity resolution start to appear at this point. Taken together, the findings indicate that the partitioned set interpretation is harder to process than the full set reading, and this processing difficulty remains even when appropriate contexts are provided.

Turning to the non-native respondents, their overall patterns were similar to those of the native speakers of English above. The partitioned set interpretation of the quantified subject NP in English was hard to obtain to both the Low-L2 and the High-L2 learners. The lower accessibility of the partitioned set interpretation was reflected in the longer judgment timing associated with this reading and by the increased reading times at the object NP position for the partitioned set interpretation, compared to the full set reading.

Crucially, the findings here are also consonant with the results obtained for the Korean speaking subjects in their native language (Experiment 4). A simple explanation for the L2 learners’ responses compared to those for the native English speakers could be the role of L1 transfer. That is, L1 scope preference carried over into the L2, by favoring the interpretation in the L2 that is strongly favored in the L1.

Notwithstanding the overall clear results, one remaining puzzle in the current experiment deserves comment, namely for the High-L2 learners’ relatively high acceptance of the partitioned set interpretation in English (69% of the time). Surprisingly,
this rate was higher than that of the native speakers of English (37% of the time). It is perhaps possible that classroom instruction had a selective effect on these advanced learners. Grammar books for English in junior high schools and colleges in Korea show that when universal quantifiers including *every* and *all* interact with negation, the sentences create scope ambiguity.  

22 Given this classroom input, the truth value responses by some of the High-L2 learners may reflect these learning strategies. However, it is not possible to ascertain the extent to which the formal instruction influences the learners’ performance, with no further individual reports or justifications regarding the issue in the present experiment.

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22 The classroom instruction doesn’t provide any details concerning the syntactic position of universal quantifier (subject vs. object). Rather, it generally covers that there exist two-way ambiguities when universal quantifiers interact with negation in a sentence.
CHAPTER 7

On-line Study: Universally Quantified Noun Phrase in Direct Object Position

This chapter explores the on-line comprehension of ambiguous sentences involving negation and a universal quantifier in direct object position. As in the case of sentences involving a subject QNP, three experiments are presented: native speakers of Korean (Experiment 7), native speakers of English (Experiment 8), and Korean speakers learning English as a foreign language (Experiment 9). As before, the same group of Korean subjects was asked to participate in both the English and the Korean versions (Experiments 7 and 9) at an interval of about four weeks. I begin with the experiment involving native Korean speakers. The methodology of the three experiments presented here is fundamentally identical to that in Chapter 6.

7.1 Experiment 7: Native Speakers of Korean

Experiment 7 examines whether there are any processing differences in scope interpretation between the short and the long negation forms, all things being equal, when each form of negation interacts with a universally quantified object NP. The following research questions are addressed.

1. Is there a preferred interpretation for ambiguous sentences involving a universal quantifier in direct object position and negation in on-line L1 Korean processing?
2. If so, how does the preferred interpretation differ with respect to negation type (short vs. long) in on-line L1 Korean processing?

3. At what points is the potential scope ambiguity resolved in on-line L1 Korean processing?

7.1.1 Method

7.1.1.1 Participants

Thirty-eight native Korean subjects (KOR) participated in the experiment. Among these participants, two were excluded because their accuracy rate on filler items was below 80%. An additional two were excluded because they didn’t complete their cloze test for the English version of the experiment (Experiment 9). The data analysis will focus on the remaining subset of thirty-six participants. Their biographic information is given in Table 28.

Table 28.
Background Information for the KOR Group: Experiment 7

<table>
<thead>
<tr>
<th></th>
<th>KOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>36</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>22.9</td>
</tr>
<tr>
<td>SD</td>
<td>2.34</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
</tr>
<tr>
<td>Female</td>
<td>17</td>
</tr>
</tbody>
</table>
7.1.1.2 Stimuli

Twenty-four sets of four conditions each were used in the experiment, in a 2 x 2 design, which manipulated the negation type (short vs. long) and the supporting context (full set vs. partitioned set). The configuration of the stimulus is basically identical to that of Experiment 4, except that the universal quantifier occurs in direct object position in Experiment 7. Thus the ambiguous sentences were divided into seven segments—a postpositional phrase (or an adverbial phrase) (Region 1), a subject (Region 2), a universal quantifier (Region 3), a direct object (Region 4), a negated verb (Region 5), a matrix subject (Region 6) and a matrix verb (Region 7). A sample set of experimental conditions is shown in (1)-(2). The segmentation indicated with slashes here was the actual segmentation used in the presentation.

(1) **Full set context: Every > Neg** (English translation)

Last night Yuna worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. However, since she was so tired, she didn’t light the candles but went to sleep right away in the dark.

c. **Sentence with long form negation**

\[
\begin{array}{cccc}
\text{R1} & \text{R2} & \text{R3} & \text{R4} & \text{R5} \\
\text{last night} & \text{Yuna-Nom} & \text{every} & \text{candle-Acc} & \text{light CI Neg do-PST-DECL-Comp} \\
\text{iyaki-nun} & \text{malhanta} \\
\text{R6} & \text{R7} \\
\text{story-Top} & \text{tell}
\end{array}
\]

‘The story says that Yuna did not light every candle last night’
d. **Sentence Short form negation**

```
last night Yuna-Nom every candle-Acc Neg light-PST-DECL-Comp
iyaki-nun / malhanta
story-Top tell
```

‘The story tells that Yuna did not light every candle last night’

(2) **Partitioned set context:Neg > Every** (English translation)

Last night Yuna worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. She took out one candle and lit it. Then she started reading a novel until she fell asleep.

c. The test sentence is the same as in (1a).
d. The test sentence is the same as in (1b).

The experiment consisted of twenty-four items, with six items per experimental condition. They were distributed among four lists in a Latin Square design. The experimental items were intermixed with forty-eight filler items in a pseudo-random order, such that experimental items were separated from each other with intervening fillers. The filler items were identical with those used in Experiment 4.

**7.1.1.3 Procedure**

The procedure for Experiment 7 was identical to that of Experiment 4. After reading a context paragraph as a single chunk, the native speakers of Korean were asked
to read an ambiguous sentence in a phrase-by-phrase, non-cumulative, moving-window self-paced reading paradigm. Next, they made a judgment about whether the target sentence was true according to the preceding context. The participants were tested individually in a quiet room. The entire experiment lasted approximately 30 minutes.

7.1.1.4 Data Analysis

As in the previous on-line experiments, data analysis was conducted on participants’ accuracy on filler items. Data from participants whose accuracy was below 80% in total were discarded. Among the thirty six participants included in the analysis, the average comprehension accuracy was 88.5% (SD = 2.67), ranging from 83.3% to 94.4%. Outliers in reading times beyond 3 standard deviations from the mean for a given condition and position were adjusted to the value of 3 standard deviations. This procedure was done for the ambiguous sentences and for the times needed for the judgment separately, affecting 3.4% and 4.6% of the data respectively. The results reported for a target sentence before the truth-value judgment are residual reading times. The dependent measures included the subject’s response of true or false, the times spent for the truth-value judgment, and reading times in the course of reading the test sentences. A repeated measures ANOVA with context (Full set vs. Partitioned set) and negation type (short vs. long) as within-subjects independent variables was conducted.
7.1.3 Results

Truth-value judgments

Table 29 summarizes the truth-value judgments by native Korean speakers.

Table 29.
Mean percentages (%) of True or False responses by KOR group: Experiment 7

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFN</td>
<td>LFN</td>
</tr>
<tr>
<td>True</td>
<td>94.44</td>
<td>92.59</td>
</tr>
<tr>
<td></td>
<td>(8.91)</td>
<td>(9.30)</td>
</tr>
<tr>
<td>False</td>
<td>5.56</td>
<td>7.41</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

A main effect of context was observed (F1(1, 35) = 257.248, p < 0.0005; F2(1, 23) = 123.874, p < 0.0005), with the full set interpretation producing significantly more acceptances than the partitioned set reading. Neither a main effect of negation type nor a significant context-by-negation type interaction was observed (all Fs < 1).

Judgment times for the truth-value judgments

The times required for the truth-value judgments showed a main effect of interpretation (F1(1, 35) = 99.741, p < 0.0005; F2(1, 23) = 65.135, p < 0.0005), indicating that Korean participants took substantially longer to reach a judgment regarding the truth of the partitioned set interpretation. No main effect of negation type or a significant context-by-negation type interaction was observed (all Fs < 1).
presents mean judgment times spent across the four conditions.

Table 30.
Judgment times (ms) for the truth-value judgments by KOR group: Experiment 7

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFN</td>
<td>LFN</td>
</tr>
<tr>
<td>Judgment times (ms)</td>
<td>1628</td>
<td>1560</td>
</tr>
<tr>
<td></td>
<td>(378.74)</td>
<td>(334.16)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

As in the previous on-line experiments, a subset analysis dependent upon the participants’ “true” responses was conducted to compare the judgment times associated with the full set interpretation against those for the partitioned set reading. The reading times yielded here can be taken to be direct reflections of interpretive processing when it comes to the access to an ambiguous sentence with its matching context. Table 31 presents the judgment times contingent on “true” responses for each condition by native Korean speakers.

Table 31.
Judgment times (ms) for TRUE by KOR group: Experiment 7

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFN</td>
<td>LFN</td>
</tr>
<tr>
<td>“True” judgment times</td>
<td>1571</td>
<td>1519</td>
</tr>
<tr>
<td></td>
<td>(341.32)</td>
<td>(218.91)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.
The analysis showed a main effect of context (F1(1, 35) = 93.894, p < 0.0005; F2(1, 23) = 37.408, p < 0.0005). This suggests that judgment times were slower for the partitioned set interpretation than the full set reading. For such comparisons, no main effect of negation type or a significant context-by-negation type interaction was observed (all Fs < 1).

**Residual reading times**

The residual reading time analysis yielded the following results. Figure 13 presents participants’ reading time profiles over the time course of the four conditions.

---

23 The number of T responses per subject and item in each condition was counted. As seen in Table 29, enough T responses across conditions were observed and thus no exclusion was considered.
At all regions prior to the fifth region (i.e., negated verb), there were no significant differences among reading times across conditions (all Fs < 1). At the negated verb (Region 5), there was a significant main effect of context (F1(1, 35) = 14.743, p < 0.0005; F2(1, 23) = 11.026, p = 0.003). That is, the native Korean speakers read the negated verb more slowly when they assigned it the partitioned set interpretation than when they assigned it the full set interpretation. Neither a main effect of negation type nor a significant context-by-negation type interaction was observed (all Fs < 1).

A significant main effect of context was also found in the sixth region (F1(1, 35) = 19.166, p < 0.005; F2(1, 23) = 11.659, p = 0.002), and in the seventh region (F1(1, 35) = 18.461, p < 0.005; F2(1, 23) = 11.014, p = 0.003). Again, the slowdowns here may be due to spill-over from slow reading times at the previous region. No other significant effects were observable at the two final regions (all Fs < 1).

The subset analysis for residual reading times was conducted with respect to test items that were judged to be “true” across the four conditions. This way allows us to compare reading times for the partitioned set scope interpreted sentences against those for the full set scope interpreted sentences. Since the critical region was the negated verb where a significant main effect of interpretation was observed above, the analysis was performed for this segment only. Expectedly, there was a main effect of context at the negated verb (F1(1, 35) = 9.688, p = 0.004; F2(1, 23) = 10.386, p = 0.004), indicating that native Korean speakers showed slower reading times in the region of sentences where the partitioned set reading is derived. No other significant effects were found. See Table 32.
Table 32. Residual reading times (ms) for “TRUE” responses in negated verb (R5): Experiment 7

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFN</td>
<td>LFN</td>
</tr>
<tr>
<td>R5 (“True” responses)</td>
<td>96</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>(196.42)</td>
<td>(96.49)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

7.1.3 Discussion

Experiment 7 was designed to test whether there native Korean speakers have a preferred interpretation for ambiguous sentences involving negation and a universal quantifier motun in direct object position. The study yielded rather clear results.

From the true or false responses for the sentences, it was observed that Korean subjects strongly preferred the full set interpretation. That is, in contexts that supported the full set interpretation, over 90% of the trials were accepted as true. By contrast, a partitioned set interpretation was assigned only around 54% of the time in the partitioned set supporting context. Apparently the discourse context boosted acceptance for the partitioned set interpretation in Experiment 7, compared to the findings in Experiment 1 where the ambiguous sentences were presented with no supportive context, in which case the partitioned set interpretation was selected in only about 30% of the trials. However, despite the rich context, participants’ rejection of the partitioned set interpretation half of the time suggests that this reading is more difficult than the full set interpretation.

The substantially longer judgment times needed to arrive at an interpretation provided another piece of evidence for the difficulty of the partitioned set interpretation.
Moreover, analysis of the reaction times for the ambiguous sentences showed that participants read the target sentences more slowly at the negated verb when they assigned it the partitioned set interpretation. The slow down at this region suggests that subjects begin evaluating the potential scope of the partitioned set reading upon encountering the negated verb.

