Acquiring the Semantics of Aspectual *-ing* in L2: Evidence from Production and Processing

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1. Introduction

The present study addresses the questions of how to understand the underlying processes in the second language (L2) acquisition of tense-aspect systems by adult learners of English. The study focuses on the recent acknowledgment of the role of real-time processing in providing information about the interlanguage grammar (Dekydtspotter & Renaud, 2014; Slabakova, 2013). This study attempts to extend our understanding of how L2 learners acquire form-function and function-form mappings of the English progressive, by considering production and processing together.

1.1. Background of the study

The aspectual interpretation of a sentence involves processes guided by the conceptualization of the aspectual morphology and by the other elements, such as the verb and its object combinations (Dowty, 1991; Jackendoff, 1996). A body of research within the generative paradigm has examined the degree to which the aspectual semantics of the target language grammar are acquired, using various comprehension or interpretation tasks (Gabriele, 2005, 2009; Montrul & Slabakova, 2002, 2003; Slabakova, 2003; Slabakova & Montrul, 2002). With regard to the acquisition of functional categories, Montrul and Slabakova (2002) and Slabakova and Montrul (2002) examine the acquisition of the morpho-syntactic properties and the semantics of viewpoint aspect, focusing on the interpretation of the Spanish preterite-imperfect contrast by learners with English as a first language (L1). Their research demonstrates that advanced L2 learners of Spanish can acquire the target-like semantics of aspectual tense morphemes, arguing that semantic knowledge is governed by Universal Grammar (UG).

A recent body of research on telicity computation argues that L2 English learners can successfully calculate the telic feature even when the learners' L1 system does not have the equivalent morphosyntactic cues (Gabriele, 2008, Kaku, Liceras, & Kazanina, 2008). Gabriele (2008) shows that Japanese learners of L2 English at advanced levels can distinguish whether or not a verb phrase can encode telicity by means of overt morphosyntax, suggesting that the telicity assigning mechanism is acquirable in L2 English.

In production, L2 learners' expression of aspect in the perfective/imperfective dimension exhibits clear developmental patterns. The early form-meaning association of the imperfective/progressive with atelic predicates and the perfective with telic predicates is robustly documented under the aspect hypothesis (Andersen & Shirai, 1994). Studies of interlanguage narratives further demonstrate that the distribution of L2 tense-aspect morphology interacts with discourse structure (foreground and background) (Bardovi-Harlig, 1995, 1998).

One of the unresolved questions in L2 tense-aspect research is how exactly learners map aspectual morphology with target-like semantics and apply such knowledge to produce sentences in discourse. This study examines the underlying mechanisms of form-function identification of progressive morphology from both a processing and a production perspective. The study assumes a crucial role of the parser in establishing the semantic values of morphemes (Dekydtspotter, 2013; Slabakova, 2013).

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1.2. The acquisition of aspectual semantics of -ing

Acquiring the semantics of aspectual morphology in L2 involves multiple steps. L2 learners must identify the range of semantic values for the morphology in the target-language input, before they select the specific value (Slabakova, 2001, 2008). Specifically, the acquisition of progressive morphology requires identifying the range of possible imperfective values and eventually selecting the progressive value.

The semantics of aspectual *-ing* have been analyzed as specifying an operator PROG, which turns sentences into stative sentences (de Swart, 1998; Dowty, 1979; Moens & Steedman, 1988; Vlach, 1981). Events can be decomposed into subparts or can be assembled into more complex events with the notion of an *event nucleus* (Kamp & Reyle, 1993; Moens & Steedman, 1998) as in Figure 1. The progressive characterizes subparts of events which exclude the culmination.

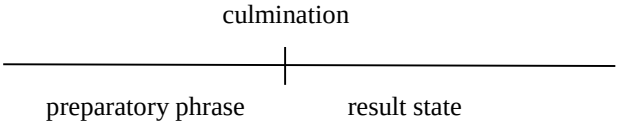

Figure 1. A schematic picture of the event nucleus in English

Based on the event nucleus, Moens and Steedman (1988) examine aspectual transitions in explaining various aspectual operations. According to Moens and Steedman, the aspectual transitions of the progressive associated with *culminated processes* entail two-step transitions: the shift from *culminated processes* to *processes* ([–culmination]) is the first transition, and the shift from *processes* to *progressive states* follows, with the [in-progress] transition (see Figure 2 in Moens & Steedman, 1988, p. 18).

More specifically, regarding *processes* in the event schema (Moens & Steedman, 1988), PROG maps *processes* to their *progressive states*; thus, a single aspectual transition is required as in the following diagram:

(1) Jessie was baking.
[$_{\text{Aspect}}$ PROG [$_{\text{VP}}$ Activity]] $_{\text{state}}$

(*process*: *Jessie bake*)

↓ Transition [in-progress]

(*progressive state* (*process*: *Jessie bake*))

Regarding *culminated processes* in the event schema, PROG maps *culminated processes* to their *progressive states* in two aspectual transitions represented in the following diagram:

(2) Jessie was baking a cake.
[$_{\text{Aspect}}$ PROG [$_{\text{VP}}$ Accomplishment]] $_{\text{state}}$

(*culminated process*: *Jessie bake a cake*))

↓ Transition [–culmination]

(*process* (*culminated process*: *Jessie bake a cake*))

↓ Transition [in-progress]

(*progressive state* (*process* (*culminated process*: *Jessie bake a cake*)))

2. The Study

2.1. Research question and hypotheses

This study addresses the following research question: "How do L2 English learners map aspectual *-ing* onto the semantics and apply such knowledge to produce a sentence in discourse?" This study particularly compares the association of *-ing* with activities and accomplishments in processing and production by L2 English learners.

