TENSE-ASPECT PROCESSING IN SECOND LANGUAGE LEARNERS

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This dissertation provides a language processing perspective on the study of second language acquisition (SLA) of tense and aspect. Of special interest are the universal vis-à-vis language-specific dimensions of temporal and aspectual semantics involved. According to the Aspect Hypothesis (AH, e.g. Andersen & Shirai, 1994), the initial acquisition and subsequent emergence of (perfective) past tense and progressive aspect morphology follow a semantic-driven, universal sequence. The AH appeals to a cognitive-based prototype account (Shirai & Andersen, 1995), and has gained ample empirical support from offline data in the past two decades. Mounting evidence of transfer, however, has begun to emerge in recent psycholinguistic research, suggesting that grammatical aspectual categories such as the English progressive (*be V-ing*) have non-trivial influence on principles of information organization in language comprehension among L2 learners and bilingual speakers (Stutterheim & Carroll, 2006).

This dissertation undertakes a psycholinguistic investigation of L2 learners' processing of English past and progressive morphology. Participants included native English speakers as well as English L2 learners from Korean, German, and Mandarin Chinese backgrounds, whose L1s differ systematically with respect to past and progressive morphology. This cross-linguistic design enabled a systematic testing of both the prototype and transfer hypotheses in one single study. Three word-by-word self-paced reading experiments examined L2 learners' automaticity in morphological processing, the universality of tense-aspect prototypes, and aspectual coercion.

Experiment I generated evidence that L2 learners were generally capable of detecting tense-aspect morphosyntactic errors online. Reading time results from Experiment II revealed that L2 learners did not show uniform processing advantages afforded by tense-aspect prototypes. Instead, there exist L1 effects in prototypes, at least from evidence in processing L2 tense-aspect distinctions. Experiment III investigated the processing consequences of aspectual coercion in L2 learners, and results indicated strong L1 influence. The most robust finding across the three experiments is that the L2 learners showed clear L1-based variations in their performance, reflecting a strong tendency for transfer. Notably, these results were obtained after controlling for L2 proficiency and inflected verb form frequencies. A more prominent role of L1 influence is implicated in L2 learners' representation of tense-aspect prototypes than previously assumed.

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ABBREVIATIONS

ACC: accusative case

AH: Aspect Hypothesis

ANCOVA: analysis of covariance

ANOVA: analysis of variance

CL: classifier

ESF: European Science Foundation

IMPERF: imperfective aspect

L1: first language

L2: second language

LOC: locative

MTELP: Michigan Test of English Language Proficiency

PAST: past tense

PERF: perfective aspect

PROG: progressive aspect

RT: reading times

SF: sentence final word

SLA: second language acquisition

TP: topic marker

V+1: first word following the verb

V+2: second word following the verb

PREFACE

I am truly grateful to many people who have inspired and assisted me along the way for making this dissertation a reality. They are dear to me, both personally and professionally.

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1.0 INTRODUCTION

Referring to time is fundamental to human language and cognition. Because time is not visible *per se*, our representational system must find ways to conceptualize and encode temporal relations beyond perceptible motions, situations, and experiences. This task naturally resides in the domain of language. The question of how language learners establish a linguistic encoding of temporal situations has become a focal area of investigation in second language acquisition research in the last two decades. This dissertation aims to contribute to such an inquiry from a second language acquisition (SLA) perspective.

One challenge facing second language (L2) learners arises from the complexity of time-related linguistic expressions. A finite verb obligatorily marks tense, aspect, or both in many languages. Verb conjugation, or morphological inflection for that matter, is notoriously difficult for L2 learners (Larsen-Freeman, 2010). Differences in grammaticized tense-aspect markings between learners' first and second languages also add to the learning challenge. A Chinese learner of English, whose first language (L1) is devoid of tense morphology, needs to acquire past tense inflections to encode deictic past. By the same token, a German learner of English, whose L1 lacks a grammaticized progressive marker, has to acquire the periphrastic progressive form (*be V-ing*) to refer to an ongoing situation in English. Furthermore, languages often partition temporal distinctions in varied and unpredictable ways. For example, Yagua, an indigenous South American language spoken in Peru, distinguishes five past tenses depending on

the degree of remoteness (Pagne & Pagne, 1990). To speakers of other languages, the grammatical distinctions in Yagua may appear confusing, if not arbitrary. In addition to tense-aspect, other time marking devices such as temporal adverbials and discourse principles are also ubiquitous. These devices, despite their abundance, differ on the form, function, and usage. Precisely, it is L2 learners' continual struggle with learning tense and aspect categories expressed by inflectional morphology that has prompted the investigation of this dissertation.

A number of hypotheses have been proposed regarding the acquisition of tense-aspect morphology. The Aspect Hypothesis (hereafter the AH, e.g., Andersen & Shirai, 1994; Bardovi-Harlig, 2000; Robison, 1995) focuses on the distribution of tense-aspect morphology across lexical classes of verbs. The AH argues that the inherent temporal meaning of lexical classes of verbs, or lexical aspect, is correlated with tense-aspect morphology in initial and subsequent stages of language development. Specifically, learners tend to associate past tense and perfective aspect forms with telic verbs (those entailing an inherent endpoint, e.g., *find* and *arrive*), and progressive aspect with activity verbs (e.g. *swim* and *sleep*). In fact, these associations have been repeatedly confirmed in child language acquisition as well as adult L2 acquisition studies, revealing a strong universal tendency. Yet, the mechanism of how such form-meaning associations emerge is less understood.

Li and Shirai (2000), Shirai (1991, 2002), and Shirai and Andersen (1995) proposed a prototype account in which the learning of a linguistic category starts with the prototype of that category. Following this proposal, the prototype of past tense is restricted to verbal predicates involving a change of state or an endpoint, and that of progressive aspect characterizes action-in-progress. However, the empirical evidence supporting such an important claim remains insufficient. The majority of data comes from L2 learner production and other elicitation tasks.

How L2 learners use prototypes in the course of language processing is largely unexplored. Only one study thus far has attempted to examine what aspectual properties impact processing speed, but this study's participants were limited to native speakers (Yap et al., 2009). To bridge the gap, this dissertation proposes a psycholinguistic investigation of L2 learners' processing of tense-aspect morphology. Because of the universal appeal of prototype, it would also be interesting to consider a cross-linguistic perspective by comparing groups of L2 learners from different L1 background to see how they are alike and differ.

Intriguingly, the role of L1 has never been a research priority on par with the prototype hypothesis in L2 tense-aspect acquisition research. Among the few existing studies, Wenzell (1989), Collins (2002), and Rocca (2002, 2007) provided suggestive evidence that L1 is likely to be responsible for L2 learners' non-native-like usage and variable suppliance of tense-aspect morphology in obligatory contexts. Also, Sugaya and Shirai (2007), Gabriele (2009), and Shirai (2009) argued in favor of a greater role that L1 plays in constraining L2 learners' tense-aspect development. Again, the foci of these studies were almost exclusively on offline language production rather than on online language comprehension.

In the spirit of language processing, Christiane von Stutterheim and colleagues at the Heidelberg University Language and Cognition (HULC) lab have conducted a series of psycholinguistic studies on bilingual speakers' representation and linguistic encoding of events. For example, it has been shown that very advanced L2 learners succeeded in using their target languages correctly, but failed to show native-like performance on a number of measurements, including verbalizing dynamic situations after witnessing short video clips, the onset and time course of L2 production, as well as the amount and quality of eye gaze and visual attention paid to video prompts (Stutterheim & Carroll, 2006). The researchers argued that grammaticized

aspectual categories in L1 (i.e. the lack of progressive in German) have a vital impact on ultimate L2 attainment, especially regarding the principles of event construal in language production (Stutterheim & Carroll, 2006). To date, only one unpublished sentence processing study (Roberts & Liszka, 2008; as cited in Roberts, 2008) has looked into the role of L1 on processing L2 tense-aspect morphology. Again, this research gap must be filled to shed light on what is universal and what is language-specific about L2 tense-aspect acquisition. This dissertation embarks on such an investigation.

The principal aim of this dissertation is to investigate the prototype and transfer hypotheses in L2 learners' processing of English tense-aspect distinctions. It departs from previous studies on two main fronts. Methodologically, this dissertation employs a genuine online method, namely sentence processing, to tap into L2 learners' representation and online processing mechanisms of tense-aspect distinctions. In this way, it complements the literature by providing much-needed processing data to validate previously proposed predictions based generally on offline data. Theoretically, this dissertation evaluates the prototype and transfer hypotheses in one single study. At the heart of this investigation is a cross-linguistic design testing three L1 groups (Korean, German, and Chinese) for one target language (English). These L1s differ systematically with respect to grammaticized past and progressive morphology. An equally important point is that the prototype and transfer hypotheses are never meant to be mutually exclusive. They could potentially interact to drive acquisition. In fact, it has been suggested that L1 may influence L2 prototype formation (Shirai & Kurono, 1998).

Although this dissertation narrowly focuses on the L2 processing of tense-aspect morphology, it contributes to the field at large by fostering the integration of psycholinguistic methodology in SLA research.

1.1 OVERVIEW OF THE DISSERTATION

There are six chapters in this dissertation. Chapter one is the introduction, in which I have briefly sketched the goals and issues that motivate the empirical investigation undertaken.

Chapter two provides a general description of the linguistic systems of tense and aspect, in addition to the grammatical and semantic properties of past tense and progressive aspect in English, Korean, German, and Mandarin Chinese. It also outlines the guiding questions, method, and procedures for the three experiments.

Chapter three (Experiment I) examines L2 learners' automaticity in second language sentence processing in general. L2 learners were found to be sensitive to morphosyntactic errors involving grammaticized past and progressive morphology, among other plural agreement and subcategorization violations.

Chapter four (Experiment II) tests whether prototypes facilitate L2 learners' processing of tense-aspect distinctions. Results indicated that prototypical associations of tense-aspect categories (e.g. achievement PAST and activity PROG) do not necessarily yield processing advantages over non-prototypical associations among all L2 learners. A strong tendency of L1 transfer was evident.

Chapter five (Experiment III) examines the psycholinguistic evidence of aspectual coercion in L2 learners. Results revealed that both temporal adverbials and grammatical aspect interact to cause a processing slowdown, rather than temporal adverbials alone. The so-called aspectual coercion effect was also observed to be susceptible to L1 influence.

Finally, chapter six summarizes the key findings from the three experiments. It concludes by highlighting contributions and limitations, and suggests directions for future research.

2.0 BACKGROUND

This chapter addresses the fundamental question of *what* (What are tense and aspect?) in preparation of the more important inquiry of *how* (How can the tense-aspect systems be acquired and processed by L2 learners? And by what mechanisms?) as it relates to SLA. The organization of the chapter is as follows. Section 2.1 introduces tense and aspect as conceptual temporal categories. Section 2.2 gives a contrastive linguistic survey of past and progressive morphology (or their equivalents) in English, Korean, German, and Chinese. Presumably, these linguistic facts represent the core substance for language acquisition, and characterizing them correctly is vital. Section 2.3 highlights the research design of this dissertation, followed by an experimental overview section to cover methodological procedures and data analysis protocols common to the three self-paced reading experiments undertaken. Because each experiment addresses a different issue related to L2 tense-aspect processing, I opt to provide a separate and self-contained literature review in each of the three chapters following.

2.1 TENSE AND ASPECT

Tense and aspect are conceptual temporal categories, referring to independent dimensions of grammar. Comrie (1985) defined tense as the "grammaticalisation of location in time" (p. 1), whereas aspect as the "grammaticalisation of expression of internal temporal constituency" (p. 6)

[1]. Tense is deictic because it refers to a time with respect to another temporal reference point, usually the moment of speaking. By contrast, aspect is concerned with the duration and temporal boundaries of a situation, independent of the situation's temporal reference. The difference between *He is crossing the road* and *He was crossing the road* is that of tense; whereas *He crossed the road* and *He was crossing the road* differ in aspect. In other words, tense describes *when* a situation occurs; aspect depicts *how* the situation unfolds over time.

Although tense and aspect are independent categories that refer to distinct conceptual dimensions related to time, the process of grammaticization has not always separated the two categorically. It is not uncommon to observe that a single grammatical form can convey both tense and aspectual meanings in a language (Dahl & Velupillai, 2008). Some scholars may prefer tense-aspect as a collective term to describe the complex phenomena involved, and the same convention will be adopted here as well.

Furthermore, the two-component theory of aspect[2] is important for the study of aspect. According to Smith (1991; 1997), situation type (*a.k.a.* lexical aspect) and viewpoint aspect (*a.k.a.* grammatical aspect) determine the composite aspectual interpretation of an utterance. These components are elaborated in the following sections.

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[1] Klein (1994) disagreed with Comrie's (1985) definitions and contended "tense does not directly specify the 'time of the situation'; rather, it imposes a temporal constraint on the time for which the assertion is made. Aspect is a temporal relation between the 'time of the situation' and 'the time for which the assertion is made'" (Klein, 1994, xii). Instead, Klein used three parameters to specify the temporal relations between tense and aspect: *Utterance Time*: time at which the sentence is uttered; *Assertion Time*: time for which an assertion is made; and *Event Time*: time of the situation.

[2] Although Smith's (1991; 1997) two-component theory is adopted here, I do not intend to imply a categorical distinction between grammar and lexicon. This issue becomes more controversial for Russian and some other Slavic languages, in which lexical entries instead of morphological forms are used to denote different aspectual distinctions.

2.1.1 Lexical aspect

Lexical aspect (a.k.a *Aktionsart*, German for "kinds of action") refers to the temporal meanings inherent in verbal predicates. It represents ontological distinctions among situation types. Vendler's (1967) taxonomy distinguishes four lexical aspectual classes — states, activities, accomplishments, and achievements. The notion of telicity is often deemed the most important in categorizing lexical aspect (Ryle, 1949), and the primary semantic contrast is between telic and atelic predicates. Both states (e.g. *know, love*) and activities (e.g. *walk, swim*) are categorized as atelic verbs because their semantic representations do not specify an inherent endpoint. By contrast, accomplishments (e.g. *cross the road, build a house*) and achievements (e.g. *fall, win the race*) are categorized as telic verbs because they encode an inherent endpoint. However, of these two verb types, only achievements are punctual, because they have no duration. Smith (1991) added the fifth category of semelfactives (e.g. *jump*, *sneeze*). By definition, semelfactives can culminate at any given time without evoking an inherent endpoint; they are therefore atelic (see Rothstein, 2004, for an alternative account). Another interesting property about semelfactives is that they are prone to shift between a unitary and an iterative interpretation. This phenomenon falls under the scope of aspectual coercion, which will be elaborated in detail in Chapter 5.

Lexical aspect and their corresponding semantic properties can be represented by their temporal contours. Table 1 illustrates the five categories of lexical aspect by temporal contours (Li & Shirai, 2000, p. 20, based on Andersen, 1990; Smith, 1991) and three binary semantic features [±punctual], [± telic], and [±dynamic] (Andersen, 1991). The dot • represents semelfactive; X refers to an inherent endpoint; and ~~~ depicts dynamic duration.

Table 1. Lexical aspect

Lexical Aspect	Example	Temporal contour	Punctual	Telic	Dynamic
State	*know, love, contain*	_____	[-]	[-]	[-]
Activity	*walk, swim, run*	~~~~~~~	[-]	[-]	[+]
Accomplishment	*cross the road, build a house*	~~~~~~X	[-]	[+]	[+]
Achievement	*fall, win the race, break*	X	[+]	[+]	[+]
Semelfactive	*jump, sneeze, hit*	•	[+]	[-]	[+]

Since lexical aspect refers to temporal meanings inherent in verbal predicates, a verb is not always assigned to a particular lexical aspectual class. Consider, for example, the sentences in (1):

(1) a. I ran. [Activity]

b. I ran. (in the sense of a specified distance) [Accomplishment]

c. I ran to the lake. [Accomplishment]

(based on Levin, 2007, p. 3)

1a is activity because the running motion can culminate in any arbitrary point in time. Despite having the same form, 1b is classified as accomplishment because the running motion is bounded by an unmentioned but specified distance in the discourse. 1c is accomplishment because running terminates as soon as the spatial destination — the lake — is reached. Importantly, (1) demonstrates that the aspectual value of a verbal predicate can shift from one to

another, depending on sentential and pragmatic contexts. Given this variable nature, the classification of lexical aspect is not an easy task, and hence there is a need for the development of diagnostic tests (e.g., Dowty, 1979). Such diagnostic tests may vary considerably in linguistic details but they make it possible to advance the theoretical discussion of tense-aspect phenomena in a more scientific way. An ordered test for English developed by Shirai and Andersen (1995) would be employed by this dissertation for the classification of lexical aspect (Appendix A).

2.1.2 Grammatical aspect

Grammatical aspect encodes different ways of viewing the internal temporal constituency of a situation (Comrie, 1976). The main contrast is between perfective and imperfective aspect. Perfective aspect refers to a temporally-bounded situation, whereas imperfective aspect presents a situation without reference to initial and final boundaries (Comrie, 1976).

Bybee, Perkins, and Pagliuca (1994) suggested that the evolution of grammar sheds light on the origins and subsequent development of aspectual oppositions and their corresponding temporal restrictions. They hypothesized that perfectives (and past tenses) are likely to develop out of the perfects (i.e. a past situation with current relevance). Also, they argued that past tense(s) and perfective aspect are closely related, largely because the perfective is often interpreted as referring to the past. Dahl and Velupillai (2008, p. 2) further posited that such a tendency has a cognitive basis: "the prototypical uses of perfectives coincide with the default view of an event as a completed whole. But normally such a perspective is possible only if the event is wholly in the past". The overlapping of temporal semantics between past tense and perfective aspect can explain why tense and aspect categories are sometimes conflated.

Similarly, Bybee et al. (1994, p. 129) suggested that imperfectives are derived from the progressive and added, "the majority of progressive forms in our database derive from expressions involving locative elements".

One important point to note here is that grammatical aspect, or viewpoint aspect in Smith's (1991; 1997) terminology, is a grammatical device insomuch as it reflects a speaker's linguistic representation of temporal situations. Interestingly, recent psycholinguistic research has begun to show that grammaticized temporal categorizes such as the English progressive can impact non-linguistic cognitive processing of events (e.g., Stutterheim et al., in press).

2.2 CROSS-LINGUISTIC VARIATIONS OF GRAMMATICIZED PAST AND PROGRESSIVE MORPHOLOGY

Languages differ markedly in how they encode tense and aspect. Many languages, however, have overt grammatical markings of tense and aspect on verbs. Often, past tense is expressed via verbal inflections, and progressive aspect by periphrastic constructions.

The goal of section 2.2 is to spell out language-specific facts for grammaticized categories of past tense (abbreviated as PAST) and progressive aspect (abbreviated as PROG) in English, Korean, German, and Mandarin Chinese. To this end, both large-scale typological surveys, including Dahl (1985) and Bybee et al. (1994), as well as reference grammar for individual languages, were consulted. Table 2 gives a contrastive summary of PAST and PROG in the four languages.

Table 2. PAST and PROG in English, Korean, German, and Chinese

	English	Korean	German	Chinese
PAST	+	+	+	−
PROG	+	(+)	−	(+)

**Note*. Brackets ( ) indicate optional usage.

In Table 2, a + sign means that such a grammaticized tense-aspect category is present for a given language. A – sign indicates that such a category is absent in that particular language. The – sign in German, for example, illustrates that PROG is absent in the German language. Therefore, the concept of ongoingness is not encoded grammatically as it is in English, Korean, and Chinese. By the same token, the – sign in Chinese indicates that PAST is absent. The Chinese language thus lacks a grammatical expression of deictic past. Furthermore, the brackets indicate that a certain usage is optional. This is true for PROG in Korean and PROG in Chinese. Now, it is clear that Korean, German, and Chinese manifest a 3-way contrast (+, − , optional) with respect to grammaticized past and progressive morphology, which makes it possible to examine the effect of L1.

In the following sections, I shall highlight the essential properties of PAST and PROG for each individual language in turn.

2.2.1 English

In English, there is a sharp grammatical distinction between present and past tenses, as shown by the variants of copula-*be* in (2):

(2) a. The temperature is below zero right now.

b. The temperature was below zero yesterday at noon.

(Dahl & Velupillai, 2008, p. 9)

According to Bybee et al. (1994, p. 152), simple past tense in English "express[es] an explicit temporal relation, that the narrated events occurred before the moment of speech". English PAST therefore denotes a deictic past function. It is overtly marked on most regular and irregular verbs via inflectional morphology.

Hatcher (1951) argued that the English progressive has many shades of meaning. The most basic of all is action-in-progress (Bybee & Dahl, 1989; Gass & Ard, 1984; Shirai, 1991). English PROG refers to the progressive phase of a temporal situation. It is obligatory, and appears in the periphrastic form *be V-ing* (e.g. *Peter is swimming*).

The meanings denoted by English PAST and PROG are certainly different, and so are their associations with lexical aspect. English PAST, for instance, is more compatible with telic predicates, even though it can combine with all lexical aspect. Alternatively, English PROG is most compatible with activity predicates. It gives rise to infelicitous interpretations in some stative (e.g. *#Sara is knowing French*) and achievement (e.g. *#The president is noticing the picture*) predicates.

Such form-meaning associations are also evident in native English spoken corpora (e.g., Wulff, Ellis, Rōmer, Bardovi-Harlig, & Leblanc, 2009). For example, the 10 most distinctive verbs associated with PAST in the spoken section of the 10-million-word British National Corpus are *start*, *die*, *become*, *wake*, *crash*, *retire*, *panic*, *explode*, *disappear*, and *occur*, all of which belong to the Vendlerian class of achievements. Activity verbs were also found to prevail

in the 10 most distinctive verbs associated with PROG. Such verbs included: *look*, *come*, *sit*, *play*, *wait*, *walk*, *joke*, *run*, *watch*, and *deal*. The only exception was *come*, which would probably be classified as achievement according to the scheme by Shirai and Andersen (1995).

2.2.2 Korean

Korean marks PAST (*-ess*) and PROG (*-ko iss*) similarly to the way English does. According to Lee (2007), *-ess* is predominantly a past morpheme rather than a perfective marker. One piece of evidence is that *-ess* can co-occur with *-ko iss* as shown in (3).

(3) *Minji-nun ku ttay chayk-ul ilk -ko iss -ess -ta.*
Minji-TP that time book-ACC read PROG PAST Declarative
'Minji was reading a book then.'

(Lee, 2007, p. 7)

It might cause potential problems if *-ess* were to function as a perfective marker and contradict the progressive *-ko iss*, which is imperfective in nature. The Korean PAST *-ess* has already grammaticized as a past morpheme to locate a situation deictically prior to the moment of utterance, and is compatible with all lexical aspect (Lee & Kim, 2007). In this light, Korean PAST functions similarly to English PAST.

The function of Korean PROG *-ko iss* is highly controversial. It has sparked a long-standing debate in Korean linguistics as to whether *-ko iss* functions as either a progressive marker or an imperfective marker. Lee (2006), for instance, argued that *-ko iss* is primarily a progressive marker, although it allows relatively more fine-grained aspectual distinctions than English PROG does. Other scholars such as Kim (1993) asserted that *-ko iss* yields a resultative

meaning instead of a canonical progressive interpretation. Ahn (1995) also argued in favor of a more general imperfective function for *-ko iss*.

The debate arises because *-ko iss* does not always refer to an ongoing situation. Its function varies considerably depending on the type of verbal predicate it is attached to. Generally, *-ko iss* refers to action-in-progress in the context of activities and accomplishments, and inchoative meaning (inception of a result state) with achievements. What is interesting is that although *-ko iss* in state verbs is generally anomalous, there are exceptions, including: *alta* 'know', *mitta* 'believe', and *kkaytatta* 'recognize'. In these cases, the combination of *-ko iss* with these verbs refers to the resulting states (the fact of knowing, believing etc.) (Sohn, 1995). Because of these distributional properties, Lee (2006) also maintained a distinction between stative predicates and *know*-type verbs that render different meanings with *-ko iss*. She argued that Korean has fewer state verbs compared to English. In her account, genuine state verbs in Korean such as *sokha-* 'to belong' and *iss-* 'to exist/stay' cannot co-occur with *-ko iss*. An example for *sokha-* 'to belong' is given in (4):

(4) *Hankwuke program-un enehak kwa-ey *sokha-ko iss-ta.*

Korean language program-TOP linguistics department-LOC belong-PROG-Declarative

'The Korean language program is belonging to the linguistics department.'

(Lee, 2006, p. 702)

On the contrary, *know*-type verbs include mental/cognitive/emotive verbs. Examples are *salangha-* 'love', *al-* 'know', *mit-* 'trust/believe', *nukki-* 'feel', *kiekha-* 'remember', *wonha-* 'desire', *kaci-* 'have', *kkaytat-* 'realize'. Unlike stative verbs, all of the *know*-type verbs are reported to be compatible with *-ko iss*. Lee (2006) based her account on the morphosyntactic behavior of simple present form *nun* in Korean. To summarize, Korean PROG *-ko iss* can co-

occur with eventive predicates that include mental/cognitive/emotive verbs, but not state descriptions.

One major difference between Korean *-ko iss* and English PROG is that *-ko iss* is not obligatory in marking an ongoing situation. The simple present form *nun* and the null morpheme are also found to refer to ongoing situations (Sohn, 1995).

2.2.3 German

In German, both präteritum (functionally English simple past) and perfekt (formally English present perfect) can refer to past situations. They differ principally in the specific time of when an assertion is made. According to Klein (2000, p. 372), "the präteritum places the listener, as it were, in the midst of the situation in the past, as 'on-going, process-like'; whereas the perfekt (under this reading) sees it from after the fact, as 'completed'". The notion of PAST in both English and German is similar in the sense that they both deictically refer to situations prior to the moment of utterance. Telic predicates such as accomplishment and achievement entail a sense of completion when combined with präteritum. However, potential ambiguities can arise because German perfekt (compound past containing a verb and an auxiliary) also covers the meaning and use of präteritum. It can convey both a perfect reading in addition to a preterite one, depending on other variables such as register, dialect, and genre.

What is special about German is that it lacks grammatical aspect altogether. Consequently, it does not have a grammaticized progressive form to grammatically encode the concept of ongoingness. In German, one needs to say "*I wait now*" to convey the ongoing meaning for "*I'm waiting*". Although ongoing situations can be expressed by the temporal adverbial *gerade* 'straight', the absence of grammatical aspect nonetheless has certain

ramifications for language processing and acquisition. One of which is that German speakers tend to infer temporal situations more holistically (e.g., Stutterheim & Nüse, 2003). Similar results have also been found in psycholinguistic experiments looking at L2 language production and processing (e.g., Stutterheim & Carroll, 2006).

2.2.4 Chinese

Mandarin Chinese differs from English, Korean and German in that it lacks tense morphology (e.g., Li & Thompson, 1981). It tends to rely more on temporal adverbials (also deictic) and aspectual markers to encode temporal situations. Generally, Chinese is characterized as having two perfective markers (perfective *le* and experiential *guo*) and two imperfective markers (progressive marker *zai* and durative marker *zhe*). The following discussion focuses on perfective *le* and progressive *zai*.

The primary function of perfective *le*[3] is to present a situation in its entirety without reference to internal structure, and denote an event bounded by beginning and end. *Le* occurs in a variety of contexts. According to a native Chinese discourse corpus study by Xiao and McEnery (2004), 80% of perfective *le* occur in telic and bounded situations, whereas the remaining 20% occur in atelic contexts.

The main function of progressive *zai* is to denote an ongoing situation. Unlike English PROG, *zai* can neither co-occur with states as shown in (5), nor achievements in (6). It denotes a

[3] *le* can occur verb-finally, sentence-finally, or both (see Chen & Shirai, 2010, p. 4). Here, the discussion of the perfective aspect marker *le* is confined to verb final *le*. The status of its counterpart, sentence final *le*, remains controversial (for discussion, see Li, 1990).

dynamic situation exclusively. In this sense, the progressive marker *zai* is more prototypically progressive than English PROG.

(5) **Xiaoming zai you yi ge xiangfa*

Xiaoming PROG have one CL thought

?'Xiaoming is having an idea'

(Chin, 2006, p. 48)

(6) **Lisi zai ying*

Lisi PROG win

'Lisi is winning'

(Lin, 2005, p. 16)

Despite the productivity, aspectual markers are largely optional in Chinese. Verbs appearing without aspectual markers do not necessarily render the sentences unacceptable or ungrammatical. For example, (7) illustrates that perfective *le* is not mandatory in the presence of the temporal adverbial *zuotian* 'yesterday':

(7) *Zhangsan zuotian qu ni jia.*

Zhangsan yesterday go you house

'Zhangsan went to your house yesterday'

(Lin, 2005, p. 3)

The progressive marker *zai* is also optional if context suffices, as shown in (8).

(8) A: *Ni zai gan shen me*

You PROG do what

'What are you doing?'

B: *Wo xi yi fu ne*

I wash clothes Interjection

'I am washing clothes.'

Furthermore, the notion of verb poses additional challenge to the study of aspect in Chinese. Verbs in Chinese, for instance, do not conjugate for tense, person, number, voice, or mood. This is complicated by the fact that the distinction between verb and adjective is not so clear. As a result, it is difficult to categorize verbs from other parts of speech, not to mention the classification of lexical aspect. No doubt few studies have examined lexical aspect in Chinese (Li & Bowerman, 1998). This said, resultative verb complements (RVCs) are typologically interesting, and they occur very frequently in Chinese. RVCs encode both a process and a result. For example, *da po cha bei* 'to break a cup' not only indicates the result of the cup being broken, it also provides information as to how the cup is broken (Xiao & McEnery, 2004, p. 56). Typically, RVCs denote situations that English specifies as accomplishments and achievements. RVCs are not compatible with progressive *zai*, which exclusively denotes a dynamic situation.

2.3 EXPERIMENTAL OVERVIEW

In this dissertation I conducted three experiments to investigate L2 learners' online processing mechanisms of tense-aspect morphology. Noted in the following are the major guiding questions for the experiments. Specific details will be elaborated in Chapters 3, 4, and 5, respectively.

2.3.1 Experiment I

The first question has to do with the linguistic encoding of tense-aspect information expressed by inflectional morphology. Prior research suggested that learning inflectional morphology is a vexing problem for L2 learners (Larsen-Freeman, 2010). As a prerequisite, Experiment I tests L2 learners' ability to detect morphosyntactic anomalies of various sorts underlying the processing of tense-aspect morphology.

2.3.2 Experiment II

A second question deals with the learning mechanisms conducive to L2 tense-aspect development. Previous research in SLA suggested that prototype, exemplified by natural associations between lexical and grammatical aspect, drives the acquisition of tense and aspect markings (Li & Shirai, 2000). Experiment II aims to test whether there is evidence about such prototypes in the course of L2 processing.

2.3.3 Experiment III

A third question focuses on real-time processing consequences when L2 learners are confronted with aspectual conflicts triggered by a punctual temporal adverbial in semelfactives. This process is commonly known as aspectual coercion. Despite the controversial findings reported in the literature, one leading hypothesis is that aspectual coercion incurs an extra processing cost within native speakers. Experiment III examines aspectual coercion in L2 learners for the first

time. More importantly, it considers how grammatical aspect and temporal adverbials interact to produce the so-called coercion effect(s).

2.3.4 Procedure

With regard to the three experiments outlined above, participants read sentences presented on a computer screen in a word-by-word non-cumulative self-paced moving window paradigm (Just, Carpenter, & Woolley, 1982). This technique is advantageous in examining self-paced, incremental language processing without the danger of potential confounds from other retrieval or control processes present in many offline grammaticality judgement and production tasks. Plus, the use of explicit or metalinguistic knowledge would also be minimized.

Each trial began with the entire sentence displayed on screen masked by dashes (-) replacing each letter. As participants read, they pressed the space bar to reveal the next word, simultaneously causing the previous word to revert to dashes. Only one word was shown on the computer screen at a time. The sentences were visually presented on a Macintosh computer running the LINGER software version 2.94 (Rohde, 2001; available at http://www.tedlab.mit.edu/~dr/Linger/). LINGER automatically randomizes the order of presentation of sentences for each participant, and records all button press to measure reading times with millisecond accuracy.