Crucially, no effect of scope interpretation on the two negation forms was observed. This finding replicates those of Experiment 1 (off-line preference judgment task) and Experiment 4 (on-line comprehension task for universally quantified NP in subject position and negation). The converging results across these experiments is an indication that the previous reports regarding different scope judgments between the two negation types need to be reconsidered.

In sum, the results in Experiment 7 show that the on-line truth value judgment and comprehension of an ambiguous sentence containing a universally quantified object NP and negation in Korean incur processing difficulty for the partitioned set interpretation, compared to the full set interpretation. Moreover, the difficulty of this interpretation arrives in the expected place – at the negated verb corresponding to the second operator in the ambiguous sentence.
7.2 Experiment 8: Native Speakers of English

Experiment 8 investigates native English speakers’ interpretation of an ambiguous sentence containing a universally quantified NP in direct object position and negation. The findings will be used as control data to compare with the L2 data in Experiment 9. The following research questions are addressed in the experiment.

1. Is there a preferred interpretation of ambiguous sentences involving negation and a universal quantifier in direct object position in on-line L1 English processing?
2. At what points is the potential scope ambiguity resolved in on-line L1 English processing?

7.2.1 Method

7.2.1.1 Participants

Twenty-six native speakers of English (ENG), all undergraduate students at a university in Hawaii participated in Experiment 8. The participants received either course credit or monetary compensation. Two participants whose accuracy rate on filler items was below 80% were discarded, leaving twenty-four native speakers of English for the final data analysis. These participants’ biographic information is given in Table 34.
Table 34.
Background Information for the ENG Group: Experiment 8

<table>
<thead>
<tr>
<th></th>
<th>ENG</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>24</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>SD</td>
</tr>
<tr>
<td>Male</td>
<td>13</td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
</tr>
<tr>
<td>Have you studied linguistics?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Cloze test score</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>SD</td>
</tr>
<tr>
<td>Score range</td>
<td>44-47</td>
</tr>
</tbody>
</table>

*Note.* The maximum score for the cloze test was 50.

7.2.1.2 Stimuli

The experimental materials in Experiment 8 were identical to those of Experiment 7, except for two minor changes. First, stimulus items and contexts appeared in English for the participants in the native English group. Second, unlike Experiment 7, which tested both negation type and context, Experiment 8 investigated only the effect of context (full set vs. partitioned set) on participants’ comprehension of the ambiguous sentences.

The test items were divided into six regions: a prepositional phrase (Region 1), a subject NP (Region 2), negated verb (Region 3), a universal quantifier *every* (Region 4), an object NP (Region 5) and a prepositional phrase or an adverbial phrase (Region 6). An example of the two contexts for a target sentence is given in (1)-(2), which is repeated from Experiment 7. The segmentation, indicated with slashes in the ambiguous sentence, was the
actual segmentation used in the presentation. A full set of experimental items for this experiment is provided in Appendix C.

(1) **Full set context: Every > Neg**

Last night Cindy worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. However, since she was so tired, she didn’t light the candles but went to sleep right away in the dark.

(2) **Partitioned set context: Neg > Every**

Last night Cindy worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. She took out one candle and lit it. Then she started reading a novel until she fell asleep.

Sentence: **According to the story, / Cindy / didn’t light / every / candle / last night.**

The twenty-four sets of two conditions each were distributed in a Latin Square design, creating two lists intermixed with forty-eight filler items in a pseudo-random order. The fillers were the English equivalents of those from the Korean version of Experiment 7.

7.2.1.3 **Procedure**

The self-paced reading procedure and the truth value judgment task were identical in format to those used in Experiment 7. Participants filled out a background questionnaire and then were individually tested in a quiet room. After the actual task,
they completed a cloze test in order to compare their scores with those of the L2 learners in Experiment 9. The entire task including the cloze test lasted approximately 45 minutes.

### 7.2.1.4 Data Analysis

The data analysis method was conducted in the same way as described in Experiment 7. Among the twenty-four participants included in the analysis, the average comprehension accuracy was 87.96% (SD = 5.29), ranging from 80.5% to 94.4%. Reading times that were more than 3 standard deviations from the mean were replaced by the mean value plus 3 times the standard deviation. This procedure was done for the ambiguous sentences and for the times needed for the judgment separately, affecting 2.92% and 2.96% of the data respectively. Then, all raw reading times for a target sentence before the truth-value judgment were transformed into residual reading times. The dependent variables were the truth value judgments by the subjects, the judgment response times, and the reading times for the test sentences. A paired t-test was performed to compare the means between the two conditions.

### 7.2.2 Results

**Truth-value judgments**

Table 35 summarizes the proportions of responses to the truth value judgment of the native English readers. A significant effect of context was found ($t_1(23) = 10.466, p < 0.0005; t_2(23) = 12.990, p < 0.0005$). That is, participants accepted the ambiguous sentences in a partitioned set interpretation (around 91%) more predominantly than in a
full set interpretation (around 45%).

Table 35.
Mean percentages (%) for True or False responses by ENG group: Experiment 8

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>True</td>
<td>45.14 (12.02)</td>
<td>90.63 (9.30)</td>
</tr>
<tr>
<td>False</td>
<td>54.86</td>
<td>9.37</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Judgment times for the truth-value judgments

Table 36 presents participants’ mean judgment timing for the truth-value in each interpretation.

Table 36.
Judgment times (ms) for the truth-value judgments by ENG group: Experiment 8

<table>
<thead>
<tr>
<th>Judgment timing (ms)</th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1779 (591.19)</td>
<td>1382 (564.38)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

The timing results for the truth-value judgments showed a main effect of context ($t_1(1, 23) = 3.766, p = 0.001; t_2(1, 23) = 3.033, p = 0.006$), indicating that English participants took reliably longer to reach a judgment regarding the true or false response of the full set interpretation.

Furthermore, when the judgment times assigned to the full set interpretation were
compared against those assigned to the partitioned set interpretation, the subset analysis too showed a main effect of context ($t_1(1, 22) = 4.700, p < 0.0005; t_2(1, 20) = 3.851, p = 0.001$). That is, “true” judgment times in sentences with a partitioned set interpretation were slower than those for sentences with a full set interpretation. Table 37 summarizes the judgment times which are contingent to only true responses between the two conditions.

Table 37.
Judgment times (ms) for TRUE by ENG group: Experiment 8

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>“True” judgment timing</td>
<td>1794 (559.12)</td>
<td>1232 (508.22)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

**Residual reading times**

There were no significant differences between residual reading times (all p’s > 0.5) at any regions prior to the fifth region. Figure 14 gives the results of the residual reading times in sentences with the two scope interpretations.

---

24 One subject and three items whose true responses were below 30% were excluded in this subset analysis. This exclusion procedure applied to the subset analysis for residual reading times shown in Table 37.
Figure 14. Residual reading times for ENG group: Experiment 8 
(PP₁, Subject₂, Neg-Verb₃, Every₄, obj-NP₅, PP₆)

At the object NP (Region 5), which corresponds to the first region after the region containing the second operator in the string, a significant effect of context was found ($t_{1}(23)=6.200$, $p < 0.0005$; $t_{2}(23)=4.273$, $p < 0.0005$). A significant main effect of context was also found in the sixth region ($t_{1}(23)=6.114$, $p < 0.0005$; $t_{2}(1, 23) = 5.919$, $p < 0.0005$), possibly due to spill-over or wrap-up effects.

The subset analysis for reading times contingent on “true” responses at the object NP (R5) in the two conditions revealed a significant main effect of context ($t_{1}(1, 22) = 3.739$, $p = 0.001$; $t_{2}(1, 20) = 3.508$, $p = 0.002$). Reading times at the object NP (R5) are shown in Table 38.
Table 38.
Residual reading times (ms) at object NP (R5) for “TRUE” responses: Experiment 8

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5 (True responses)</td>
<td>108.73 (162.07)</td>
<td>-19 (60.07)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

7.2.3 Discussion

For native speakers of English, the truth-value judgment responses bear out a preference for the partitioned set interpretation over the full set reading in sentences containing a universally quantified direct object NP and negation.

Recall that in Experiment 2 where the native English speakers were asked to choose a favored paraphrase for the two possible interpretations in the absence of a helpful context, the partitioned set interpretation was predominantly selected, compared to the full set reading (i.e. 94% vs. 6% respectively). In the current experiment where the ambiguous sentences were presented with a rich discourse context, participants’ acceptance rates of the full set interpretation rose to 45%. This shows a contextual contribution during processing of the full set reading. Moreover, it confirms that given the right context, sentences containing a universally quantified direct object NP and negation are also ambiguous.

The finding that such sentences are ambiguous conflicts with most of the previous research under consideration, which argues that only the partitioned set interpretation is available for sentences of this kind in English. As discussed earlier in Chapter 2,
sentences with a universally quantified direct object NP and negation in the theory I adopt, are ambiguous but the partitioned set interpretation is typically favored for pragmatic reasons pertaining to Grice’s maxim ‘Avoid ambiguity.’ Because alternative non-ambiguous constructions are available to express the full set reading as in as in Cindy didn’t light any candles or Cindy lit no candles, they should be favored over the ambiguous ‘not-every’ pattern, all other things being equal.

When the judgment times needed to assign each scope interpretation were compared, times for the full set interpretation were slower than those for the partitioned set reading. In sentences with contexts supporting the full set interpretation, increases in reading times were observed once the second operator was encountered, suggesting that the resolution of scope ambiguity in this pattern takes place at this point.

Why is there an increase in reading time after the quantified NP in the case of the full set interpretation? At first glance, this seems surprising. According to the theory of scope interpretation that I have adopted (see section 2.2.2 in Chapter 2), the processor can assign either interpretation to the patterns in which the negative precedes the quantified NP without having to retract its steps. From this point of view at least, the two interpretations should therefore be on equal footing. However, as William O’Grady notes (p.c.), this may not be the only thing that matters. As just noted, for instance, the full set interpretation in negative sentences is expressed by a construction that does not leave room for ambiguity – usually the ‘not-any’ pattern. It is therefore quite possible that the slowdown in reading time observed for the full set interpretation of sentences such as Cindy didn’t light every candle comes from the processor’s surprise that this meaning
was not expressed in the more common way – as *Cindy didn’t light any candles*. As we will see later, possible support for this idea comes from the behavior of second language learners.

In sum, the results of this experiment show that despite two-way ambiguity, in sentences involving a universally quantified direct object NP and negation, the partitioned set interpretation is pragmatically more appropriate and easier to access than the full set reading during comprehension.
7.3 Experiment 9: Korean L2 learners of English

In Experiment 7, where native speakers of Korean were tested with ambiguous sentences involving a universally quantified object NP and negation, the full set interpretation was strongly favored over the partitioned set reading. By contrast, Experiment 8 showed that native speakers of English displayed a significant preference for the partitioned set interpretation. This difference between the two different languages enables us to test how scope interpretation is acquired by second language learners. Experiment 9 is designed to investigate on-line processing of scope with Korean L2 learners of English. The research questions for this experiment are as follows.

1. Is there a preferred interpretation of ambiguous sentences involving a universal quantifier in direct object position and negation in on-line L2 English processing? If so, does it vary with respect to L2 learners’ proficiency?
2. At what point is the potential scope ambiguity resolved in on-line L2 English processing? Does it vary with respect to L2 learners’ proficiency?

7.3.1 Method

7.3.1.1 Participants

Forty-two subjects, all recruited at a university in Korea, originally participated in Experiment 9. The following participants were removed from the final data for the same reasons as in previous experiments: four based on results from the comprehension
questions in the self-paced reading task and two based on cloze test results. The data analysis thus included thirty-six participants. These 36 were divided into two groups according to their English proficiency as measured by the cloze test: high level (High-L2) and low level (Low-L2). The participants’ biographic information and the cloze test scores are given in Table 39. The data for each individual participant appears in Appendix G.

Table 39.
Background Information for the L2 Learner Groups: Experiment 6

<table>
<thead>
<tr>
<th></th>
<th>KOR L2 learners of English</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High-L2</td>
<td>Low-L2</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>M</td>
<td>24.7</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.52</td>
<td>1.37</td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Have you studied linguistics?</td>
<td>YES</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Age of first learning English (years)</td>
<td>M</td>
<td>11.4</td>
<td>12.1</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.75</td>
<td>1.12</td>
</tr>
<tr>
<td>Length of living in English-speaking countries (months)</td>
<td>M</td>
<td>7.4</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>6.81</td>
<td>2.87</td>
</tr>
<tr>
<td>Cloze test score (max: 50)</td>
<td>M</td>
<td>39.9</td>
<td>24.8</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>2.19</td>
<td>2.71</td>
</tr>
<tr>
<td></td>
<td>Score range</td>
<td>37-45</td>
<td>22-29</td>
</tr>
</tbody>
</table>

As with previous L2 learners, the two learner groups varied with respect to experience studying linguistics and duration of exposure to an English-speaking environment.
7.3.1.2 Stimuli

The materials in Experiment 9 were identical to those used in Experiment 8 (see Appendix C for a complete list). An example of the experimental items is repeated below as (1)-(2).