To prevent participants from pressing the space bar mechanically and to ensure meaningful reading comprehension, a yes/no comprehension question prompt was presented with each of the 120 filler sentences (Appendix B) embedded throughout the three experiments. These filler sentences were unrelated to experiments in this dissertation, and they were obtained from Schwartz and Kroll (2006). Immediately following the last word of each filler sentence, a

relatively straightforward yes/no comprehension question was presented. Participants were instructed to answer the comprehension question as quickly and accurately as possible by pressing the 'F' key for yes, and the 'J' key for no. Feedback on accuracy was given for comprehension questions.

Participants were informed that some sentences presented to them might not always be acceptable. However, they were instructed to read them naturally and carefully enough to answer the comprehension prompts.

At the beginning of the experimental session, participants received six practice trials to familiarize themselves with the self-paced reading technique. They also received a break in between every 50 trials. Participants sat for the three experiments in one single session, and most participants finished in an hour.

Following the self-paced reading task, participants went on to complete a two-page language history questionnaire (Appendix C). All L2 participants also completed a standardized English proficiency test, namely the Michigan Test of English Language Proficiency (MTELP) of the Michigan Test Battery (Corrigan, Dobson, Kellman, Spaan, Strowe, and Tyma, 1979). The Michigan Test Battery consists of the MTELP, a written composition, and a listening test. Only the MTELP, which contains 100 multiple-choice items on grammar, vocabulary, and comprehension, was administered. Participants were given a maximum of 75 minutes to complete the test. However, the majority finished within an hour or so.

2.3.5 Participants

Participants consisted of native English speakers as well as second/foreign language (hereafter L2 for brevity) learners of English from Korean, Mandarin Chinese, and German L1

backgrounds. A breakdown was as follows: native English speakers (15 women, 9 men, M_{age} = 20.2 years, age range: 18-25 years); Korean (14 women, 1 man, M_{age} = 21.7 years, age range: 18-29 years); Chinese (16 women, 5 men, M_{age} = 23.8 years, age range: 21-30 years). All these participants were recruited with flyers posted on the campuses of the University of Pittsburgh and Carnegie Mellon University. German (21 women, 4 men, M_{age} = 25.5 years, age range: 20-41 years) participants were recruited in the same way from the Ruprecht-Karls-Universität Heidelberg, Germany. All participants provided informed consent, and were compensated \$10/€10 per hour for their participation. Table 3 lists the profile information of the participants.

Table 3. Participant profile

	English (N=24)		*Korean (N=15)*		*German (N=25)*		*Chinese (N=21)*	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	20.19	1.91	21.07	2.89	25.48	5.8	23.81	2.38
Beginning age of English instruction	na	na	8.73	3.15	10.46	2.2	10.48	0.98
Comprehension questions score (max. 120)	112.79	4.63	113.93	3.81	113.56	3.39	108.81	6.04
Michigan test score (max. 100)	na	na	81.13	14.77	79.88	11.66	63	16.47
Self-rating*								
Speaking	na	na	5.93	0.8	5.34	0.83	4.48	0.93
Listening	na	na	5.93	1.03	5.84	0.8	5	1
Reading	na	na	5.8	1.01	5.72	0.79	4.86	1.06
Writing	na	na	5.33	0.98	5.22	0.89	4.38	0.92

Results of the Michigan Test of English Language Proficiency are also given in Table 3. The maximum score was 100. At the time of testing, both Korean (M = 81.13, SE = 3.67) and German (M = 79.88, SE = 2.85) participants were more proficient in English than Chinese participants (M = 63, SE = 3.11), ps = .001. This result was in line with participants' self-ratings of their four language skills — speaking, listening, reading, and writing — on a 7-point scale,

with 7 indicating native like proficiency. Chinese participants rated themselves consistently lower in all language skills than Korean and German participants, Fs > 6.126, ps < .01.

2.3.6 Data analysis

A data analysis protocol standard to many sentence processing studies was applied to the three self-paced reading experiments. First, all participants who contributed to the reported analyses in this dissertation had scored 85% or above for the comprehension questions. Extreme reading times (RTs) shorter than 100 ms or longer than 2,500 ms per word were discarded. These criteria led to the exclusion of 0.59%, 1.36%, 1.26%, and 2.31% of data points for the English, Korean, German, and Chinese samples, respectively.

Next, RTs were transformed logarithmically to stabilize data skewness and variability among the four participant groups. To reduce the effects of word length differences across conditions and to reduce the effects of participant reading rates, linear regression was performed on the log data for each participant, predicting reading times from word length in letters. This procedure utilized all words from both experimental items and fillers (e.g., Ferreira & Clifton, 1986; Trueswell, Tanenhaus, & Garnsey, 1994). The values predicted from the regressions were subtracted from the actual reading times to produce residual reading times. Therefore, the length-adjusted residual log RTs were analyzed as the dependent variable with a combination of statistical tests, including paired-samples t tests and ANOVAs for Experiment I, and ANCOVAs for Experiments II and III, in which English proficiency was used as a covariate.

In all cases, separate analyses were conducted at four word regions, including the verb, the first word following the verb (V+1) to capture spill-over effects, the second word following

the verb (V+2) to assess further downstream effects among L2 learners, and lastly, the sentence-final (SF) word to investigate sentence wrap-up (Just & Carpenter, 1980).

2.4 SUMMARY

In this chapter, I provided a typological survey of the four languages' grammaticized past and progressive morphology, including their temporal semantics, as well as distributional restrictions among situation types (i.e. lexical aspect). It is shown that lexical aspect tends to be more semantics-based and universal, whereas the associations between lexical and grammatical aspect show greater language-specific variations. These linguistic descriptions, albeit perfunctory, will guide the bases for formulating predictions for the three experiments.

I also summarized the method used in this dissertation. Details for the self-paced reading procedure, participants' profile, and statistical analysis protocol were described as well.

3.0 MORPHOLOGICAL PROCESSING IN L2 LEARNERS

A key observation that has provoked the investigation in this chapter is that L2 learners experience extensive difficulties with the inflectional morphology that marks tense, aspect, number, and so forth. The first priority in L2 tense-aspect processing research that needs to be determined is whether L2 learners are able to process tense-aspect morphology in the first place. Unfortunately, research dedicated to this specific area remains very sparse. Experiment I described in this chapter begins to bridge this gap.

3.1 LITERATURE

The difficulties of inflectional morphology confronted by L2 learners are well documented in the SLA literature. To name a few, L2 learners exhibit inflectional errors of various types in both spontaneous speech and written prose, variable and inconsistent performance within and across individual learners, and a lack of ultimate L2 attainment for the majority of learners (Larsen-Freeman, 2010). Besides poor accuracy, slow processing speed and effortful processing are also characteristic of L2 morphosyntactic processing (e.g., Clahsen & Felser, 2006a).

What makes inflectional morphology difficult for L2 learners remains a major question of interest that drives much SLA and bilingualism research. Regarding language processing, one

basic question needs to be addressed: Do L2 learners process inflectional morphology at all? In a recent review article, Gor (2010, p. 15) provided an accurate and succinct summary that L2 learners do in fact process inflectional morphology of various types. These learners' processing, however, is constrained by an array of linguistic and extra-linguistic factors, including L2 morphological richness, complexity, and predictability of allomorphy; inflectional properties of L1 morphology (thus possibilities of transfer); L2 proficiency, quantity of input, quality of input, practice, age of acquisition, individual differences of working memory; and so forth. The vast complexity involved makes it unlikely that any single factor can sufficiently explain the difficulties confronted by L2 learners. McDonald (2006) also highlighted a multi-factor account in which low working memory capacity, poor morphological decoding, and a slow processing speed conspire to constrain L2 inflectional processing.

Alternatively, Clahsen and Felser (2006b) examined both child and adult language learners and proposed the shallow structure hypothesis to account for the processing deficits observed among L2 learners compared to native speakers. Their general claim is that L2 learners are restricted to structurally shallower syntactic parsing when processing morphologically complex words or sentences. Such a tendency is not unique to L2 learners. Native speakers were also found to demonstrate strategies for "good enough language processing" without invoking a full structural representation at all times (Ferreira, Bailey, & Ferraro, 2002; Ferreira & Patson, 2007; Ferreira, Engelhardt, & Jones, 2009). To compensate, L2 learners tend to rely more on meaning-based heuristics for language processing.

Returning to the L2 processing of progressive morphology in particular, Tokowicz and MacWhinney (2005) used event-related potentials (ERPs) in addition to an offline grammaticality judgment task to examine how beginning English learners of Spanish responded

to anomalous sentences in English and Spanish. Three types of morphosyntactic contrasts were manipulated based on the structural properties of English and Spanish (i.e. similar, dissimilar, and unique). The ERP results indicated that the participants were sensitive (e.g., showed brain responses that differed between grammatical and ungrammatical sentences) to auxiliary omission in the progressive construction when reading Spanish sentences like **Su abuela cocinando muy bien* 'Lit: *His grandmother cooking very well'. The researchers reasoned that L2 learners did not encounter difficulties in detecting violations in the similar condition, primarily because English and Spanish use comparable periphrastic forms in the progressive. Tokowicz and Warren (2011) replicated the finding using a converging online method, namely self-paced reading, in another group of L2 learners of Spanish. In the latter study, reading times were analyzed at three locations of a sentence — the critical word at which a morphosyntactic violation could be first detected, the post-critical word, and the sentence-final word. Tokowicz and Warren reported that the participants took significantly longer to read critical and post-critical words when they cued violations that are morphosyntactically similar (i.e. auxiliary omission in the progressive) or different (determiner-noun number agreement) between L1 English and L2 Spanish. The researchers interpreted this finding as an instance of transfer using the Competition Model (e.g., MacWhinney, 2005), but cautioned against using surface cross-language similarities to predict L2 learners' sensitivity to morphosyntactic violations on the ground that other aspects of the Competition Model such as cue validity and reliability should also be taken into account.

Regarding the L2 processing of past inflection, Roberts and Liszka (2008; as cited in Roberts, 2008) was probably the only processing study dedicated to L2 tense-aspect processing. Roberts and Liszka used self-paced reading to examine how French and German L2 learners of

English processed simple past and present perfect sentences containing temporal-aspectual mismatches. As shown in (9b) and (10b), mismatches were triggered by sentence-initial temporal adverbials that did not align with the temporal scope specified by inflected verbs.

(9) *Simple past*

a. Last year, Jill wanted to get married. *Match*

b. # For months now, Jill wanted to get married. *Mismatch*

(10) *Present perfect*

a. For months now, Jill has wanted to get married. *Match*

b. # Last year, Jill has wanted to get married. *Mismatch*

(Roberts, 2008, p. 59)

The researchers analyzed reading times at the finite verbs only. Results indicated that the French participants, but not the German participants, slowed down in both simple past and present perfect mismatch conditions. Apparently, the German participants were not affected by temporal incongruence in either mismatch condition relative to the French participants. Roberts and Liszka took this result as suggestive evidence of transfer. The basic idea is — unlike French *passé composé* (compound past) that functions similarly to English present perfect -- German *perfekt* mainly licenses a simple past interpretation. In this light, the present perfect mismatch in English is not necessarily infelicitous in the German grammar.

Apart from testing potential L1 effect(s), which is a major line of inquiry in many morphological processing studies, what is common among the above reviewed studies is that they employed a violation detection paradigm to probe into L2 learners' sensitivities to morphosyntactic anomalies of various types. The self-paced reading task, for instance, allows both grammar-induced violation (i.e. auxiliary omission in the progressive) and meaning-induced

violation (i.e. triggered by temporal adverbials) to be examined in a sentential context. Such a point is taken up by Faroqi-Shah and Dickey (2009) in which they distinguished between morphosyntactic and morphosemantic dimensions of tense processing in a processing study of agrammatic aphasia. The researchers compared morphosemantic (#*Next year/last year, my sister lived in New Hampshire*) and morphosyntactic (*The nurse *calling/called a doctor*) violations. Their manipulation was well justified because "matching a tense morpheme with a temporal context (as provided by an adverb, for example) is a linguistically and psycholinguistically distinct process [morphosemantic] from selecting the right tense morpheme in a given syntactic position (as selected by an auxiliary, for instance)" (Faroqi-Shah & Dickey, 2009, p. 108). Crucially, the methodological point here is that one must consider anomaly type corresponding to various linguistic processes when using a violation detection paradigm.

Furthermore, because inflectional morphology is generally problematic for L2 learners, and there is a lack of empirical research investigating L2 learners' real time processing of tense-aspect, one needs to consider how tense-aspect fares against other types of morphosyntactic processing. The reason is simple. Suppose a null effect is found. For one reason, the null effect can stem from the general difficulty of L2 inflectional processing. Alternatively, some unknown factors related to tense-aspect processing may be responsible for the null effect. Either way, one would end up having a dilemma in interpreting the observed results. To counteract this possibility, it is necessary to consider other well-established areas of research that shed light on morphological processing. Plural morpheme agreement is a case in point.

Jiang (2004; 2007), for example, investigated L2 learners' sensitivity to grammatical violations when their L1 and L2 differed with regard to whether they marked subject–verb plural agreement. He showed that high-intermediate Chinese L2 learners of English exhibited nearly

perfect performance on a written grammar test when selecting the correct verbal form in sentences, such as *The crime in the cities (was/were) a reflection of the violence in today's society*, but were poor in detecting number disagreement involving obligatory plural *-s* morphology in an on-line comprehension task. This interesting finding indicates that even when the L2 learners demonstrated explicit knowledge of subject–verb plural agreement in English, they were not sensitive to such grammatical information during on-line sentence comprehension. The same participants, however, were found to be sensitive to subcategorization errors involving violations of verbal argument structure. Jiang (2004) reasoned that subcategorization knowledge is well integrated in L2 learners' competence but plural *-s* is not. This argument gained further empirical support in a revised follow-up study (Jiang, 2007). Jiang assumes that the knowledge integration process underlying inflectional morphology is considerably weaker than the process underlying lexical semantics, assuming that plural *-s* is redundant (i.e. not functionally loaded). The reason behind this lies in the core of processing constraints, namely automaticity, where native and non-native processing[4] manifest maximal difference.

As mentioned before, the shallow structure hypothesis (Clahsen & Felser, 2006b) also predicts selective integration of morphological knowledge. It is conceivable that L2 learners continue to struggle with morphological processing precisely because they execute a shallower and less detailed computation on syntactic representation during sentence comprehension. According to Clahsen and Felser (2006b, p. 33), the shallow structure hypothesis also accounts for the absence of L1 transfer effects.

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[4] Jiang (2007) dismissed knowledge transfer as an alternative explanation. He argued that the difficulty in the use of plural marking and plural agreement are not limited to Chinese L2 learners. Previous research suggested that L2 English learners from Korean and Spanish L1 background also experienced difficulties, although their L1s overtly employ plural morphology.

To recap, it is necessary to examine L2 tense-aspect processing in conjunction with other linguistic phenomena to see if different types of morphosyntactic and lexical structures would incur similar or different reading time patterns in L2 learners.

3.2 PURPOSE

The purpose of Experiment I is to examine L2 learners' ability to process inflectional morphology in general, and tense-aspect morphology in particular. Because of the research design and number of conditions involved, Experiment I will be further divided into two experiments, and their results will be reported separately. Experiment IA is concerned with L2 learners' online sensitivity to erroneous use of past and progressive morphology, whereas Experiment IB focuses on plural agreement and subcategorization errors. Together, these two experiments offer complementary insights into the automaticity of L2 learners' processing of inflectional morphology in real time. These insights are important in their own right. Equally important is that they serve as the prerequisite to discern how L2 learners meaningfully process tense-aspect distinctions, as will be investigated subsequently by Experiments II & III.

3.3 RESEARCH QUESTIONS

The following research questions are addressed in Experiment I:

Experiment IA: Tense-aspect morphology

1. Do L2 learners take longer to read sentences containing PAST and PROG anomalies?

2. Do they show differential reading time patterns for sentences containing grammar-induced violation and meaning-induced violation for both PAST and PROG?
3. Does L1 influence tense-aspect morphological sensitivity?

Experiment IB: Plural agreement and subcategorization

1. Are L2 learners sensitive to plural agreement and subcategorization errors?
2. Does L1 influence sensitivity to these errors?

A general prediction is that L2 learners will slow down significantly in sentences containing anomalies, relative to well-formed sentences, similar to what native speakers do. However, an interaction effect between anomaly type and L1 may occur in the case of tense-aspect morphology (e.g., Roberts & Liszka, 2008; cited in Roberts, 2008). A transfer-based account, for example, predicts more variabilities in RTs if an L1 lacks the corresponding tense-aspect markers (PROG for German; PAST for Chinese), or if an L1 allows optional suppliance of the relevant markers (PROG for Korean; PROG for Chinese).

According to Jiang's (2004) empirical results, L2 learners regardless of L1 background will not show a delay in plural disagreement errors, relative to subcategorization errors.

Importantly, native English speakers will exhibit a significant delay in reading times, demonstrating their sensitivity to errors of various sorts.

3.4 EXPERIMENT IA: TENSE-ASPECT MORPHOLOGY

I examined two variables: grammaticized tense-aspect category (abbreviated as TA: PAST, PROG); and anomaly type (well-formed, grammar-induced violation, meaning-induced violation). This entailed a 2 × 3 within-participant design.

3.4.1 Method

3.4.1.1 Materials

Table 4 presents sample stimuli sentences for Experiment IA. A full version of the stimuli can be found in Appendix D. For both PAST and PROG, stimuli sentences consisted of minimal triplets that varied across the three conditions of anomaly type. The well-formed condition served as a baseline to the other two violation conditions. Anomalous sentences were created in two principled ways. Grammar-induced violation sentences were created by omitting the relevant inflectional morphology, namely the regular or irregular past forms in PAST, or the auxiliaries in PROG. The absence of obligatory inflectional morphology in PAST or PROG triggered a grammar-induced violation.

To construct genuine meaning-induced violation sentences, an anchoring temporal adverbial was used to denote a time frame outside the temporal boundary of the verbal predicate. This created a mismatch between the temporal restrictions imposed by a temporal adverbial and the restrictions imposed by the past or progressive morphology. For example, temporal adverbials such as *tomorrow* and *next year* were used to contradict the obligatory past reference in *#Tomorrow the large snakes escaped from their cage at the zoo*. The presence of a deictic temporal adverbial rendered the use of anything but PAST unacceptable. Similarly, temporal adverbials such as *suddenly*, *immediately*, *recently*, and *lately* were used to disrupt the ongoing interpretation in *#Lately the baby is laughing while the mother tickles him*.

A temporal adverbial was placed in the sentence initial position to specify a temporal frame at the propositional level (i.e. the Topic Time, Klein, 1994). This arrangement was critical for the word-by-word self-paced reading methodology in that any potential cost of temporal mismatch could be assessed at a single critical word, namely the (un)inflected verb.

Another important consideration is that the subjects of the sentences were constructed to be as general as possible (e.g. *Last night the children kicked…*) to offset any anticipatory priming effects during comprehension.

The critical materials included sixty sentences. Half of the sentences involved PAST and the other half for PROG. That is, thirty achievement verbs were used for PAST, and thirty activity verbs were used for PROG. These highly compatible associations could potentially reduce processing load, and spare up cognitive resources on violation detection, consistent with the principal goal of Experiment IA. Also, morphological regularity was counterbalanced for PAST, as 15 achievements had regular past forms, whereas the other 15 had irregular past forms. Each of the 30 sentences in PAST and PROG varied across the three conditions of anomaly type. Overall, one condition of each item was randomly assigned to one of the three lists in a Latin Square design for PAST and PROG. As a result, no participant saw an item in more than one condition.

Table 4. Sample stimuli for Experiment IA

TA	Sentence type	Explanation	Example
PAST	Well-formed	Baseline PAST condition	Yesterday several large snakes *escaped from their* cage at the *zoo*.
	Grammar-induced violation	The critical verb misses PAST in an obligatory past context.	*Yesterday several large snakes *escape from their* cage at the *zoo*.
	Meaning-induced Violation	The inflected critical verb clashes with the specified temporal adverbial.	#Tomorrow several large snakes *escaped from their* cage at the *zoo*.
PROG	No violation	Baseline PROG condition	Currently the baby is *laughing while the* mother tickles *him*.
	Grammar-induced violation	The critical verb misses the auxiliary in an obligatory progressive context.	*Currently the baby *laughing while the* mother tickles *him*.
	Meaning-induced violation	The inflected critical verb clashes with the specified temporal adverbial.	#Lately the baby is *laughing while the* mother tickles *him*.

Note. The symbol # indicates semantic anomaly. The critical verb is underlined. The italic font highlights the word regions where reading times data are analyzed.

3.4.1.2 Data analysis

Table 5 lists the mean residual log RTs by condition for each word region and language group.

Table 5. Mean residual log RTs for Experiment IA

		Verb		V+1		V+2		SF	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
PAST									
English	W	-.006	.04	-.042	.041	-.016	.028	.045	.067
	G	-.038	.024	-.034	.042	-.004	.045	.05	.061
	M	-.006	.028	-.023	.044	-.004	.039	.09	.083
Korean	W	-.002	.042	-.008	.05	-.037	.054	.045	.082
	G	.011	.043	.016	.065	.017	.054	.026	.07
	M	.001	.051	.011	.047	.009	.074	.067	.06
German	W	-.022	.042	-.03	.046	-.032	.046	.095	.087
	G	-.029	.045	.005	.057	.011	.064	.091	.089
	M	-.013	.059	-.005	.047	-.001	.046	.113	.093
Chinese	W	-.001	.043	-.008	.05	-.032	.048	.018	.08
	G	.007	.041	-.011	.034	-.043	.036	.012	.059
	M	.034	.061	-.000	.037	-.003	.041	.044	.078
PROG									
English	W	-.000	.042	-.039	.025	-.041	.028	.05	.067
	G	.026	.047	-.002	.053	-.015	.038	.083	.065
	M	-.003	.04	-.039	.031	-.033	.035	.096	.096
Korean	W	-.028	.05	-.024	.052	-.06	.046	.028	.067
	G	.017	.066	.021	.058	-.016	.045	.078	.047
	M	-.029	.052	-.012	.064	-.036	.048	.075	.072
German	W	-.034	.049	-.033	.046	-.04	.032	.118	.097
	G	-.009	.064	.028	.064	-.016	.045	.14	.1
	M	-.018	.044	-.035	.035	-.037	.032	.128	.101
Chinese	W	-.042	.041	-.02	.036	-.047	.041	.01	.071
	G	.009	.071	.037	.048	-.007	.058	.034	.058
	M	-.017	.048	-.01	.038	-.028	.032	.048	.079

Note. W = Well-formed; G = Grammar-induced violation; M = Meaning-induced violation

Based on Table 5, two sets of reading time analyses were performed. The first analysis started with three-way mixed-design ANOVAs to examine the main effects and interactions. Among the three variables involved in the analysis, TA and anomaly type were treated as within-participant variables, and language was treated as a between-participant variable. Separate ANOVA analyses were run at the four word regions, including the verb, V+1, V+2, and SF.

Next, planned comparisons were conducted for each language group's RTs for anomalous sentences and well-formed sentences of PAST and PROG separately. Both participants and items analyses were performed in all cases. Participants were treated as a random factor in the participants analysis, which is labeled as F_1 in ANOVAs or t_1 in t tests. Likewise, items were treated as a random factor in the items analysis, which is labeled as F_2 in ANOVAs or t_2 in t tests.

3.4.2 Results

In this section, results a first presented by word region, followed by group.

3.4.2.1 Word region

Verb

The ANOVAs revealed a main effect for TA in the items analysis, $F_1(1, 81) = 2.062$, $p = .155$; $F_2(1, 112) = 19.703$, $p < .001$, a main effect for anomaly in the participants analysis, $F_1(1.841, 149.117) = 4.948$, $p = .01$; $F_2 < 1.561$, and a main effect for language by both participants and items, $F_1(3, 81) = 2.899$, $p = .04$; $F_2(3, 112) = 5.398$, $p = .002$. The TA × Language interaction was significant by participants only, $F_1(3, 81) = 10.705$, $p < .001$; $F_2 < 2.049$. The TA × Anomaly interaction was significant by participants only, $F_1(2, 162) = 12.212$, $p < .001$; $F_2 < 1.878$. The Anomaly × Language interaction was significant by items only, $F_1(6, 162) = 2.048$, $p = .062$; $F_2(6, 224) = 2.197$, $p = .044$. The three-way TA × Anomaly × Language interaction was not significant, both Fs < 1.046.

V+1

The ANOVAs revealed a main effect for anomaly by both participants and items, $F_1(2, 162) = 28.919$, $p < .001$; $F_2(2, 232) = 21.847$, $p < .001$, and a main effect for language in both analyses, $F_1(3, 81) = 5.611$, $p = .002$; $F_2(3, 116) = 7.747$, $p < .001$. The TA × Anomaly interaction was significant in both analyses, $F_1(2, 162) = 11.541$, $p < .001$; $F_2(2, 232) = 9.448$, $p < .001$. No other effects approached significance by either participants or items: TA, Fs < .401; TA × Language, both Fs < .799; Anomaly × Language, Fs < 1.447; and TA × Anomaly × Language, Fs < 1.282.

V+2

The ANOVAs revealed a main effect for TA by participants only, $F_1(1, 81) = 26.878$, $p < .001$; $F_2 < 2.201$, a main effect for anomaly by both participants and items, $F_1(2, 162) = 20.965$, $p < .001$; $F_2(2, 232) = 11.52$, $p < .001$. The TA × Language interaction was significant by participants only, $F_1(3, 81) = 2.736$, $p = .049$, $F_2 < .325$. The Anomaly × Language interaction was significant by participants only, $F_1(6, 162) = 2.184$, $p = .047$, $F_2 < 1.854$. The TA × Anomaly interaction was significant by participants only, $F_1(2, 162) = 5.711$, $p = .004$, $F_2 < 1.887$. No other effects approached significance by either participants or items: Language, Fs < .734; and TA × Anomaly × Language, Fs < 1.707.

SF

The ANOVAs revealed a main effect for TA by both participants and items, $F_1(1, 81) = 11.789$, $p = .001$; $F_2(1, 116) = 8.171$, $p = .005$, a main effect for anomaly by both participants and items, $F_1(2, 162) = 16.947$, $p < .001$; $F_2(2, 232) = 6.938$, $p = .001$, a main effect for language in both analyses, $F_1(3, 81) = 7.195$, $p < .001$; $F_2(3, 116) = 41.145$, $p < .001$. The TA × Anomaly

interaction was significant by participants only, $F_1(2, 162) = 7.023$, $p = .001$; $F_2 < 1.263$. No other effects approached significance by either participants or items: TA × Language, Fs < 1.17; Anomaly × Language, Fs < 1.206; and TA × Anomaly × Language, Fs < .469.

Short summary

The very first thing to notice is that there are significant main effects of TA, anomaly, and language, as well as their interactions at various word regions. For instance, all participants as a group responded to PROG sentences significantly faster than PAST sentences, but this is not theoretically meaningful as those sentences involved different lexical items. Also, the participants responded to well-formed sentences significantly faster than to sentences containing grammar-induced violation and meaning-induced violation, demonstrating sensitivity to tense-aspect anomalies among all participants as a group. In addition, the mean reading speed of native English speakers was faster than that of L2 participants, suggesting some differences in reading proficiency between native and L2 participants.

3.4.2.2 Group

To explore the possibility of how different groups of participants might have responded to different types of anomaly in PAST and PROG, the second type of RT analysis focused on within-group variabilities. Separate paired-samples *t* tests were conducted to compare RTs in well-formed and anomalous conditions (grammar-induced violation vs. meaning-induced violation). The same procedure was replicated for both PAST and PROG, and for each language group. Table 6 summarizes the results of paired-samples *t* tests for Experiment IA.

Table 6. Results of paired-samples t tests for Experiment IA

		Verb		V+1		V+2		SF	
		t	*p*	*t*	*p*	*t*	*p*	*t*	*p*
Native English speakers									
t test: well-formed vs. grammar-induced violation									
PAST	P Analysis	3.928	**.001**	.659	.516	1.136	.268	.497	.624
	I Analysis	2.308	**.028**	1.709	.098	2.242	**.033**	.955	.348
PROG	P Analysis	1.801	.085	3.266	**.003**	2.504	**.02**	2.566	**.017**
	I Analysis	.432	.669	1.917	.065	1.613	.118	1.468	.153
t test: well-formed vs. meaning-induced violation									
PAST	P Analysis	.024	.981	2.059	.051	1.304	.205	3.087	**.005**
	I Analysis	1.794	.083	.732	.47	.295	.77	3.355	**.002**
PROG	P Analysis	.284	.779	.44	.664	.894	.381	2.673	**.014**
	I Analysis	3.079	**.005**	.862	.396	.022	.983	2.633	**.013**
Korean L2 learners									
t test: well-formed vs. grammar-induced violation									
PAST	P Analysis	.798	.438	2.637	**.02**	2.878	**.012**	1.088	.295
	I Analysis	.342	.735	1.947	.061	2.253	**.032**	1.766	.088
PROG	P Analysis	2.796	**.014**	2.795	**.014**	4.431	**.001**	2.646	**.019**
	I Analysis	.58	.566	1.506	.143	3.405	**.002**	.624	.537
t test: well-formed vs. meaning-induced violation									
PAST	P Analysis	.153	.881	2.314	**.036**	2.192	**.046**	1.525	.15
	I Analysis	1.87	.072	.893	.379	.787	.437	.037	.971
PROG	P Analysis	.127	.901	1.131	.277	1.645	.122	3.557	**.003**
	I Analysis	.89	.381	.964	.343	.921	.365	1.61	.118
German L2 learners									
t test: well-formed vs. grammar-induced violation									
PAST	P Analysis	.602	.553	2.849	**.009**	2.632	**.015**	.274	.786
	I Analysis	1.519	.14	2.127	**.042**	2.993	**.006**	1.478	.15
PROG	P Analysis	1.857	.076	3.749	**.001**	2.435	**.023**	1.427	.166
	I Analysis	.02	.984	3.864	**.001**	.761	.453	.449	.657
t test: well-formed vs. meaning-induced violation									
PAST	P Analysis	.647	.524	1.868	.074	2.568	**.017**	1.442	.162
	I Analysis	.458	.65	1.218	.233	1.374	.18	.165	.87
PROG	P Analysis	1.269	.217	.221	.827	.317	.754	.834	.413
	I Analysis	1.411	.169	1.827	.078	1.286	.209	.117	.908
Chinese L2 learners									
t test: well-formed vs. grammar-induced violation									
PAST	P Analysis	.543	.593	.266	.793	.839	.411	.417	.681
	I Analysis	.694	.493	.36	.722	.018	.986	.034	.973
PROG	P Analysis	3.132	**.005**	4.022	**.001**	2.681	**.014**	1.455	.161
	I Analysis	1.968	.059	4.011	**.000**	1.044	.305	.22	.827
t test: well-formed vs. meaning-induced violation									
PAST	P Analysis	2.392	**.027**	.556	.584	2.626	**.016**	1.967	.063

	I Analysis	1.318	.198	.442	.662	2.547	**.016**	.873	.39
PROG	P Analysis	1.807	.086	1.009	.325	1.653	.114	2.242	**.036**
	I Analysis	.556	.583	.164	.871	.301	.766	1.088	.286

Note. P Analysis = participants analysis; I Analysis = items analysis. Significant results were highlighted in bold.