(1) **Full set context: Every > Neg**

Last night Cindy worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. However, since she was so tired, she didn’t light the candles but went to sleep right away in the dark.

(2) **Partitioned set context: Neg > Every**

Last night Cindy worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. She took out one candle and lit it. Then she started reading a novel until she fell asleep.

**Sentence:** According to the story, / Cindy / didn’t light / every / candle / last night.

R1                      R2              R3            R4      R5            R6

7.3.1.3 Procedure

Experiment 9 adopted exactly the same procedure as that of Experiment 8. The participants were tested individually in a quiet room. They completed a background questionnaire and then the actual experiment was administered. After the task, participants completed a cloze test. The whole session took approximately one and a half hours.
7.3.1.4 Data Analysis

The data analysis method was identical to that of the previous on-line experiments. Among the thirty-six participants included in the analysis, average comprehension accuracy was 86.95% (SD = 3.62), ranging from 80.6% to 94.4. The difference in the comprehension accuracy between the two group means was not statistically significant ($F(1, 34) = 2.031$, $p= 0.163$).

As in the previous experiments, the reading times of a segment below or above 3 standard deviations from the group mean for that segment were replaced by the mean value plus (or minus) 3 times the standard deviation. This procedure was performed for the ambiguous sentences and for the times needed for a judgment separately, affecting 3.12% and 1.74% of the test data respectively. All raw reading times for a target sentence before the truth value judgment were transformed into residual reading times. A repeated measures ANOVA was conducted with context (full set vs. partitioned set interpretation) as the within-subject variable and with English proficiency (Low-L2 vs. High-L2) as the between-subject variable. When needed, a t-test was conducted for pairwise comparisons. The dependent variables involved the truth-value judgment by the subjects, the judgment response times, and reading times for the test sentences.

7.3.2 Results

Truth-value judgments

Table 40 summarizes the results for truth-value judgments by the two learner groups.
Table 40.
Mean percentages (%) for True or False responses by KOR-L2 group: Experiment 9

<table>
<thead>
<tr>
<th></th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True</td>
<td>False</td>
</tr>
<tr>
<td>Low-L2</td>
<td>86.57 (15.01)</td>
<td>37.50 (15.57)</td>
</tr>
<tr>
<td>High-L2</td>
<td>True</td>
<td>False</td>
</tr>
<tr>
<td></td>
<td>78.54 (16.40)</td>
<td>75.17 (15.81)</td>
</tr>
<tr>
<td></td>
<td>21.46</td>
<td>24.93</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

Pairwise comparisons revealed the following results. The Low-L2 group accepted the full set interpretation significantly more often than the partitioned set interpretation (t1(1, 17) = 7.005, p < 0.0005; t2(1, 23) = 7.436, p < 0.0005). However, no effect of context was found in the High-L2 group (all ps > 0.1). In the partitioned set interpretation, the High-L2 group accepted the test items of the interpretation more often than the Low-L2 group (t1(1, 34) = 5.544, p < 0.0005; t2(1, 46) = 5.586, p < 0.0005).

The rates of “true” responses for each condition were entered into a repeated measures ANOVA. A significant main effect for context was observed (F1(1, 34) = 40.993, p < 0.0005; F2(1, 22) = 42.667, p < 0.0005). The interaction of context and proficiency was significant (F1(1, 34) = 30.518, p < 0.0005; F2(1, 46) = 31.910, p < 0.0005).
Judgment times for the truth-value judgments

Table 41 summarizes times for the truth-value judgments of the two L2 learner groups. The Low-L2 learners took significantly longer judging the truth-value of the partitioned set interpretation, compared to the full set reading ($t_1(1, 17) = 5.608, p < 0.0005; t_2(1, 23) = 4.632, p < 0.0005$). However, such a main effect of context was not found in the High-L2 group (all $p$’s < 0.1). In the partitioned set interpretation, the Low-L2 group took significantly longer judging the truth-value of the sentence than the High-L2 group ($t_1(1, 34) = 3.393, p = 0.002; t_2(1, 46) = 2.415, p = 0.02$). The times required for the truth-value judgments were entered into a repeated measures ANOVA. There was a main effect of context ($F_1(1, 34) = 26.344, p < 0.0005; F_2(1, 46) = 21.669, p < 0.0005$), largely due to the performance of the Low-L2 group. The interaction of context and proficiency also was significant ($F_1(1, 34 = 7.103, p = 0.012; F_2(1, 46) = 7.393, p = 0.009$).

Table 41.
Judgment times (ms) for the truth-value judgment by the KOR-L2 group: Experiment 9

<table>
<thead>
<tr>
<th>Group</th>
<th>Full Set Interpretation</th>
<th>Partitioned Set Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-L2</td>
<td>1701 (467)</td>
<td>2508 (472)</td>
</tr>
<tr>
<td>High-L2</td>
<td>1675 (393)</td>
<td>1930 (541)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.

In a subject analysis for judgment times dependent upon “true” responses, only the data for the High-L2 learners was compared between the two conditions. The Low-L2
learners didn’t provide enough T responses in the partitioned set interpretation and thus the observed numbers per subject and item for this interpretation was not comparable to those of the full set reading. The analysis for the High-L2 group found no effect of context although the times required to accept the partitioned set interpretation (1858 ms) were numerically longer than those of the full set interpretation (1652 ms) (all p’s > 0.1).

Residual reading times

The residual reading time profiles of the two L2 groups are provided in Figure 15.

Figure 15. Residual reading times for the KOR-L2 group: Experiment 9 (PP₁, Subject₂, Neg-Verb₃, Every₄, obj-NP₅, PP₆)
With the Low-group, until the fifth region, no significant reading times between the two scope interpretations were found. At the object NP (Region 5) the Low L2 learners read significantly slower with a context supporting the partitioned set interpretation compared to a context with the full set reading ($t_1(1, 17) = 2.723, p = 0.014; t_2(1, 23) = 2.434, p = 0.023$). At the sixth region, significant differences in reading times were found ($t_1(1, 17) = 2.522, p = 0.022; t_2(1, 23) = 2.317, p = 0.03$), possibly due to a spill-over effect.

Interestingly, with the High-L2 group, no reading time differences between the two scope interpretations reached significance at any region of the sentence.

### 7.3.3 Discussion

Experiment 9 was designed to investigate how L1 Korean speakers process ambiguous sentences involving a universally quantified direct object NP and negation in English, and whether the time course for interpreting scope varies with respect to the proficiency level of the L2 learners. Recall that for the native speakers of English (Experiment 8), the partitioned set interpretation was strongly preferred whereas the full set reading of the target sentences, despite the help of a rich context, was rejected in approximately half of the trials in group results. The dispreference for the full set interpretation among the native English speakers, was reflected in the longer judgment times assigned to this reading compared to the partitioned set interpretation. Moreover, slower reading times were detected at the object NP right adjacent to the universal quantifier *every* when the sentence was associated with the full set interpretation, compared to with the partitioned set reading.
For the non-native speakers, an interesting finding of the present experiment is an effect of proficiency level on scope interpretation in comprehending the L2. Let us first consider the Low-L2 learners’ performance. The participants in the Low-L2 group accepted the ambiguous sentences with a full set supporting context compared at a higher rate than with the partitioned set counterpart. Moreover, the judgment times required to associate with the partitioned set interpretation were slower than with the full set reading. In the former context, the target sentence was read slower at the object NP in the first region after the region containing a universal quantifier *every*, compared to the same region for the latter interpretation. Such findings together reflect that for the Low-L2 learners, the partitioned set interpretation is harder in real time processing than the full set reading.

The Low-L2 learners do not manifest different processing behavior according to their native language, Korean. In Experiment 7, the native Korean speakers strongly preferred the full set interpretation over the partitioned set reading in sentences containing a universally quantified NP in direct object position and negation in Korean. The combined results of judgment times and reading times for the ambiguous sentences also confirmed a preference for the full set interpretation. Therefore, the observed processing routines of the Low-L2 group in this study are accounted for by the effect of L1 scope properties. That is, the learners followed the preference manifested in L1 scope processing when interpreting scope in L2.

Compared to the Low-L2 speakers, the High-L2 group’s performance is confounding. With respect to the responses of the truth-value judgment, their behavior
manifests signs of both the native and the non-native languages. The learners in this
group exhibited interference from their L1 preference, accepting the full set interpretation
around 78% of the time. However, they accepted the partitioned set interpretation at
approximately the same rate (75% of the time) – which was higher than the rate observed
with the Low L2 learners (40%) but lower than the rate by native speakers of English
(91%). The Judgment times and reading times for the ambiguous sentences did not differ
between the two scope interpretations either, presumably due to the similar weight of the
two interpretations to the learners.

Why should this be? One possibility, suggested to me by William O’Grady (p.c.),
relates to a point made earlier with respect to the performance of native speakers of
English (section 7.2.3). There, we noted that what makes the full set interpretation of
sentences such as Cindy didn’t light every candle difficult for native speakers is the
presence of a ‘better’ way of saying the same thing – normally the full set interpretation
is expressed by an unambiguous ‘not-any’ construction such as Cindy didn’t light any
candles. Crucially, it seems reasonable to suppose the second language learners, who
have had far less exposure to English than native speakers, are unaware of the extent to
which the ‘not-any’ pattern is preferred. They therefore see no reason why the ‘not every’
pattern should not be highly natural with the full set interpretation – a sentiment that is
perhaps further reinforced by the strong acceptability of the corresponding interpretation
in Korean.
CHAPTER 8
GENERAL DISCUSSION

This dissertation probed scope interpretation involving sentences with universally quantified NPs and negation, with the help of nine experiments by native Korean speakers, native English speakers and Korean speaking learners of English. The key findings from these experiments are summarized here, and I will discuss implications for research on scope interpretation in sentence processing, including research on second language acquisition and L2 sentence processing.

8.1 Summary of the major findings

Experiments 1, 2 and 3 measured the off-line interpretive preferences for sentences containing a universally quantified NP in subject or direct object position and negation. The off-line judgment task did not present a supporting context and asked the participants to select one preferred interpretation between two possible readings of an ambiguous sentence when given as much time as they needed.

- Experiment 1: Native speakers of Korean strongly preferred the full set interpretation irrespective of the syntactic position of the universal quantifier (subject vs. direct object) or negation type (short vs. long).
- Experiment 2: Native speakers of English showed no dominant preference for either scope interpretation for sentences involving a universally quantified

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subject NP and negation whereas they strongly preferred the partitioned set interpretation in cases where a universal quantifier in direct object position interacts with negation.

- Experiment 3 (by L2 learners of English at three levels of proficiency): In sentences containing a universal quantifier in subject position and negation in English, the Low-L2 and the Inter-L2 groups preferred the full set interpretation whereas the High-L2 group did not show any preference for either interpretation, similar to the native speakers of English. In sentences containing a universal quantifier in direct object position and negation in English, the Low-L2 and the Inter-L2 groups manifested a preference for the full set interpretation, while the High-L2 group preferred the partitioned set interpretation, as did the native speakers of English.

Experiments 4, 5 and 6 tested on-line processing of ambiguous sentences containing negation and a universally quantified subject NP. The experiments implemented a self-paced reading format in conjunction with a truth-value judgment task. A context that favored either the full set or the partitioned set interpretation was provided to participants. They then read a target statement at self-paced speed and determined its truth-value according to the preceding context.

- Experiment 4: The native Korean speakers strongly preferred the full set interpretation in Korean. Their difficulty assigning the partitioned set interpretation to the ambiguous sentence was indicated by the high rate of
rejection in judgment responses, slow judgment times needed for the interpretation and increasing reading times at the negated verb in the interpretation, compared to the full set reading. None of these findings varied with respect to the two negation types (short vs. long).

- **Experiment 5:** The observed patterns aligned with those of native speakers of Korean in Experiment 4. The native English speakers showed a preference for the full set interpretation over the partitioned set reading in English. With the latter interpretation, they accepted the target sentence less frequently and took longer to associate the ambiguous sentence with this reading. A slowdown at the object NP – the region corresponding to the first region after the negative – was detected in the partitioned set interpretation.

- **Experiment 6 (by L2 learners of English at two levels of proficiency):** Both the Low-L2 and the High-L2 learners showed native-like patterns, as in Experiment 5.

Experiments 7, 8 and 9 tested the on-line processing of ambiguous sentences containing negation and a universally quantified direct object NP, using the same methodology as in Experiments 4, 5 and 6.

- **Experiment 7:** Native speakers of Korean preferred the full set interpretation in Korean. Lower acceptance of the sentence with a partitioned set reading, longer judgment times required to arrive at an interpretation and slower reading times at the negated verb all emerged in the partitioned set
interpretation. None of these findings differed with respect to the two negation types (short vs. long) The overall pattern of results in Experiment 7 is similar to that found in cases where a universally quantified subject NP interacts with negation.

- Experiment 8: Native speakers of English showed a preference for the partitioned set interpretation in English. They rejected the full set reading more often and took a significantly longer time to assign this interpretation to the sentence. This apparent difficulty in accessing the full set interpretation was underscored by the finding that the object NP – the region corresponding to the first region after the universal quantifier – was read slowly in this interpretation.

- Experiment 9 (by L2 learners of English at two levels of proficiency): The Low-L2 group exhibited the same processing behavior as did the native speakers of Korean (Experiment 7) in L2. On the other hand, the High-L2 group did not reveal any particular preference for either interpretation, but rather showed a pattern wherein the preferred interpretations coexist in the L1 and L2.
8.2 Processing issues

A fundamental question set out in my dissertation has to do with what principle guides the reader in determining the preferred (or dispreferred) interpretation of scopally ambiguous sentences containing a universal quantified NP and negation. Theoretically, the essential fact to deal with is that two different sources for processing difficulty in scope interpretation have been proposed.

On one account, scope processing involves a grammatical principle that is sensitive to abstract linguistic structure. For instance, Anderson (2004) found that the inverse scope reading of doubly quantified sentences (e.g., *A climber scaled every cliff*) incurred a cost during on-line comprehension in English. Anderson attributed the cost of the inverse scope to the greater grammatical complexity of this interpretation than the surface reading, arguing that the inverse scope interpretation demands an additional step in the derivation compared to the other interpretation. However, such a claim confronts a critical problem in light of the proposal that inverse scope interpretation requires no additional movement in the derivation (Hornstein, 1995).

Another account, which I adopt to explain the findings in my dissertation, proposes that the difficulty in assigning the dispreferred scope interpretation is located in the processor. A processing-based hypothesis of this sort (O’Grady et al., 2008) for the interpretation of negation and a universally quantified NP was fully discussed in Chapter 2. A crucial prediction in the processing-based account is that the full set interpretation will be easier to arrive at than the partitioned set interpretation when the quantified NP precedes the negation.
The data from the native speakers of Korean in Experiments 1, 4 and 7 supported this prediction, showing a strong preference for the full set interpretation, invariably, when a universal quantified NP appears in either subject or direct object position. This preference was found both in the off-line and the on-line tasks. Korean is an SOV language and quantified expressions always precede the negative operator. Assuming (as usual) that the processor works through the string from left-to-right, the full set interpretation will initially be activated for a universally quantified NP in either subject or object position, and will be maintained to the point of negation. Consequently, the full set interpretation is less costly, compared to the partitioned set interpretation, which demands backtracking during the processing routine.

The same account can be applied to the pattern involving a universally quantified NP in subject position in English. In Experiment 5, the native speakers of English revealed such an effect of processing, showing a significant preference for the full set interpretation. Although clear results were borne out with the native speakers of English in a real time process (Experiment 5), it should be noted that in the case of the off-line experiment (Experiment 2), no preference for either scope interpretation emerged.

At least two explanations are worth considering. One is that there is a task effect. The off-line judgment task was not time constrained while the on-line experiment was conducted under time pressure. The second possibility is that there was an effect of contextual information. The off-line judgment task did not provide a supporting context, which may have impeded interpretation for some speakers. On the other hand, during the
on-line experiment the participants had an opportunity to fully consult with the context presented.

In cases where a universally quantified NP in object position interacts with negation in English, it was noted that the processing based account gives equal weight to two interpretations in terms of the degree of processing difficulty. Since negation precedes the quantified direct object NP, unlike the subject NP pattern, for the partitioned set interpretation, the processor does not require the revision of an initially assigned reading. The full set interpretation can also be activated with no requirement of revision in that nothing prevents this reading to the universally quantified direct object NP. Thus preference for a specific interpretation in this pattern in English, if any, is not processing oriented.

In Experiments 2 and 8, the native speakers of English preferred the partitioned set interpretation over the full set reading in both the off-line and the on-line comprehension. As discussed in the section on Experiment 8, a pragmatic reason arguably explains the preference for the partitioned set interpretation over the other. Surely, there is a simple way to deliver the full set interpretation by uttering nonambiguous expressions, such as *Cindy lit no candles last night* or *Cindy didn’t light any candles last night.*

Finally, one remaining issue deserves a comment – the locus of processing difficulty in dispreferred interpretations. The rationale of the self-paced reading task in the current study is that processing difficulty of a dispreferred scope interpretation is
identified locally in increased reading times at a particular region compared to the equivalent region in a preferred interpretation.

The native Korean speakers read the target ambiguous sentence more slowly at the negated verb when they assigned it the partitioned set interpretation. See examples (1) and (2).

(1) Universal quantifier in subject position
\[ \text{motun sonyen-i kwukhi-lul an mek-ess-ta} \]
\[ \text{every boy -NOM cookie-ACC NEG eat-PAST-DECL} \]
\[ \text{‘every boy didn’t eat cookies’} \]
slow reading times for the partitioned set interpretation

(2) Universal quantifier in direct object position
\[ \text{sonyen-i motun kwukhi-lul an mek-ess-ta} \]
\[ \text{boy -NOM every cookie-ACC NEG eat-PAST-DECL} \]
\[ \text{‘The boy didn’t eat every cookie.’} \]

The slowdown at this point suggests that the speakers start to integrate the partitioned set interpretation upon encountering the negated verb, which corresponds to the region containing the second operator in the string.

For native English speakers, slowdown in the case of a universally quantified subject NP interacting with negation, occurred at the direct object NP when the sentence was associated with the partitioned set interpretation. See the following sentence.

(3) Universal quantifier in subject position
\[ \text{Every kid didn’t feed the ducks in the pond.} \]
slow reading times for the partitioned set interpretation
In sentences involving a universally quantified direct object NP and negation, the increased reading times were detected at the direct object NP where the sentence was associated with the full set interpretation. See the sentence (4).

(4) Universal quantifier in direct object position
Cindy didn’t light every candle in the pond.
slow reading times for the full set interpretation

In sum, the slowdown point in English appears to correspond to the first region after the region containing the second operator – the negative in (3) and every in (4), suggesting that the resolution of scope ambiguity happens at the first opportunity.

8.3 Second language acquisition and processing

As a follow-up to the native English speakers’ data in Experiments 2, 5 and 8, Experiments 3, 6 and 9 tested Korean speaking learners of English in order to investigate L1 transfer during off-line and on-line processing. Overall, a developmental divergence emerged according to the learners’ L2 proficiency.

Let us first consider the low proficiency group. In both the off-line and the on-line comprehension, irrespective of the syntactic position of a universally quantified NP, the low proficiency learners (the Low-L2 and the Inter-L2 group for the off-line task and the Low group for the on-line task) showed a strong preference for the full set interpretation, which is also strongly favored for both universally quantified subject and direct object NP patterns in their native language. This is particularly interesting in the case of
sentences containing a universally quantified direct object NP and negation, for which the native English speakers strongly favored the partitioned set interpretation over the full set reading (Experiments 2 and 8). Low proficiency learners appear to carry over the interpretive preference from scopally ambiguous sentences in Korean.

Following the processing-based account discussed in the previous section, I argue that for the low proficiency learners, the L2 scope interpretation is determined by L1 processing cost. More specifically, following O’Grady et al. (2008), the preferred interpretation in the L1 is carried over into L2 if the interpretation is not costly in L2. Recall that in sentences containing a universally quantified direct object NP and negation in Korean, the full set interpretation involving no revision is less costly, compared to the partitioned set interpretation, which requires revision during the course of computation. In English, the full set interpretation is as easy as the partitioned set interpretation in the case of a universally quantified object NP, because the full set interpretation can be derived without the need to revise a previously assigned interpretation as can the partitioned set interpretation. Thus nothing prevents low proficiency learners from transferring the full set interpretation from their L1 to their L2.

 Turning to the advanced learners (High-L2 group), they showed a native-like pattern in the off-line task. They showed no specific scope preference for the universally quantified subject NP, similar to native English speakers. They preferred the partitioned set interpretation for the universally quantified direct object NP, as did native English speakers. In on-line comprehension of the universally quantified subject patterns, they showed preference for the full set interpretation, as expected. However, they showed no
preference for either interpretation of the universally quantified direct object patterns, unlike English speakers who strongly preferred the partitioned set interpretation.

The results with the advanced learners are confusing. Before moving on to further discussion of this issue, it is important to note that scope interpretation in the case at hand is not a candidate for poverty of stimulus phenomena in L2 acquisition since commonly used English grammar books in Korea discuss the facts related to scope in English. Although the classroom materials may be somehow responsible to the learners’ performance, this would fail to capture why the advanced learners’ behavior diverges for same type of test sentences.

For instance, in sentences containing a universally quantified direct object NP for the off-line judgment task, the advanced learners showed a native-like pattern, but during the on-line comprehension, their processing was not like that of native speakers. This may derive from time pressure, which was also suggested as an explanation for the inconsistency of results by native speakers of English. Speeded tasks such as the on-line experiments are likely to increase respondents’ computational load. It is therefore possible that the advanced L2 learners’ unexpected findings, particularly during the on-line task for the sentences containing a universally quantified direct object NP, stem from performance factors including the ability to integrate relevant discourse context and individual memory resources. However, it is worth noting that the advanced learners generally responded in a native-like way on sentences containing a universally quantified subject NP. The matter thus remains unsolved.
In sum, the present findings from non-native speakers of English shed light on the processing of scope interpretation, especially the results by low proficiency learners (O’Grady, 2008). With respect to the advanced learners, some questions remain unsolved. Further studies with a more refined methodology are necessary to investigate these mysterious issues.
CHAPTER 9

CONCLUSION

9.1 Concluding remarks

In recent years many developmental studies have focused on young children’s scope interpretation of ambiguous sentences involving a universal quantified NP and negation. My dissertation has extended the topic to the area of adults’ sentence processing, and attempted to document the empirical data from a processing perspective. In particular, I investigated what interpretation can be accessed in comprehension, and how or when the relevant scope interpretation is resolved in real time. To delve into these questions, I have presented a set of off-line and on-line experiments that explored the processing of scope at issue with the native Korean speakers, the native English speakers and the Korean speaking learners of English. The core findings in the experiments were discussed on the basis of the processing-based account of O’Grady et al. (2008), who argues that the nature and acquisition of scopal contrasts is best understood with reference to the operation of an efficiency-driven processor.

However, there are many puzzles left unaddressed. For instance, why does a variation in scope interpretation emerge between the off-line and the on-line tasks? Is such a variation task-dependent or does it rely on individual capacity (e.g., working memory) to integrate resources within a task? Why do advanced L2 learners show signs of both L1 and L2 in sentences containing negation and a universally quantified NP in direct position? If the resolution of scope starts being computed at the first opportunity following the second operator in the string, when does the resolution end? How are the
comprehension results here related to input frequency? Further studies with a more refined methodology should follow to investigate these unsolved issues. Limitations of the current study and some suggestions for future directions are provided in the following section.

9.2 Suggestions for future research

The present study employed a self-paced reading format combined with a truth-value judgment task. The experimental materials were presented in written texts on a computer monitor, with the auditory bias uncontrolled. It is often argued that scope interpretation is determined by the prosodic representations projected upon processing scopally ambiguous sentences (Jackendoff, 1972; Horn, 1989). Each scope interpretation thus can be realized with a different intonation of the sentence, even in the case of a silent reading. In the current experiments it is not clear how prosody played a role in encoding scope during the time course of processing, but the issue should be explored further.

One missing component in my study is the presentation of corpus data. A comprehension task enables us to test a complicated phenomenon, such as scopally ambiguous sentences, which a speaker hardly produces during spontaneous speech, possibly due to a dispreference or avoidance of the particular construction. However, observations about the distributional patterns of language use in the input would alternatively provide an answer as to why certain expressions are easier or harder to access during comprehension (Gennari & MacDonald, 2005/2006).
Another suggestion for future research on the processing of scope interpretation is to have each region consist of a single word rather than a chunk of one or two phrases. One of the most fundamental assumptions in sentence comprehension research is that interpretation is an incremental process in which input is interpreted as rapidly as possible as each word is encountered. Since the self-paced format in the present study used regions consisting of more than one word, it is hard to see whether the processing effect occurs immediately at the relevant point.