Native English speakers

As expected, native English speakers exhibited full sensitivity to tense-aspect anomalies during sentence comprehension. Significant RT differences were found between anomalous sentences and well-formed ones in participants and/or items analyses. The effects varied as a function of TA and anomaly type. For PAST, native English speakers were immediately sensitive to grammar-induced violation at the verb, $t_1 = 3.928$, $p = .001$; $t_2 = 2.308$, $p = .028$. For PROG, sensitivity to grammar-induced violation occurred at V+1, $t_1 = 3.266$, $p = .003$; $t_2 = 1.917$, $p = .065$, and V+2, $t_1 = 2.504$, $p = .02$; $t_2 = 1.613$, $p = .118$, as well as SF, $t_1 = 2.566$, $p = .017$; $t_2 = 1.468$, $p = .153$. Remarkably, native English speakers slowed down significantly when encountering meaning-induced violation only at SF (PAST: $t_1 = 3.087$, $p = .005$; $t_2 = 3.355$, $p = .002$; PROG: $t_1 = 2.673$, $p = .014$; $t_2 = 2.633$, $p = .013$). Again, Table 5 lists the specific reading time results for Experiment IA.

The processing profiles of native English speakers set a clear benchmark before examining L2 participants' reading performance, which is prone to be more variable. Two observations are noteworthy. First, the self-paced reading task that was employed appears to be a valid method to assess individuals' integrated linguistic knowledge, such as knowledge of tense-aspect morphology. The native English speaker data revealed that a morphological anomaly or a related error would cause a delay in reading time. Second, the delay in reading time could appear at the point in which an anomaly is detected or somewhere following. It is therefore critical to take into account reading time performance at multiple word regions in this

type of psycholinguistic study, especially when non-native speakers' processing consequence may take longer to materialize (e.g., Jiang, 2007).

On a similar note, native English speakers immediately detected an uninflected verb in an obligatory past context (grammar-induced violation such as **Yesterday several large snakes escape…*), whereas their sensitivities appear to emerge later approaching the sentence final word when a temporal adverbial was incongruent with the inflected verb in either PAST or PROG (meaning-induced violation such as *#Tomorrow several last snakes escaped…*). Overall, these results seem to suggest an incremental process to linguistic meaning integration.

Korean L2 learners

The Korean group showed an RT pattern similar to native English speakers. Overall, Korean L2 learners showed clear sensitivity to violations for both PAST and PROG.

For PAST, they took significantly longer in reading grammar-induced violation sentences at V+1, $t_1 = 2.637$, $p = .02$; $t_2 = 1.947$, $p = .061$, and at V+2, $t_1 = 2.878$, $p = .012$; $t_2 = 2.253$, $p = .032$. Exactly the same trend was observed for meaning-induced violation sentences at V+1, $t_1 = 2{,}314$, $p = .036$; $t_2 = .893$, $p = .379$, and V+2, $t_1 = 2.192$, $p = .046$; $t_2 = .787$, $p = .437$.

For PROG, Korean L2 learners showed robust sensitivity to grammar-induced violations at all word regions, ps $< .019$, and meaning-induced violation at sentence final word, $t_1 = 3.557$, $p = .003$; $t_2 = 1.61$, $p = .118$. This pattern closely resembled that of native English speakers.

German L2 learners

German L2 learners were primarily sensitive to grammar-induced violations (e.g., **Yesterday several large snakes escape…*). For PAST, reliable RT differences were revealed at

V+1, $t_1 = 2.849$, $p = .009$; $t_2 = 2.127$, $p = .042$, and at V+2, $t_1 = 2.632$, $p = .015$; $t_2 = 2.993$, $p = .006$, and similarly for PROG at V+1, $t_1 = 3.749$, $p = .001$; $t_2 = 3.864$, $p = .001$, and V+2, $t_1 = 2.435$, $p = .023$; $t_2 = .761$, $p = .453$. The only word region where German L2 learners displayed sensitivity to meaning-induced violation was at V+2 in PAST, $t_1 = 2.568$, $p = .017$; $t_2 = 1.374$, $p = .18$.

More strikingly, no reliable RT difference was obtained for meaning-induced violation in PROG (#*Lately the baby is laughing*…), *p*s > .078. Further statistical analyses treating L2 English proficiency as a factor also confirmed this observation. Higher proficiency German participants ($M = 87.07$, $SD = 5.05$) did not perform better than lower proficiency German participants ($M = 69.1$, $SD = 10.37$), despite a significant difference in proficiency, $p < .001$. These results suggested that German participants were aware of an error when a past tense or progressive marking (operationalized as auxiliary *be*) was conspicuously omitted in an obligatory context (i.e. grammar-induced violation). However, their processing system showed less sensitivity when an incongruent past tense or progressive aspect marker was present (i.e. meaning-induced violation). What caused the observed dissociations is yet to be explored. Looking ahead, results from Experiments II and III would be particularly informative when they were designed to explore the semantic processing mechanisms.

Chinese L2 learners

Chinese L2 learners did not seem to be bothered when a past tense marking was omitted in an obligatory past context (**Yesterday several large snakes escape*…). Paired-samples *t* test results show there was no reliable RT difference for such grammar-induced violations in any of the four word regions (as shown in Table 6), *p*s > .411. Further statistical analyses treating L2

English proficiency as a factor also confirmed this observation. Higher proficiency Chinese participants (M = 77.9, SD = 5.78) did not perform better than lower proficiency Chinese participants (M = 49.45, SD = 9.42), despite a significant difference in proficiency, $p < .001$. This lack of sensitivity was in stark contrast to native English speakers as well as to Korean and German L2 learners. However, the same participants demonstrated sensitivity to meaning-induced violations in PAST at both the verb and V+2.

For PROG, Chinese L2 learners showed an RT pattern similar to native English speakers. They exhibited sensitivity to grammar-induced violations (**Currently the baby laughing...*) at all word regions except the sentence final word. Also, they were sensitive to meaning-induced violation (*#Lately the baby is laughing...*) at the sentence final word, $t_1 = 2.242$, $p = .036$; $t_2 = 1.088$, $p = .286$. Table 7 provides a high level summary of RT findings for Experiment IA.

Table 7. Summary of results for Experiment IA

		Verb		V+1		V+2		SF	
	Analysis	Participants	Items	Participants	Items	Participants	Items	Participants	Items
PAST	*t-test*: well-formed vs. grammar-induced violation								
	English	**	*				*		
	Korean			*		*	*		
	German			**	*	*	**		
	Chinese								
	t-test: well-formed vs. meaning-induced violation								
	English							**	**
	Korean			*		*			
	German					*			
	Chinese		*			*	*		
PROG	*t-test*: well-formed vs. grammar-induced violation								
	English			**		*		*	
	Korean	*		*		**	**	*	
	German			**	**	*			
	Chinese		**	**	***	*			
	t-test: well-formed vs. meaning-induced violation								
	English		**					*	*
	Korean							**	
	German								
	Chinese							*	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Short summary

The foremost research question in Experiment IA is concerned with whether L2 learners are able to process tense-aspect morphology in real time, as indexed by their online sensitivities to erroneous use of past and progressive morphology. The answer is positive, as the 3-way ANOVAs revealed a main effect of anomaly collapsed across TA and language in every word region. The same was also true when anomaly type (grammar-induced vs. meaning induced violations) was taken into account, as the interaction between TA × Anomaly was significant in all word regions. Moreover, the main effect of language was significant at the verb, V+1, and SF. These results clearly supported the observation that native speakers and L2 learners alike were sensitive to tense-aspect anomalies.

More importantly, the paired-samples *t* tests results for each language group provided additional support to the above claim. As shown in Table 7, native English speakers and Korean L2 learners were sensitive to all erroneous PAST and PROG usage. The pattern is largely the same for German and Chinese L2 learners, except that German overlooked meaning-induced violation in PROG (#*Lately the baby is laughing*…), whereas Chinese failed to notice grammar-induced violation in PAST (**Yesterday several large snakes escape*…).

On top of these specific findings from Experiment IA, two generalizations are noteworthy. First, as is evident in the data from Korean L2 learners as well as from native English speakers, the word-by-word self-paced reading technique was powerful enough to allow native speakers and L2 learners to show online sensitivity to both grammar- and meaning-induced violations in PAST and PROG, at least in the current experimental setup. It is therefore unlikely that a lack of sensitivity in individual L2 learner group or condition was due to an inappropriate method or task. Second, the processing results indicated clearly that both form and

function (i.e. grammar- and meaning-induced violations) as well as learners' L1 background (i.e. grammaticized TA category) are critical when examining L2 tense-aspect morphological processing.

3.5 EXPERIMENT IB: PLURAL AGREEMENT & SUBCATEGORIZATION

Experiment IB examines L2 learners' automaticity in processing plural agreement morphology and subcategorization.

3.5.1 Method

3.5.1.1 Materials

For plural agreement morphology, 18 sentences were obtained from Experiment 2 of Jiang (2004). Each sentence had a grammatical and an ungrammatical version, and was randomly distributed across two counterbalanced lists. Each list contained 18 grammatical and 18 ungrammatical sentences.

For subcategorization, 12 sentence pairs were obtained from Experiment 2 of Jiang (2004). Because these materials were not counterbalanced in Jiang (2004), an additional 12 sentence pairs were created to ensure each verb pair was matched across conditions. Thus, each verb pair was used to create a total of four sentences that vary with regard to the verb, as well as subcategorization specifications.

To ensure consistency with experimental sentences from Experiment IA, an adverb was placed in the sentence initial position in all sentences. Table 8 lists sample stimuli sentences for Experiment IB. All stimuli can be found in Appendix E.

Table 8. Sample stimuli for Experiment IB

	Sentence type	Explanation	Example
Plural agreement	Grammatical	The head noun agrees in number with the verb.	Surprisingly the boxes for the toy <u>*were found in*</u> the *backyard*.
	Ungrammatical	The head noun did not agree in number with the verb.	*Surprisingly the box for the toy <u>*were found in*</u> the *backyard*.
Subcategorization	Grammatical	The verb complies with the subcategorization specification.	Loudly the teacher <u>*introduced*</u> *the speaker* to everyone in the *room*. OR Rudely Susan <u>*refused*</u> *to talk* to her *mother*.
	Ungrammatical	The verb violates the subcategorization specification.	*Loudly the teacher <u>*refused*</u> *the speaker* to everyone in the *room.* OR *Rudely Susan <u>*introduced*</u> *to talk* to her *mother*.

Note. The critical verb is underlined. The italic font highlights the word regions where reading times data are analyzed.

3.5.1.2 Data analysis

Table 9 lists the mean residual log RTs by condition for each word region and language group.

Table 9. Mean residual log RTs for Experiment IB

		Verb		V+1		V+2		SF	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Plural agreement									
English	G	-.04	.039	-.04	.031	-.041	.032	.068	.089
	U	-.038	.041	.001	.069	.02	.051	.089	.066
Korean	G	-.025	.044	-.022	.046	-.031	.05	.082	.096
	U	-.004	.054	-.027	.049	-.027	.06	.11	.124
German	G	-.029	.034	-.048	.044	-.03	.037	.127	.111
	U	-.026	.045	-.02	.043	-.014	.047	.118	.091
Chinese	G	.013	.065	-.016	.044	-.013	.054	.054	.08
	U	-.016	.058	-.042	.052	-.028	.049	.04	.088
Subcategorization									
English	G	.001	.056	-.033	.048	-.049	.036	.063	.094
	U	-.006	.032	-.024	.071	-.005	.067	.115	.099
Korean	G	.014	.049	-.016	.054	-.037	.042	.037	.071
	U	-.003	.076	-.007	.103	-.057	.051	.076	.098
German	G	-.004	.063	-.016	.058	-.039	.057	.12	.109
	U	-.004	.062	-.033	.044	-.018	.049	.165	.122
Chinese	G	.018	.061	-.006	.064	-.027	.052	.013	.075
	U	.007	.064	.001	.058	.002	.051	.061	.115

Note. G = Grammatical; U = Ungrammatical

The main goal of Experiment IB was to compare whether L2 learners showed a difference in reading times between grammatical and ungrammatical sentences, and because the number of items was different for plural agreement and subcategorization, separate analyses were conducted. Paired-samples *t* tests were performed separately for plural agreement and subcategorization for each language group's RTs on grammatical and ungrammatical sentences. Both participants and items analyses were carried out at the four word regions. The results of these analyses are summarized in Table 10.

Table 10. Results of paired-samples t tests for Experiment IB

		Verb		V+1		V+2		SF	
		t	*p*	*t*	*p*	*t*	*p*	*t*	*p*
Native English speakers									
Plural	P Analysis	.156	.878	2.729	**.012**	4.605	**.000**	1.586	.126
	I Analysis	2.009	.061	2.361	**.03**	4.706	**.000**	.403	.692
Subcat	P Analysis	.608	.549	.595	.557	2.987	**.007**	2.265	**.033**
	I Analysis	1.535	.153	1.152	.274	2.476	**.031**	3.377	**.006**
Korean L2 learners									
Plural	P Analysis	1.143	.272	.313	.759	.193	.85	.933	.367
	I Analysis	1.056	.306	.945	.358	.614	.547	.254	.802
Subcat	P Analysis	1.08	.298	.337	.741	1.025	.323	1.378	.19
	I Analysis	.936	.369	2.336	**.039**	.061	.953	2.657	**.022**
German L2 learners									
Plural	P Analysis	.295	.771	2.776	**.011**	1.176	.251	.555	.584
	I Analysis	.081	.936	3.717	**.002**	.281	.782	.81	.429
Subcat	P Analysis	.037	.971	1.377	.181	1.673	.107	2.602	**.016**
	I Analysis	.821	.429	1.813	.097	.289	.778	1.422	.183
Chinese L2 learners									
Plural	P Analysis	1.487	.153	1.955	.065	.878	.391	1.069	.298
	I Analysis	1.26	.225	.047	.963	.711	.487	.356	.733
Subcat	P Analysis	.449	.658	.465	.647	1.729	.099	1.9	.072
	I Analysis	3.279	**.007**	1.151	.274	.541	.599	1.792	.101

Note. Subcat stands for subcategorization.

3.5.2 Results

The results of Experiment IB were presented in the following by group.

Native English speakers

As expected, it took native English speakers significantly longer to read sentences involving plural agreement errors than it took them to read the grammatical ones (see Table 9).

Reading time evidence can be found at V+1 and V+2 in both the participants and items analyses, V+1: $t_1 = 2.729$, $p = .012$; $t_2 = 2.361$, $p = .03$; V+2: $t_1 = 4.605$, $p < .001$; $t_2 = 4.706$, $p < .001$. Also, native English speakers showed a significant delay in reading times for subcategorization errors at V+2 and SF in both the participants and items analyses, V+2: $t_1 = 2.987$, $p = .007$; $t_2 = 2.476$, $p = .031$; SF: $t_1 = 2.265$, $p = .033$; $t_2 = 3.377$, $p = .006$. As shown, these results were robust and generalizable beyond the tested items.

Korean L2 learners

Unlike native English speakers, Korean L2 learners showed no reliable RT difference between grammatical and ungrammatical sentences either for plural agreement (ps > .272) or subcategorization errors (ps > .19).

German L2 learners

German L2 learners showed reliable RT difference at V+1 for plural disagreement, $t_1 = 2.776$, $p = .011$; $t_2 = 3.717$, $p = .002$. They also showed sensitivity to subcategorization errors at SF in the participants analysis, $t_1 = 2.602$, $p = .016$; $t_2 = 1.422$, $p = .183$. On the whole, German L2 learners and native English speakers showed comparable sensitivities to plural agreement and subcategorization errors.

Chinese L2 learners

The performance of Chinese L2 learners was similar to Korean L2 learners because they were insensitive to plural agreement and subcategorization errors. Looking more closely at the quantitative results, it took Chinese L2 learners longer to read ungrammatical sentences

involving subcategorization errors than it took to read grammatical sentences. The differences were as expected but they were not statistically significant. Presumably, since plural -s is not functionally loaded, and Chinese does not grammatically encode plurality, L2 learners thus have a greater tendency to ignore plural agreement (Jiang, 2007; Gor, 2010).

Short summary

One important observation is that while both native English speakers and German L2 learners were sensitive to plural agreement and subcategorization errors, Korean and Chinese L2 learners were not. As native English speakers demonstrated robust sensitivities, the differences observed cannot be attributed to insufficient items or statistical power. It is also difficult to cast doubt on the native versus non-native contrast, because German L2 learners also demonstrated clear sensitivity to ungrammatical constructions involving plural agreement and subcategorization. Recall that the Korean participants had the highest English proficiency as measured by MTELP (see Table 3), and the German participants also had comparable scores. If L2 proficiency were to be responsible, it would be questionable why German L2 learners exhibited sensitivity but Korean L2 learners did not.

One important point to note, though, is that there are cross-linguistic differences in terms of plural marking and plural agreement. English has an overt plural morpheme -s, whereas German has a rich plural marking system. In contrast, plural marking is not obligatory in Korean and Chinese (Lardiere, 2009, p. 200). Although overt plural morphemes such as *tul* in Korean or *men* in Chinese exist, they are often not required. If L2 learners transfer their language processing routines in dealing with (the lack of) plural agreement, it is not surprising that both Korean and Chinese L2 learners were unable to process plural disagreement in L2 English. It

remains to be explained why the Korean and Chinese participants failed to detect subcategorization errors, however. One speculation is that the verbal argument structures differ among English, Korean, and Chinese. What constitutes a subcategorization error in English may in fact be a grammatical construction in Korean and Chinese.

3.6 DISCUSSION

In this section, I synthesize results from Experiment IA and IB and discuss their theoretical significance. In response to the first research question, reading time results indicated that both native English speakers and L2 learners noticed erroneous use of past tense and progressive aspect morphology during sentence processing. There were, however, several theoretically important findings emerging from the interactions between anomaly types and individual L2 learner groups, which are correlated with L1-specific morphological make-up. Similar findings were obtained for plural morphology and subcategorization as well. I contend that a transfer-based account provides a principled explanation for the observed results. In the domain of tense and aspect in particular, knowledge of L1 continues to exert its influence even when speakers compute temporal representations using tense-aspect morphological cues from an L2.

3.6.1 Tense-aspect morphology

One strong indication in favor of transfer is that the L2 learner groups did not perform uniformly. That is, although Korean participants detected all violations in PAST and PROG, German participants overlooked meaning-induced violation in PROG, and Chinese participants failed to

detect grammar-induced violation in PAST. More importantly, each language group's within-group differences could be systematically attributed to the grammatical and/or functional properties of tense-aspect in respective L1s. As discussed in Chapter 2, Korean, German, and Chinese form a three-way typological contrast in terms of grammaticized past and progressive morphology. Korean has both PAST and PROG; German has PAST but not PROG; and Chinese has PROG but not PAST. Seemingly, the L1 grammaticization patterns predicted how past and progressive morphology was processed in an L2 in real time.

Before moving on, it is essential to elucidate what counts as empirical evidence of transfer. Among the many definitions[5] offered in the SLA literature, Jarvis (2000) posited three types of evidence for transfer. Principally, they include intra-L1-group similarities, inter-L1-group differences, and L1-interlanguage performance similarities. Jarvis argued that the emergence of any single one of these effects could be sufficient, but he added that the case would be more compelling if two or more of these effects are simultaneously present to corroborate the evidence for transfer. Applying Jarvis's criteria to Experiment IA, it is observed that the reading time data indeed revealed effects of intra-L1-group similarities and inter-L1-group differences. The third effect could not be assessed because it would have required an experimental setup that tested tense-aspect processing in the speakers' first and second languages.

To illustrate the effect of intra-L1-group similarities, let's look at the reading performance of each L2 learner group. As predicted, the Korean participants slowed down significantly for grammar- and meaning-induced violations in both PAST and PROG, similar to

[5] Although the role of L1 in L2 learning is well documented and acknowledged in SLA research, the characterization of transfer, or similar notions such as L1 influence, conceptual transfer, cross-language similarities, and so forth, tends to be vague and loose at times. One viable approach is to operationalize transfer in the context of specific empirical studies, as is situated in Experiment I in this chapter, or according to a particular theoretical idea or framework. Jarvis (2011, p. 3), for instance, described conceptual transfer studies as those "mainly [focusing] on linguistic behavior (both receptive and productive) in order to determine how conceptual influences associated with the L1 or any previously acquired language might affect the acquisition and use of another language".

what native English speakers did. The picture was somewhat different for the German participants. They slowed down significantly for grammar- and meaning-induced violations in PAST. There was, however, a substantial difference of how the German participants responded to PROG. They noticed grammar-induced violation for PROG, but overlooked meaning-induced violation in PROG. One likely explanation is that the form for PROG (*be V-ing*) is perceptually salient. It is therefore not difficult for German participants to notice a missing auxiliary in a progressive construction, as all L2 learners did. As discussed in Chapter 2, since PROG is a conceptual temporal category, lacking such a grammaticized notion in the first place may deprive the speaker of one way to grammatically represent the concept of ongoingness. Precisely, the German participants did not show an aspectual distinction with respect to progressiveness in English. It is important to note the uniqueness of the situation. Only the German participants failed to notice meaning-induced violation in PROG (#*Lately the baby is laughing…*), compared to native English, and Korean and Chinese participants. Furthermore, data from the Chinese participants confirmed intra-L1-group similarities. The Chinese participants were sensitive to all violations, except that they were not bothered by grammar-induced violation in PAST (**Yesterday several large snakes escape…*). Again, this observation can be readily explained by the language-specific fact that Chinese is a language that lacks tense morphology. Ellis and Sagarra (2010) trained a group of native Chinese speakers on Latin temporal adverbs and tense conjugations in present, past and future. It was found that the Chinese participants failed to acquire the inflectional cues when temporal adverbs and verb tense cues were equally available. In a perception task, the Chinese participants were less sensitive to verbal morphological cues than the native English participants were. From a usage-based perspective on language learning, Ellis and Sagarra (2010, p. 573) interpreted these results as suggestive of transfer, claiming that

"a lifetime of prior L1 usage results in long-term influence of attention to language, processing bias, and subsequent blocking of cue learning".

Results from Experiment IA show that the three L2 learner groups differed systematically from one another in terms of their processing profile, satisfying the second type of evidence concerning inter-L1-group differences. One caveat here is that L2 tense-aspect sensitivity may interact with language proficiency (Slabakova, 2000; 2001). Consequently, lower proficiency L2 groups would probably show less sensitivity to anomalies. In Experiment IA, the systematic differences observed could not be readily attributed to the pre-existing differences in L2 English proficiency. If L2 English proficiency were to be fully responsible, it would entail comparable processing performance among Korean and German participants, and an overall poor sensitivity for Chinese participants in PAST and PROG across the board. Both of these were not true in Experiment IA.

On the contrary, one direct piece of counter-evidence for transfer would be that all L2 learners regardless of L1 background follow the same order of development, or in the context of a violation detection paradigm, perform in a uniform way. Again, the processing results do not support such a conclusion in Experiment IA.

3.6.2 Plural agreement and subcategorization

The role of L1 is also evident in L2 learners' processing of plural agreement morphology and subcategorization. As expected, native English and German speakers slowed down when they encountered plural agreement and subcategorization errors, relative to grammatically well-formed sentences. On the contrary, Korean and Chinese were not sensitive to plural disagreement or subcategorization errors.

Plural marking and plural agreement are known to be difficult for L2 learners. The observed differences may very well lie in the linguistic differences in the plural marking system. In this light, results for Korean and Chinese were hardly surprising, as numerous previous L2 studies involving Chinese and Korean learners have documented the difficulty in the use and processing of plural morphology (e.g., Bardovi-Harlig & Bofman, 1989; Jiang, 2004, 2007; Johnson, 1992; Johnson & Newport, 1989). Again, L2 English proficiency cannot possibly offer a viable explanation. Because Korean and German participants had comparable L2 English proficiency, the account would be at odds with the observed data.

The picture becomes more complicated for subcategorization errors. The Chinese data, in particular, did not align with previous findings in Jiang (2004) where the high-intermediate Chinese L2 learners of English could detect subcategorization errors. There could be multiple reasons for this discrepancy. One possible reason is that Experiment IB included a counterbalancing procedure to ensure each verb in the verb pair was matched for grammaticality in subcategorization. Such a procedure was absent in Jiang (2004), which might potentially increase the chances for verb-specific biases underlying the detection of subcategorization errors.

Another possibility stems from the verbal argument structure that differs among English, Korean, and Chinese. Jiang (2007), for example, suggested that the translation equivalent of the verb pair for subcategorization might not differ in terms of subcategorization properties. For example, "the Chinese verbs for 'encourage' and 'support' both take a verbal phrase as their object complement, so the Chinese translations of the two versions of 'Their teacher encouraged/supported them to send the letter to the president' are both grammatical" (p. 20). A similar idea has also been proposed for language-specific differences in container verbs (e.g. *cover*, *fill*), in which container verbs in Chinese are described to have a larger scope than their

English counterparts (Juffs, 1996, p. 189). This idea will need to be evaluated on a predicate-by-predicate basis.

Furthermore, details in task difference may contribute to the observed difference. Jiang (2004, p. 632) adopted a fixed position presentation procedure for the self-paced reading task, whereas Experiment I here employed the commonly used moving window paradigm (Just, Carpenter, & Woolley, 1982). Interestingly, Jiang (2004) reported in footnote 6 that he attempted to implement a moving window presentation, but found native English speakers to be insensitive to plural agreement errors for some mysterious reasons. Considering the above possibilities, a direct comparison on subcategorization performance between Jiang (2004) and Experiment IB seems difficult. This said, it is unambiguous that Korean and Chinese participants lacked sensitivities when processing English plural agreement and subcategorization errors in Experiment IB.

Importantly, the experimental results in Experiment I showed that properties of the learners' L1 affected many facets of L2 morphological processing. The evidence for L1 transfer remains strong, considering the fact that typologically different L1 groups (Korean, German, and Chinese) showed different but systematic patterns of L2 processing. This inevitably calls into question the shallow structure hypothesis and its assumption on L1 transfer (Clahsen & Felser, 2006b, p. 33).

On a final note, it is important to note that native English speakers were sensitive to all violations tested in past tense, progressive aspect, plural morphology, and subcategorization. These observations are vital as they serve as the baseline for comparing L2 learners' performance.

3.7 SUMMARY

In this chapter, I investigated how L2 learners processed past and progressive morphology (Experiment IA), as well as plural agreement and subcategorization (Experiment IB) during sentence comprehension. Reading time results indicated that L2 learners were generally capable of detecting morphosyntactic violations in the past and progressive. Similarly, L2 learners exhibited online sensitivity to plural agreement and subcategorization errors. However, there were conditions in which particular L2 learner groups failed to demonstrate any sensitivity, and such findings coincided systematically with properties of L2 learners' respective L1s. Given these results, I contended that L1 transfer provides the most plausible explanation.

This chapter accomplished two important goals. First, Experiment IA was devoted to a psycholinguistic investigation of tense-aspect morphology. This was necessary because although it is well-attested that bound inflectional morphology is problematic for L2 learners, how L2 learners process tense-aspect cues in real time is less understood. Experiment I as a whole provided new empirical data regarding L2 tense-aspect processing, and how it fared against the processing of plural agreement and subcategorization.

Second, for dissertation-internal reasons, Experiment I systematically investigated and illustrated that factors such as anomaly type and L1 background are likely to constrain L2 learners' sensitivities to morphological anomalies using a violation detection paradigm in self-paced reading. Crucially, Experiment I has paved the way forward for subsequent experiments (e.g., Experiments II & III), which were designed to further explore the online mechanisms involved in the semantic processing of tense-aspect categories.

4.0 PROTOTYPE

The universal and language-specific dimensions involved in tense and aspect are bound to spur debate on the theoretical underpinning of L2 acquisition and processing. Presumably, lexical aspect is universal. It is not a grammatical category, unlike tense and grammatical aspect, which are more susceptible to language-specific influence on forms and processes of grammaticization.

Previous research has suggested that the interaction between universal lexical aspect and language-specific grammatical aspect (and tense) follow a predictable developmental sequence among child L1 and adult L2 learners. The influential Aspect Hypothesis, which will be elaborated in section 4.1.1, capitalizes on such interactions between lexical and grammatical aspect (and tense) to explain universal acquisition patterns. This explanation rests on a number of proposals, one of which is notably prototype. The basic idea behind a prototype account is that the most representative form-meaning correspondence is first established before the meaning is extended to cover broader instances. Consistent with the Aspect Hypothesis description, the prototype account has the broad appeal of universality. However, one of the most pressing issues facing L2 tense-aspect acquisition research to date is perhaps the other side of the same phenomena that remain unaccounted for. That is, although universal trends are researched and theorized, idiosyncratic or language-specific patterns that are probably as theoretically important are being neglected. A small number of L2 acquisition studies have begun to address the potential role of L1 on L2 tense-aspect acquisition, trying to bring together a more

comprehensive view of second language development. This chapter systematically explores the role of L1 in the L2 processing of tense-aspect prototype. I contend that a satisfactory and adequate explanation for L2 tense-aspect acquisition needs to take into account insights from both prototype and transfer. Results from Experiment II support this claim.

4.1 LITERATURE

4.1.1 The Aspect Hypothesis

The Aspect Hypothesis (Andersen & Shirai, 1994; Bardovi-Harlig, 2000; Robison, 1995) focuses on the distribution of tense-aspect morphology across lexical aspect. In other words, it concerns the interaction between grammatical and lexical aspect. The AH asserts that "first and second language learners will initially be influenced by the inherent semantic aspect of verbs or predicates in the acquisition of tense and aspect markers associated with or affixed to these verbs (Andersen & Shirai, 1994, p. 133). The tenets of the AH include:

1. Learners first use past marking or perfective making on achievement and accomplishment verbs, eventually extending its use to activity and state verbs.

2. In languages that encode the perfective/imperfective distinction, imperfective past appears later than perfective past, and imperfective past marking begins with state and activity verbs, then extends to accomplishment and achievement verbs.

3. In languages that have progressive aspect, progressive marking begins with activity verbs, and then extends to accomplishment or achievement verbs.

4. Progressive markings are not incorrectly overextended to state verbs (in L1 acquisition).

(Andersen & Shirai, 1996, p. 533; originally Shirai, 1991, pp. 11-12)

These four tenets have been robustly confirmed by numerous child[6] and adult language acquisition studies, and in a variety of different target languages. Notable L2 acquisition studies and the languages under investigation include English (Bardovi-Harlig, 1998; Lee, 2001; Robison, 1995), Italian (Giacalone-Ramat, 2002), French (Izquierdo & Collins, 2008), Japanese (Gabriele, 2009; Nishi & Shirai, 2007; Shirai & Kurono, 1998; Sugaya & Shirai, 2007), and Korean (Lee & Kim, 2007), among others. One appeal, as well as the central claim of AH, is that the influence of lexical aspectual semantics on tense-aspect morphological acquisition is universal.

Although empirical evidence in favor of the AH was predominantly accrued from learner production data (e.g., Bardovi-Harlig, 2000; Shirai, 2009), corpus analyses of native speech also revealed similar distributional biases in native speaker discourse (see Andersen & Shirai, 1996, for review). For example, Wulff et al. (2009) looked beyond raw frequency distribution and computed a multiple distinctive collexeme analysis[7] (MDCA, e.g., Gries & Stefanowitsch, 2004) on two native-speaker corpora — the spoken section of the British National Corpus and the Michigan Corpus of Academic Spoken English. Their elaborated analyses provided quantitative

[6] Notable L1 tense-aspect studies include Bronckart and Sinclair (1973), Antinucci and Miller (1976), Bickerton (1981), Bloom, Lifter, and Hafitz (1980), and Shirai and Andersen (1995).

[7] In short, MDCA provides an association-based distributional analysis between words and linguistic constructions in context.

evidence that frequency, semantic distinctiveness, and prototypicality of lexical aspect present in native speaker discourse interact to promote tense-aspect acquisition.

The AH, however, is not without challenges. The European Science Foundation (ESF) coordinated a large-scale, multilingual, and longitudinal second language acquisition project (Perdue, 1993) to investigate naturalistic L2 acquisition by adult immigrants to various European countries during 1982-1988. Dietrich, Klein, and Noyau (1995) provided an in-depth, qualitative analysis of those untutored L2 learners, and argued against any systematic associations between tense-aspect morphology and lexical aspect. Regarding the acquisition of English, Klein (1995) concluded that learners' temporal marking by grammatical means was virtually absent. What was observed instead was an elementary communication system, known as the basic variety, which was devoid of any functional morphology (but see Chan, Finberg, Costello, and Shirai (in press) for an alternative quantitative analysis of ESF data).