Employing an eye tracker is another way to look into the processing of scope interpretation (for overviews, see Marinis, 2003). There have been a few studies that implemented an eye tracking technique to explore doubly quantified sentences containing a universal quantifier and an existential quantifier in a string (e.g., Filik et al., 2004 and 2005), but no attempts were made to examine the ambiguous sentences under consideration here. Since eye movements unfold in different stages over the course of processing, using this technique would enable us to investigate not only the initial reading of the interpretation, but also the reanalysis process in later stages. Another benefit of using an eye-tracker is that the method is child friendly. Despite the abundant number of studies on scope acquisition, no study has yet investigated children’s semantic processing in the interpretation of scopally ambiguous strings from a time course perspective. Given this gap, the findings derived from this technique would provide empirical evidence that children’s cognitive resources are more limited compared to those of adults (Trueswell et al., 1999).
This dissertation added a crosslinguistic set of empirical data to the study of scope interpretation in L1 and L2 research, and argued that the properties and consequence of scope interpretation are processing induced. However, the role of an abstract grammatical device should not be ruled out. Further investigation of the topic and other scope phenomena is necessary to establish a complete picture regarding how the grammar and the processor are related to each other in the case of scope.
APPENDIX A
Experimental materials in Experiments 2 and 3

Universally Quantified Subject NP

1. Every girl didn’t wash her hands in the restroom.
   A. None of the girls washed her hands in the restroom.
   B. Only some girls washed her hands in the restroom.

2. Every professor didn’t eat the sushi in the restaurant.
   A. None of the professors ate the sushi in the restaurant.
   B. Only some professors ate the sushi in the restaurant.

3. Every friend didn’t clear the tables in the dining room.
   A. None of the friends cleared the tables in the dining room.
   B. Only some friends cleared the tables in the dining room.

4. Every boy didn’t pet the giraffes at the zoo.
   A. None of the boys pet the giraffes at the zoo.
   B. Only some boys pet the giraffes at the zoo.

5. Every neighbor didn’t sweep the rooms in Kelly’s house.
   A. Only some neighbors sweep the rooms in Kelly’s house.
   B. None of the neighbors sweep the rooms in Kelly’s house.

6. Every undergraduate didn’t borrow the videos in the museum.
   A. None of the undergraduates borrowed the videos in the museum.
   B. Only some undergraduates borrowed the videos in the museum.

7. Every tenant didn’t close the windows the other day.
   A. None of the tenants closed the windows the other day.
   B. Only some tenants closed the windows the other day.

8. Every kindergartener didn’t ride the carousels in the amusement park.
   A. None of the kindergarteners rode the carousels in the amusement park.
   B. Only some kindergarteners rode the carousels in the amusement park.

9. Every guy didn’t carry a bag during the event period.
   A. None of the guys carried a bag during the event period.
   B. Only some guys carried a bag during the event period.

10. Every actress didn’t open the gifts in the café.
    A. None of the actresses opened the gifts in the café.
    B. Only some actresses opened the gifts in the café.
11. Every singer didn’t sing the songs at the contest.
   A. None of the singers sang the songs at the contest.
   B. Only some singers sang the songs at the contest.

12. Every couple didn’t take the pictures in Hanauma Bay.
   A. None of the couples took the pictures in Hanauma Bay.
   B. Only some couples took the pictures in Hanauma Bay.

13. Every student didn’t read the books in the library.
   A. Only some students read the books in the library.
   B. None of the students read the books in the library.

14. Every organist didn’t play the organ on Tuesdays.
   A. Only some organists played the organ on Tuesdays.
   B. None of the organists played the organ on Tuesdays.

15. Every tourist didn’t bring the umbrellas to the shop.
   A. Only some tourists brought the umbrellas to the shop.
   B. None of the tourists brought the umbrellas to the shop.

16. Every assistant didn’t run the experiments in the lab.
   A. Only some assistants ran the experiments in the lab.
   B. None of the assistants ran the experiments in the lab.

17. Every man didn’t cut out the coupons in the newspaper.
   A. Some of the men cut out the coupons in the newspaper.
   B. None of the men cut out the coupons in the newspaper.

18. Every violinist didn’t order lobster in the restaurant.
   A. Only some violinists ordered lobster in the restaurant.
   B. None of the violinists ordered lobster in the restaurant.

19. Every teller didn’t sell the cookies on the street.
   A. Only some tellers sold the cookies on the street.
   B. None of the tellers sold the cookies on the street.

20. Every niece didn’t draw the flowers in the park.
   A. Only some nieces drew the flowers in the park.
   B. None of the nieces drew the flowers in the park.

21. Every worker didn’t fix the pipes under the sink.
   A. Only some workers fixed the pipes under the sink.
   B. None of the workers fixed the pipes under the sink.
22. Every kid didn’t feed the doves in the park.
   A. Only some kids fed the doves in the park.
   B. None of the kids fed the doves in the park.

23. Every daughter didn’t hang the pictures on the wall.
   A. Only some daughters hung the pictures on the wall.
   B. None of the daughters hung the pictures on the wall.

24. Every cop didn’t chase the robbers toward the direction.
   A. Only some cops chase the robbers toward the direction.
   B. None of the cops chase the robbers toward the direction.

Universally quantified direct object

1. Cindy didn’t light every candle in the night.
   A. Cindy lit only some of the candles in the night.
   B. Cindy lit none of the candles in the night.

2. Sandra didn’t move every cabinet in the office.
   A. Sandra moved only some of the cabinets in the office.
   B. Sandra moved none of the cabinets in the office.

3. Tom didn’t solve every puzzle in the classroom.
   A. Tom solved only some of the puzzles in the classroom.
   B. Tom solved none of the puzzles in the classroom.

4. David didn’t buy every comic in the bookstore.
   A. David bought none of the comics in the bookstore.
   B. David bought only some of the comics in the bookstore.

5. Adam didn’t climb every pyramid in Mexico City.
   A. Adam climbed only some of the pyramids in Mexico City.
   B. Adam climbed none of the pyramids in Mexico City.

6. Mrs. Johns didn’t wrap every gift for her cousins.
   A. Mrs. Johns wrapped only some of the gifts for her cousins.
   B. Mrs. Johns wrapped none of the gifts for her cousins.

7. Cathy didn’t lift every box in the living room.
   A. Cathy ate only some of the boxes in the living room.
   B. Cathy ate none of the boxes in the living room.
8. Annie didn’t wear every boot in winter.
   A. Annie wore only some of the boots in winter.
   B. Annie wore none of the boots in winter.

9. Jenny didn’t set every alarm in the evening.
   A. Jenny set only some of the alarms in the evening.
   B. Jenny set none of the alarms in the evening.

10. Andrea didn’t answer every phone in her office.
    A. Andrea answered only some of the phones in her office.
    B. Andrea answered none of the phones in her office.

11. Daniel didn’t drive every convertible in the auto show.
    A. Daniel drove only some of the convertibles in the auto show.
    B. Daniel drove none of the convertibles in the auto show.

12. Susan didn’t catch every fly in the room.
    A. Susan caught only some of the flies in the room.
    B. Susan caught none of the flies in the room.

13. Paul didn’t pack every bottle in the picnic bag
    A. Paul packed only some of the bottles in the picnic bag.
    B. Paul packed none of the bottles in the picnic bag.

14. Ben didn’t plant every tree in the yard.
    A. Ben planted only some of the trees in the yard.
    B. Ben planted none of the trees in the yard.

15. Mrs. Tupay didn’t use every onion for her cooking.
    A. Mrs. Tupay used only some of the onions for her cooking.
    B. Mrs. Tupay used none of the onions for her cooking.

16. Mike didn’t kick every ball against the wall.
    A. Mike kicked none of the balls against the wall.
    B. Mike kicked only some of the balls against the wall.

17. Judy didn’t boil every potato in the cooking test.
    A. Judy boiled only some of the potatoes in the cooking test.
    B. Judy boiled none of the potatoes in the cooking test.

18. Stacie didn’t scrub every guestroom in the afternoon.
    A. Stacie scrubbed none of the guestrooms in the afternoon.
    B. Stacie scrubbed only some of the guestrooms in the afternoon.
19. Allen didn’t squeeze every lemon during the cooking.
   A. Allen squeezed only some of the lemons during the cooking.
   B. Allen squeezed none of the lemons during the cooking.

20. Doris didn’t drink every beer in the refrigerator.
   A. Doris drank none of the beers in the refrigerator.
   B. Doris drank only some of the beers in the refrigerator.

21. Steven didn’t wipe every chair in the lobby.
   A. Steven wiped only some of the chairs in the lobby.
   B. Steven wiped none of the chairs in the lobby.

22. Chris didn’t swallow every pill in the morning.
   A. Chris swallowed none of the pills in the morning.
   B. Chris swallowed only some of the pills in the morning.

23. Eric didn’t pay every bill in the bank.
   A. Eric paid only some of the bills in the bank.
   B. Eric paid none of the bills in the bank.

24. Brian didn’t smoke every cigarette in the lanai.
   A. Brian smoked none of the cigarettes in the lanai.
   B. Brian smoked only some of the cigarettes in the lanai.
Appendix B
(Experimental materials in Experiments 5 and 6)

Subject Quantified Noun Phrases with negation

(1) Every > Neg
Three female students, Sarah, Jane and Katherine, came into the classroom after playing outside. They looked very dirty. The teacher asked the students to wash their hands in the restroom. However, instead of going to the restroom, they went back to the playground. The teacher recorded the students’ behavior so that he could lower their grade.

Neg> Every
Three female students, Sarah, Jane and Katherine, came into the classroom after playing outside. They looked very dirty. The teacher asked the students to wash their hands in the restroom. Sarah went to the restroom. However, the other two students, Jane and Katherine went directly back to the playground. The teacher recorded the students’ behavior so that he could lower their grade.

According to the story, every girl didn’t wash her hands in the restroom.

(2) Every > Neg
Three visiting Korean professors at UH went to Sorabol to have lunch. Cold noodle is the most famous dish in the restaurant, so they ordered it. Today the owner served three pieces of salmon sushi as a special side dish for them. However, the professors didn’t even try one piece of sushi because they were so busy eating cold noodle. After they went out, the owner was not happy to see that the special side dish was left.

Neg> Every
Three Korean visiting professors at UH went to Sorabol to have lunch. Cold noodle is the most famous dish in the restaurant, so they ordered it. Today the owner served three pieces of salmon sushi as a special side dish for them. Professor Park ate some of the sushi, which was so delicious. However, the other two professors didn’t even try one piece of salmon sushi because they were so busy eating cold noodle. After they went out, the owner was not happy to see that so much of the special side dish was left.

According to the story, every professor didn’t try the sushi in the restaurant.

(3) Every > Neg
Cindy took her three boys to the Honolulu Zoo since they wanted to pet some of the animals. First they saw a gorilla and approached it but as they got closer, the gorilla started growling and the boys thought it would not be safe to pet it. Next they went to two baby giraffes. When the three boys approached them, they ran far away. Then Cindy took them to a birdcage so that they could pet the birds this time.
Neg> Every
Cindy took her three boys to the Honolulu Zoo since they wanted to pet some of the animals. First they saw a gorilla and approached it but as they got closer, the gorilla started growling and the boys thought it would not be safe to pet it. Next they went to two baby giraffes. When Mike petted them, they gave him a happy smile. However, when Joshua and Tom approached them, they ran far away and did not come back. Then, Cindy took the boys to a birdcage so that they could pet the birds this time.

**According to the story, every boy didn’t pet the giraffes at the zoo.**

(4) **Every > Neg**
While Chika was doing her spring-cleaning, three classmates from her math class visited her. They wanted to do their homework together. Since Chika was still in the middle of cleaning, the friends told her that they would help. Chika asked them to clear the tables in the dining room. However, the tables were too dirty to clean quickly. Instead, they told Chika they would organize the kitchen utensils in the dining room.

Neg> Every
While Chika was doing her spring cleaning, Martha, Sandy and Joy from her math class visited her. They wanted to do their homework together. Since Chika was still in the middle of cleaning, the friends told her that they would help. Chika asked them to clear the tables in the dining room. Martha started to clear the tables. Since the friends wanted to finish all cleaning quickly, Sandy and Joy left the table clearing to Martha and they organized the kitchen utensils in the dining room.

**According to the story, every friend didn’t clear the tables in the dining room.**

(5) **Every > Neg**
Last Sunday, three undergraduates went to the museum for their history homework. They had to report what interested them the most after touring the museum. They were all interested in the development of sugar cane plantations in Hawaii and wanted to borrow videos to get more information. However, the person who is in charge of the video section was sick and didn’t come that day. So, they had to move to the galleries to see the picture display.

Neg> Every
Last Sunday, three undergraduates went to the museum for their history homework. They had to report what interested them the most after touring the museum. Chris first borrowed some videos about the development of sugar cane plantations in Hawaii and watched them. Jack and Mike first went to the galleries to see the picture display and came back later to see the videos. However, when they arrived at the video desk, it was about time to close the section and they were not allowed to borrow them. They realized that they had spent too much time in the gallery.
According to the story, every undergraduate didn’t borrow the videos from the museum.

(6) Every > Neg
Kelly will host a house warming party in the afternoon today. Her three neighbors in the Latin dance club volunteered to help her and came together early in the morning. Since Kelly had to go to Safeway to buy food, she asked her neighbors to sweep the messy rooms. When Kelly got back home one hour later, the rooms were the same as they were before and her three neighbors were still chatting on the couch in the living room. Kelly was so upset but she didn’t say anything.

Neg> Every
Kelly will host a house warming party in the afternoon today. Her three neighbors in the Latin dance club volunteered to help her and came together early in the morning. Since Kelly had to go to Safeway to buy food, she asked her neighbors to sweep the messy rooms. When Kelly got back home in one hour, she saw only Jane sweeping the rooms. The other two neighbors, Juliet and Mari, were chatting on the couch in the living room. Kelly was so upset but didn’t say anything to them.

According to the story, every neighbor didn’t sweep the rooms in Kelly’s house.

(7) Every > Neg
Thelma tutors three kindergartners in basic math. One day, she took them to the amusement park because they got an A on the math test. The most popular ride was the roller coaster. They rode it first. Then they moved to the carousel. However, they thought that riding the carousel was too slow and no fun. So they decided not to ride it. Before they went to other rides, they ran to McDonald’s to drink a coke.

Neg> Every
Thelma tutors three kindergartners in basic math. One day, she took them to the amusement park because they got an A on the math test. The most popular ride was the roller coaster. They rode it first. Then they moved to the carousel. Kimberly rode the carousel and had fun. However, the other two children thought that riding the carousel was too slow and no fun. So they decided not to ride it. Before they went to other rides, they ran to MacDonald’s to drink a coke.

According to the story, every kindergartener didn’t ride the carousels in the amusement park.

(8) Every > Neg
Very recently there have been many theft reports around the community. Mrs. Smith warned her three tenants to make sure that all the windows and doors were closed at night. The other day Mrs. Smith happened to find that all the windows in the three tenants’
rooms were open. She thought the tenants might have opened the windows to circulate the air and forgotten to close them. Mrs. Smith will warn them once again about the safety policy.

Neg> Every
Very recently there have been many theft reports around the community. Mrs. Smith warned her three tenants to make sure that all the windows and doors were closed at night. The other day Mrs. Smith happened to find that only Mr. Kim had closed his windows and that the other two tenants had left all the windows open. Mrs. Smith will warn them once again about the safety policy.

According to the story, every tenant didn’t close the windows the other day.

(9) Every > Neg
The magazine reporter met three actresses in the café to interview them. He gave a small gift box to each actress and told her not to open it until she went home. Although the actresses were curious about what was inside their boxes, they put the boxes into their handbags and did not open them until they got home. Then, the actresses happily participated in the interview with the reporter.

Neg> Every
The magazine reporter met three actresses in the café to interview them. He gave a small gift box to each actress and told her not to open it until she went home. They were curious about what was in their boxes. Julia secretly opened her box when the reporter went to the restroom. However, Nicole and Sharon put their boxes into their handbags and decided to open them later at home. Then, they happily participated in the interview with the reporter.

According to the story, every actress didn’t open her box in the café.

(10) Every > Neg
There was a surprise event at the Gucci shop in the Ala Moana Shopping Center. If a male shopper didn’t have any bags when he visited the shop between 10 a.m. and 10:20 a.m. on Monday, he received a cute key chain signed by the Gucci designer. Three Japanese guys came into the shop together for the twenty minutes. Luckily all of them visited the shop with only a shopping center map. They were happy to receive the cute chains for free.

Neg> Every
There was a surprise event at the Gucci shop in the Ala Moana Shopping Center. If a male shopper didn’t have any bags when he visited the shop between 10 a.m. and 10:20 a.m. on Monday, he will receive a cute key chain signed by the Gucci designer. There were three Japanese guys who came into the shop together for the twenty minutes. One
guy was holding a mini bag, but the other two guys’ hands were empty. The guys who happened to receive a free gift were happy.

According to the story, every guy didn’t have a bag during the event period.

(11) Every > Neg
Jason is a tour guide. This afternoon he took three newly wed couples from Europe to Hanauma Bay, one of the most popular tour sites on Oahu. When they arrived there, they were amazed to see the beautiful landscape and they were eager to take pictures. However, they realized that none of them had brought the suitcases containing their cameras due to a sudden schedule change. Jason didn’t have one, either. It was so disappointing.

Neg> Every
Jason is a tour guide. This afternoon he took three newly wed couples from Europe to Hanauma Bay, one of the most popular tour sites on Oahu. When they arrived there, they were amazed to see the beautiful landscape and they were eager to take pictures. However, due to a sudden schedule change, they had to move to the next place right away. Only one couple took pictures in a hurry, but the other two couples had been to the restroom and didn’t have time to take any pictures.

According to the story, every couple didn’t take the pictures in Hanauma Bay.

(12) Every > Neg
Three amateur singers were selected as finalists for a singing contest. A panel of celebrity judges was supposed to ask the three candidates to sing two country songs, which were big hits in the late 70s. They couldn’t remember the lyrics of the songs at all and didn’t even start singing. Naturally, the judges were embarrassed about this.

Neg> Every
Three amateur singers, Betty, Michael and James, were selected as finalists for a singing contest. A panel of celebrity judges is supposed to ask the three candidates to sing two country songs, which were big hits in the late 70s. Betty knew the songs, but the other two singers couldn’t remember the lyrics of the songs at all and didn’t even start singing. One person will be a grand winner. Guess who!

According to the story, every singer didn’t sing the songs at the contest.

(13) Every > Neg
The Newman Center has three organists. Since they have different personal schedules, it has been really difficult to make a plan regarding who comes when. This year, the three organists already have another important job to do on Tuesdays. So, Sister Alicia had to play the organ that day even though she is just an amateur organist.
The Newman Center has three organists. Since they have different personal schedules, it has been really difficult to make a plan regarding who comes when. This year, Sister Alicia was worried because the three organists already have another important job to do on Tuesdays. However, Christina rescheduled her plan and volunteered to play the organ on Tuesdays. Sister Alicia was so happy about this.

**According to the story, every organist didn’t play the organ on Tuesdays.**

(14) **Every > Neg**
Tom, Jerry and Daniel went to the library to write a report after dinner. They first borrowed some books and they were looking for a group table to start reading. Just then, the fire alarm went off and people had to take shelter in the underground passage. By the time everything was settled, it was time to close the library. So, they had to check out the books to read them at home.

**According to the story, every student didn’t read the books in the library.**

(15) **Every > Neg**
It was unusual for there to be only three tourists in the ABC store since the shop is almost always crowded. The tourists were happy to be able to slowly browse a wide selection of gift and souvenir items. Suddenly it started to rain hard outside. Since they had left their umbrellas back at their hotel, they had to wait until the rain stopped. So they continued browsing in the store.

**According to the story, every tourist didn’t bring the umbrellas to the shop.**
(16) Every > Neg
Professor Harris asked three assistants to run a two-hour experiment in the lab because they needed to prepare for the next lab class. Right after the professor went out, two of his assistants took out the laptop to play games and another assistant started to listen to music for the full two hours, not even looking at the experiment for one minute. Later when the professor came back to check, he got very upset.

Neg> Every
Professor Harris asked three assistants to run a two-hour experiment in the lab because they needed to prepare for the next lab class. An assistant who joined the group just last week worked hard to run the experiments. However, right after the professor went out, the other two took out the laptop to play games. Later when the professor came back to check, he got very upset.

According to the story, every assistant didn’t run the experiments in the lab.

(17) Every > Neg
Dr. Chen opened a dental practice downtown. Since today is the first day that the office is open to the public, people over 60 years old could get a free dental check-up if they had cut out a coupon from the newspaper. Three old men went to Dr. Chen’s office in the morning time. When they arrived at the dental practice, they realized that they hadn’t cut out the coupons. It was too far to go back to their home and they told the nurse that they would bring the coupons back later.

Neg> Every
Dr. Chen opened a dental practice downtown. Since today is the first day that the office is open to the public, people over 60 years old could get a free dental check-up if they had a coupon from the newspaper. Three old men went to Dr. Chen’s office in the morning time. One man showed his coupon to the nurse at the front desk, but the other two men had forgotten to cut out their coupons. It was too far to go back to their home and they told her that they would bring the coupons back later.

According to the story, every man didn’t cut a coupon from the newspaper.

(18) Every > Neg
Three amateur violinists went to a fancy Chinese restaurant to celebrate after they finished their recital. They first ordered Chinese beer and looked at the menu. Although the red lobster looked appetizing, they all had an allergy to lobster. Instead, they ordered bamboo-wrapped chicken, Chinese omelets, big dumplings and ginger beef.

Neg> Every
Three amateur violinists went to a fancy Chinese restaurant to celebrate after they finished their recital. They first ordered Chinese beer and looked at the menu. Although the red lobster looked appetizing, only one violinist ordered it because the other two
musicians had an allergy to lobster. Instead, they ordered bamboo-wrapped chicken, Chinese omelets, and big dumplings.

Neg> Every

According to the story, every violinist didn’t order lobster in the restaurant.

(19) Every > Neg

When Christmas came around, the bank wanted to participate in some charitable activities. Three tellers volunteered to sell cookies, candy and chocolates and to donate money to the less fortunate. Today was their first day. When they opened the boxes, however, the cookies inside were all broken. Fortunately, the other items still looked good and they decided to sell only those good-looking items.

Neg> Every

When Christmas came around, the bank wanted to participate in some charitable activities. Three tellers volunteered to sell cookies, candy and chocolates and to donate money to the less fortunate. Today was their first day. However, when Joe and Cliff opened the boxes, the cookies inside were all broken and they had to sell only candies and chocolates. Fortunately, Sandy’s cookies still looked good and Sandy could sell the cookies as well as the other snacks.

According to the story, every teller didn’t sell cookies on the street.

(20) Every> Neg

After early brunch on Saturday Yao took her three nieces to Kapiolani Park to practice drawing. Next Sunday, there will be a big drawing contest for small children in Honolulu. The flowers bloomed in large clusters among the leaves, making the landscape so beautiful and Yao asked her nieces to draw the flowers today. However, when the nieces got together one hour later, it turned out that they didn’t draw the flowers but drew a fluffy puppy instead. They said that the puppy was prettier than the flowers and that they were just tempted to draw it.

Neg>Every

After early brunch on Saturday Yao took her three nieces to the Kapiolani Park to practice drawing. Next Sunday, there will be a big drawing contest for small children in Honolulu. The flowers bloomed in large clusters among the leaves, making the landscape so beautiful and Yao asked her nieces to draw the flowers today. In one hour the oldest niece brought her flower drawing to Yao but the younger nieces showed their fluffy puppy drawings. They said that the puppy was much prettier than the flowers and that they were just tempted to draw it.

According to the story, every niece didn’t draw the flowers in the park.
(21) Every>Neg
The faucet was leaking and Susan found two broken pipes under the kitchen sink. Just then, three male classmates visited Susan to discuss a school project with her. Since she wanted to save plumbing money, she asked them to repair the pipes. However, the men were not mechanically inclined and they kindly refused to try fixing them. Susan had to call a plumber to work on the pipes.

Neg>Every
The faucet was leaking and Susan found two broken pipes under the kitchen sink. Just then, three male classmates visited Susan to discuss a school project with her. To save plumbing money she asked her classmates to help fix the pipes. Since John and Tom were not mechanically inclined, they couldn’t help. However, Ralph carefully began to work on the pipes and fixed them. Susan was so happy and promised to treat him to dinner later.

According to the story, every man didn’t fix the pipes under the sink.

(22) Every>Neg
Mrs. Keenan and her three kids were enjoying the beautiful sunset while taking a walk in the park. Suddenly many doves flocked to the park. Since the kids were afraid to come near them, they stepped back and watched other people feeding the doves from a distance.

Neg>Every
Mrs. Keenan and her three kids were enjoying the beautiful sunset while taking a walk in the park. Suddenly many doves flocked to the park. Joy and Martina were afraid to come near them and they stepped back. However, Alfred remained there to feed bread crumbs to the doves.

According to the story, every kid didn’t feed the doves in the park.

(23) Every>Neg
According to the news, a man called 911 to report that two armed robbers were stealing money from the Seven-Eleven store. He said that the robbers displayed a gun and forced the clerk to open the cash register. Although three cops arrived at the store immediately, the robbers had already fled in a southeast direction. The cops reported back to the police station about the current situation and waited for the next development.

Neg>Every
According to the news, a man called 911 to report that two armed robbers were stealing money from the Seven-Eleven store. He said that the robbers displayed a gun and forced the clerk to open the cash register. Although three cops arrived at the store immediately, the robbers had already fled in a southeast direction. One cop drove his car in that direction. The remaining two cops reported back to the police station about the current situation and waited for the next development.
According to the story, every cop didn’t chase the robbers toward the southeast.

(24) Every>Neg
Before the sick widow died, she gave some old pictures to her three daughters. The pictures were all taken a long time ago when the daughters were really happy. Although the daughters thought of hanging the pictures on the wall so they could look at them all the time, they didn’t do so because the pictures made them feel sad.

Neg>Every
Before the sick widow died, she gave some old pictures to her three daughters. The pictures were all taken a long time ago when the daughters were really happy. Although the daughters thought of hanging the pictures on the wall so they could look at them all the time, only the youngest daughter did so. The two older daughters just kept the pictures in a box because they didn’t want to feel sad.