Another problem is that the AH remains descriptive at this point (Shirai, 2009). Questions such as how the distributional phenomena invariably emerge in native speakers and L2 learners, or how do L2 learners exploit those characteristics in learning are not fully investigated. Follow-up inquiries must therefore seek explanations to the AH. A semantic-based prototype account looks promising.

4.1.2 Prototype

Shirai (1991, 2002), Shirai and Andersen (1995), Li and Shirai (2000), and Wagner (2009) appealed to a prototype account, inspired by Rosch and colleagues' (1973, 1975, 1978; Rosch & Mervis, 1975) prototype theory on the cognitive representations of semantic categories, to explain the developmental emergence of tense-aspect morphology in L1 and L2 acquisition.

A prototype, by definition, is the most representative member of a category. It assumes graded membership with other exemplars of the category. The prototype account supposes that acquisition starts with prototypical members/associations of a grammatical category, and gradually extends its application to less prototypical cases, following psycholinguistic principles of induction of categories (e.g., Ellis, 2006). The distributional bias in language input promotes the acquisition of more frequent, distinctive, and prototypical exemplars (Ellis, 2010). In this light, Shirai and colleagues assumed tense-aspect morphology as a prototype category that encompasses both central and marginal exemplars, and prototypical PAST and PROG exemplars would be acquired more readily than their less prototypical counterparts.

To be specific, a prototypical PAST exemplar is formed by Achievement predicates marked in the past. Because telic verbs depict situations resulting in a change of state, the semantic congruence between Achievement [+punctual, +telic] and deictic past morphology renders this association the most prototypical. Shirai (1991, p. 45) summarized the form-meaning associations for prototypical PAST in the following hierarchy:

Deictic past (Achievement → Accomplishment → Activity → State → habitual/iterative past) → counterfactual/pragmatic softener

Similarly, a prototypical PROG exemplar is formed when a progressive marker combines with an activity predicate. Stative PROG, by contrast, is deemed the least prototypical exemplar because PROG primarily refers to action in progress. The hierarchy for PROG, from prototypical to less prototypical associations, is shown as follows (Shirai, 1991, p. 46):

Process (Activity → Accomplishment) → iterative → habitual/futurate → stative progressive

Under the prototype account, it is the semantic prototype formation mechanism that drives the acquisition of tense-aspect categories. The Aspect Hypothesis and its characterization of form-function distributions are epiphenomenal. However, this is not to dispute the fundamental role of frequency in the emergence of grammatical structure (Bybee & Hopper, 2001). Andersen (1993) and Shirai and Andersen (1995), for example, have demonstrated that input frequency as a basis for prototype formation is important to children's development of tense-aspect morphology. They argued that the distributional bias in the input (e.g., the distributional bias hypothesis) exposed young language learners to data conducive to a prototype representation. Frequency has an indispensable role to play in prototype formation. Ellis and Collins (2009, p. 331) also remarked on the intertwined relation between frequency and prototype: "the greater the token frequency of an exemplar, the more it contributes to defining the category and the greater the likelihood it will be considered the prototype".

Yap et al. (2009) provided the most compelling evidence for a prototype account for aspectual processing within native speakers. Previous reading time studies revealed that native speakers exploit grammatical aspectual cues such as perfective (PERF) and imperfective (IMPERF) morphology when constructing mental situation models (e.g., Carreiras, Carriedo, Alonso, & Fernández, 1997; Ferretti, Kutas, & McRae, 2007). Using three picture-sentence matching tasks, Madden and Zwaan (2003) observed that native English participants matched perfective sentences with pictures depicting completed situations more quickly than they matched them with pictures depicting ongoing situations. They reasoned that the perfective-imperfective contrast is responsible for the perfective facilitation effect. The morphological exponent of the imperfective aspect (e.g., English PROG) provides a within-the-event perspective, which allows readers to represent dynamic situations at various intermediate stages

of completion. By contrast, the perfective aspect prevents access to the internal, temporal structure of a situation (Comrie, 1976), and is thus easier for readers to converge on a representation for the endpoint (Madden & Zwaan, 2003). Employing one of the three experiments in auditory processing, Yap et al. (2009) systematically manipulated combinations of lexical and grammatical aspect (i.e. accomplishment-PERF and activity- IMPERF) and tested whether they would yield faster cognitive processing than less semantically-compatible combinations. The predictions were borne out among native Cantonese participants, whose L1 is rich in aspectual morphology. Importantly, Yap et al.'s (2009) results lent strong support to a prototype representation of tense-aspect categories within native Cantonese speakers. Further empirical studies are necessary to validate the prototype account and explore its processing consequence among L2 learners.

4.1.3 Transfer

Although relatively few acquisition studies have investigated L1 influence on L2 acquisition of tense-aspect categories, there is growing evidence that learners' knowledge of their native language also affects language performance, thus calling into question the account that exclusively relies on prototype universal.

Wenzell (1989) is among one of the earliest ESL studies in this area of investigation. She analyzed three Russian speakers' English oral narratives for tense-aspect morphosyntactic coding, and found that the perfective/imperfective distinction salient in Russian is marked via English past and non-past tense contrast. Wenzell (1989, p. 95) argued that her data bespeak a strong case of aspectual transfer from Russian because "perfective contexts are marked with

English simple past and the imperfective contexts with the English non-past (usually the base form of the verb)".

Using a cloze task adopted from Bardovi-Harlig and Reynolds (1995), Collins (2002) found that adult Francophone ESL learners inappropriately used present perfect in simple past contexts, especially among telic verbs (contra Ayoun and Salaberry, 2008). She offered transfer as an explanation: French *passé composé* (a compound past) renders both the definite past and indefinite past interpretations that are coded by English simple past and present perfect separately. It appears that the similarity in form between *passé composé* and English present perfect triggered transfer.

The progressive aspect also appears to be a locus of transfer. For example, Rocca (2002) conducted a bi-directional study of three Italian children learning English, and reciprocally, three English children learning Italian. Interestingly, she found a high frequency of occurrence of stative progressive in past context among the three Italian children learning English. These tokens include *wanting*, *knowing*, *belonging*, and *needing*. She argued that the Italian children applied the prototypical feature of *imperfetto* (a past tense that denotes imperfectivity) to English progressive, which has a more limited semantic scope. More remarkably, Rocca (2002) argued that the English children learning Italian had an opposite problem. They overused *passoto prossimo* (a past tense that denotes perfectivity) in imperfective contexts, but underused *imperfetto* in state verbs. The transfer of L1 aspectual distinctions was very apparent among these children. Rocca's study illustrates two very important points. First, transfer emerges subsequent to the influence of lexical aspect in language development, which can only be evaluated in a longitudinal or cross-sectional study. Second, the bi-directional design allows a two-way comparison to test the occurrence and directionality of transfer.

Similar to Rocca (2002), Collins (2004) argued for developmentally constrained L1 influence. In a cross-sectional study of French- and Japanese-learners of English using a cloze test, she found that while telic-past and activity-progressive associations were strong across different learner groups in general, Francophone learners were consistently less successful in using simple past tense with achievement verbs compared to Japanese learners. She attributed the difference to Francophone learners' inappropriate use of the present perfect, which is influenced by *passé composé* in L1 French. Importantly, Collins (2004) demonstrated that should transfer emerge, it is insufficient to override the dominant lexical aspectual effect predicted by the Aspect Hypothesis.

For language processing, Stutterheim and colleagues argued in a series of studies that the absence of grammaticized progressive in German influences L2 information organization and language production. In particular, Stutterheim and Carroll (2006) asked advanced German learners of English, and reciprocally advanced English learners of German, to verbally describe situations they had witnessed on short film clips. Their speech output was then transcribed and coded based on whether an endpoint was explicitly mentioned. German learners of English reported endpoints at a rate of 36.7%, whereas English learners of German only did so at 31.6%. For comparison, native German speakers mentioned endpoints 76.4% of a time in German, but native English speakers did so at a meager 25.2% in English. An interesting part of this experiment was that all dynamic scenes featured in the clips did not actually show the stage at which the endpoint was reached (i.e. a car driving along a road towards the house but not yet reaching it). Still, native German speakers as well as German learners of English adhered to the general tendency to conceptualize a situation holistically, and to linguistically encode and report the endpoints even when they were less evident. English speakers, however, did so to a

significantly lesser degree. Stutterheim and Carroll (2006) reasoned that the absence of grammatical aspect is responsible for German speakers' holistic pattern of event construal. They hypothesized that "grammaticized meanings" of tense-aspect categories like English PROG is central to the development of "specific overarching principles in the construction of referential frames and hence the types of event-time relations they [speakers] incorporate" (Stutterheim & Carroll, 2006, p. 51). English PROG, by contrast, is a highly automatized grammatical option that enables English speakers to readily encode and report a situation in any intermediate phase before culmination. Results from Stutterheim and Carroll (2006) are compatible with Slobin's (1996) claim — "thinking for speaking", which posits that "one fits one's thoughts into available linguistic forms" (Slobin, 1987; as cited in Slobin, 2003).

4.2 PURPOSE

The dual purpose of Experiment II is to test whether there is psycholinguistic evidence about tense-aspect prototype, and determine its universality in language processing. In other words, Experiment II tests both the prototype and transfer hypotheses. Because frequency is often confounded with prototype in non-experimental research, Experiment II exercises control for frequency-related effects in prototype.

4.3 RESEARCH QUESTIONS

Two research questions are addressed in Experiment II.

1. Does tense-aspect prototype yield a processing advantage within native speakers and L2 learners? If not, what are the specific patterns observed?
2. Does L1 influence the processing of tense-aspect prototype?

A general prediction is that a prototype yields processing advantage. If native speakers and L2 learners were to exploit aspectual biases during language processing, prototypical associations such as Achievement PAST and Activity PROG associations ought to engender shorter reading times than less prototypical associations such as State PAST and State PROG for all participants. If no processing advantage is observed, or if it varies from language group to language group, other interpretations may result.

4.4 EXPERIMENT II

I examined two variables: lexical aspect (State, Activity, Achievement); and grammaticized tense-aspect category (TA: PAST, PROG). This entailed a 3 × 2 within-participants design.

4.4.1 Method

4.4.1.1 Materials

Table 11 presents sample stimuli sentences for Experiment II. The stimuli for PAST and PROG consisted of twenty-four sentence triplets, each of which had the critical verbs vary in lexical aspect: State, Activity, and Achievement. A full version of the stimuli can be found in Appendix F. Similar to Experiment I in Chapter 3, the subjects of the sentences were constructed to be as general as possible to offset any anticipatory priming effects during comprehension.

Table 11. Sample stimuli for Experiment II

TA	Lexical aspect	Example
PAST	State	Susan *loved the red* guitar at the musical *fair*.
	Activity	Susan *played the red* guitar at the musical *fair*.
	Achievement	Susan *sold the red* guitar at the musical *fair*.
PROG	State	Ben is *believing what the* book said about cell *biology*.
	Activity	Ben is *reading what the* book said about cell *biology*.
	Achievement	Ben is *forgetting what the* book said about cell *biology*.

Note. The critical verb is underlined. The italic font highlights the word regions where reading times data are analyzed.

In Experiment II, all critical verbs marked in PAST and PROG were matched for token frequencies according to the CELEX database* (Baayen, Pipenbrock, & Gulikers, 1995), Fs < 2.243, ps > .13. Mean characteristics of the stimuli are given in Table 12. To be precise, the token frequencies of a target verb's infinitive, PAST, and PROG forms were obtained from CELEX, and percentages of the PAST and PROG forms were computed as a fraction of the sum of token frequencies. The percentages, or relative verb form frequencies, were then used for matching purposes. Verb participle, gerund, adjective, and noun counterparts that share identical forms with the target verbs were systematically excluded in token frequency counts.

Table 12. Properties of stimuli for Experiment II

	State		*Activity*		*Achievement*	
	M	*SD*	*M*	*SD*	*M*	*SD*
PAST						
Word length	6.33	2.01	6.63	1.66	5.25	1.7
CELEX token frequency	28.04	7.73	25.45	10.17	27.7	11.1
PROG						
Word length	8.29	2.01	8.33	1.71	7.5	1.45
CELEX token frequency	30.68	16.17	33.4	14.83	32.09	14.02

**Note*: The CELEX frequency counts are based on a corpus of 17.9 million words.

As can be seen in Table 12, word length differed across lexical aspect in PAST, $F(2, 46) = 4.155$, $p = .022$. Pairwise comparisons with Bonferroni adjustment revealed that Achievement word lengths ($M = 5.25$, $SE = 0.35$) were significantly shorter than Activity word lengths ($M = 6.63$, $SE = 0.34$), $p = .018$. No other differences regarding word length were significant, ps > .151.

Sentence triplets were distributed over three versions in a Latin Square design. Each version contained 24 different sentences — eight from each of the three conditions (State, Activity, Achievement) for both PAST and PROG. No sentence appeared more than once in any version, and no participant saw more than one sentence from any given triplet. 120 filler sentences plus another 138 items from the two other experiments were presented in tandem to prevent participants from developing strategies in reading the stimuli.

4.4.1.2 Data analysis

Table 13 shows an overview of the mean unadjusted reading times per word in milliseconds by lexical aspect and TA for each language group. Visual inspection of the RT distribution revealed that English native speakers exhibited the shortest reading times across the board, followed by Korean, German, and lastly Chinese, for both PAST and PROG. Word length and reading times

were significantly correlated in all language groups averaged across lexical aspect, for PAST: Spearman *r*s = .035, .104, .119, .233 for English, Korean, German, Chinese, respectively, *p*s < .013, and similarly for PROG: Spearman *r*s = .036, .132, .146, .253, *p*s < .007. Therefore, length-adjusted reading times were used for subsequent analyses.

Table 13. Mean unadjusted RTs for Experiment II

	State		*Activity*		*Achievement*	
	M	*SD*	*M*	*SD*	*M*	*SD*
PAST						
English	288.31	115.06	289.78	128.94	285.51	123
Korean	384.06	205.23	386.62	209.35	377.94	207.1
German	391.02	188.14	409.33	188.28	403.34	195.48
Chinese	483.55	245.07	493.69	262.55	481.08	252.2
PROG						
English	285.36	126.47	286.64	150.12	292.63	146.21
Korean	388	218.32	376.04	180.83	387.09	210.54
German	390.54	184.36	403.72	198.31	401.12	186.5
Chinese	482.88	254.73	483.01	249.53	494.9	273.68

Because L2 participants' English proficiency differed reliably across language groups, the analysis of covariance (ANCOVA) procedure was employed to partial out the potential confound of English proficiency. A default score of 100 was entered for native English participants for the ANCOVA. In case a proficiency score was missing for a participant, all data from that participant were excluded. All participants listed in Table 1 were included in the reported analyses.

Table 14 lists the residual log reading times at four targeted word regions. Data in Table 14 were entered into a three-way mixed-design ANCOVA with TA and lexical aspect as within-participants factors, language as the between-participants factor, and English proficiency as the covariate. The ANCOVA model included all interaction terms among within-participants factors, the between-participants factor, and the covariate. An alpha level of .05 was used, and in

cases in which the assumption of sphericity was violated, the *F*s, *SE*s, and *p*s reported correspond to the significance test with the Huynh-Feldt correction applied. In addition, the assumption of homogeneity of variance was checked by the Levene's Test of Equality of Error Variance in SPSS.

Table 14. Mean residual log RTs for Experiment II

			State		*Activity*		*Achievement*	
			M	*SD*	*M*	*SD*	*M*	*SD*
PAST	Verb	English	0.005	0.041	0.008	0.042	-0.006	0.039
		Korean	0.022	0.061	0.006	0.076	-0.028	0.050
		German	-0.031	0.062	-0.019	0.058	-0.032	0.056
		Chinese	0.004	0.060	0.015	0.056	-0.009	0.036
	V+1	English	-0.025	0.041	-0.021	0.043	-0.032	0.030
		Korean	-0.009	0.043	0.020	0.058	0.007	0.093
		German	-0.039	0.050	-0.004	0.050	-0.037	0.041
		Chinese	-0.004	0.041	0.009	0.053	-0.005	0.049
	V+2	English	0.001	0.045	0.008	0.047	-0.007	0.041
		Korean	0.017	0.052	0.025	0.067	-0.021	0.041
		German	-0.025	0.049	0.013	0.059	0.002	0.049
		Chinese	0.018	0.059	0.012	0.048	0.000	0.047
	SF	English	0.070	0.078	0.069	0.066	0.065	0.077
		Korean	0.084	0.098	0.093	0.085	0.058	0.067
		German	0.116	0.112	0.122	0.118	0.123	0.094
		Chinese	0.044	0.082	0.033	0.096	0.054	0.078
PROG	Verb	English	0.011	0.032	0.022	0.058	0.007	0.052
		Korean	-0.007	0.055	-0.009	0.047	-0.015	0.046
		German	-0.039	0.056	-0.021	0.049	-0.018	0.049
		Chinese	-0.020	0.079	-0.018	0.067	-0.006	0.072
	V+1	English	-0.036	0.046	-0.038	0.042	-0.045	0.049
		Korean	-0.007	0.061	-0.023	0.036	0.010	0.082
		German	-0.031	0.047	-0.029	0.043	-0.031	0.044
		Chinese	0.015	0.063	-0.012	0.049	-0.003	0.071

V+2	English	-0.014	0.037	-0.025	0.040	-0.010	0.054
	Korean	0.025	0.094	0.007	0.050	-0.002	0.058
	German	-0.027	0.038	-0.024	0.055	-0.013	0.047
	Chinese	-0.003	0.054	-0.031	0.062	0.001	0.057
SF	English	0.074	0.063	0.071	0.082	0.091	0.084
	Korean	0.094	0.086	0.090	0.059	0.106	0.102
	German	0.116	0.103	0.136	0.094	0.141	0.102
	Chinese	0.042	0.074	0.058	0.079	0.055	0.083

4.4.2 Results

Two types of RT analysis were conducted. First, a three-way mixed-design ANCOVA was performed to examine the main effects and interactions at each word region. Results are presented in the following by word region. A summary of results can be found in Appendix H.

Verb

An ANCOVA controlling for English proficiency at the verb revealed a significant main effect of TA by participants and items, $F_1(1, 80) = 4.543$, $p = .036$; $F_2(1, 92) = 24.575$, $p < .001$. Also, the main effect of lexical aspect was significant by participants, $F_1(2, 160) = 4.504$, $p = .013$; $F_2 < .51$. The interaction between lexical aspect and language was significant by participants, $F_1(6, 160) = 2.201$, $p = .046$; $F_2 < .855$. Moreover, the main effect of language was highly significant by both participants and items, $F_1(3, 80) = 6.358$, $p = .001$; $F_2(3, 92) = 644.552$, $p < .001$. No other effects approached significance by either participants or items: all interactions, Fs < 2.432.

V+1

An ANCOVA controlling for English proficiency at the first word after the verb revealed a significant interaction between TA and lexical aspect by participants and items, $F_1(2, 160) = 7.566$, $p = .001$; $F_2(2, 184) = 3.057$, $p = .049$. The main effect of language was significant by both participants and items, $F_1(3, 80) = 3.564$, $p = .018$; $F_2(3, 92) = 388.401$, $p < .001$. All other main effects and interactions were not significant by either participants or items: TA, $F_1(1, 80) = 1.653$, $p = .202$; $F_2 < .201$; lexical aspect, $F_1(2, 160) = 1.865$, $p = .158$; $F_2 < .038$; all interactions, Fs < 1.504.

V+2

An ANCOVA controlling for English proficiency at the second word after the verb revealed a significant interaction between lexical aspect and language by participants, $F_1(6, 160) = 2.939$, $p = .01$; $F_2 < .807$. The main effect of language was significant by items but not participants, $F_1(3, 80) = 2.588$, $p = .059$; $F_2(3, 92) = 317.066$, $p < .001$. All other main effects and interactions were not significant by either participants or items: TA, $F_1(1, 80) = .93$, $p = .338$; $F_2 < .585$; lexical aspect, $F_1(2, 160) = .885$, $p = .415$; $F_2 < .155$; all interactions, Fs < 2.247.

SF

An ANCOVA controlling for English proficiency at the sentence final word revealed a significant interaction between TA and lexical aspect by participants, $F_1(1.801, 144.071) = 3.726$, $p = .031$; $F_2 < .89$. Also, the main effect of language was significant by both participants and items, $F_1(3, 80) = 5.728$, $p = .001$; $F_2(3, 92) = 219.324$, $p < .001$. No other main effects and

interactions reached significance: TA, $F_1(1, 80) = 1.074$, $p = .303$; $F_2 < 1.395$; lexical aspect, $F_1(2, 160) = 1.61$, $p = .203$; $F_2 < .053$; all interactions, Fs < .976.

Next, because the overall three-way mixed-design ANCOVA controlling for English proficiency did not reveal a significant three-way interaction in any word region, and the items in the PAST and PROG conditions were not directly comparable, two separate ANCOVAs were performed for PAST and PROG. Accordingly, the alpha level ($\alpha = 0.05$) was divided by these two separate procedures, and the statistical tests were made at the adjusted level of significance ($\alpha = 0.025$) to maintain an experiment-wise alpha level of 0.05. A summary of results of the two-way mixed-design ANCOVA can be found in Appendix I.

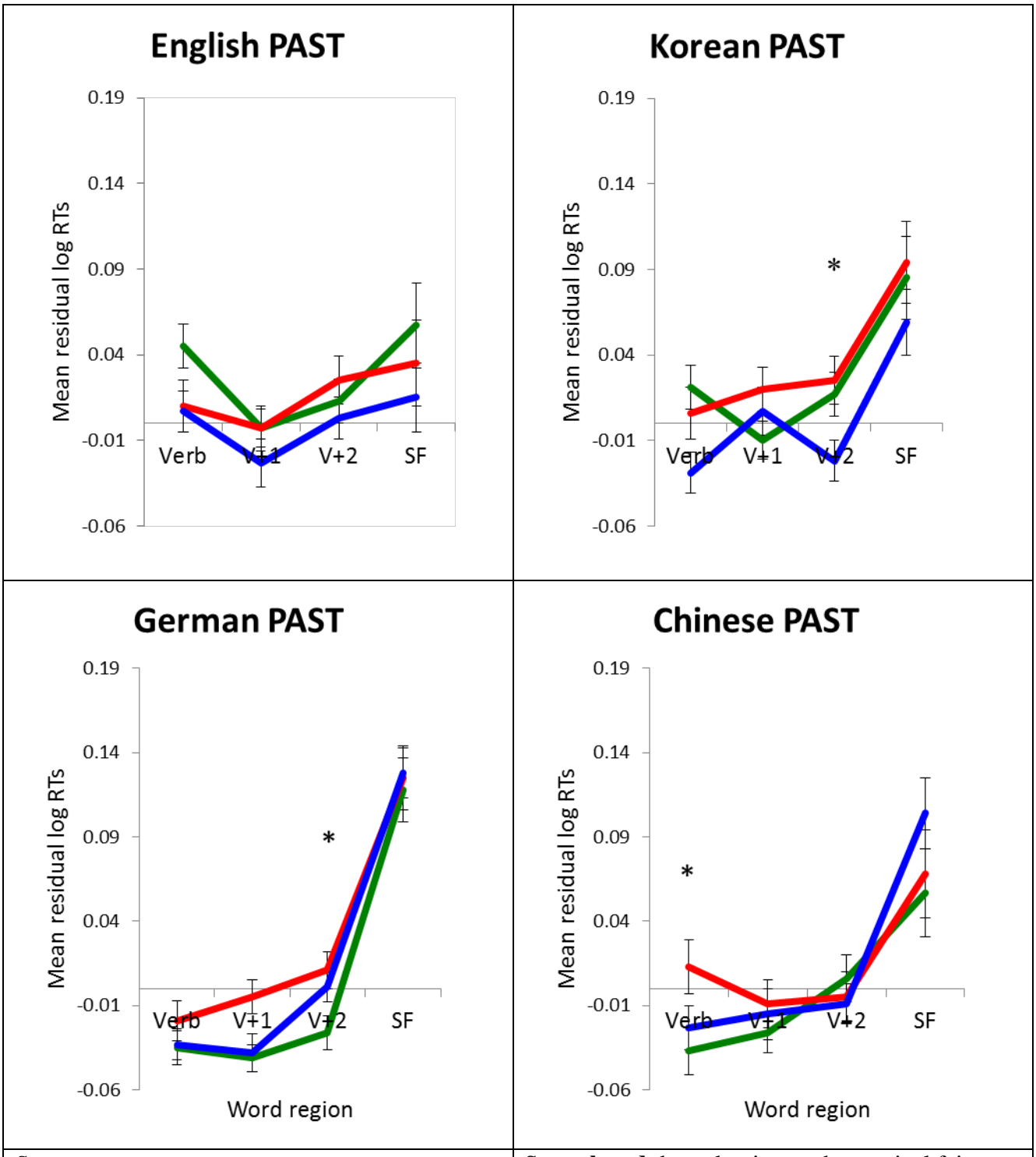
4.4.2.1 Past tense

Table 15 lists the adjusted means and standard errors of residual log reading times in PAST. Figure 1 plots the corresponding RTs by condition and word region for each language group. The y-axis has been adjusted to the same scale for direct comparison across groups.

Table 15. Adjusted mean residual log RTs for PAST for Experiment II

			State		*Activity*		*Achievement*	
			M	*SE*	*M*	*SE*	*M*	*SE*
PAST	Verb	English	.045	.013	.01	.015	.007	.012
		Korean	.021	.013	.006	.015	-.029	.012
		German	-.035	.01	-.019	.012	-.033	.009
		Chinese	-.037	.014	.013	.016	-.023	.013
	V+1	English	-.003	.011	-.003	.013	-.023	.014
		Korean	-.01	.011	.02	.013	.007	.014
		German	-.041	.008	-.005	.01	-.038	.011
		Chinese	-.026	.012	-.009	.014	-.015	.015
	V+2	English	.013	.013	.025	.014	.003	.012
		Korean	.017	.013	.025	.014	-.022	.012
		German	-.026	.01	.011	.011	.001	.009
		Chinese	.006	.014	-.005	.015	-.009	.012
	SF	English	.057	.025	.035	.025	.015	.02
		Korean	.085	.024	.094	.024	.059	.019
		German	.118	.019	.125	.019	.128	.015
		Chinese	.057	.026	.068	.026	.104	.021

Figure 1. Adjusted mean residual log RTs for PAST for Experiment I



Note. Error bars indicate ±1 standard error. An asterisk * denotes a statistically significant result.

Verb

An ANCOVA controlling for English proficiency at the verb revealed a significant interaction effect between lexical aspect and language by participants, $F_1(6, 160) = 2.818$, $p = .012$; $F_2 < .996$. The main effect of lexical aspect was significant by participants, $F_1(2, 160) = 7.66$, $p = .001$; $F_2 < .597$. Also, the main effect of language was significant by both participants and items, $F_1(3, 80) = 5.341$, $p = .002$; $F_2 (3, 92) = 292.902$, $p < .001$.

To explore the observed interaction between lexical aspect and language, a follow-up simple main effect of lexical aspect across language groups was conducted in this word region. Chinese participants read *State* ($M = -.037$, $SE = .014$) significantly faster than *Activity* ($M = .013$, $SE = .016$), $p = .009$. Also, Korean participants read *Achievement* ($M = -.029$, $SE = .012$) significantly faster than *State* ($M = .021$, $SE = .013$), $p = .004$. No other significant comparison was observed for English and German participants.

V+1

An ANCOVA controlling for English proficiency at the first word after the verb revealed a significant main effect of language by participants and items, $F_1(3, 80) = 3.478$, $p = .02$; $F_2 (3, 92) = 192.733$, $p < .001$. All other main effects and interactions were not significant by participants or items: lexical aspect, $F_1(2, 160) = .785$, $p = .458$; $F_2 < .042$; all interactions, Fs < .907.

To explore how different language groups performed in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that the reading speed of German

participants (M = -.028, SE = .006) was significantly faster than that of Korean participants (M = .005, SE = .008), p = .012. All other comparisons were not significant, ps > .441.

V+2

An ANCOVA controlling for English proficiency at the second word after the verb revealed a significant interaction effect between lexical aspect and language by participants, $F_1(6, 160) = 2.162$, p = .049; F_2 < .665. The main effect of language was significant by items only, $F_1(3, 80) = 1.037$, p = .381; $F_2(3, 92) = 224.034$, p < .001. All other main effects and interactions were not significant by participants or items: lexical aspect, $F_1(2, 160) = .596$, p = .552; F_2 < .554; all interactions, Fs < .665.

To explore the observed interaction between lexical aspect and language, a follow-up simple main effect of lexical aspect across language groups was conducted in this word region. Korean participants read *Achievement* (M = -.022, SE = .012) significantly faster than *Activity* (M = .025, SE = .014), p = .022. Moreover, German read *State* (M = -.026, SE = .01) marginally faster than *Activity* (M = .011, SE = .011), p = .026. Recall that α was set at 0.025 in this analysis. All other comparisons were not significant, ps > .067.

SF

An ANCOVA controlling for English proficiency at the sentence final word revealed a significant main effect of language by participants and items, $F_1(3, 80) = 5.203$, p = .002; F_2 (3, 92) = 91.402, p < .001. All other main effects and interactions were not significant by participants or items: lexical aspect, $F_1(2, 160) = 3.159$, p = .045; F_2 < .387; all interactions, Fs < 1.391.

To explore how different language groups performed in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that German participants (M = .123, SE = .014) were significantly slower than native English speakers (M = .036, SE = .019), p = .003. All other comparisons were not significant, ps > .311.

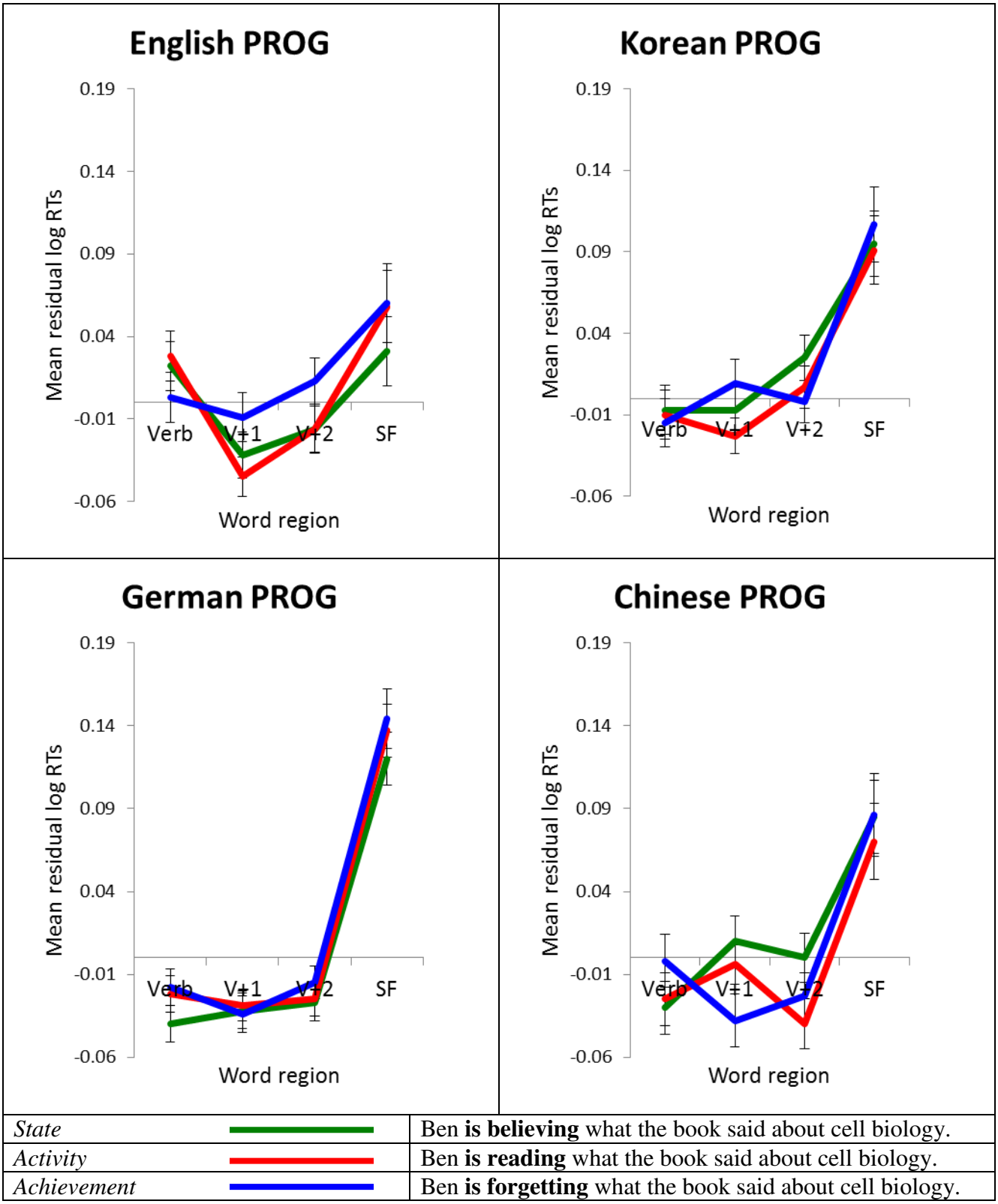
4.4.2.2 Progressive aspect

Table 16 lists the adjusted means and standard errors of residual log reading times in PROG. Figure 2 plots the corresponding RTs by condition and word region for each language group. The y-axis has been adjusted to the same scale for direct comparison across groups.