According to the story, every daughter didn’t hang the pictures on the wall.
Appendix C
Experimental materials in Experiments 8 & 9

Object Quantified Noun Phrases with negation (24 items)

1. Neg > Every
Last night Cindy worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. She took out one candle and lit it. Then she started reading a novel until she fell asleep.

Every > Neg
Last night Cindy worked late and came back home around midnight. Right after she took a shower, the electric lights suddenly went out. She found three candles on the table near the bed. However, since she was so tired, she didn’t light the candles but went to sleep directly in the dark.

According to the story, Cindy didn’t light every candle in the night.

2. Neg > Every
Sandra’s office mates decided to do spring cleaning today, and Sandra was asked to take care of rearranging and cleaning three cabinets. After considering the best way to arrange things, she moved one cabinet to put it right beside the door and cleaned it. When she was walking towards the second cabinet, however, she got an emergency call from home and she had to leave right away. Sandra apologized to her colleagues because the remaining two unclean cabinets were still in the same old spot.

Every > Neg
Sandra’s office mates decided to do spring cleaning today, and Sandra was asked to take care of rearranging and cleaning three cabinets. While she was walking towards the cabinets, however, she got an emergency call from home and she had to leave right away. Sandra apologized to her colleagues because she didn’t do the assigned work and all the unclean cabinets were still in the same old spot.

According to the story, Sandra didn’t move every cabinet in the office.

3. Neg > Every
Tom had to stay indoors after class because of a big traffic accident near his house. Mr. Kim put three puzzles on the blackboard while he was waiting. One puzzle was easy and he answered it with ease. However, he had not answered the other two puzzles, which were more difficult, by the time it was safe to go home. Mr. Kim asked Tom to solve the unsolved puzzles as additional homework.

Every > Neg

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Tom had to stay indoors after class because of a big traffic accident near his house. Mr. Kim put three puzzles on the blackboard while he was waiting. Although Tom worked hard to solve them, the puzzles were too difficult and he could not solve them before it was safe to go home. Mr. Kim asked Tom to solve the unsolved puzzles as additional homework.

**According to the story, Tom didn’t solve every puzzle in the classroom.**

4. **Neg > Every**
David stopped by the bookstore on the way back home to buy three comic books for his son, Robert. Robert got a B+ in the math quiz, which was a big jump from the previous test. Although Robert wanted his dad to buy all three comic books for him, David bought only one and decided to save the other two books for next time.

**Every > Neg**
David stopped by the bookstore on the way back home to buy three comic books for his son, Robert. Robert got a B+ in the math quiz, which was a big jump from the previous test. However, the bookstore didn’t have the books that Robert wanted to read. So, David didn’t buy any this time and decided to save the books for next time.

**According to the story, David didn’t buy every comic in the bookstore.**

5. **Neg > Every**
While touring Mexico City with friends, Jim visited the pyramids to the north of the city. At the site there were three pyramids and a number of smaller structures, walls, steps, small buildings and the like. Jim climbed one large pyramid and it seemed as if he could touch the sky. It was awesome! Although he wanted to climb the other two pyramids, he had to move on to the next place.

**Every > Neg**
While touring Mexico City with friends, Jim visited the pyramids to the north of the city. At the site there were three pyramids and a number of smaller structures, walls, steps, small buildings and the like. Jim eagerly wanted to climb the pyramids. However, since Jim broke his ankle, he couldn’t do so. He watched his friends climbing them, instead. It was still awesome!

**According to the story, Jim didn’t climb every pyramid in Mexico City.**

6. **Neg > Every**
Tomorrow is Children’s Day and Mrs. Johns’ little cousins are looking forward to receiving gifts. Mrs. Johns bought three toys at the Disney Store the other day and she wanted to wrap them for her cousins. Mrs. Johns took out the wrapping paper from the
desk drawer, but there was enough paper to wrap only one toy. So, she had to give two unwrapped toys to her cousins.

Every > Neg
Tomorrow is Children’s Day and Mrs. Johns’ little cousins are looking forward to receiving gifts. Mrs. Johns bought three toys at the Disney Store the other day and she wanted to wrap them for her cousins. Mrs. Johns took out the wrapping paper from the desk drawer, but there was not enough paper to wrap them. So, she had to give the unwrapped toys to her cousins.

According to the story, Mrs. Johns didn’t wrap every gift for her cousins.

7. Neg > Every
Cathy and Tom just moved into a new apartment this morning and they have been busy unpacking things all day long. When there were only three book boxes left in the living room, Tom had to leave for an appointment with his customer. Cathy lifted the smallest box which contained old books and put it on the top of the cabinet. She couldn’t lift the other two boxes because they were so heavy. So she just took the books out and started to organize the book shelf.

Every > Neg
Cathy and Tom just moved into a new apartment this morning and they have been busy unpacking things all day long. When there were only three book boxes left in the living room, Tom had to leave for an appointment with his customer. Cathy tried to lift the smallest box containing old books in order to put it on the top of the cabinet, but it was too heavy to lift. Instead, she opened all three boxes and took the books out. Then, she started to organize the book shelf with the books.

According to the story, Cathy didn’t lift every box in the living room.

8. Neg > Every
Annie’s aunt, who lives in Australia, sent three pairs of boots of different colors to Annie as a Christmas gift this winter. Annie was so happy to see that the boots were all handmade in Australia from premium quality 100% sheepskin. As first Annie wore the beige pair to school but after a couple of days a rash broke out on her feet. She didn’t know that she had an allergy to sheepskin until then. It was so disappointing not to be able to wear them any longer.

Every > Neg
Annie’s aunt, who lives in Australia, sent three pairs of boots to Annie as a Christmas gift this winter. Annie knew that the boots were all handmade in Australia from premium quality 100% sheepskin. However, alas, she knew that she had an allergy to sheepskin, and that a rash would break out on her feet if she wore the boots. It was so disappointing not to be able to wear them. Instead, Annie gave them to her sister.
According to the story, Annie didn’t wear every boot this winter.

9. Neg > Every
Jenny’s boss is a very early riser and very punctual. He advises other employees to be punctual as well, particularly in the morning. Tomorrow there is a morning meeting for which Jenny should set up the table in advance. Before she went to bed, she got her three alarm clocks from the drawer. But all of them were out of order. She got nervous and couldn’t sleep.

Every > Neg
Jenny’s boss is a very early riser and very punctual. He advises other employees to be punctual as well, particularly in the morning. Tomorrow there is a morning meeting for which Jenny should set up the table in advance. Before she went to bed, she got her three alarms clocks from the drawer. But only one alarm was working. She got nervous because one alarm wasn’t loud enough to wake her up.

According to the story, Jenny didn’t set every alarm in the evening.

10. Neg > Every
At lunch time on Monday, only Andrea remained in the office while her office mates went out for lunch. She had to turn in a report in one hour. There are three telephones in Andrea’s office. All of a sudden, all three telephones started ringing almost simultaneously. Andrea picked up only the one near her desk. However, it turned out that the person on the phone had a wrong number. The two other phones were still ringing but she just ignored them, concentrating on her work.

Every > Neg
At lunch time on Monday, only Andrea remained in the office while her office mates went out for lunch. She had to turn in a report in one hour. There are three telephones in Andrea’s office. All of a sudden, all three telephones started ringing almost simultaneously. Since she was so busy to do her work, she ignored all of them. She thought it would be okay since it is now lunch time.

According to the story, Andrea didn’t answer every phone in her office.

11. Neg > Every
An international auto show was held in the Jacob Convention Center, which opened to the public on Saturday. Daniel went there to check out the latest automobiles. He was interested in convertibles and three new models of convertibles were introduced there. The show host asked members of the public to volunteer to drive the cars outdoors. Daniel raised his hand and was chosen to drive his favorite car. Although he wanted to drive the two other models as well, he yielded them to other people.
Every > Neg
An international auto show was held in the Jacob Convention Center, which opened to the public on Saturday. Daniel went there to check out the latest automobiles. He was interested in convertibles and three new models of convertibles were introduced there. The show host asked members of the public to volunteer to drive the cars outdoors. Although Daniel raised his hand, the host didn’t see him and the wonderful opportunity was given to other people.

According to the story, Daniel didn’t drive every convertible at the auto show.

12. Neg > Every
Ben bought three small trees and put them in the yard for one night. However, the following day he found that two of them had been killed by a sudden frost and only one still looked fine. So, he planted the good tree in the yard on Arbor Day. He still wants to buy more grass and trees to make the backyard beautiful.

Every > Neg
Ben bought three small trees and put them in the yard for one night. However, the following day he found that all of them had been killed by a sudden frost. He blamed himself because he hadn’t planted them right away. He still needs to buy more grass and trees to make the backyard beautiful.

According to the story, Ben didn’t plant every tree in the yard.

13. Neg > Every
Tomorrow Paul will go camping with his French reading club friends. He bought three bottles of water and put them in the freezer to make them icy cold. The next day, he found that two of the bottles had cracks in them and that only one was fine. He learned that he should not have set the temperature so low. Anyhow, he decided to pack only one bottle of iced water.

Every > Neg
Tomorrow Paul will go camping with his French reading club friends. He bought three bottles of water and puts them in the freezer to make them icy cold. The next day, he found that all of the bottles had cracks in them. He learned that he should not have set the temperature so low. Anyhow, he couldn’t take them to the picnic and he had to ask his friend to drink something else.

According to the story, Paul didn’t pack every bottle for the picnic.

14. Neg > Every
On a steamy summer day three flies were annoying Susan while she was reading articles for her chemistry exam. She tried to catch the flies but she ended up catching only one of them. When she approached the other two flies, they flew away through the window. She closed the window quickly.
On a steamy summer day three flies were annoying Susan while she was reading articles for her chemistry exam. She tried to catch the flies but it was not easy. After the flies were flying around for a while, they finally went out through the window. She closed the window quickly.

According to the story, Susan didn’t catch every fly in the room.

Mrs. Tupay wanted to cook long rice for her daughter’s birthday party on Friday. She bought three onions the other day and put them on the lanai because the containers in the refrigerator were so full. On Friday morning, she brought the onions to cook and found out that two onions were rotten. So, Mrs. Tupay had to use only one onion to cook the long rice. Instead, she added more of other vegetables.

According to the story, Mrs. Tupay didn’t use every onion for her cooking.

Mike joined a junior soccer club recently and the coach was teaching him how to kick the ball properly. He was asked to practice kicking three balls against the wall for three hours. His work was to kick each ball fifty times rapidly and repeatedly. Mike picked up one ball and started to kick it at varying distances. However, when the coach came back in three hours, Mike was still kicking the first ball and other two balls remained untouched.

According to the story, Mike didn’t kick every ball against the wall.
17. Neg > Every
In order to be a chef at a fancy restaurant, Judy had to pass a difficult test that included actual cooking in public. In the test she was given three potatoes along with other vegetables, and she had to demonstrate a special menu with those common ingredients within the time limit. She finally decided to cook a potato salad which she learned to make in Europe. At first, she baked one big potato and prepared the rest of the mixture. Although she realized later that she needed more baked potatoes, it was too late to bake the remaining two potatoes. It was so frustrating.

Every > Neg
In order to be a chef at a fancy restaurant, Judy had to pass an actual cooking test in public. In the test she was given three potatoes along with other vegetables, and she had to demonstrate a special menu with those common ingredients within the time limit. She finally decided to cook a potato salad which she learned in Europe. She knew that the potatoes should be baked according to the original recipe but she boiled them together to save time. What if the taste is different? She is worried but it is too late!

According to the story, Judy didn’t bake every potato in the test.

18. Neg > Every
This evening, many relatives will visit Mrs. Harris’ house for a three-day family gathering. Mrs. Harris asked her daughter, Stacie, to mop and scrub three guestrooms in the afternoon. After she mopped and scrubbed the first room, however, her lower back was throbbing and her arms felt sore. Although the remaining rooms still needed a good scrubbing, she walked back to her bedroom to take a nap after finishing only the mopping.

Every > Neg
This evening, many relatives will visit Mrs. Harris’ house for a three-day family gathering. Mrs. Harris asked her daughter, Stacie, to mop and scrub three guestrooms in the afternoon. After she finished mopping the rooms, however, her lower back was throbbing and her arms felt sore. Although the three rooms still needed a good scrubbing, she walked back to her bedroom to take a nap, wiping sweat from her forehead.

According to the story, Stacie didn’t scrub every guestroom in the afternoon.

19. Neg > Every
Allen was cooking fish fillets for his girlfriend. To remove the fishy smell, he took out three lemons from the refrigerator. However, only one lemon looked fresh and the other two lemons had gone bad. Since he didn’t have time to go shopping again, he just tried to squeeze the fresh lemon, making sure to use every last drop.

Every > Neg
Allen was cooking fish fillets for her girlfriend. To remove the fishy smell he took out three lemons from the refrigerator. However, he could tell that all of them were too old to
use. Since he didn’t have time to go shopping again, this time he used ginger and green onion. He hopes that they will have a good effect as well.