Table 16. Adjusted mean residual log RTs for PROG for Experiment II

			State		*Activity*		*Achievement*	
			M	*SE*	*M*	*SE*	*M*	*SE*
PROG	Verb	English	.022	.015	.028	.015	.003	.015
		Korean	-.007	.015	-.01	.015	-.015	.015
		German	-.04	.011	-.022	.011	-.018	.011
		Chinese	-.03	.016	-.025	.016	-.002	.016
	V+1	English	-.032	.014	-.045	.012	-.009	.015
		Korean	-.007	.014	-.023	.011	.009	.015
		German	-.032	.011	-.029	.009	-.034	.011
		Chinese	.01	.015	-.004	.012	-.038	.016
	V+2	English	-.016	.015	-.016	.014	.013	.014
		Korean	.025	.014	.007	.013	-.002	.013
		German	-.027	.011	-.025	.01	-.015	.01
		Chinese	0	.015	-.04	.015	-.023	.014
	SF	English	.031	.021	.058	.022	.06	.024
		Korean	.095	.02	.091	.021	.107	.023
		German	.12	.016	.137	.016	.144	.018
		Chinese	.085	.022	.07	.023	.086	.025

Figure 2. Adjusted mean residual log RTs for PROG for Experiment II



State	Ben **is believing** what the book said about cell biology.
Activity	Ben **is reading** what the book said about cell biology.
Achievement	Ben **is forgetting** what the book said about cell biology.

Verb

An ANCOVA controlling for English proficiency at the verb revealed a significant main effect of language by participants and items, $F_1(3, 80) = 3.939$, $p = .011$; $F_2(3, 92) = 356.519$, $p < .001$. All other main effects and interactions were not significant by participants or items: lexical aspect, $F_1(2, 160) = .581$, $p = .561$; $F_2 < .134$; all interactions, Fs < .747.

To explore how different language groups performed differently in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that the reading speed of German participants ($M = -.027$, $SE = .008$) was significantly faster than that of native English speakers ($M = .018$, $SE = .01$), $p = .006$. All other comparisons were not significant, ps > .217.

V+1

An ANCOVA controlling for English proficiency at the first word after the verb revealed a significant main effect of lexical aspect by participants, $F_1(2, 160) = 7.294$, $p = .001$; $F_2 < 1.098$. The main effect of language was significant by items only, $F_1(3, 80) = 2.398$, $p = .074$; $F_2(3, 92) = 224.936$, $p < .001$. All other interactions were not significant by participants or items, Fs < 1.755.

To explore how levels of lexical aspect may have differed across language groups, posthoc pairwise comparisons with Bonferroni adjustment revealed no significant effects of lexical aspect.

V+2

An ANCOVA controlling for English proficiency at the second word after the verb revealed a significant main effect of language by participants, $F_1(3, 80) = 3.569$, $p = .018$; F_2(3,

92) = 152.619, $p < .001$. No other main effects and interactions were significant by participants or items: lexical aspect, $F_1(2, 160) = 2.107$, $p = .125$; $F_2 < 1.295$; all interactions, Fs < 1.201.

To explore how different language groups performed differently in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that German participants (M = -.022, SE = .006) were significantly faster than Korean participants (M = .01, SE = .008), p = .016. No other comparisons were significant, ps > .073.

SF

An ANCOVA controlling for English proficiency at the sentence final word revealed a significant main effect of language by participants, $F_1(3, 80) = 5.515$, $p = .002$; $F_2(3, 92)$ = 144.869, $p < .001$. All other main effects and interactions were not significant by participants or items: lexical aspect, $F_1(2, 160) = 2.42$, $p = .092$; $F_2 < .328$; all interactions, Fs < .339.

To explore how different language groups performed in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that the reading speed of German participants (M = .133, SE = .014) was significantly slower than that of native English participants (M = .05, SE = .018), p = .004. All other comparisons were not significant, ps > .15.

Short summary

A comparison of the reading time patterns for various lexical aspectual distinctions for PAST and PROG in native English speakers, and L2 learners from Korean, German, and Chinese backgrounds revealed interesting differences. First, native English speakers did not show any reading time differences among State, Activity, and Achievement for both PAST and PROG, even though they showed the shortest RTs across the board. Second, L2 learners did not

show any reading time differences by language for PROG, but they responded to lexical aspect in PAST differently. For instance, Korean participants read Achievement sentences significantly faster than State and Activity sentences for PAST. Chinese and German participants, however, read State sentences significantly faster than Activity sentences. These RT differences held up to rigorous experimental control, including matching critical stimuli for token form frequencies, a logarithmic transformation to stabilize RT variances among all L2 groups, a regression analysis on RTs to correct for the linear word-length effect, and a statistical procedure to adjust for English proficiency. Apparently, these results cannot be accounted for by form-related differences in the stimuli or proficiency-induced differences among L2 participants.

4.5 DISCUSSION

The goal of Experiment II is to test the prototype account put forward by Li and Shirai (2000), Shirai (1991, 2002), Shirai and Andersen (1995), and supported by Yap et al (2009) in which prototypical associations of tense-aspect categories would engender shorter reading times. The role of L1 transfer was also tested. Because different L1 groups showed variable reading time performance after controlling for English proficiency, the results presented a series of challenges for the prototype account under its current formulation. In this section, I draw on empirical data from each L2 learner group in turn to discuss the functional and theoretical significance of prototype and transfer, and their joint impact on second language development of tense-aspect categories.

4.5.1 Native English speakers

First and foremost, the absence of any processing speed bias within native English speakers is telling. The current experiment thoroughly compared and contrasted lexical aspect in PAST and PROG. According to language norms of the English tense-aspect system and theoretical predictions, prototypical associations such as Achievement PAST and Activity PROG ought to yield shorter RTs than less prototypical associations. Yet, such online processing biases did not reach statistical significance for native speakers. It was unlikely that the null result was due to a faulty experimental setup, because the same participants demonstrated acute sensitivity to grammatical violations of various types, including those involving tense-aspect anomalies in Experiment I.

Given the rigorous experimental control and statistical analyses, it appears that the null result is reliable. Contrary to what existing literature has suggested, there was no processing asymmetry (cf. Yap et al., 2009) or perfective facilitation effect in PAST (cf. Madden & Zwaan, 2003) among the native English speakers tested. It is imperative to spell out the major differences between the current experiment and previous studies in order to understand the discrepancies.

Let us first consider the linguistic facts of the tense-aspect systems involved. Yap et al. (2009) focused on Cantonese, and particularly the perfective marker *zo* and the progressive marker *gan*. Cantonese is tenseless -- it lacks grammaticized tense but is rich in aspectual marking. Perfective *zo* and progressive *gan* yield a two-way grammatical contrast as in *ngo sik* ***zo*** *fan* 'I ate rice already' vs. *ngo sik* ***gan*** *fan* 'I'm eating rice'. Yap et al. (2009) observed significantly faster processing speed in accomplishment-*zo* (perfective) and activity-*gan* (progressive) associations relative to other conditions in native Cantonese speakers. They argued

that a basic cognitive principle, namely semantic compatibility, accounted for their findings. Unlike Cantonese, English has both grammaticized tense and aspect. Tense and aspect can interact to yield a legitimate construction in English as in *I was eating noodles* (both PAST and PROG). Such a phenomenon simply does not exist in Cantonese because of the absence of grammaticized tense. In this light, a language like English is more prone to complex and subtle interactions of tense-aspect categories. Because PAST encodes a past vs. nonpast contrast, and is not restricted to any lexical aspect, and PROG can readily extend beyond its core usage of denoting action in progress, it is not surprising that the vast flexibility afforded by the English tense-aspect marking did not render any reading time differences within native English speakers.

Another possibility is task. Madden and Zwaan (2003) and Yap et al. (2009) presented hand-drawn pictures on a computer screen and asked participants to select the picture that best matched the printed or auditory description. In the current experiment, sentences were presented visually word-by-word in a self-paced manner, and no picture was involved. The cognitive demand required of a forced choice sentence-picture matching task is fundamentally different from that of a reading comprehension task. Presumably, less perceptual and visual-spatial processing are engaged in a pure reading task than in a sentence-picture matching task, at least when reading alphabetical English. Results from these dissimilar tasks were therefore not directly comparable.

One caveat is that although language and task differences may account for the dissimilar results between Experiment II and other reading time studies, they do not necessarily pinpoint the root cause of the null result. On a positive note, the null effect could be a corollary of the proper stimuli control implemented in the current experiment. The unbiased RTs within native English speakers provide an ideal baseline when comparing L2 learners' reading performance.

But the null result does raise serious questions about prototype's distributional linguistic facts on one hand, and the actual processing consequence within adult native speakers on the other hand. Furthermore, it casts doubt on the psycholinguistic reality of aspectual prototype, because no processing evidence could be adduced from native speaker data. This very question is an empirical as well as a methodological one, which I shall return to later. To complicate the picture, L2 learners showed dissimilar reading profiles distinct from native English speakers. Does this mean language learners are more susceptible to prototype effects? That's why two more variables — L1 background and L2 proficiency — need to be taken into account when looking at L2 learners' reading time performance.

4.5.2 L2 learners

L2 learners as a whole showed divergent reading time patterns for PAST and PROG. For PROG, reading time differences did not reach significance among lexical aspectual distinctions for all L2 groups. One explanation from the literature is that PROG possesses certain kinds of form advantage that foster acquisition. L2 morpheme acquisition research, for instance, has consistently shown that the periphrastic *be V-ing* is acquired earlier than morphological *-ed* due to higher perceptual salience (e.g., Goldschneider & DeKeyser, 2001). Presumably, PROG in English enjoys a more privileged status in the developmental timescale. Because of PROG's distinct form advantages, one hypothesis is that the L2 learners have more or less good control of PROG at the time of the experiment to the extent that it can be automatically and flexibly processed regardless of verb semantics. In fact, the majority of the L2 learners had received more than 10 years of formal English instruction prior to the current experiment. What is more

difficult to interpret is the systematic reading time differences among various groups of L2 participants for PAST.

As expected, the prototypical association Achievement PAST indeed yielded significantly shorter reading times than State PAST and Activity PAST for Korean participants. This is consistent with offline L2 acquisition data reported in the literature. Lee (2001), for example, concluded from a longitudinal study from two Korean learners of English that PAST was predominantly associated with telic predicates before emerging in other atelic contexts.

Because Korean *-ess* and English PAST share identical combinatorial restrictions with lexical aspect, in addition to similar online processing profiles, the Korean data did not provide any discriminating evidence between the prototype and transfer accounts. They were consistent with both accounts at best.

Unlike the Korean participants, both German and Chinese participants showed a significant reduction of reading times in State PAST relative to Activity PAST. At first blush, this finding supports neither a prototype nor a transfer account. However, we must not equate both groups' online processing mechanisms given the *prima facie* evidence. The two languages are typologically dissimilar. They were chosen in the current experiment precisely because of the facts that German does not have grammatical aspect, whereas Chinese overtly marks the perfective-imperfective contrast. In what follows, I will demonstrate that an L1-induced prototype formation mechanism accounts for the seemingly ambiguous result.

What's intriguing about the German data is that the processing speed of State PAST was equally fast as Achievement PAST, but the former was significantly faster than Activity PAST. Either way, State PAST seems to enjoy some kind of processing privilege among German participants. A closer look at the RT patterns on PROG also revealed the same trend — State

PROG was read the fastest most of the time, despite no statistically significant effects. These processing results suggested that the aspect category PROG might not necessarily make a temporal distinction for German participants. This is not surprising, given there is no grammatical contrast between progressive (i.e. imperfective) and perfective in L1 German. In present tense, the same form *sie iβt* could either mean 'She is eating' or 'She eats', depending on discourse contexts. Regarding lexical aspect, State does not involve the temporal decomposition into process vs. endpoint that is characteristic of Activity and Achievement. State is arguably simpler in terms of processing of lexical temporal contents. Taken together, one tenable explanation can be described as follows: Because German does not have grammatical aspect, German native speakers become less susceptible to compute a temporal representation based on the interactions of grammatical and lexical aspect, which were operationalized as prototypes of PAST and PROG in this experiment. Instead, lexical aspect alone is sufficient to disambiguate various situation types in German. This tendency to exclusively rely on lexical aspect in the L1 German system is transferred to L2 English processing of tense-aspect distinctions.

The faster processing results obtained in State PAST were consistent with observations noted in other studies involving German learners of English. Particularly, Rohde (2002) observed that state verbs have a very high past marking rate (80-100%) in obligatory past context among 4 German children (aged 4-9) learning English during a 6-month stay in California (Rohde, 1996). This observation is contrary to the distributional predictions of the Aspect Hypothesis. Rohde reasoned that verb form and function can develop independently of each other during language acquisition, without assuming that grammatical form is derived from lexical meaning, which is central to the AH. Although it is somewhat speculative, the German processing data here are consistent with a transfer-based account.

The Chinese tense-aspect system differs markedly from the German system in that it lacks obligatory tense marking. The past and non-past contrast can thus become ambiguous. One consequence in second language processing, as we saw from Experiment I, is that Chinese participants appeared to be insensitive to PAST violations in which the morphological cue was missing in an obligatory context (**Yesterday several large snakes escape…*). Although Chinese has an optional perfective aspect marker *le*, it denotes the completion of a situation with potential reference time in past, present, or future.

Perfective *le* is predominantly associated with telic predicates in isolated sentences. Interestingly, when *le* is used in an activity predicate, a temporal boundary has to be imposed by means of temporal adverbials or additional clauses; otherwise native Chinese speakers would find the utterances incomplete (Jin & Hendriks, 2003; Lin, 2005). Lin (2005), for example, argued that (11) is problematic unless it is modified by another clause to enrich the temporal description as in (12). Lin (2005), however, emphasized that it was not clear to him why Activity-*le* associations were problematic for the Chinese aspectual system.

(11) *?Lisi he-le jiu*

Lisi drink-PERF wine

'Lisi drank wine.'

(12) *Lisi he-le jiu ye chang-le ge*

Lisi drink-PERF wine also sing-PERF song

'Lisi drank wine and sang songs as well.'

(Lin, 2005, pp. 12-13)

The above linguistic analyses in L1 Chinese predicts an incompatibility in activity PAST associations. Indeed, an increase in reading times was observed for Activity PAST within the Chinese participants (Figure 1). The RT difference between State PAST and Activity PAST was significant (p = .009), and no further significant RT differences between State PAST and Achievement PAST were found. It was clear that Chinese participants strongly dispreferred Activity PAST associations in L2 English (as predicted in L1 Chinese), and there was no processing speed bias towards the prototypical association Achievement PAST. The prototype account did not predict this kind of result.

Alternatively, the shortest reading time in State PAST can be accounted for by first language acquisition data. For example, Chen and Shirai (2010) observed that children acquiring L1 Mandarin Chinese used perfective *le* with stative predicates more frequently than expected, ranging from 11-41% of all total usage of *le*. Following this acquisition pattern present in their L1, it is not surprising that the Chinese participants read State PAST faster. Either by invoking linguistic analyses or L1 acquisition data, a transfer account seems equally tenable.

4.6 SUMMARY

In this chapter, I examined whether L2 learners and native English speakers apply PAST and PROG prototypes in the course of language processing. Because very few experimental studies have addressed L1 transfer, I also examined L2 learners from three different L1 groups (Korean, German, and Chinese) and tested how their L1 influenced L2 tense-aspect processing. Both the prototype and transfer hypotheses were tested. I hypothesized all L1 groups would perform similarly should they more or less apply PAST and PROG prototypes, after controlling for other

factors such as L2 English proficiency. Otherwise, the predictions for transfer were that Korean and German L2 learners, compared to Chinese L2 learners, would process achievement in the past more quickly since both languages have grammaticized past markings. Likewise, Korean and Chinese L2 learners, compared to German L2 learners, would more readily process activity in the progressive.

The results from Experiment II indicated that while Korean participants applied the PAST prototype, the German participants did not. Both the German and Chinese participants processed state PAST the quickest, which goes against the prediction of prototype. These data suggest that the non-prototypical use of state PAST were indeed facilitated by the properties from respective L1s. No evidence was adduced for the PROG prototype from any L1 groups. More interestingly, data from native English speakers provided support for PAST and PROG prototypes even though the reading time trends observed were not statistically significant.

Taken together, these results may indicate two things: 1) prototypical learning is a developmental phenomenon. Precisely so, the prototype representation of PAST is more visible in Korean L2 learners than it is within native English speakers, who are expert users of the target language; and 2) a more prominent role of L1 influence is implicated, at least in L2 language processing. Future research needs to detail L1 effects in prototype. In fact, it has been suggested that L1 can influence prototype formation (Shirai & Kurono, 1998), and interact with other factors such as task variation (Sugaya & Shirai, 2007). Future experimental research also needs to replicate transfer effects across tasks, among learners from different L1 background, proficiency levels, in addition to gathering language acquisition and processing data.

5.0 ASPECTUAL COERCION

This chapter extends the psycholinguistic investigation of tense-aspect categories as it relates to aspectual coercion. According to DeVelle (2005), "aspectual coercion refers to an inferential process not explicitly stated in surface form structure. A prime example of this process is an iterative interpretation, that is, the encoding of a series of repetitions within a given situation, rather than in a protracted event over time" (p. 105). One classic example is *the horse jumped until dawn*. Readers of this sentence have no choice but to invoke an iterative interpretation that the horse jumped *repeatedly* until dawn. How iteration arises, and what mechanisms govern such an operation have important implications to semantic theories and models of language processing and acquisition.

5.1 LITERATURE

Theoretically, aspectual coercion presents a problem to the notion of compositionality, in which "the meanings of expressions are a function of their parts and the way the parts are syntactically combined" (Brennan & Pylkkänen, 2008, p. 132). Yet, in the sentence *the horse jumped until dawn*, neither the verb nor the temporal adverbial give rise to the meaning of iteration. This observation is coupled with the fact that English does not overtly encode iteration. Equally intriguing is that the example sentence is not syntactically or semantically ill-formed, although

there exists an aspectual mismatch between the verb *jumped* and the modifier *until dawn* at some levels of representation. This is very different from sentences containing tense-aspect anomalies that lead to ungrammaticality (see Experiment I in Chapter 3).

Empirically, there have been a few studies investigating the processing cost associated with aspectual coercion in native English speakers using a variety of behavioral and brain-imaging techniques. The reported findings are mixed. Finding the processing correlates of aspectual coercion becomes a major empirical problem, not to mention that it has never been explored in L2 processing research. Because L2 learners' semantic processing tends to be more restricted to aspectual prototypes and prone to L1 transfer compared to native speakers' semantic processing (see Experiment II), aspectual coercion and related phenomena present a challenge for L2 learners.

Against this background, Experiment III in this chapter concentrates on the online effects of aspectual coercion. The goal is two-fold. First, the experiment gathers reading time data to examine whether aspectual coercion incurs any extra processing cost among native and L2 comprehenders alike. Second, in contrast to previous studies, which mainly focused on adverbials, the current experiment investigates how grammatical aspect and adverbials interact to govern aspectual coercion. As a preview, reading time results from Experiment III showed that aspectual coercion is psychologically real. Readers dynamically compute and synthesize aspectual information from multiple sources, such as grammatical aspect and adverbials, during sentence comprehension. Moreover, L2 learners behaved differently from native speakers and varied as a function of L1 backgrounds. These results advance our understanding on the fundamental issue of how an aspectual mismatch is resolved online, and importantly, shed light on the processing implications of L2 tense-aspect acquisition.

There are many types of coercion phenomena. Moens (1987), and Moens and Steedman (1998) first introduced the term coercion to the semantic and aspectual literature.

DeVelle's (2005) definition, as introduced previously, is adopted here because it is theory-neutral, and distinguishes among unitary, iterative, and habitual interpretations that are central to the study of aspectual coercion. Brinton (1988) also asserted that "habitual may be distinguished from iterative, because the habitual portrays actions repeated on different occasions, while the iterative portrays actions repeated on the same occasion" (p. 54). To illustrate these important notions, let's consider the minimal pair in (13):

(13) a. The horse *slept* until dawn.

b. The horse *jumped* until dawn.

(Piñango, Winnick, Ullah, and Zurif, 2006, p. 234)

One should notice that 13a and 13b are syntactically identical. The verbal predicates, however, differ in two dimensions — lexical aspect and iterativity. *Slept* is an example of activity, which is temporally unbounded. The interpretation of 13a is that *the horse* carried out the *sleeping* activity for an extended duration, which is in this case specified by an adverbial modifier of duration or a durative adverbial, namely *until dawn*. The depicted situation was unitary, and no iteration (i.e. repetition in one occasion) was involved. Conversely, *jumped* in 13b is semelfactive. It denotes a single, temporally bounded situation. The combination of semelfactive *jumped* with the durative adverbial *until dawn* is problematic, as the two are aspectually infelicitous with each other. However, 13b is not ill-formed and yields an iterative interpretation that the horse jumped *repeatedly* until dawn. To resolve this problem, one proposal suggested in the literature is to coerce the unitary semelfactive *jumped* into an iterative process via a durative adverbial. More formally, a type shifting operation shifts the existing

representation of a semelfactive verb from a non-iterative sense to an iterative one. Because aspectual coercion is purely semantic in English, De Swart (1998) described aspectual coercion as "syntactically and morphologically invisible: it is governed by implicit contextual reinterpretation mechanisms triggered by the need to resolve aspectual conflicts" (p. 360). The complex phenomenon in question is known as aspectual coercion.

Formal semantic theories have provided different theoretical accounts for the "implicit contextual reinterpretation mechanisms" associated with aspectual coercion. De Swart (1998), for example, presented an algorithmic semantic analysis of aspectual shift and coercion within the Discourse Representation Theory (DRT, see Kamp & Reyle, 1993). Similarly, Bott (2010) introduced a computational approach based on the event calculus model by van Lambalgen and Hamm (2005), which was originally developed for path planning in artificial intelligence. Alternatively, without assuming the dissociation between syntax and semantics as many accounts have relied on, Michaelis (2004) provided a construction-based model in which "a single combinatory mechanism, the construction, is responsible for both coerced and compositional meanings" (p. 1). Although these approaches differ in their theoretical assumptions, their goal is the same — to provide a mechanistic account for how an aspectual conflict is resolved via some type of coercion operation in the computational system. At least four different hypotheses have been proposed to explain how that may be accomplished (see Brennan & Pylkkänen, 2008, for review), and they are elaborated in the next paragraphs.

One general approach is to invoke a type-shifting rule to promote iteration from a unitary interpretation. It can be executed at either the lexical or pragmatic level. At the lexical level, the computational system resolves an aspectual mismatch by shifting the lexical meaning of the verb from a non-iterative one to an iterative one (i.e. jump repeatedly). This approach assumes a

polysemous lexicon that supports various shades of meaning within one lexical item (e.g., Pustejovsky, 1995). Alternatively, iteration can be derived by a more context-dependent or pragmatic approach. Such approaches are subject to other contributing factors such as plausibility and frequency. Common to these two approaches is that an iterative operation is involved to derive an iterative interpretation from an initial unitary, punctual interpretation. Collectively, these two approaches are called iterative coercion (Brennan & Pylkkänen, 2008).

Another possibility, though less likely, is to apply coercion in the opposite direction. That is, semelfactive verbs such as *jump* are initially represented as repetitive activities, which are coerced into punctual interpretation in the context of punctual situations (e.g., Rothstein, 2004). Because the coercion under this model achieves a punctual interpretation as the outcome, it is called punctual coercion.

Finally, there is the underspecification hypothesis. Moens and Steedman (1988) argued from the vantage point of a contingency-based framework that punctual verbs are semantically underspecified with respect to duration. They can describe both punctual and durative situations without committing to one representation over another. Accordingly, verbs such as *run* and *jump* share identical aspectual properties in the lexicon. The processing implication of an underspecification account is that there will be no difference in processing cost among verbs that differ in lexical aspect.

5.1.1 Psycholinguistic evidence

A small number of empirical studies have used behavioral and brain-imaging techniques to look for the psycholinguistic evidence of aspectual coercion. The reported results, however, remain controversial as to whether aspectual coercion incurs an extra computational cost. Differences in

task, poor stimuli control, and null results, among other things, make it difficult to make generalizations about the phenomena under investigation.

Piñango, Zurif, and Jackendoff (1999) first examined the processing load associated with aspectual coercion using a cross-modal lexical decision task. The experimental procedure was as follows: Participants listened to a sentence during which a visual probe that was totally unrelated to the sentence was presented on a computer screen. At that moment, participants performed a lexical decision task to decide whether the probe was a real word in English. A key assumption in this dual-task interference paradigm was that both listening to and understanding a sentence, as well as making a lexical decision, were competing for the same pool of cognitive resources (e.g., Shapiro, Zurif, & Grimshaw, 1987, 1989). The researchers compared lexical decision times at the probe position (indicated by ^) during comprehension of sentences like (14) in which a durative temporal adverbial introduced by *until* followed either an activity verb such as *glide* or a semelfactive verb such as *hop*.

(14) a. The insect *glided* effortlessly until ^ it reached the far end of the garden that was hidden in the shade.

b. The insect *hopped* effortlessly until ^ it reached the far end of the garden that was hidden in the shade.

As predicted, lexical decision times were found to be significantly longer in 14b than in 14a. Piñango et al. hypothesized that longer decision times reflect increased processing cost associated with coercing the semelfactive *hop* into an iterative reading. They corroborated this finding by norming the semantic plausibility of the sentence pairs in (14). In addition, they ensured that the frequency of semelfactive verbs was at least as frequent, if not more frequent, than non-semelfactive verbs for each verb pair.

Piñango, Winnick, Ullah, and Zurif (2006) performed two follow-up experiments to examine the timing of online aspectual coercion effect during sentence processing. In both experiments, they used the same set of stimuli as in Piñango et al. (1999) but varied the timing (immediate vs. delayed) of the presentation of the visual probe at which a secondary lexical decision task was administered. Crucially, they found no reaction time differences between coerced and non-coerced sentences when a visual probe was presented immediately after the durative adverbial, but replicated Piñango et al.'s (1999) finding when the probe was presented at a delayed interval of 250 ms. Piñango et al. (2006) explained that the reanalysis effort involved in aspectual coercion may take some time to develop, and consequently, the online effects of aspectual coercion may not be detected immediately.

One shortcoming concerning Piñango et al.'s studies was that the experimental stimuli as shown in (14) conflated both lexical aspect and iterativity. In the presence of a durative adverbial, semelfactive verbs such as *hop* obligatorily generate an iterative reading. Activity verbs such as *glide*, however, do not yield any iterative interpretation. Inevitably, the minimal pair manipulation was problematic.

Todorova, Straub, Badecker, and Frank (2000) avoided the confound by using only punctual verbs such as *send*. Also, they systematically explored whether there was a difference in processing between an iterative reading arising from aspectual coercion and that by other means by testing sentences like (15), which varied in cardinality of direct objects (singular vs. plural) and adverbial type (durative vs. non-durative):

(15) a. Even though Howard sent *a large check* to his daughter *for many years*, she refused to accept his money.

b. Even though Howard sent *large checks* to his daughter *for many years*, she

refused to accept his money.

c. Even though Howard sent *a large check* to his daughter *last year*, she refused to accept his money.

d. Even though Howard sent *large checks* to his daughter *last year*, she refused to accept his money.

15a exemplifies aspectual coercion, because of the aspectual conflict between the verbal predicate *send a large check* and the durative adverbial *for many years*. An iterative reading is therefore derived in 15a; Todorova et al. (2000) called this adverbial coercion. In 15b, the plural direct object *large checks* denotes an iterative reading lexically, which is compatible with *for many years*. 15b is thus the non-coerced control of 15a. Both 15c and 15d are modified by the deictic adverbial *last year* and thus no coercion is expected. Interestingly, the plural direct objects in 15b and 15d exemplify iteration without coercion. Todorova et al. (2000) and many other experimental studies shared the key assumption that aspectual coercion had to be triggered by durative adverbials. As predicted, reading latencies were significantly higher in coercion as well as post-coercion regions in 15a than those in 15b, 15c, and 15d. Todorova et al. hypothesized that the observed latencies could be attributed to one of the following factors: an initial misanalysis of the aspectual interpretation of an utterance, or an iterative operation to build a coherent propositional representation. One problem of this study stemmed from the self-paced, makes-sense judgment task, which required participants to resolve all potential ambiguities locally. As a result, nothing could be left unspecified. This procedure created an awkward reading situation to the detriment of assessing the online effects of aspectual coercion, as pointed out by Brennan and Pylkkänen (2008), among others. Husband, Beretta, and Stockall (2006), and Husband, Stockall, and Beretta (2008) used a moving-window self-paced reading

paradigm on the same stimuli and reported a replication of the results. These studies remain unpublished.

To foster naturalistic comprehension in an experimental setting, Pickering, McElree, Frisson, Chen, and Traxler (2006) employed self-paced reading and eye-tracking techniques, and used materials from Piñango et al. (1999) and Todorova et al. (2000). Unlike previous studies, Pickering et al. placed the adverbials at sentence-initial position followed by target verbs. This arrangement was advantageous because the processing burden of unifying aspectual information from various sources in a sentence converges on a single verb instead of spreading across multiple words in an adverbial phrase. After analyzing reading performance on the disambiguating word and each of the next three words, however, Pickering et al. found no behavioral differences in terms of reading times and other eye-tracking estimates between coercion and non-coerced sentences in all self-paced and eye-tracking experiments. To account for the null effects, they hypothesized that native English speakers do not immediately commit to the telicity of situations during normal comprehension. What happens is that readers routinely underspecify aspectual representation of an utterance until disambiguating information becomes available. One general critique from the literature is that many factors can be responsible for null effects, not to mention that there is the danger of Type II error, which underestimates potential genuine effects.

Another challenge in investigating online effects of aspectual coercion is the classification of lexical aspect. Brennan and Pylkkänen (2008) addressed this problem by first norming a selection of verbs for punctuality. A subset of strongly punctual verbs (all semelfactives) was then chosen for the self-paced reading and MEG (i.e.

magnetoencephalography) experiments. As illustrated in (16), the stimuli sentences varied in adverbial type (durative vs. punctual), followed by a semelfactive verb:

(16) a. Throughout the day the student *sneezed* in the back of the classroom.

b. After twenty minutes the student *sneezed* in the back of the classroom.

In the self-paced reading experiment, Brennan and Pylkkänen reported significantly longer reading times at the verb in 16a than in 16b within native English speakers. This finding was generally compatible with Piñango et al. (1999; 2006), Todorova et al. (2000), and Husband et al. (2006; 2008), except Pickering et al. (2006). From this research, Brennan and Pylkkänen argued that the aspectual representation of strong semelfactive verbs is not underspecified and that their evidence supported the iterative coercion hypothesis in particular.

As reviewed above, previous experimental studies such as Todorova et al (2000) examined aspectual coercion in which a punctual situation (usually conveyed by semelfactive verbs) is interpreted as iterative by virtue of interaction with a specific type of temporal modifier (i.e. adverbial coercion). Little is known about how grammatical aspect such as the progressive affects aspectual coercion. Semelfactive progressive in English provides an excellent opportunity to study this effect, primarily because it denotes iterative action-in-progress (Smith, 1991; 1997). In the sentence *Tom was kicking the ball*, the verbal predicate *kicking* encodes iteration. This is in contrast to a unitary situation conveyed by *kicked* in the counterpart sentence *Tom kicked the ball*. Presumably, semelfactive progressive in English derives an iterative meaning even in the absence of any durative adverbial. I shall call this grammatical coercion. This is theoretically important because psycholinguistic evidence thus far has indicated that durative adverbials alone could trigger aspectual coercion. The potential psycholinguistic

evidence of grammatical coercion will thus have far-reaching implications for aspectual coercion phenomena as a whole.

5.2 PURPOSE

Experiment III is designed to explore the real time processing consequences that occur when native English speakers and L2 learners are confronted with aspectual conflicts in the course of language processing.

5.3 RESEARCH QUESTIONS

The following research questions are addressed in Experiment III:

1. Does aspectual coercion incur an extra processing cost for native and L2 learners alike? If so, what are the processing similarities and differences?
2. Does grammatical aspect mediate the online effects of aspectual coercion? In particular, is there an interaction between grammatical aspect and adverbial when taking into account an iteration prompted by the semelfactive progressive in English?
3. Do different groups of L2 learners exhibit language-specific processing tendencies?

5.4 EXPERIMENT III

I examined two variables: Adverbial (punctual, durative); and grammatical aspect (SIMPLE, PROG). This entailed a 2 × 2 within-participant design. SIMPLE does not involve iteration normally (i.e. *Tom kicked the ball*), whereas PROG indicates an iteration (i.e. *Tom was kicking the ball*).

5.4.1 Method

5.4.1.1 Materials

Table 17 presents sample stimuli sentences for Experiment III. A full version of the stimuli can be found in Appendix G. Experiment III exclusively focused on semelfactive verbs such as *jump*, *sneeze*, and *knock*. Seventeen semelfactive verbs were selected according to norming results for punctuality (Brennan & Pylkkänen, 2008) and ratings for telicity (Wulff et al., 2009). Rare semelfactive verbs such as *curtsey*, *belch*, and *twitch* used by a number of previous studies were avoided because this experiment involved L2 learners of English.

Following Brennan and Pylkkänen (2008), each sentence began with a temporal adverbial (punctual vs. durative), followed by a semelfactive verb. The semelfactive verb varied in grammatical aspect (SIMPLE vs. PROG) and was inflected for past tense. Twenty-four sentences were constructed and each had four versions that varied with regard to adverbial types and grammatical aspect. Four lists rotated each critical stimulus through the within-participants manipulations (adverbial, grammatical aspect), so that each participant saw a given item only once, but each item occurred in all four conditions equally across the experiment. This

counterbalancing procedure was required to prevent a participant from reading the almost identical versions of a given sentence.

Table 17. Sample stimuli for Experiment III

	Punctual adverbial	Durative adverbial
SIMPLE	**At noon** the kid **jumped** into the swimming pool. A (Baseline)	**All day** the kid **jumped** into the swimming pool. B (Adverbial Coercion)
PROG	**At noon** the kid **was jumping** into the swimming pool. C (Grammatical Coercion)	**All day** the kid **was jumping** into the swimming pool. D (Baseline)

Table 17 lists the four experimental conditions crossing adverbial and grammatical aspect. Condition A conveys a unitary situation. It also serves as a baseline for condition B, because there is no aspectual mismatch between the punctual adverbial *at noon* and the semelfactive verb *jump* marked in SIMPLE. Conversely, condition B is an example of aspectual coercion. To adhere to the definition by DeVelle (2005), an inferential process, namely iteration, has to be invoked to resolve the aspectual mismatch between the durative adverbial *all day* and the semelfactive verb *jump* marked in SIMPLE. Previous studies (e.g., Brennan & Pylkkänen, 2008) described this as iterative coercion. Because iteration is essentially triggered by an adverbial, condition B is therefore called Adverbial Coercion. This term first appeared in Todorova et al (2000). Conditions C and D are both marked in PROG. They test the online effect(s) of grammatical aspect on aspectual coercion, which has not been explored previously. Condition C is interesting. As discussed earlier, Smith (1991; 1997) asserted that semelfactive verbs marked in English progressive denote iterative action-in-progress. The combination is therefore not compatible with a punctual adverbial in condition C. Although both conditions B and C involve aspectual coercion, iteration in condition C arises via the progressive marking,

whereas that in condition B is enforced by a durative adverbial external to the verbal predicate. To differentiate between the triggering mechanisms involved, condition C is called Grammatical Coercion. Lastly, condition D serves as a baseline to Grammatical Coercion in condition C.

The following processing predictions are made accordingly. First, Adverbial Coercion sentences (Condition B: ***All day*** *the kid* ***jumped…*****)** will take longer time to read than control sentences (Condition A: ***At noon*** *the kid* ***jumped***…). This is based on previous experimental studies in which durative adverbials alone could trigger aspectual coercion (e.g., Todorova et al., 2000). Second, a new prediction for this study is that Grammatical Coercion sentences (Condition C: ***At noon*** *the kid* ***was jumping…***) will take longer time to read than control sentences (Condition D: ***All day*** *the kid* ***was jumping…***), because semelfactive progressive in English also involves iteration (Smith, 1991; 1997). The longer reading times are expected at the inflected verb and potentially downstream. As illustrated in Table 17, the 2 × 2 design predicts a trade off between adverbial and grammatical aspect (i.e. interaction between Adverbial Coercion and Grammatical Coercion conditions).

5.4.1.2 Data analysis

Table 18 lists the mean unadjusted RTs per word by condition for each group. Table 19 lists the mean residual log RTs by condition and word region for each group.

Table 18. Mean unadjusted RTs for Experiment III

	Punctual adverbial		*Durative adverbial*	
	M	*SD*	*M*	*SD*
SIMPLE				
English	284.78	123.69	278.41	108.14
Korean	392.51	231.6	383.75	187.62
German	410.21	216.88	399.45	188.87
Chinese	492.84	258.19	463.7	233.14
PROG				
English	287.3	139.36	291.68	136.44
Korean	370.28	185.87	362.04	197.55
German	392.13	179.45	398.13	184.85
Chinese	487.6	264.74	479.3	260.17

Table 19. Mean residual log RTs for Experiment III

		SIMPLE				PROG			
		Punctual adverbial		*Durative adverbial*		*Punctual adverbial*		*Durative adverbial*	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Verb	English	-.005	.042	-.01	.052	.002	.057	.023	.087
	Korean	.04	.117	-.01	.061	-.011	.06	.004	.094
	German	.003	.079	.009	.069	-.026	.072	-.012	.08
	Chinese	.039	.092	.005	.101	.002	.085	.017	.103
V+1	English	-.015	.058	-.058	.037	-.018	.072	-.019	.085
	Korean	-.008	.058	.013	.096	.002	.062	.003	.068
	German	.006	.065	-.003	.082	.002	.076	-.006	.085
	Chinese	.034	.073	.031	.079	.055	.061	.034	.089
V+2	English	-.037	.072	-.035	.063	-.015	.074	-.024	.065
	Korean	-.016	.066	-.011	.074	-.033	.038	-.028	.056
	German	-.019	.061	-.01	.064	-.028	.051	-.008	.063
	Chinese	-.011	.085	-.042	.072	-.019	.063	-.029	.077
SF	English	.089	.103	.091	.086	.08	.106	.106	.114
	Korean	.09	.126	.092	.119	.079	.068	.057	.105
	German	.154	.14	.166	.087	.159	.113	.158	.126
	Chinese	.076	.099	.052	.108	.039	.096	.061	.122

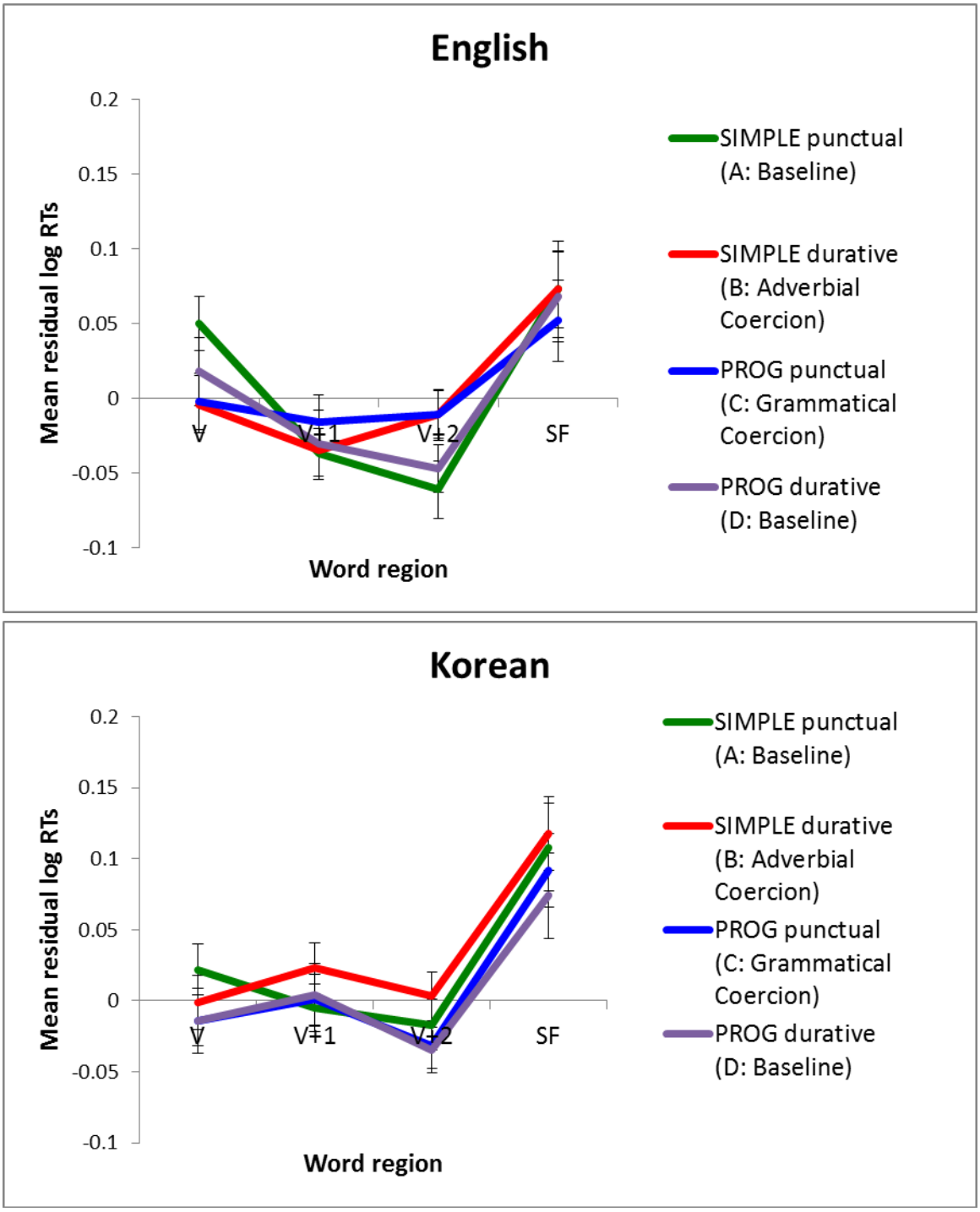
Based on Table 19, a three-way mixed-design ANCOVA was performed with grammatical aspect (SIMPLE vs. PROG) and adverbial (punctual vs. durative) as within-participant variables, group (English, Korean, German, and Chinese) as a between-participant variable, and English proficiency as a covariate. Follow-up tests with Bonferroni adjustments were conducted to explore the online effects of aspectual coercion.

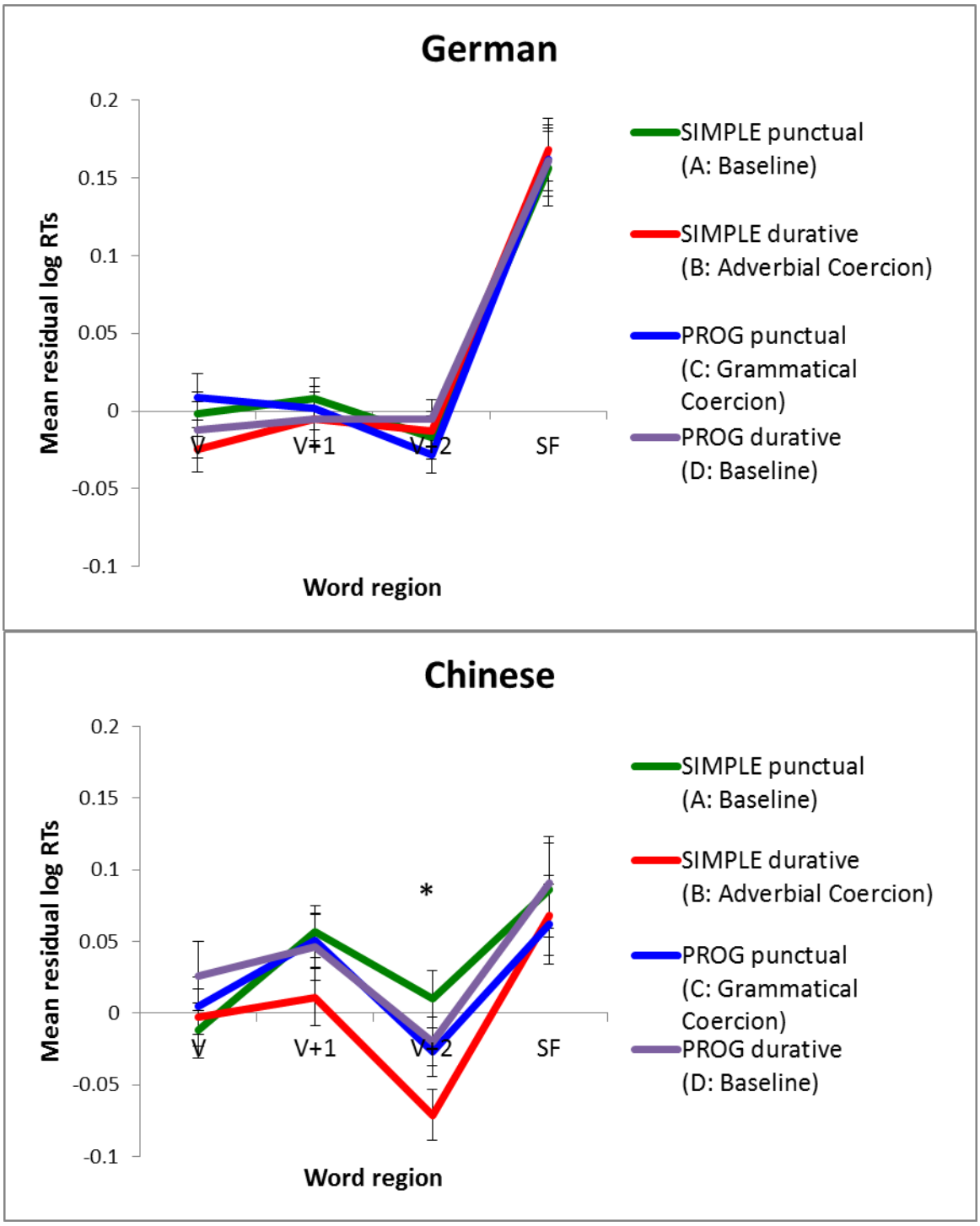
One special note for Experiment III is that a number of problematic items were excluded from statistical analyses. They were problematic because duration was not punctual even though they were meant to be punctual adverbials. That is, all trials containing adverbials such as *yesterday*, *last night, last week,* and the verb *open* were excluded. This procedure reduced the entire data set by another 36.98%.

5.4.2 Results

Figure 3 plots the corresponding RTs by condition and word region for each language group. The y-axis has been adjusted to the same scale for direct comparison across groups. A summary of results from the three-way mixed-design ANCOVA can be found in Appendix J.

Figure 3. Mean residual log RTs for Experiment III





Note. Error bars indicate ±1 standard error. An asterisk * denotes a statistically significant result.

Several observations were noteworthy from Figure 3. First, native English speakers and L2 learners showed dissimilar reading profiles after controlling for English proficiency. Native English speakers exhibited the quickest RTs across the board, demonstrating a native language advantage. A visual inspection of their RTs revealed that sentences involving aspectual coercion (both Adverbial Coercion and Grammatical Coercion) appeared to take longer than control sentences, despite variations across word regions. Conversely, Chinese participants seemed to show the opposite patterns in which they spent more time on control sentences relative to Adverbial Coercion sentences. The reading speed of German participants decreased dramatically at the sentence final word regardless of conditions. These observations were supported by subsequent statistical analyses.

Verb

An ANCOVA controlling for English proficiency at the verb revealed a significant Adverbial × Grammatical Aspect interaction by both participants and items, $F_1(1, 80) = 5.773$, $p = .019$; $F_2(1, 56) = 4.607$, $p = .036$. Also, the main effect of grammatical aspect was significant by participants, $F_1(1, 80) = 7.265$, $p = .009$; $F_2 < 3.072$. No other effects approached significance by either participants or items: adverbial, F_1 (1, 80) = 3.757, $p = .056$; $F_2 < .071$; language, $F_1(3, 80) = 1.412$, $p = .245$; $F_2 < .892$; all interactions, Fs < 1.128.

To explore the Adverbial × Grammatical Aspect interaction collapsed across language groups, a follow-up simple main effect of adverbial across levels of grammatical aspect was performed in this word region. However, none of the comparisons reached significance, ps > .113.

V+1

An ANCOVA controlling for English proficiency at the first word after the verb revealed a significant Adverbial × Grammatical Aspect interaction by participants, $F_1(1, 80) = 5.036$, $p = .028$; $F_2 < .002$. The main effect of language was significant by both participants and items, $F_1(3, 80) = 5.456$, $p = .002$; $F_2(3, 56) = 2.893$, $p = .043$. All other main effects and interactions were not significant by either participants or items: grammatical aspect, $F_1(1, 80) = .119$, $p = .731$; $F_2 < .559$; adverbial, $F_1(1, 80) = 1.605$, $p = .209$; $F_2 < .818$; all interactions, Fs < 1.025.

To explore the Adverbial × Grammatical Aspect interaction, a follow-up simple main effect of adverbial across levels of grammatical aspect was conducted in this word region. No comparisons approached significance, ps > .492.

In order to understand how different language groups performed in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that the reading speed of Chinese participants ($M = .041$, $SE = .011$) was significantly longer than that of native English participants ($M = -.03$, $SE = .01$), $p = .001$, as well as German participants ($M = .000$, $SE = .008$), $p = .014$, respectively. No other comparisons were significant, ps > .107.

V+2

An ANCOVA controlling for English proficiency at the second word after the verb revealed a significant Adverbial × Grammatical Aspect interaction by participants, $F_1(1, 80) = 11.736$, $p = .001$; $F_2 < .39$, and a three-way Adverbial × Grammatical Aspect × Language interaction by participants, $F_1(3, 80) = 3.251$, $p = .026$; $F_2 < .169$, suggesting that the four language groups may behave differently across levels of adverbial and grammatical aspect. All other main effects and interactions were not significant by either participants or items:

grammatical aspect, $F_1(1, 80) = .848$, $p = .36$; $F_2 < .038$; adverbial, $F_1(1, 80) = .923$, $p = .34$; $F_2 < .143$; language, $F_1(3, 80) = 1.025$, $p = .386$; $F_2 < .149$; all interactions, Fs < 2.206.

Because of a significant three-way interaction, a follow-up simple main effect of adverbial across levels of grammatical aspect was performed separately for each language group in this word region. English native speakers slowed down at Adverbial Coercion sentences (M = -.011, SE = .017) relative to corresponding control sentences (M = -.061, SE = .019), $p = .052$. Also, they read Grammatical Coercion sentences (M = -.011, SE = .016) marginally slower than respective control sentences (M = -.047, SE = .016), $p = .096$. Although these results were only marginally significant, native English participants in this experiment behaved in accord with the prediction that sentences involving aspectual coercion generally took longer to read than non-coercion sentences. Importantly, these results provided a reasonable baseline when evaluating L2 participants' reading performance in the same experiment.

However, Chinese participants read Adverbial Coercion sentences (M = -.071, SE = .018) significantly faster than the respective control sentences (M = .01, SE = .02), $p = .003$, which is opposite to the prediction of adverbial coercion. All other comparisons were not significant in this word region, ps > .164.

SF

An ANCOVA controlling for English proficiency at the sentence final word revealed a significant main effect of language by both participants and items, $F_1(3, 80) = 7.122$, $p < .001$; $F_2(3, 56) = 11.948$, $p < .001$. All other main effects and interactions were not significant by either participants or items: grammatical aspect, $F_1(1, 80) = 1.207$, $p = .275$; $F_2 < .952$; adverbial, $F_1(1, 80) = .155$, $p = .695$; $F_2 < .049$; all interactions, Fs < 1.549.

To explore how different language groups performed in this word region, posthoc pairwise comparisons with Bonferroni adjustment revealed that the reading speed of German participants (M = .162, SE = .016) was significantly slower than that of native English speakers (M = .066, SE = .021), p = .004, and Chinese participants (M = .077, SE = .022), p = .01, respectively. German participants also appeared to be slower than Korean participants (M = .098, SE = .02), p = .087. All other comparisons were not significant, ps > . 087.

These results presented clear evidence of differential reading time patterns. At the verb, there were no RT differences by condition collapsed across language groups. The same was generally true for V+1. At V+2, native English participants exhibited marginally significant trends that Adverbial Coercion and Grammatical Coercion sentences took longer time to process. The Chinese participants, however, took significantly longer to read control sentences relative to Adverbial Coercion sentences. At the sentence final word, the German participants showed elevated RTs regardless of conditions when compared to Korean, Chinese, and native English participants. This pattern was also observed in the two self-paced reading experiments (Experiments I and II).

5.5 DISCUSSION

With regard to the three research questions, these results provided partial support for the hypothesis that there is a processing cost for aspectual coercion, because native English speakers tended to slow down in those target sentences. The online effects of aspectual coercion, however, were only marginally significant.

In addition, reading time results clearly revealed that aspectual coercion is mediated by the interaction among grammatical aspect, lexical aspect, and adverbial. This is supported by a significant Adverbial × Grammatical Aspect interaction effect collapsed across language groups at three of the four word regions, *p*s < .028. As predicted, not only adverbials but also grammatical aspect trigger aspectual coercion. This finding provides a new theoretical insight to aspectual coercion phenomena, as previous studies showed that a durative adverbial is solely responsible for iteration involved in a semelfactive predicate (e.g., Todorova et al., 2000).

Furthermore, Experiment III extended the psycholinguistic investigation of aspectual coercion to L2 learners for the first time. The results lent strong support for the hypothesis of language-specific influence on L2 tense-aspect acquisition, which is consistent with the findings presented in chapters 3 and 4. Although native English speakers behaved differently from L2 learners in general, L2 learners also differed systematically from each other after removing pre-existing differences in L2 English proficiency.

In the following paragraphs, I shall discuss the processing performance of native English speakers and L2 learners in relation to the theoretical importance of aspectual coercion and L2 aspect acquisition. More broadly, I will also discuss implications of prototype and aspectual coercion in section 5.5.3.

5.5.1 Native English speakers

Reading time results indicated that native English speakers slowed down at sentences involving Adverbial Coercion (*All day the kid jumped…*) and Grammatical Coercion (*At noon the kid was jumping…*), even though the reading time results were only marginally different from their control counterparts. These results are consistent with the general prediction that aspectual

coercion incurs a greater processing cost. It is noted that these results were somehow delayed, and were found at the second word after the verb (V+2). It is unclear why no strong, immediate online effects emerge as other self-paced reading studies have shown. Brennan and Pylkkänen (2008), for example, presented evidence that iterative coercion can produce significant, immediate effects. The highly frequent, salient semelfactive verbs used in this experiment may contribute to the diminished online effects within the native English participants.

Another important finding is that native English speakers demonstrated the predicted Adverbial × Grammatical Aspect interaction effect. What this suggests is that there is no reason to believe that temporal adverbials independently cause processing slowdown in aspectual coercion, as previous experimental studies such as Todorova et al (2000) have shown. Instead, lexical aspect, grammatical aspect, and adverbial conspire to shape the aspectual interpretation of a sentence. Also, the results were at odds with the underspecification account put forward by Pickering et al. (2006) to account for their null effects. Pickering et al. asserted that readers routinely underspecify aspectual properties of an interpretation during comprehension. The underspecification account is untenable here because of the strong interaction between adverbial and grammatical aspect. In this regard, native speaker results from Experiment III is compatible with Brennan and Pylkkänen (2008), among others.

5.5.2 L2 learners

The Chinese participants showed significantly shorter reading times in Adverbial Coercion (*All day the kid jumped…*) sentences than respective control sentences (*At noon the kid jumped…*), which is opposite to the prediction. At first glance, these results were puzzling. However,

differences in the aspectual systems of English and Chinese provide clues why this may have happened.

According to Yang (1995), perfective *le* strongly prefers telic and bounded situations in Chinese. This explains why the semelfactive predicate *kesou* 'cough' in (17) cannot felicitously co-occur with *le*, because semelfactives are by definition atelic. However, when a bounded temporal situation is introduced via a verbal classifier phrase *yi-sheng* 'once' as shown in (18), the utterance becomes felicitous.

(17) **Lisi kesou le*

Lisi cough PERF

"Lisi coughed"

(18) *Lisi kesou le yi-sheng*

Lisi cough PERF one-CL

"Lisi coughed once"

(Yang, 1995; cited in Xiao and McEnery, 2004, p. 103)

Xiao and McEnery (2004) adduced native Chinese corpus data to support the idea that the sensitivity of *le* to boundedness is relative rather than absolute. In their sample, an overwhelming 89.4% of all 1138 tokens of *le* occur in bounded contexts, whereas a meager 10.6% occurred in unbounded contexts. Of the 27 tokens of semelfactives taking *le* in the same corpus, 16 are bounded by additional adverbials that impose a spatially or temporally bounded situation. This quantitative finding suggests that the semelfactive plus durative adverbial combination is quantitatively more common in Chinese. Although Xiao and McEnery did not articulate the underlying reason for such a language-specific bias in Chinese, they maintained

that semelfactive verbs taking perfective *le* prefers to be bounded, particularly by means of a verbal classifier phrase, verb reduplication, or by a *for*-adverbial as shown in (19).

(19) *Da-le ni ji-tian*

beat-PERF you how-many-day

"For how many days did they beat you?"

(Xiao & McEnery, 2004, p. 111)

The co-occurrence of a semelfactive verb taking *le* in the presence of a durative adverbial in (19) is equivalent to the Adverbial Coercion construction in English. Not surprisingly, the processing advantage found in Chinese participants can be attributed to the slightly skewed distribution of *le* in bounded contexts for semelfactives, as Xiao and McEnery have shown. This claim remains to be independently verified by Chinese sentence processing experiments. But what is interesting here is that the Chinese participants exhibited a language-specific bias from the L1 aspectual system of Chinese even when they were reading in L2 English. If that's the case, results from the Chinese participants provided support for transfer.

The Korean participants did not exhibit any within-subject differences in terms of their reading performance across experimental conditions. They behaved similarly to native English speakers in the sense that aspectual coercion sentences tended to be read slower than control sentences. Although no statistically significant results were found, the trends observed were consistent with the idea that learning tense-aspect distinctions in an L2 is a developmental and gradual process.

Two interesting observations were found in the German participants. First, grammatical aspect such as SIMPLE and PROG did not seem to make any processing difference for the German participants. The reading times performance were highly comparable across conditions.

This result is indeed very similar to the main finding in Experiment II, in which the same German participants only showed differential reading time patterns across levels of lexical aspect but not within levels of grammatical aspect, nor their interactions. As discussed in chapter 4, Stutterheim and Carroll (2006) argued that the absence of grammatical aspect such as the progressive is ultimately responsible for German speakers' more holistic approach to conceptualize a temporal situation.

Another noteworthy finding is that the reading speed was dramatically slower at the end of the sentence when German participants read sentences in L2 English. If properties of L1 German such as the verb-second constraint in German main clauses is responsible for this observation, it will provide additional support for L1 transfer., Of course, this language-specific hypothesis needs to be verified by L1 German sentence processing data.

What's interesting about aspectual coercion is that it involves contextual re-interpretation of aspectual information, which can be more demanding for L2 learners. A psycholinguistic investigation thus can reveal important information regarding L2 learners' real-time combinatorial semantic operations. Under much scrutiny is the influence of tense, grammatical aspect, lexical aspect, and temporal adverbials that yield an overall aspectual reading of a sentence. Importantly, Experiment III demonstrated that L2 learners dynamically synthesized temporal information in the course of language processing, and much of it to be susceptible to L1 influence in a systematic way.

5.5.3 A note on aspectual coercion and prototype

If prototype exemplifies the privileged interaction between lexical and grammatical aspect, aspectual coercion extends its application to include temporal adverbials in the aspectual interpretation of an utterance. Native English speakers in the current dissertation study did not exhibit any processing advantage in prototype (Experiment II), and processing penalty for aspectual coercion was marginal (Experiment III).

The case was different for L2 learners. The Korean participants showed trends of facilitation and penalty effects for prototype and aspectual coercion. Compared to native English speakers, data from the Korean participants highlighted the developmental dimension of processing and representing tense-aspect distinctions in an L2.

The German participants were unique in the sense that they were indifferent to grammatical aspectual distinctions such as PAST and PROG when processing sentences containing prototypes and aspectual coercion. One possible explanation is that the lack of grammaticized meanings in L1 (i.e. the progressive in German) are responsible for the indifference (Stutterheim & Carroll, 2006).

The Chinese participants presented a compelling case for L1 influence when processing L2 tense-aspect distinctions. They slowed down significantly when reading activity PAST combinations in English as shown in Experiment II, and they speeded up in adverbial coercion sentences (*All day the kid jumped…*) in Experiment III. Each of these results was opposite to what native English speakers supposedly do. Yet, they can be accounted for by aspectual phenomena in L1 Chinese.

Although this dissertation investigated different contributing factors about prototype and aspectual coercion, it begs the same underlying question of what are the core mechanisms that

promote (or impede) the acquisition and processing of tense-aspect distinctions in an L2. The systematic L1 effects found in L2 aspectual interpretation suggests that the cognitive basis of transfer in the associative learning of form-meaning relations in tense and aspect categories should not be overlooked (e.g., Ellis & Sagarra, 2010).

5.6 SUMMARY

In this chapter, I examined whether there is psycholinguistic evidence for aspectual coercion among native English speakers as well as L2 learners in the course of language processing. For native English speakers, empirical results provided partial support for a processing cost associated with aspectual coercion. The marginally significant trends further suggested that aspectual coercion might be cognitively easy to perform. In comparison, L2 learners showed different but systematic reading performance. For instance, Korean L2 learners showed trends of aspectual coercion despite no statistically significant results; German L2 learners showed indifference across experimental conditions; and Chinese L2 learners showed adverbial coercion effects opposite to native English speakers. I contended that these L2 processing results could be accounted for by properties from respective L1s. Experiment III extended the psycholinguistic investigation of aspectual coercion to L2 learners for the first time in the L2 tense-aspect literature.