**According to the story, Allen didn’t squeeze every lemon during the cooking.**

20. *Neg > Every*

After a hard workout at the gym, Jack felt thirsty. He opened the refrigerator and found that there were three cans of Bud Light. He drank one can to cool off. Although he wanted to drink more, he remembered that he was advised to consider the calories in beer by his doctor, so he drank cold water instead.

*Every > Neg*

After a hard work out at the gym, Jack felt thirsty. He opened the refrigerator and found that there were three cans of Bud Light. Although he wanted to drink beer, he remembered that was advised to consider the calories in beer by his doctor. So, he drank cold water instead.

**According to the story, Jack didn’t drink every beer in the refrigerator.**

21. *Neg > Every*

Steven, who finished work early, was waiting for Kelly in the hotel lobby. They had a plan to attend an opera after work. He looked around for a chair. There were three chairs in the lobby but all of them looked dirty. Steven went to the restroom and moistened paper tissues. He wiped off one chair and sat on it. Then he started to read a newspaper.

*Every > Neg*

Steven, who finished work early, was waiting for Kelly in the hotel lobby. They had a plan to attend an opera after work. He looked around for a chair. There were three chairs in the lobby, but all of them looked so dirty. He couldn’t find anything to wipe the chairs with, so he had to stand and lean against the wall. Then he started to read a newspaper.

**According to the story, Steven didn’t wipe every chair in the lobby.**

22. *Neg > Every*

Chris caught a cold and had a fever shooting up to 105 degree Fahrenheit last night. He had to swallow three pills 30 minutes before a meal. This morning he swallowed one pill first but couldn’t do the remaining two pills. So, he had them crushed by his mom. Mom thought that Chris never had a problem swallowing pills but he told her that he seemed to have developed a phobia since he had a choking incident one month ago.

*Every > Neg*

Chris caught a cold and had a fever shooting up to 105 degree Fahrenheit last night. He had to swallow three pills 30 minutes before a meal. Chris never had a problem
swallowing pills before but couldn’t swallow them this morning. So, he had them crushed by his mom. He seemed to have developed a phobia since he had a choking incident one month ago.

According to the story, Chris didn’t swallow every pill in the morning.

23. Neg > Every
This afternoon when Eric came back from a one-month trip, he found outstanding bills for the phone, water and electricity. He realized that the bills would be doubled due to the late charge if he didn’t pay them by today. Since he didn’t have time, he wanted to pay them online. First he paid the water bill quickly. However, when he opened the Web sites for the remaining two bills, the payment services were temporally unavailable. That was really annoying to him.

Every > Neg
This afternoon when Eric came back from a one-month trip, he found outstanding bills for the phone, water and electricity. He realized that the bills would be doubled due to the late charge if he didn’t pay them by today. Since he didn’t have time, he wanted to pay them online. However, when he opened the Web sites for the remaining two bills, the payment services were temporally unavailable. That was really annoying to him.

According to the story, Eric didn’t pay every bill online.

24. Neg > Every
Brian decided to quit smoking and threw away all the cigarettes he had yesterday. However, while he was cleaning his room this afternoon, he found three cigarettes on the bookshelf. He couldn’t resist the temptation to smoke and he went out to the lanai and smoked one cigarette. He felt very guilty, but he made a new resolution to quit smoking from that moment.

Every > Neg
Brian decided to quit smoking the other day and threw away all the cigarettes he had. However, while he was cleaning his room today, he found three cigarettes on the bookshelf. Although he was tempted to smoke, he didn’t. Instead, he went out to the lanai to take a deep breath.

According to the story, Brian didn’t smoke every cigarette on the lanai.
APPENDIX D
Background Questionnaire (Native speakers of Korean)

This survey is used to collect information about your language learning background. The information that you provide on this questionnaire will be maintained in strict confidentiality and only seen by the researcher herself. Please answer the following questions.

1. Participant’s name: ___________________ Subject Number: _______________
2. Gender: Male [ ] Female [ ]
3. Age: _______________
4. University Level: Undergraduate [ ] Graduate [ ]
5. Major: _______________
6. What is your native language? _______________
7. What other languages do you know?
   Second language: _______________ Third language: _______________
8. At what age did you begin learning English? _____ years old
9. How long have you been studying English? If you are still learning English, please consider the current period as well.
10. How frequently do you use English everyday?
    Reading: About _____ hours Listening: About _____ hours
    Writing: About _____ hours Speaking: About _____ hours
11. If you have ever lived and/or studied for longer than 6 months in countries where English is spoken as a primary language, provide the total length of residence and the name of the country of residence.
    Length of residence: From _____ years old To _____ years old
    Name of the country: ____________________________
12. Have you studied linguistics before?
    NO
    YES: What kind of linguistics courses have you taken?
13. How do you self-rate overall proficiency of your English?
    Beginner [ ] Intermediate [ ] Advanced [ ] Near Native [ ]
14. If you have taken TOEIC and/or TOEFL, please specify your most recent score and provide when you took one.
    What _________ When _________ Score _________
15. Please provide your cellular phone number and email address in order to make an appointment for the next experiment.
   Phone____________________ E-mail ____________________

   Thank you very much for your cooperation!
APPENDIX E
CLOZE TEST

DIRECTIONS
1. Read the passage quickly to get the general meaning.
2. Write only one word in each blank next to the item number. Contractions (example: don’t) and possessives (John’s bicycle) are one word.
3. Check your answers.

NOTE: Spelling will not count against you as long as the scorer can read the word.

EXAMPLE: The boy walked up the street. He stepped on a piece of ice.
He fell (1) down but he didn’t hurt himself.

-----------------------------------------------------------------------------------------------------

MAN AND HIS PROGRESS

Man is the only living creature that can make and use tools. He is the most teachable of living beings, earning the name of Homo sapiens. (1) ever restless brain has used the (2) and the wisdom of his ancestors (3) improve his way of life. Since (4) is able to walk and run (5) his feet, his hands have always (6) free to carry and to use (7). Man’s hands have served him well (8) on earth. His development, (9) can be divided into three major (10), is marked by several different ways (11) life.

Up to 10,000 years ago, (12) human beings lived by hunting and (13). They also picked berries and fruits, (14) dug for various edible roots. Most (15), the men were the hunters, and (16) women acted as food gatherers. Since (17) women were busy with the children, (18) men handled the tools. In a (19) hand, a dead branch became a (20) to knock down fruit or to (21) for tasty roots. Sometimes, an animal (22) served as a club, and a (23) piece of stone, fitting comfortably into (24) hand, could be used to break (25) or to throw at an animal. (26) stone was chipped against another until (27) had a sharp edge. The primitive (28) who first thought of putting a (29) stone at the end of a (30) made a brilliant discovery: he (31) joined two things to make a (32) useful tool, the spear. Flint, found (33) many rocks, became a common cutting (34) in the Paleolithic period of man’s (35). Since no wood or bone tools (36) survived, we know of this man (37) his stone implements, with which he (38) kill animals, cut up the meat, (39) scrape the skins, as well as (40) pictures on the walls of the (41) where he lived during the winter.

(42) the warmer seasons, man wandered on (43) steppes of Europe without a fixed (44), always foraging for food. Perhaps the (45) carried nuts and berries in shells (46) skins or even in light, woven (47). Wherever they camped, the primitive people (48) fires by striking flint for sparks (49) using

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dried seeds, moss, and rotten (50) _______ for tinder. With fires that he kindled himself, man could keep wild animals away and could cook those that he killed, as well as provide warmth and light for himself.

**Answer keys**

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<th>Blank</th>
<th>Exact</th>
<th>Acceptable</th>
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<td>his</td>
<td>man’s, our, the</td>
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<tr>
<td>3</td>
<td>to</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>man</td>
<td>he</td>
</tr>
<tr>
<td>5</td>
<td>on</td>
<td>upon, using, with</td>
</tr>
<tr>
<td>6</td>
<td>been</td>
<td>felt, hung, remained</td>
</tr>
<tr>
<td>7</td>
<td>tools</td>
<td>adequately, carefully, conventionally, creatively, diligently, efficiently, freely, implements, objects, productively, readily, them, things, weapons</td>
</tr>
<tr>
<td>8</td>
<td>during</td>
<td>all, for improving, in, through, throughout, with</td>
</tr>
<tr>
<td>9</td>
<td>which</td>
<td>also, basically, conveniently, easily, historically, however, often, since, that, thus</td>
</tr>
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<td>10</td>
<td>periods</td>
<td>areas, categories, divisions, eras, facets, groups, parts, phrases, sections, stages, steps, topics, trends</td>
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<tr>
<td>11</td>
<td>of</td>
<td>for, in, through, towards</td>
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<td>all</td>
<td>early, hungry, many, most, only, primitive, the, these</td>
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<td>13</td>
<td>fishing</td>
<td>farming, foraging, gathering, killing, scavenging, scrounging, sleeping, trapping</td>
</tr>
<tr>
<td>14</td>
<td>and</td>
<td>often, ravenously, some, the</td>
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<td>15</td>
<td>often</td>
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</tr>
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<td>18</td>
<td>the</td>
<td>all, constructive, many, most, older, primate, tough, younger</td>
</tr>
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<td>19</td>
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<td>able, big, closed, coordinated, creative, deft, empty, free, human(‘s), hunter’s, learned, needed, needy, person’s, right, single, skilled, skillful, small, strong, trained</td>
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<tr>
<td>20</td>
<td>tool</td>
<td>club, device, instrument, pole, rod, spear, stick, weapon</td>
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<tr>
<td>21</td>
<td>dig</td>
<td>burrow, excavate, probe, search, test</td>
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<td>bone</td>
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<td>sharp</td>
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<td>24</td>
<td>the</td>
<td>a, his, man’s one(‘s)</td>
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<td>25</td>
<td>nuts</td>
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<td>one</td>
<td>a, each, flat, flint, glass, hard, obsidian, shale, softer, some, the,</td>
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then, this, each, one, they

27 it each, one, they
28 man being, creature, human’s, hunter, men, owner, people, person
29 sharp glass, hard, jagged, large, lime, pointed, sharpened, small
30 stick bone, branch, club, log, pole, rod, shaft
31 had accidentally, cleverly, clumsily, conveniently, creatively,
dexterously, double, easily, first, ingeniously, securely, simply,
soon, suddenly, tastefully, tightly, then, would
32 very bad, extremely, good, hunter’s, incredibly, intelligent, long,
modern, most, necessarily, new, portentously, quite,
tremendously, useful
33 in all, among, amongst, by, inside, on, that, using, within
34 tool device, edge, implement, instrument, item, material, method,
object, piece, practice, stone, utensil
35 development age, ancestry, discoveries, era, evolution, existence, exploration,
history, life, time
36 have actually, apparently, ever
37 by and, for, from, had, made, through, used, using
38 could did, would
39 and carefully, help, or, skillfully, then, would
40 draw carve, create, drawing, engrave, hang, paint, painting, place,
sketch, some, the
41 cave(s) animals, place(s), room
42 in and, during, with
43 the across, aimless, all, barren, in, dry, flat, high, long, many, plain,
stone, through, to, toward, unknown, various
44 home appetite, camp, course, destination, destiny, diet, direction,
domain, foundation, habitant, income, knowledge, location,
lunch, map, meal, path, pattern, place, plan, route, supplement,
supply, time, weapons
45 women children, families, group, human, hunter, man, men, people,
primitives, voyager, wanderers, woman
46 or and, animal, animal’s, covered, in, like, of, on, their, using, with
47 baskets bags, blankets, chests, cloth(es), fabric, garments, hides, material,
ets, pouches, sacks
48 made began, built, lighted, lit, produced, started, used
49 and also, by, occasionally, or, then, together, while
50 wood bark, branches, drug, forage, grass, leaves, lumber, roots, skin,
timber, tree(s)
### APPENDIX F
Individual data by KOR-L2 group

#### Experiment 3
Responses to Scope interpretation (%) by KOR-L2 group

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<th>Object-every</th>
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**Experiment 6**

Mean percentages (%) of True or False responses by KOR-L2 group

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**Experiment 9**
Mean percentages (%) of True or False responses by KOR-L2 group
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| High s05 | 83.3 | 50.0 |
| High s06 | 75.0 | 58.3 |
| High s07 | 75.0 | 100.0 |
| High s08 | 50.0 | 58.3 |
| High s09 | 66.7 | 58.3 |
| High s10 | 83.3 | 75.0 |
| High s11 | 83.3 | 91.7 |
| High s12 | 100.0 | 90.9 |
| High s13 | 75.0 | 91.7 |
| High s14 | 91.7 | 83.3 |
| High s15 | 91.7 | 83.3 |
| High s16 | 91.7 | 75.0 |
| High s17 | 81.8 | 72.7 |
| High s18 | 81.8 | 63.6 |
# APPENDIX G
## RELEVANT BACKGROUND INFORMATION OF THE KOREAN SUBJECTS

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