Also, unlike previous experimental studies such as Todorova et al. (2000), Experiment III systematically examined and demonstrated that adverbial and grammatical aspect interact to derive aspectual coercion effects in native English speakers. This finding has important

implications for the definition of aspectual coercion, as well as the processing consequence. Experiment III begs more questions than it has set out to answer. Future research needs to differentiate similar behavioral consequences (e.g., delay in reading times) found in aspectual coercion versus other tense-aspect morphosyntactic anomalies (Experiment I), which may register as very different brain responses or processing correlates. Empirical investigation using more time-sensitive methodologies such as eye tracking or electroencephalography (EEG), in addition to behavioral measures may bear fruit in this regard.

6.0 CONCLUSION

6.1 PREVALENCE OF L1 INFLUENCE IN L2 TENSE-ASPECT PROCESSING

This dissertation has offered a language processing perspective to the study of second language acquisition of tense and aspect. In three sentence processing experiments, I explored whether adult L2 learners could detect tense-aspect errors, use prototype, and shift aspectual meaning in real time. Each of these inquiries sheds light on inter-related issues of tense-aspect processing in L2 inflectional sensitivity, prototype, and aspectual coercion. The most robust finding across all three experiments is that there was a strong tendency for L1 transfer when L2 learners of English inferred temporal information encoded by English past and progressive. These transfer effects could not have been exposed without a systematic cross-linguistic comparison of L2 learners from three typologically different languages — Korean, German, and Chinese, whose L1s differ in past and progressive markings. A summary of each group's processing results is given in the next few paragraphs.

To begin, native English speakers were sensitive to errors present in past tense, progressive aspect, plural morphology, and subcategorization. They were indifferent to prototypes, and yet only showed a marginal processing cost when resolving aspectual coercion triggered by adverbials (p = .052). Taken together, the native speaker data demonstrated that the self-paced reading technique employed was sound; prototype is arguably a developmental

phenomenon rather than an end-state for English speakers; and it is cognitively not difficult to coerce an aspectual interpretation from its original specification.

Among all L2 learners, the Korean participants resembled native English speakers to the most extent. They were sensitive to errors in past and progressive morphology, but not for plural and subcategorization. This is unlike native English speakers. Koreans showed reliable processing advantage for prototype in the past only, and no sign of processing slowdown for aspectual coercion. The Korean data provided a comparable control for reading performance of the other two groups of L2 learners.

The German L2 learners of English showed several unique processing behaviors that can be attributed to L1 influence. They could detect all errors tested, except when the progressive was used in a meaningfully awkward context such as #*Lately she is cleaning the sticky jelly from her son's hands*. Also, contrary to the prototype hypothesis, the German participants processed state PAST more readily than achievement PAST. Similar results have been reported when German-speaking children learned English (e.g., Rohde, 2002). With respect to coercion, the German participants seemed to be indifferent to differences created by levels of grammatical aspect. All the observed results can be attributed to the lack of grammatical aspect, particularly the lack of grammaticized progressive marker in the German system. Lastly, one interesting yet consistent observation is that the reading speed was dramatically slower at the last word of a sentence for the German participants.

The lower proficiency Chinese L2 learners of English appeared to suffer from greater problems in inflectional processing. They could not detect grammatical errors present in obligatory past and plural morphology, or subcategorization. Relatively speaking, their processing performance showed greater automaticity in the progressive. Also, no processing

advantage was found in prototype, as might be expected when achievement is marked in the past. Instead, the Chinese participants slowed down significantly in activity PAST. One explanation for this is that such a combination is considered incomplete according to the aspectual system in Chinese (Lin, 2005). More intriguingly, the Chinese data showed coercion effects opposite to the predictions specified by the English grammar. Chinese corpus data (Xiao & McEnery, 2004) were evoked to account for the observed language-specific phenomena.

One limitation in this dissertation is that the German participants were recruited in Germany, whereas the Korean and Chinese participants were recruited in the United States. One may argue that the place of residence and/or learning context would have an instrumental role on L2 morphological processing in general. It is acknowledged that such a possibility might exist although SLA research indicates residence abroad does not help grammatical development (e.g., Freed, 1995). Future empirical investigation may pursue how learning contexts influence L2 morphological development.

6.2 DIRECTIONS FOR FUTURE RESEARCH

As succinctly put by Odlin (2003, p. 467), "categories such as aspect have universal as well as language-specific dimensions, and none should be neglected". This dissertation represents a very first step to bring together universal as well as language-specific dimensions to the study of L2 acquisition of tense and aspect. Although traces of cross-linguistic influence from the L1 systems were found, it is unlikely that the grammatical factors alone are responsible for L2 learners' development. Other factors such as cognitive, developmental, and social factors are likely to be at play as well. This is particularly relevant to L2 acquisition and bilingual language

processing, as L2 learners have at their disposal an established L1 grammar in the very beginning of L2 acquisition, whereas L1 children do not, not to mention cognitive maturity. That's probably the reason L2 learners rely heavily on lexical rather than morphological means to encode temporal relations (Dietrich, Klein, & Noyau, 1995; Shirai, 2009). The prevalence of L1 influence is one important discovery in L2 tense-aspect acquisition, but more elaborated empirical work is required to independently verify the reported online effects. Recommendations for future research directions include but are not limited to the following:

6.2.1 The extent of L1 influence

Numerous questions can be asked about L1 transfer. For example, under what conditions do transfer occur in the L2 acquisition of tense and aspect? How strong is the tendency? Is transfer context-dependent? Does it affect languages such as German and Chinese more than in others? Does it affect more in initial stages rather than later stages of language acquisition? What about cross-sectionally — do very advanced L2 learners exhibit the same quantity and quality of transfer compared to beginning L2 learners? What about the reverse — does gaining L2 tense-aspect knowledge have a reciprocal effect on L1 tense-aspect processing? What about bi-directional transfer within bilingual speakers? Does transfer affect only the verbal domain, or its effects are visible in other aspects of non-verbal temporal cognition? Can grammaticization reliably predict transfer?

6.2.2 Processing and acquisition data

One of the most pressing issues is to reconcile the differences between universal trends reported in the SLA literature and strong transfer effects observed in this dissertation. One open question is that the differences between acquisition and processing data might lead to different observations. Traditionally, L2 learner data were adduced from offline production and elicitation tasks. Data gathered and reported in this dissertation were generated from online sentence comprehension. This said, applying a language processing perspective to the acquisition of tense and aspect enables a more direct probe into the learning processes and mechanisms as they happen over time. I suggest that both approaches have much to gain by paying attention to each other. To make progress, using converging methods to collect both acquisition and processing data from the same participants in one study is perhaps a good way to start.

6.2.3 Language diversity

To ensure generalizability, it would be particularly fruitful to research less commonly researched languages such as Cantonese. This is especially important as prompted by the strong evidence of transfer in this dissertation study. The domain of L2 acquisition of tense-aspect morphology is arguably one of the best testing grounds to test cognitive-based versus language-specific mechanisms of language acquisition.

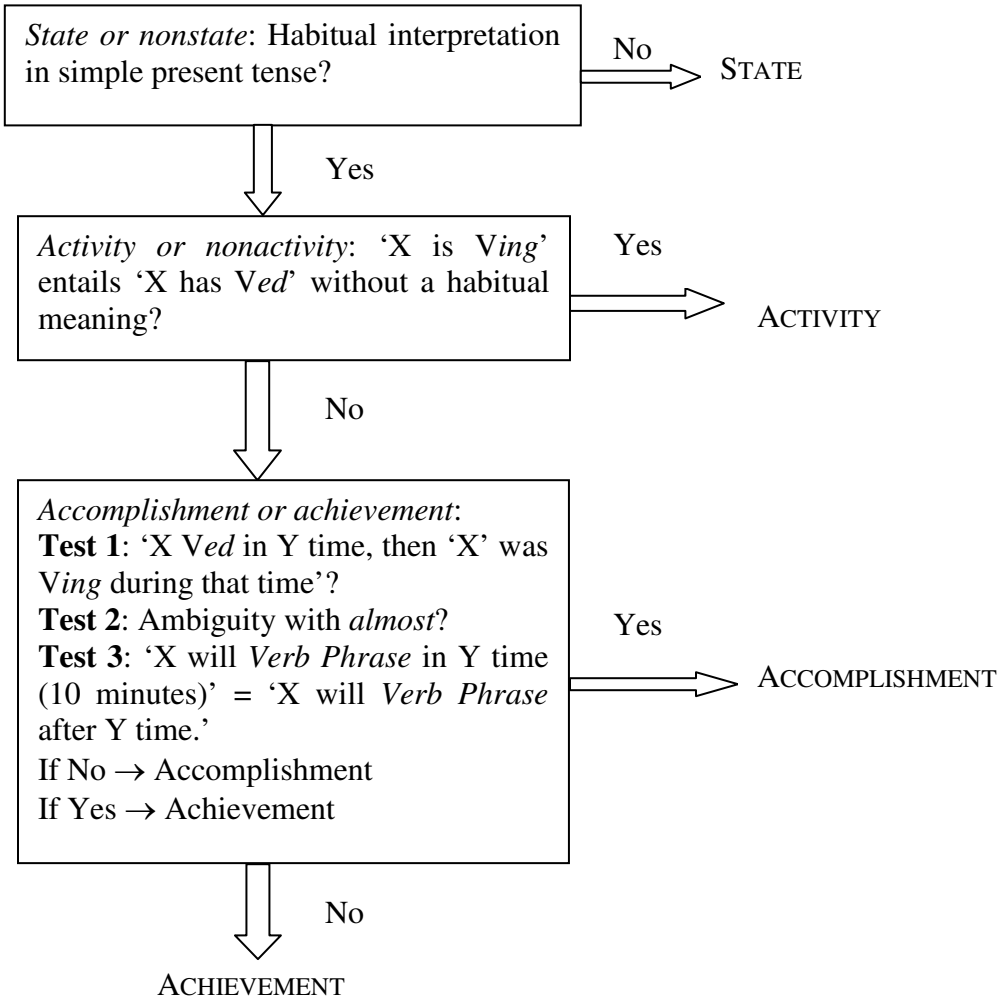
6.2.4 Models development

After identifying essential components from previous and ongoing research, the utmost goal is to develop more sophisticated frameworks or models that capture the interactive processes of representation, processing, and acquisition to showcase how language works in general. Models can be theoretical, psychological, and/or computational, among others. Connecting tense-aspect research to explaining language phenomena at large remains a long-range goal.

APPENDIX A

DIAGNOSTIC TESTS FOR LEXICAL ASPECT

Operational steps to classify lexical aspect of verbs (Shirai & Andersen, 1995, pp. 748-9)



APPENDIX B

FILLER ITEMS

Filler 1 a
John did not get the Oscar because he is not a very good actor and there were better deserving candidates.
? Did John win the Oscar? N

Filler 2 a
Every morning for breakfast Mary put milk in her bowl of cereal even though it would no longer be crunchy.
? Does Mary put milk in her bowl of cereal? Y

Filler 3 a
Actors need to follow the instructions of the director during filming.
? Do actors need to follow directions? Y

Filler 4 a
I got a lower grade on my paper because I made a careless error and the teacher expected better.
? Were careless errors made on the paper? Y

Filler 5 a
He had to rent a tuxedo because the party was formal and very high class.
? Was the party formal? Y

Filler 6 a
His fever was high so we drove him to the hospital in the strange town.
? Was the town strange? Y

Filler 7 a
The restaurant was so dirty that the health inspector came and forced it to close.
? Was the restaurant dirty? Y

Filler 8 a
The phone company charges for long distance calls but not for local calls, which are free.
? Does the phone company charge for long distance calls? Y

Filler 9 a
At the airport gate, his belt buckle set off the metal detector and embarrassed us all.

? Did the belt buckle set off the metal detector? Y

Filler 10 a
Before playing, the musical composer first wiped the keys of the piano at the beginning of the concert.
? Did the musical composer wipe the piano keys? Y

Filler 11 a
Watching the tornado near my home I felt great terror but tried to keep calm.
? Was there a tornado? Y

Filler 12 a
My new salary is more than double, if not triple what I used to make.
? Is the new salary lower than the original? N

Filler 13 a
The local farmer rode on his tractor where ever he went.
? Does the farmer only ride his tractor on the farm? N

Filler 14 a
Compared with others, the luxury car was far superior in terms of performance.
? Does the luxury car perform poorly? N

Filler 15 a
For years she was a singer in a band that used to play in this bar.
? Was she a drummer in the band? N

Filler 16 a
Although annoyed, I tried to keep my calm as she complained.
? Was I happy that she complained? N

Filler 17 a
The child was ashamed because her answer was not correct and she did not raise her hand again.
? Did the child raise her hand again? N

Filler 18 a
The child yelled into the well and she could hear her voice echo a few times.
? Did the child fall in the well? N

Filler 19 a
The frog caught a fly and another insect on its tongue.
? Did the frog catch a bird? N

Filler 20 a
After writing a few sonnets he decided to become a poet and we enjoyed his work very much.
? Did he write a few essays? N

Filler 21 a
She enjoyed the college course because the young professor was interesting and helpful.
? Was the professor boring? N

Filler 22 a
He lit candles and bought flowers to make the mood more romantic for their anniversary.
? Did he buy a car? N

Filler 23 a
While in New York the unfaithful husband had an affair with another woman.
? Did the husband have an affair? Y

Filler 24 a
As we got to know each other we felt a close bond growing between us.
? Did they get to know each other? Y

Filler 25 a
It was getting very cold so I put on my coat and ski gloves.
? Was it very cold? Y

Filler 26 a
I fell off the horse and knew that I should get back up on the saddle and try jumping again.
? Did she fall off the horse? Y

Filler 27 a
My aunt just had a baby so now I have a new cousin to play with.
? Was a baby born? Y

Filler 28 a
The students learned to follow the instructions of their teacher before being allowed to play with the blocks.
? Did the student learn to follow instructions? Y

Filler 29 a
To throw the ball in the hoop you need to bend your elbow at the correct angle.
? Do you need to bend you elbow to throw a ball in the hoop? Y

Filler 30 a
At first the movie was interesting but it had a strange ending which we could not comprehend.
? Was the movie interesting at first? Y

Filler 31 a
Once pregnant we realized the cat was actually a female and not a male.
? Was the cat pregnant? Y

Filler 32 a
The guests cried when the priest said, "I now pronounce you husband and wife.
? Did the guests cry? Y

Filler 33 a
The body aches and high fever indicated that she had an illness that would not soon go away.
? Did she have a fever? Y

Filler 34 a
His future bride was so angry that she broke off the engagement for an entire year.
? Was the bride happy? N

Filler 35 a
The steamboat floated slowly down the river as the sun set in the distance.
? Did the steam boat sink? N

Filler 36 a
They found the gun and arrested him for attempted murder and armed robbery.
? Did they find a knife? N

Filler 37 a
The student looked for some paper and a sharp pencil to write with.
? Did the student look for an ink pen? N

Filler 38 a
Most of the year it is warm but it gets really hot in the summer months before school starts.
? Is it cold most of the year? N

Filler 39 a
At the art gallery I admired the painting that had come from France.
? Did the painting come from Germany? N

Filler 40 a
She was sick for a long time and we hoped for a quick recovery so she could go to the wedding.
? Was she feeling well? N

Filler 41 a
The soup was so hot I burned my tongue and almost spit it back out.
? Was the soup cold? N

Filler 42 a
Just the right spices made the sauce even more tasty and we all asked for seconds.
? Did the sauce taste bad? N

Filler 43 a
The warring nations signed the peace treaty after many months of discussion.
? Did the warring nations sign the treaty? Y

Filler 44 a
She assured me that he was a wonderful actor and that the movie was great.
? Did she think the movie was great? Y

Filler 45 a
As soon as I had turned around my nephew threw the cereal on the floor and refused to eat.
? Did the nephew throw the food on the floor? Y

Filler 46 a
They disagreed a lot and did not like the director after a few months.
? Did they disagree a lot? Y

Filler 47 a
Carlos was the one who made the error in calculation.
? Did Carlos make an error in calculation? Y

Filler 48 a
She informed us that it was a formal party and that we would need to dress up.
? Did they need to dress up? Y

Filler 49 a
He was relieved that the hospital was only a few blocks away.

? Was the hospital only a few blocks away? Y

Filler 50 a
The family hoped that the inspector would come and test the water.
? Did the family want the inspector to test the water? Y

Filler 51 a
We read about a new local restaurant which served great food.
? Does the restaurant serve great food? Y

Filler 52 a
On our way back home we noticed the metal roof had come off of the shed.
? Did the shed have a wooden roof? N

Filler 53 a
When we entered the dining hall we saw the piano in the corner of the room.
? Was there a guitar in the corner of the room? N

Filler 54 a
My uncle was pleased with the tractor he had bought at the state fair.
? Did the uncle buy a car at the fair? N

Filler 55 a
The town people remembered the terror they had felt during the hurricane.
? Were the town people happy about the hurricane? N

Filler 56 a
Last time, I had to take triple the amount of pain reliever in order to sleep.
? Did the person drink wine to fall asleep? N

Filler 57 a
They kept searching for a superior carpenter to get the job done.
? Were they searching for a plumber? N

Filler 58 a
She finally got a chance to see a good band play live music at the bar.
? Did a terrible band play at the bar? N

Filler 59 a
It was impressive that she was calm through all those problems.
? Was she anxious about her problems? N

Filler 60 a
I checked to make sure the correct ingredients were added.
? Were incorrect ingredients added? N

Filler 61 a
We were interested in the talk but there was an echo in the room and we could not hear well.
? Was it easy to hear the talk? N

Filler 62 a
The teacher explained to us how the insect mated and laid eggs.
? Did the teacher explain how chickens lay eggs? N

Filler 63 a
An old friend of mine from college was a poet and was enjoying her work very much.
? Did the friend dislike her work? N

Filler 64 a
They looked forward to the arrival of the professor to the university.
? Did they look forward to the professor's arrival? Y

Filler 65 a
For a few months he seemed romantic and bought me flowers and chocolates.
? Did he buy chocolates and flowers? Y

Filler 66 a
My neighbor told me it was a long affair that she would rather forget.
? Was it a long affair? Y

Filler 67 a
He saw there was a bond between the mother and her daughter.
? Was there a bond between the mother and the daughter? Y

Filler 68 a
He was nice enough to pick up the coat that was left behind.
? Was there a coat left behind? Y

Filler 69 a
They selected some props for the play including a saddle and a cowboy hat.
? Did they select props for the play? Y

Filler 70 a
We insisted that it was not our fault that his cousin got so angry.
? Did someone get angry? Y

Filler 71 a
They listened to the advice of the teacher who was well known for his wisdom.
? Was the teacher well known? Y

Filler 72 a
They carefully examined the diagram of the elbow and knee joints.
? Was the diagram of elbow and knee joints? Y

Filler 73 a
I thought that was a weird ending for that movie.
? Was the ending of the movie weird? Y

Filler 74 a
We found out yesterday that it was a female puppy that had been lost.
? Was a puppy lost? Y

Filler 75 a
My friend was annoyed that the husband did not allow his wife to go out.
? Was the friend annoyed? Y

Filler 76 a
It seemed to me that the illness would only get worse.
? Was the illness getting better? N

Filler 77 a
The group of friends were sure that the engagement would last a long time.
? Will the engagement be short? N

Filler 78 a
We heard about the river flowing into the town.
? Did the river flow past the town? N

Filler 79 a
I fell asleep and did not hear whether the murder case had been solved.
? Did they find out if the murder case was solved? N

Filler 80 a
When I was not looking he kept trying to take the pencil away from me.
? Was he trying to take a wallet? N

Filler 81 a
I wrote my friend a letter about the summer I spent in Australia.
? Did they spend a summer in Australia? N

Filler 82 a
They made a space for the painting being shipped in from France.
? Was the painting being shipped in from Germany? N

Filler 83 a
None of us dreamed that the recovery would be so fast.
? Did they expect the recovery to be fast? N

Filler 84 a
We stared at the picture of the tongue and all of its taste bulbs.
? Was the picture of a face? N

Filler 85 a
The officials were satisfied with the treaty that had been signed.

? Were the officials unhappy? N

Filler 86 a
My sister took the tasty sauce to our grandmother.
? Was the sauce disgusting? N

Filler 87 a
The basketball game took place in the brand new arena that was built with taxpayer money.
? Did the basketball game take place outdoors? N

Filler 88 a
Bob swallowed a small chicken bone and began to choke during last night's dinner.
? Did Bob swallow a chicken bone? Y

Filler 89 a
The thieves tried to crack the secret code to open the safe.
? Did the thieves try to open the safe? Y

Filler 90 a
The prince became a frog because the witch had put a curse on him.
? Did the witch put a curse on the prince? Y

Filler 91 a
Robert was so cruel we thought he was possessed by the devil and avoided him at all costs.
? Was Robert cruel? Y

Filler 93 a
From the beach we could see the shark's fin pass through the water.
? Was there a shark in the water? Y

Filler 94 a
We vacuumed the rug and mopped the floor to help our parents.
? Did they vacuum the rug? Y

Filler 95 a
The accountant examined how the university spent the funds last year.
? Did the accountant examine how the university spent its funds? Y

Filler 96 a
The mother's voice was warm and gentle as she talked to her new baby.
? Did the mother talk to the new baby? Y

Filler 97 a
The annoyed driver kept honking the car horn while he yelled out the window.
? Did the driver honk the horn? Y

Filler 98 a
During these elections we will be choosing a new town mayor and a new district attorney.
? Are the elections for the town mayor and district attorney? Y

Filler 99 a
She took off all her clothes and jumped in the water completely nude in the middle of the night.
? Did she jump in the water in the middle of the night? Y

Filler 100 a
He was so frightened that his lips trembled and his face was deathly pale from the sight of the accident.
? Was he calm when he saw the accident? N

Filler 101 a
I leave a bacon frying for a while in the pan until it becomes crisp.
? Did the bacon catch on fire? N

Filler 102 a
I sliced apples because I was going to bake a pie for my dinner guests that evening.
? Were peaches being sliced? N

Filler 103 a
The child saw the new toy and wanted to play with it right away.
? Did the child see a dog? N

Filler 104 a
He was so embarrassed his face turned bright red and I thought he would cry.
? Was he proud? N

Filler 105 a
He had hung himself from the ceiling with a piece of rope and was discovered the next day.
? Did he hang himself from a tree? N

Filler 106 a
My daughter tried to forge my signature on her report card.
? Did the daughter try to forge a check? N

Filler 107 a
The groom pulled back the bride's veil to see her blushing face.
? Did the groom push the bride? N
Filler 108 a
There was a lot of dust in the air conditioner's vent which needed to be cleaned.
? Was the air conditioner's vent clean? N

Filler 109 a
I put the flowers in the ceramic vase in the dining room.
? Was the vase made of metal? N

Filler 110 a
Between the two buildings was a long and dark alley filled with garbage cans.
? Was the alley filled with stores? N

Filler 111 a
Mike never offered to pay for anything because he was so cheap and she was very much annoyed.
? Did Mike always offer to pay? N

Filler 112 a
When the winning goal was scored the fans began to cheer and celebrate the victory.
? Did the fans cheer and celebrate? Y

Filler 113 a
The detective became impatient as he looked for a clue at the crime scene.
? Did the detective become impatient? Y

Filler 114 a
At the barbeque I ate a burger and an ear of corn fresh from the nearby farm.
? Was the corn from a nearby farm? Y

Filler 115 a
In the museum we saw the king's gold, royal crown locked behind a glass door.
? Was the king's gold crown in the museum? Y

Filler 116 a
Beth moved to the music very well and wanted to become a dancer when she grew up.
? Did Beth want to become a dancer? Y

Filler 117 a
We talked about the cows and chickens we saw when we visited the farm in New York state.
? Was there a farm in New York state? Y

Filler 118 a
The unexpected storm was not predicted in the forecast that we heard on the radio.
? Was the storm unexpected? Y

Filler 119 a
She wanted to hang the portrait so we went shopping for a frame to put it in.
? Did she want to hang a portrait? Y

Filler 120 a
At the pond we could see a green frog jumping in and out of the water.
? Was the frog jumping in and out of the water? Y

APPENDIX C

LANGUAGE HISTORY QUESTIONNAIRE

Language History Questionnaire

Experimenter_____

Please answer all of the following questions to the best of your ability. If a particular question does not apply to you, please fill in the appropriate space with an N/A.

1. Name (print):_____ 2. Date:_____

3. Age:_____ 4. DOB:_____ 5. Sex:_____ 6. Country of Birth:_____

7. If you were not born in the U.S., at what age did you move to the U.S.?_____

8. What is the first language you spoke?:_____

(if more than one please indicate)

9. Please list **all** of the languages you know, **in order in which you learned them from earliest to most recent**. Indicate the age at which you were first exposed to each language, the source(s)

of this exposure, and the number of years you have formally studied (in a classroom or other structured situation) each:

LANGUAGE	AGE AT FIRST EXPOSURE	SOURCE OF EXPOSURE	YEARS OF STUDY
1.			
2.			
3.			
4.			

10. Have you had classroom instruction (schooling) in your first language?:_____

11. How much?:_____

12. Have you had classroom instruction (schooling) in your second language?:_____

13. How much?:_____

14. Have you ever taken an ESL class? _____ If so, for how long? _____

15. How proficient are you **currently** in each of your languages? Please rate them using the following scale:

1 = almost none 2 = very poor 3 = fair 4 = functional

5 = good 6 = very good 7 = like a native speaker

Language	Speech	Reading	Writing	Understanding Speech
1.				
2.				
3.				
4.				

16. Estimate what percent of the time (out of 100%) you **currently** use your <u>three best</u> languages

When speaking to:	Language 1: _____	Language 2: _____	Language 3: _____
A. FATHER			
B. MOTHER			
C. SONS/ DAUGHTERS			
D. BROTHERS/ SISTERS			
E. FRIENDS			
F. YOURSELF			
G. SPOUSE			
H. PETS			

17. Which languages, other than English, do you use every week? _____

18. Before you started kindergarten or preschool, what language did you most frequently use when speaking to:

Father _____ Mother _____

Older Brothers/ Sisters _____ Other Caretaker _____

----------Do Not Write Below This Line----------

Checked by _____	Comments:
Exp code _____	

APPENDIX D

STIMULI FROM EXPERIMENT IA

Conditions are coded as follows:

a: well-formed

g: grammar-induced violation

m: meaning-induced violation

PAST

1 a Last night the children kicked the front door open to go to the playground.

1 g Last night the children kick the front door open to go to the playground.

1 m Tomorrow the children kicked the front door open to go to the playground.

2 a Yesterday the policemen found a small white dog in the park.

2 g Yesterday the policemen find a small white dog in the park.

2 m Tomorrow the policemen found a small white dog in the park.

3 a Three weeks ago the couples arrived at the beautiful sandy beach.

3 g Three weeks ago the couples arrive at the beautiful sandy beach.

3 m Next week the couples arrived at the beautiful sandy beach.

4 a Last night they finished the cherry pie and the ice cream too.

4 g Last night they finish the cherry pie and the ice cream too.

4 m Tomorrow night they finished the cherry pie and the ice cream too.

5 a Last year my grandparents retired after working at the same company for 40 years.

5 g Last year my grandparents retire after working at the same company for 40 years.

5 m Next year my grandparents retired after working at the same company for 40 years.

6 a A few nights ago I lost my favorite shoes that I bought in Mexico.

6 g A few nights ago I lose my favorite shoes that I bought in Mexico.

6 m Two days later I lost my favorite shoes that I bought in Mexico.

7 a Yesterday several large snakes escaped from their cage at the zoo.

7 g Yesterday several large snakes escape from their cage at the zoo.

7 m Tomorrow several large snakes escaped from their cage at the zoo.

8 a Last year Mary and her sister opened their restaurant just down the street from my house.

8 g Last year Mary and her sister open their restaurant just down the street from my house.

8 m Next year Mary and her sister opened their restaurant just down the street from my house.

9 a Last night I locked the front door but this morning it was open.

9 g Last night I lock the front door but this morning it was open.

9 m Tomorrow I locked the front door but this morning it was open.

10 a Last week I caught a cold from not getting enough rest.

10 g Last week I catch a cold from not getting enough rest.

10 m Next week I caught a cold from not getting enough rest.

11 a Yesterday the wine bottles exploded and made a mess on the floor.

11 g Yesterday the wine bottles explode and made a mess on the floor.

11 m Tomorrow the wine bottles exploded and made a mess on the floor.

12 a Two days ago the gangsters murdered an old woman down the street.

12 g Two days ago the gangsters murder an old woman down the street.

12 m In two days the gangsters murdered an old woman down the street.

13 a Last time the phone calls interrupted our intense game of chess.

13 g Last time the phone calls interrupt our intense game of chess.

13 m Next time the phone calls interrupted our intense game of chess.

14 a Last night I shot the basketball into the net perfectly.

14 g Last night I shoot the basketball into the net perfectly.

14 m Tomorrow night I shot the basketball into the net perfectly.

15 a Three months ago the volunteers sold lemonade at the baseball game.

15 g Three months ago the volunteers sell lemonade at the baseball game.

15 m Three months later the volunteers sold lemonade at the baseball game.

16 a Last year my two teammates won an award in the tournament.

16 g Last year my two teammates win an award in the tournament.

16 m Next time my two teammates won an award in the tournament.

17 a Yesterday the children dove into the ice cold sea.

17 g Yesterday the children dive into the ice cold sea.

17 m Tomorrow the children dove into the ice cold sea.

18 a Four days ago I noticed my favorite ring was missing.

18 g Four days ago I notice my favorite ring was missing.

18 m In four days I noticed my favorite ring was missing.

19 a Last week I broke my arm while skiing down a mountain.

19 g Last week I break my arm while skiing down a mountain.

19 m Next week I broke my arm while skiing down a mountain.

20 a Last night the thieves stole jewelry from seven different houses.

20 g Last night the thieves steal jewelry from seven different houses.

20 m Tomorrow night the thieves stole jewelry from seven different houses.

21 a Yesterday I married the woman I met on the cruise to the Caribbean.

21 g Yesterday I marry the woman I met on the cruise to the Caribbean.

21 m Tomorrow I married the woman I met on the cruise to the Caribbean.

22 a A few weeks ago my parents spent all of their money on a new car.

22 g A few weeks ago my parents spend all of their money on a new car.

22 m In a few weeks my parents spent all of their money on a new car.

23 a Last month I gave my kitten away because I was allergic to it.

23 g Last month I give my kitten away because I was allergic to it.

23 m Next month I gave my kitten away because I was allergic to it.

24 a Last night I threw the touchdown to win the football game.

24 g Last night I throw the touchdown to win the football game.

24 m Tomorrow night I threw the touchdown to win the football game.

25 a Yesterday the workers left garbage all over the kitchen floor.

25 g Yesterday the workers leave garbage all over the kitchen floor.

25 m Tomorrow the workers left garbage all over the kitchen floor.

26 a Last week the flowers died because of the river flood.

26 g Last week the flowers die because of the river flood.

26 m Next week the flowers died because of the river flood.

27 a Last year the hikers reached the top of the mountain without any help.

27 g Last year the hikers reach the top of the mountain without any help.

27 m Next year the hikers reached the top of the mountain without any help.

28 a Last month my cousins began their first semester of school in Germany.

28 g Last month my cousins begin their first semester of school in Germany.

28 m Next month my cousins began their first semester of school in Germany.

29 a Three days ago my parents sent a letter to Mary in Japan.

29 g Three days ago my parents send a letter to Mary in Japan.

29 m In three days Laura my parents sent a letter to Mary in Japan.

30 a Yesterday the children touched the spider hanging from the tree.

30 g Yesterday the children touch the spider hanging from the tree.

30 m Tomorrow the children touched the spider hanging from the tree.

PROG

101 a Now they are discussing his punishment for skipping school.

101 g Now they discussing his punishment for skipping school.

101 m Immediately they are discussing his punishment for skipping school.

102 a Presently she is cleaning the sticky jelly from her son's hands.

102 g Presently she cleaning the sticky jelly from her son's hands.

102 m Lately she is cleaning the sticky jelly from her son's hands.

103 a At this moment Linda is designing her very own wedding dress.

103 g At this moment Linda designing her very own wedding dress.

103 m Instantly Linda is designing her very own wedding dress.

104 a Now she is reading outside in the park.

104 g Now she reading outside in the park.

104 m Instantly she is reading outside in the park.

105 a Currently George is swimming in his neighbor's new pool.

105 g Currently George swimming in his neighbor's new pool.

105 m Right away George is swimming in his neighbor's new pool.

106 a At this moment students are working hard for their examination.

106 g At this moment students working hard for their examination.

106 m Right away students are working hard for their examination.

107 a Right now Joe is studying chemistry and cannot come to the party.

107 g Right now Joe studying chemistry and cannot come to the party.

107 m Immediately Joe is studying chemistry and cannot come to the party.

108 a Now Peter is washing his new car in the driveway.

108 g Now Peter washing his new car in the driveway.

108 m Immediately Peter is washing his new car in the driveway.

109 a Presently she is sailing with her husband to New Zealand.

109 g Presently she sailing with her husband to New Zealand.

109 m All of a sudden she is sailing with her husband to New Zealand.

110 a Presently the houses are burning in the middle of the village.

110 g Presently the houses burning in the middle of the village.

110 m Lately the houses are burning in the middle of the village.

111 a Now Steve is talking to his lawyer about the divorce.

111 g Now Steve talking to his lawyer about the divorce.

111 m In an instant Steve is talking to his lawyer about the divorce.

112 a Presently Karen is waiting for her pizza to be done cooking.

112 g Presently Karen waiting for her pizza to be done cooking.

112 m Right away Karen is waiting for her pizza to be done cooking.

113 a Now my uncle is chatting about my least favorite subject, politics.

113 g Now my uncle chatting about my least favorite subject, politics.

113 m Immediately my uncle is chatting about my least favorite subject, politics.

114 a At this moment Alex is stirring the sauce so it does not burn.

114 g At this moment Alex stirring the sauce so it does not burn.

114 m Suddenly Alex is stirring the sauce so it does not burn.

115 a Presently Peter is smoking his cigarette in the hotel lobby.

115 g Presently Peter smoking his cigarette in the hotel lobby.

115 m In an instant Peter is smoking his cigarette in the hotel lobby.

116 a Currently the baby is laughing while his mother tickles him.

116 g Currently the baby laughing while his mother tickles him.

116 m Lately the baby is laughing while his mother tickles him.

117 a Now the plane is flying with more people than ever.

117 g Now the plane flying with more people than ever.

117 m Immediately the plane is flying with more people than ever.

118 a At this moment the birds are fighting over the bread we threw.

118 g At this moment the birds fighting over the bread we threw.

118 m Lately the birds are fighting over the bread we threw.

119 a Right now Tim is riding the largest horse on the farm.

119 g Right now Tim riding the largest horse on the farm.

119 m Immediately Tim is riding the largest horse on the farm.

120 a Currently the baby is sleeping so we must keep quiet.

120 g Currently the baby sleeping so we must keep quiet.

120 m Lately the baby is sleeping so we must keep quiet.

121 a Now Kim is dancing in the kitchen to her favorite song.

121 g Now Kim dancing in the kitchen to her favorite song.

121 m Immediately Kim is dancing in the kitchen to her favorite song.

122 a Now the dog is tearing apart the pillow from the old couch.

122 g Now the dog tearing apart the pillow from the old couch.

122 m Recently the dog is tearing apart the pillow from the old couch.

123 a At this moment Mary is singing the National Anthem at the baseball game.

123 g At this moment Mary singing the National Anthem at the baseball game.

123 m Recently Mary is singing the National Anthem at the baseball game.

124 a At this moment Joan is eating the biggest slice of pizza in the box.

124 g At this moment Joan eating the biggest slice of pizza in the box.

124 m Recently Joan is eating the biggest slice of pizza in the box.

125 a Now the child is screaming at his mother for more candy.

125 g Now the child screaming at his mother for more candy.

125 m Immediately the child is screaming at his mother for more candy.

126 a Presently Joe is climbing a tree to rescue his cat.

126 g Presently Joe climbing a tree to rescue his cat.

126 m Lately Joe is climbing a tree to rescue his cat.

127 a Currently she is baking cookies for her sister’s birthday.

127 g Currently she baking cookies for her sister’s birthday.

127 m Instantly she is baking cookies for her sister’s birthday.

128 a Now he is training for his second marathon in May.

128 g Now he training for his second marathon in May.

128 m Suddenly he is training for his second marathon in May.

129 a Now Jack's dog is playing in the garden backyard.

129 g Now Jack's dog playing in the garden backyard.

129 m In an instant Jack's dog is playing in the garden backyard.

130 a Currently Betty is crying as a result of the broken flower vase.

130 g Currently Betty is crying as a result of the broken flower vase.

130 m Recently Betty is crying as a result of the broken flower vase.

APPENDIX E

STIMULI FROM EXPERIMENT IB

Conditions are coded as follows:

g: grammatical

u: ungrammatical

Plural

201 g Surprisingly the boxes for the toy were found in the backyard.

201 u Surprisingly the box for the toy were found in the backyard.

202 g Neatly the illustrations in the manual were done by a well-known artist.

202 u Neatly the illustration in the manual were done by a well-known artist.

203 g Unfortunately the addresses on the envelope were not clear to the postman.

203 u Unfortunately the address on the envelope were not clear to the postman.

204 g Sadly the definitions in the dictionary were not helpful for understanding the word.

204 u Sadly the definition in the dictionary were not helpful for understanding the word.

205 g Recently the badges on the uniform were made by factories in China.

205 u Recently the badge on the uniform were made by factories in China.

206 g Interestingly the stories in the magazine were unknown to her for many years.

206 u Interestingly the story in the magazine were unknown to her for many years.

207 g Fortunately the drawings in the textbook were much better in this edition.

207 u Fortunately the drawing in the textbook were much better in this edition.

208 g Accidentally the doors to the office were left unlocked by the cleaning service.

208 u Accidentally the door to the office were left unlocked by the cleaning service.

209 g Luckily the memos from the accountant were about the delinquent tax return.

209 u Luckily the memo from the accountant were about the delinquent tax return.

210 g Regrettably the proposals by the committee were under consideration for a long time.

210 u Regrettably the proposal by the committee were under consideration for a long time.

211 g Surprisingly the bags for the purchase were left on the counter by the customer.

211 u Surprisingly the bag for the purchase were left on the counter by the customer.

212 g Remarkably the answers to the question were simpler than we had expected.

212 u Remarkably the answer to the question were simpler than we had expected.

213 g Obviously the reasons for the test were to make sure the effect was reliable.

213 u Obviously the reason for the test were to make sure the effect was reliable.

214 g Unbelievably the designs of the study were shown to be problematic in subsequent tests.

214 u Unbelievably the design of the study were shown to be problematic in subsequent tests.

215 g Yesterday the roads to the house were covered with water and mud.

215 u Yesterday the road to the house were covered with water and mud.

216 g Terribly the words on the screen were hard to be recognized.

216 u Terribly the word on the screen were hard to be recognized.

217 g Carefully the causes of the accident were under investigation by the local police.

217 u Carefully the cause of the accident were under investigation by the local police.

218 g Quickly the cooks for the family were hired through an employment agency.

218 u Quickly the cook for the family were hired through an employment agency.

Subcategorization

301 a Loudly the teacher introduced the speaker to everyone in the room.

301 b Loudly the teacher refused the speaker to everyone in the room.

301 c Rudely Susan refused to talk to her mother.

301 d Rudely Susan introduced to talk to her mother.

302 a Everybody in the office felt his hostility towards the new worker.

302 b Everybody in the office agreed his hostility towards the new worker.

302 c Fairly they all agreed the plan to be unwise under such circumstances.

302 d Fairly they all felt the plan to be unwise under such circumstances.

303 a Politely the mother asked her son not to hurt himself while cooking.

303 b Politely the mother played her son not to hurt himself while cooking.

303 c Cheerfully the children played at the new amusement park.

303 d Cheerfully the children asked at the new amusement park.

304 a Unexpectedly the lady bought herself a necklace in the mall.

304 b Unexpectedly the lady stopped herself a necklace in the mall.

304 c Suddenly the red car stopped in front of the junction.

304 d Suddenly the red car bought in front of the junction.

305 a Sensibly the editor wanted the paper to be further revised by the author.

305 b Sensibly the editor threw the paper to be further revised by the author.

305 c Surprisingly the kid threw the new book out of the room.

305 d Surprisingly the kid wanted the new book out of the room.

306 a Amazingly the company named Susan the employee of the year this morning.

306 b Amazingly the company decided Susan the employee of the year this morning.

306 c Without a clue Peter decided to travel to Mexico later this year.

306 d Without a clue Peter named to travel to Mexico later this year.

307 a Certainly your boss expected you to be there as early as possible.

307 b Certainly your boss cried you to be there as early as possible.

307 c Understandably the hungry baby cried for a long period of time.

307 d Understandably the hungry baby expected for a long period of time.

308 a Reasonably the advisor asked him to talk to his colleagues about it.

308 b Reasonably the advisor repaired him to talk to his colleagues about it.

308 c Quickly the car dealer repaired the bumper of the truck.

308 d Quickly the car dealer asked the bumper of the truck.

309 a Wisely the police allowed the couple to leave the scene.

309 b Wisely the police worked the couple to leave the scene.

309 c Diligently the chef worked from morning till evening for the wedding banquet.

309 d Diligently the chef allowed from morning till evening for the wedding banquet.

310 a Thoughtfully my boss asked me to take a long vacation.

310 b Thoughtfully my boss opened me to take a long vacation.

310 c Curiously the kid opened the box to check out the food inside.

310 d Curiously the kid asked the box to check out the food inside.

311 a Cautiously the security guard checked everyone at the hotel lobby.

311 b Cautiously the security guard said everyone at the hotel lobby.

311 c Suddenly our teacher said that school is cancelled next week.

311 d Suddenly our teacher checked that school is cancelled next week.

312 a Miserably they kept themselves too busy throughout the lovely summer.

312 b Miserably they punished themselves too busy throughout the lovely summer.

312 c Understandably the parents punished their children for being naughty.

312 d Understandably the parents kept their children for being naughty.

APPENDIX F

STIMULI FROM EXPERIMENT II

Conditions are coded as follows:

s: State

a: Activity

p: Achievement

PAST

1 s He knew the innocent child in the playground.

1 a He helped the innocent child in the playground.

1 p He killed the innocent child in the playground.

2 s The teacher hated the naughty boy from a local school.

2 a The teacher taught the naughty boy from a local school.

2 p The teacher punished the naughty boy from a local school.

3 s Susan loved the red guitar at the musical fair.

3 a Susan played the red guitar at the musical fair.

3 p Susan sold the red guitar at the musical fair.

4 s Henry liked the children in front of the school building.

4 a Henry taught the children in front of the school building.

4 p Henry found the children in front of the school building.

5 s She needed the bike while going up the hill.

5 a She pushed the bike while going up the hill.

5 p She escaped the bike while going up the hill.

6 s Joe liked the hot coffee and burned his tongue.

6 a Joe enjoyed the hot coffee and burned his tongue.

6 p Joe touched the hot coffee and burned his tongue.

7 s She remembered some huge carrots in her vegetable garden.

7 a She grew some huge carrots in her vegetable garden.

7 p She forgot some huge carrots in her vegetable garden.

8 s Steve needed two more language classes before he travelled abroad.

8 a Steve considered two more language classes before he travelled abroad.

8 p Steve took two more language classes before he travelled abroad.

9 s They disliked the woman at the karaoke bar around the corner.

9 a They recorded the woman at the karaoke bar around the corner.

9 p They met the woman at the karaoke bar around the corner.

10 s The new couple preferred their honeymoon in New Zealand.

10 a The new couple enjoyed their honeymoon in New Zealand.

10 p The new couple spent their honeymoon in New Zealand.

11 s He remembered his teacher from karate class.

11 a He fought his teacher from karate class.

11 p He kicked his teacher from karate class.

12 s David hated the brown dog in his neighborhood.

12 a David walked the brown dog in his neighborhood.

12 p David found the brown dog in his neighborhood.

13 s My sister loved the chocolate cookies last Christmas.

13 a My sister burned the chocolate cookies last Christmas.

13 p My sister sold the chocolate cookies last Christmas.

14 s Mary wanted some cookies when she was working at the bakery.

14 a Mary burned some cookies when she was working at the bakery.

14 p Mary took some cookies when she was working at the bakery.

15 s Bob wanted three gold medals at the Olympic Games.

15 a Bob shook three gold medals at the Olympic Games.

15 p Bob won three gold medals at the Olympic Games.

16 s Karen had five kittens in her house.

16 a Karen trained five kittens in her house.

16 p Karen locked five kittens in her house.

17 s Peter owned the white tent used for the wedding.

17 a Peter shook the white tent used for the wedding.

17 p Peter found the white tent used for the wedding.

18 s Sam liked big screen televisions in the shopping mall.

18 a Sam repaired big screen televisions in the shopping mall.

18 p Sam won big screen televisions in the shopping mall.

19 s He hated the yellow car in the parking lot.

19 a He shook the yellow car in the parking lot.

19 p He lost the yellow car in the parking lot.

20 s The teacher believed Lynn about her studies.

20 a The teacher encouraged Lynn about her studies.

20 p The teacher questioned Lynn about her studies.

21 s The little girl wanted colorful hats on her birthday party.

21 a The little girl knitted colorful hats on her birthday party.

21 p The little girl threw colorful hats on her birthday party.

22 s He agreed at the airport to learn to fly planes.

22 a He trained at the airport to learn to fly planes.

22 p He arrived at the airport to learn to fly planes.

23 s Chris preferred the expensive pair of shoes at the store.

23 a Chris considered the expensive pair of shoes at the store.

23 p Chris left the expensive pair of shoes at the store.

24 s Tom understood travel books written by a famous author.

24 a Tom read travel books written by a famous author.

24 p Tom stole travel books written by a famous author.

PROG

101 s The mayor is living the vibrant city life of New York City.

101 a The mayor is learning the vibrant city life of New York City.

101 p The mayor is selling the vibrant city life of New York City.

102 s Tom is disliking his sister Mary's birthday present.

102 a Tom is considering his sister Mary's birthday present.

102 p Tom is finding his sister Mary's birthday present.

103 s She is expecting Tony to study abroad during the summer.

103 a She is helping Tony to study abroad during the summer.

103 p She is sending Tony to study abroad during the summer.

104 s Peter is wanting a French novel at Christmas.

104 a Peter is reading a French novel at Christmas.

104 p Peter is finding a French novel at Christmas.

105 s Susan is disliking the fruit salad at the fast food restaurant.

105 a Susan is considering the fruit salad at the fast food restaurant.

105 p Susan is ordering the fruit salad at the fast food restaurant.

106 s Amy is expecting her travel agent to find a cheaper ticket.

106 a Amy is helping her travel agent to find a cheaper ticket.

106 p Amy is calling her travel agent to find a cheaper ticket.

107 s Daniel is understanding the details to publish a book.

107 a Daniel is reading the details to publish a book.

107 p Daniel is agreeing the details to publish a book.

108 s Eric is wanting the German book in the library.

108 a Eric is reading the German book in the library.

108 p Eric is forgetting the German book in the library.

109 s Sarah is expecting her dog to get in the car.

109 a Sarah is helping her dog to get in the car.

109 p Sarah is calling her dog to get in the car.

110 s Jack is loving the abstract painting for the art exhibition.

110 a Jack is considering the abstract painting for the art exhibition.

110 p Jack is finishing the abstract painting for the art exhibition.

111 s My brother is hoping to win the marathon on Saturday.

111 a My brother is training to win the marathon on Saturday.

111 p My brother is beginning to win the marathon on Saturday.

112 s Ben is believing what the book said about cell biology.

112 a Ben is reading what the book said about cell biology.

112 p Ben is forgetting what the book said about cell biology.

113 s George is disliking the business plan for a new salon.

113 a George is considering the business plan for a new salon.

113 p George is finding the business plan for a new salon.

114 s He is expecting Sally to move her belongings from the kitchen.

114 a He is helping Sally to move her belongings from the kitchen.

114 p He is calling Sally to move her belongings from the kitchen.

115 s The authority is worrying whether there are too many cars on the highway.

115 a The authority is commenting whether there are too many cars on the highway.

115 p The authority is asking whether there are too many cars on the highway.

116 s My brother is believing the material about aliens landing on Earth.

116 a My brother is reading the material about aliens landing on Earth.

116 p My brother is forgetting the material about aliens landing on Earth.

117 s Jessica is living up the hill near the church.

117 a Jessica is walking up the hill near the church.

117 p Jessica is going up the hill near the church.

118 s The children are living with their cousins from Chicago.

118 a The children are playing with their cousins from Chicago.

118 p The children are going with their cousins from Chicago.

119 s Mike is disliking dog food for his new puppy.

119 a Mike is considering dog food for his new puppy.

119 p Mike is ordering dog food for his new puppy.

120 s He is living with the ambassador of Italy.

120 a He is speaking with the ambassador of Italy.

120 p He is departing with the ambassador of Italy.

121 s She is feeling that she could make a useful contribution.

121 a She is considering that she could make a useful contribution.

121 p She is saying that she could make a useful contribution.

122 s My cousin is hoping for first place in the marathon.

122 a My cousin is training for first place in the marathon.

122 p My cousin is reaching for first place in the marathon.

123 s The child is preferring the original version of Cinderella from the library.

123 a The child is reading the original version of Cinderella from the library.

123 p The child is finding the original version of Cinderella from the library.

124 s David is expecting a question about the universe.

124 a David is enjoying a question about the universe.

124 p David is asking a question about the universe.

APPENDIX G

STIMULI FROM EXPERIMENT III

Conditions are coded as follows:

A: SIMPLE punctual — Baseline (Unitary)

B: SIMPLE durative — Adverbial Coercion

C: PROG punctual — Grammatical Coercion

D: PROG durative — Baseline

1 A At noon the kid jumped into the swimming pool.

1 B All day the kid jumped into the swimming pool.

1 C At noon the kid was jumping into the swimming pool.

1 D All day the kid was jumping into the swimming pool.

2 A Yesterday the teacher sneezed in front of the classroom.

2 B For an hour the teacher sneezed in front of the classroom.

2 C Yesterday the teacher was sneezing in front of the classroom.

2 D For an hour the teacher was sneezing in front of the classroom.

3 A At five o'clock Joe coughed in the opera theatre.

3 B All afternoon Joe coughed in the opera theatre.

3 C At five o'clock Joe was coughing in the opera theatre.

3 D All afternoon Joe was coughing in the opera theatre.

4 A Two hours ago David kicked a football in the playground.

4 B All day long David kicked a football in the playground.

4 C Two hours ago David was kicking a football in the playground.

4 D All day long David was kicking a football in the playground.

5 A Right after breakfast the child licked the peanut butter on the knife.

5 B The whole morning the child licked the peanut butter on the knife.

5 C Right after breakfast the child was licking the peanut butter on the knife.

5 D The whole morning the child was licking the peanut butter on the knife.

6 A At Christmas the black cat hopped down from the red sofa.

6 B For an hour the black cat hopped down from the red sofa.

6 C At Christmas the black cat was hopping down from the red sofa.

6 D For an hour the cat was hopping down from the red sofa.

7 A Instantly Susan opened my letters without asking me.

7 B For a long time Susan opened my letters without asking me.

7 C Instantly Susan was opening my letters without asking me.

7 D For a long time Susan was opening my letters without asking me.

8 A Last night the corn popped violently in the microwave.

8 B For five minutes the corn popped violently in the microwave.

8 C Last night the corn was popping violently in the microwave.

8 D For five minutes the corn was popping violently in the microwave.

9 A After an hour the students nodded to show their attentiveness.

9 B During the lecture the students nodded to show their attentiveness.

9 C After an hour the students were nodding to show their attentiveness.

9 D During the lecture the students were nodding to show their attentiveness.

10 A Yesterday midnight the guard yawned in the empty science museum.

10 B All night long the guard yawned in the empty science museum.

10 C Yesterday midnight the guard was yawning in the empty science museum.

10 D All night long the guard was yawning in the empty science museum.

11 A Last week the audience hissed loudly at the poor singer.

11 B Throughout the concert the audience hissed loudly at the poor singer.

11 C Last week the audience was hissing loudly at the poor singer.

11 D Throughout the concert the audience was hissing loudly at the poor singer.

12 A At noon the angry boss slapped the secretary in the office.

12 B During lunch the angry boss slapped the secretary in the office.

12 C At noon the angry boss was slapping the secretary in the office.

12 D During lunch the angry boss was slapping the secretary in the office.

13 A At dinner John hiccupped noisily and was forced to go home.

13 B During class John hiccupped noisily and was forced to go home.

13 C At dinner John was hiccupping noisily and was forced to go home.

13 D During class John was hiccupping noisily and was forced to go home.

14 A Yesterday midnight a light flashed at the top of the mountain.

14 B For several hours a light flashed at the top of the mountain.

14 C Yesterday midnight a light was flashing at the top of the mountain.

14 D For several hours a light was flashing at the top of the mountain.

15 A Last night the children hit the dog with a baseball bat.

15 B All afternoon the children hit the dog with a baseball bat.

15 C Last night the children were hitting the dog with a baseball bat.

15 D All afternoon the children were hitting the dog with a baseball bat.

16 A At noon the naughty boy kicked his father in the carpark.

16 B All morning the naughty boy kicked his father in the carpark.

16 C At noon the naughty boy was kicking his father in the carpark.

16 D All morning the naughty boy was kicking his father in the carpark.

17 A At noon the baby knocked on the kitchen door loudly.

17 B For ten minutes the baby knocked on the kitchen door loudly.

17 C At noon the baby was knocking on the kitchen door loudly.

17 D For ten minutes the baby was knocking on the kitchen door loudly.

18 A Yesterday the girl dove into the pool to overcome her fear of water.

18 B For two years the girl dove into the pool to overcome her fear of water.

18 C Yesterday the girl was diving into the pool to overcome her fear of water. .

18 D For two years the girl was diving into the pool to overcome her fear of water.

19 A Two days ago the old woman sneezed in the park with her shivering dog.

19 B For an hour the old woman sneezed in the park with her shivering dog.

19 C Two days ago the old woman was sneezing in the park with her shivering dog.

19 D For an hour the old woman was sneezing in the park with her shivering dog.

20 A Yesterday at four my uncle coughed heavily in the living room.

20 B For the whole evening my uncle coughed heavily in the living room.

20 C Yesterday at four my uncle was coughing heavily in the living room.

20 D For the whole evening my uncle was coughing heavily in the living room.

21 A Last night the audience yawned because of the boring movie.

21 B For two hours the audience yawned because of the boring movie.

21 C Last night the audience was yawning because of the boring movie.

21 D For two hours the audience was yawning because of the boring movie.

22 A At noon the clown jumped happily in front of the crowd.

22 B The whole day the clown jumped happily in front of the crowd..

22 C At noon the clown was jumping happily in front of the crowd.

22 D The whole day the clown was jumping happily in front of the crowd.

23 A At two o'clock the boy hit his friend in the heavy rain.

23 B All day long the boy hit his friend in the heavy rain.

23 C At two o'clock the boy was hitting his friend in the heavy rain.

23 D All day long the boy was hitting his friend in the heavy rain.

24 A After two minutes the insect hopped to the other end of the grass.

24 B All morning the insect hopped to the other end of the grass.

24 C After two minutes the insect was hopping to the other end of the grass.

24 D All morning the insect was hopping to the other end of the grass.

APPENDIX H

Table 20. Summary of three-way mixed-design ANCOVA for Experiment II

	Sources of Variation	*SS*	*df*	*MS*	*F*	*p*
Verb	BETWEEN SUBJECTS					
	Language	.117	3	.039	6.358	**.001**
	Error	.491	80	.006		
	WITHIN SUBJECTS					
	TA	.011	1	.011	4.543	**.036**
	TA × Language	.002	3	.001	.293	.83
	Error	.196	80	.002		
	Lexical aspect	.02	2	.01	4.504	**.013**
	Lexical aspect × Language	.029	6	.005	2.201	**.046**
	Error	.357	160	.002		
	TA × Lexical aspect	.011	2	.005	2.432	.091
	TA × Lexical aspect × Language	.013	6	.002	.983	.439
	Error	.358	160	.002		
V+1	BETWEEN SUBJECTS					
	Language	.049	3	.016	3.564	**.018**
	Error	.368	80	.005		
	WITHIN SUBJECTS					
	TA	.003	1	.003	1.653	.202
	TA × Language	.005	3	.002	1.127	.343
	Error	.128	80	.002		
	Lexical aspect	.009	2	.005	1.865	.158
	Lexical aspect × Language	.019	6	.003	1.272	.273
	Error	.395	160	.002		
	TA × Lexical aspect	.029	2	.015	7.566	**.001**
	TA × Lexical aspect × Language	.018	6	.003	1.504	.18
	Error	.31	160	.002		
V+2	BETWEEN SUBJECTS					
	Language	.034	3	.011	2.588	.059
	Error	.347	80	.004		
	WITHIN SUBJECTS					
	TA	.002	1	.002	.93	.338
	TA × Language	.009	3	.003	1.58	.201

	Error	.151	80	.002		
	Lexical aspect	.004	2	.002	.885	.415
	Lexical aspect × Language	.041	6	.007	2.939	**.01**
	Error	.373	160	.002		
	TA × Lexical aspect	.01	2	.005	1.939	.147
	TA × Lexical aspect × Language	.007	6	.001	.433	.856
	Error	.41	160	.003		
SF	BETWEEN SUBJECTS					
	Language	.475	3	.158	5.728	**.001**
	Error	2.212	80	.028		
	WITHIN SUBJECTS					
	TA	.002	1	.002	1.074	.303
	TA × Language	.002	3	.001	.372	.773
	Error	.166	80	.002		
	Lexical aspect	.01	2	.005	1.61	.203
	Lexical aspect × Language	.015	6	.002	.784	.583
	Error	.5	160	.003		
	TA × Lexical aspect	.03	1.801	.017	3.726	**.031**
	TA × Lexical aspect × Language	.024	5.403	.004	.976	.438
	Error	.654	144.071	.005		

(Significant *p*-values highlighted in bold, $\alpha = 0.05$)

APPENDIX I

Table 21. Separate two-way mixed-design ANCOVA for Experiment II

		Sources of Variation	*SS*	*df*	*MS*	*F*	*p*
PAST	Verb	BETWEEN SUBJECTS					
		Language	.068	3	.023	5.341	**.002**
		Error	.338	80	.004		
		WITHIN SUBJECTS					
		Lexical aspect	.028	2	.014	7.66	**.001**
		Lexical aspect × Language	.031	6	.005	2.818	**.012**
		Error	.292	160	.002		
	V+1	BETWEEN SUBJECTS					
		Language	.032	3	.011	3.478	**.02**
		Error	.247	80	.003		
		WITHIN SUBJECTS					
		Lexical aspect	.003	2	.002	.785	.458
		Lexical aspect × Language	.011	6	.002	.907	.491
		Error	.317	160	.002		
	V+2	BETWEEN SUBJECTS					
		Language	.01	3	.003	1.037	.381
		Error	.253	80	.003		
		WITHIN SUBJECTS					
		Lexical aspect	.003	2	.001	.596	.552
		Lexical aspect × Language	.028	6	.005	2.162	.049
		Error	.347	160	.002		
	SF	BETWEEN SUBJECTS					
		Language	.239	3	.08	5.203	**.002**
		Error	1.223	80	.015		
		WITHIN SUBJECTS					
		Lexical aspect	.024	2	.012	3.159	**.**045
		Lexical aspect × Language	.032	6	.005	1.391	.221
		Error	.608	160	.004		
PROG	Verb	BETWEEN SUBJECTS					
		Language	.052	3	.017	3.939	**.011**
		Error	.35	80	.004		
		WITHIN SUBJECTS					
		Lexical aspect	.003	2	.002	.581	.561
		Lexical aspect × Language	.012	6	.002	.747	.613
		Error	.424	160	.003		

V+1	BETWEEN SUBJECTS					
	Language	.022	3	.007	2.398	.074
	Error	.249	80	.003		
	WITHIN SUBJECTS					
	Lexical aspect	.035	2	.018	7.294	**.001**
	Lexical aspect × Language	.026	6	.004	1.755	.112
	Error	.389	160	.002		
V+2	BETWEEN SUBJECTS					
	Language	.033	3	.011	3.569	**.018**
	Error	.245	80	.003		
	WITHIN SUBJECTS					
	Lexical aspect	.011	2	.006	2.107	.125
	Lexical aspect × Language	.02	6	.003	1.201	.309
	Error	.436	160	.003		
SF	BETWEEN SUBJECTS					
	Language	.239	3	.08	5.515	**.002**
	Error	1.155	80	.014		
	WITHIN SUBJECTS					
	Lexical aspect	.017	2	.008	2.42	.092
	Lexical aspect × Language	.007	6	.001	.339	.915
	Error	.546	160	.003		

(Significant *p*-values highlighted in bold, $\alpha = 0.025$)

APPENDIX J

Table 22. Summary of three-way mixed-design ANCOVA for Experiment III

	Sources of Variation	*SS*	*df*	*MS*	*F*	*p*
Verb	BETWEEN SUBJECTS					
	Proficiency	.024	1	.024	4.418	**.039**
	Language	.023	3	.008	1.412	.245
	Error	.439	80	.005		
	WITHIN SUBJECTS					
	Adverbial	.022	1	.022	3.757	.056
	Adverbial × Language	.01	3	.003	.578	.631
	Error	.471	80	.006		
	Aspect	.049	1	.049	7.265	**.009**
	Aspect × Language	.023	3	.008	1.128	.343
	Error	.541	80	.007		
	Adverbial × Aspect	.026	1	.026	5.773	**.019**
	Adverbial × Aspect × Language	.011	3	.004	.843	.474
	Error	.294	80	.004		
V+1	BETWEEN SUBJECTS					
	Proficiency	.000	1	.000	.076	.783
	Language	.101	3	.034	5.456	**.002**
	Error	.492	80	.006		
	WITHIN SUBJECTS					
	Adverbial	.007	1	.007	1.605	.209
	Adverbial × Language	.013	3	.004	1.025	.386
	Error	.333	80	.004		
	Aspect	.001	1	.001	.119	.731
	Aspect × Language	.007	3	.002	.497	.685
	Error	.384	80	.005		
	Adverbial × Aspect	.029	1	.029	5.036	**.028**
	Adverbial × Aspect × Language	.008	3	.003	.454	.715
	Error	.461	80	.006		
V+2	BETWEEN SUBJECTS					
	Proficiency	.004	1	.004	.786	.378
	Language	.014	3	.005	1.025	.386
	Error	.372	80	.005		
	WITHIN SUBJECTS					
	Adverbial	.003	1	.003	.923	.34
	Adverbial × Language	.025	3	.008	2.206	.094
	Error	.297	80	.004		

	Aspect	.004	1	.004	.848	.36
	Aspect × Language	.013	3	.004	1.016	.39
	Error	.334	80	.004		
	Adverbial × Aspect	.048	1	.048	11.736	**.001**
	Adverbial × Aspect × Language	.04	3	.013	3.251	**.026**
	Error	.33	80	.004		
SF	BETWEEN SUBJECTS					
	Proficiency	.088	1	.088	3.611	.061
	Language	.522	3	.174	7.122	**.000**
	Error	1.955	80	.024		
	WITHIN SUBJECTS					
	Adverbial	.001	1	.001	.155	.695
	Adverbial × Language	.001	3	.000	.079	.971
	Error	.505	80	.006		
	Aspect	.01	1	.01	1.207	.275
	Aspect × Language	.009	3	.003	.359	.783
	Error	.69	80	.009		
	Adverbial × Aspect	.000	1	.000	.043	.837
	Adverbial × Aspect × Language	.015	3	.005	.626	.6
	Error	.654	80	.008		

Note. Significant *p*-values highlighted in bold, $\alpha = 0.05$. Adjustments based on proficiency mean = 81.61.

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