I formulated two hypotheses of how learners identify the semantics of *-ing* in the course of processing as follows: In Hypothesis 1 (Predicate-Based Feature Specifications Hypothesis), learners' identification of *-ing* would be guided by salient characteristics of L2 input, in which *-ing* is associated with [+homogeneous, +dynamic] VPs (based on Shirai & Andersen, 1995). According to this hypothesis, learners would first identify *-ing* as characterizing events as *processes* ([+homogeneous, +dynamic]).

In Hypothesis 2 (Transition-Based Operator Selection Hypothesis), learners' identification of *-ing* in processing would be guided by the range of aspectual transitions for the imperfective viewpoint (based on Moens & Steedman, 1988). According to Hypothesis 2, the value of *-ing* would be built from the aspectual transitions that are required by each aspectual operation. The most relevant aspectual operator would be selected from imperfective values based on the type of required transitions.

2.2. Participants

Matriculated international students whose native language is not English were recruited from a U.S. university. Fifty four learners from a Chinese or Korean L1 background at intermediate levels of L2 English participated. They were divided into two proficiency groups of 27 learners each, on the basis of the results of cloze-test scores (Brown, 1980). The mean test score of all 54 learners was 18.05 (SD = 6.42), dividing them into a higher proficiency group (labeled as the High group) and a lower proficiency group (labeled as the Low group). According to a paired samples t-test, these two groups differed significantly from each other, $t(26) = 13.06$, $p < .001$. Eighteen native speakers of English also participated in the study as a control group.

2.3. Judgment task

Along with production and processing tasks, participants performed a judgment task. Based on methodology created by Kim (2014), the Imperfectivity Judgment Task tested general knowledge of the imperfective-perfective distinction. Such knowledge needed to be examined first in order to establish a baseline for the processing investigation. The participants rated the plausibility of 20 sentences such as in (3) on a scale of 1 (very implausible) to 9 (very plausible).

(3) a. When they built the Golden Gate Bridge, they used the best materials. (PERF-PROCESS condition)
b. When they built the Golden Gate Bridge, they finally solved most of their traffic problems. (PERF-CONSEQ condition)
c. When they were building the Golden Gate Bridge, they used the best materials. (IMPF-PROCESS condition)
d. When they were building the Golden Gate Bridge, they finally solved most of their traffic problems. (IMPF-CONSEQ condition)

The main result was that all three groups judged the imperfective-consequence sentences (3d) as anomalous more often than the imperfective-process sentences (3c), as shown in Table 1. It appeared that the learner groups had a general imperfective-perfective distinction, which was necessary for further investigation of their processing behaviors.

Table 1. *Judgment Rating Scores by Condition*

Condition	Group Low	High	NS
PERF-PROCESS	5.9 (1.4)	6.5 (1.6)	8.0 (1.0)
PERF-CONSEQ	6.1 (1.5)	6.3 (1.6)	7.3 (0.9)
IMP-PROCESS	6.1 (1.6)	7.2 (1.7)	7.3 (1.1)
IMP-CONSEQ	4.7 (1.4)	4.4 (1.8)	4.4 (1.5)

Note. Standard deviations in parentheses.

2.4. Film retell task: Material, data collection and analysis

For production, a written film retell task was employed to examine how learners produce *-ing* with activities and accomplishments. Learners' narratives were elicited through *Alone and Hungry*, a seven-minute excerpt from the silent film *Modern Times* (Chaplin, 1936), which was used in previous L2 narrative studies (Bardovi-Harlig, 1995, 1998; Dietrich, Klein, & Noyau, 1995). After viewing the film excerpt twice, each learner wrote a film retell in 30 minutes.

Since narrative research has demonstrated that tense-aspect morphology is differentially distributed according to grounding (Andersen & Shirai, 1994; Bardovi-Harlig, 1995, 1998), the data were analyzed maintaining the distinction between the foreground and background.

2.5. Self-paced reading task: Materials, data collection and analysis

For processing, a word-by-word self-paced reading task was used to examine processing costs associated with the computation of progressive and simple past sentences in the context of [±telic] predicates. The processing task used garden-path sentences in a 2 x 2 design ([Morphology: *-ed* vs.*-ing*] x [Sentence Structure: garden-path vs. non garden-path]), yielding four experimental conditions (Table 2). Twenty experimental sentences were embedded in 40 fillers.

Table 2. *Sample Sentence Stimuli in the Self-Paced Reading Task*

Conditions	Regions 1	2	3	4	5	6	7	8	9	10	11
PERF-GP	When	he	baked	the	cake	*smelled*	so	very	good		
IMPF-GP	When	he	was	baking	the	cake	*smelled*	so	very	good	
PERF-NGP	When	he	baked	the	cake	it	*smelled*	so	very	good	
IMPF-NGP	When	he	was	baking	the	cake	it	*smelled*	so	very	good

It was predicted that the processing costs associated with garden-path recovery from the when-clause in the progressive (IMPF-GP condition) with the PROG value should be less than those in the simple past (PERF-GP condition); thus *smelled* in the IMPF-GP condition should be processed faster than *smelled* in the PERF-GP condition. Since *he was baking the cake* involves two aspectual shifts, which is more costly to compute than *he was baking*, the parser would not readily take *the cake* as the direct object of *baking* in the IMPF-GP condition.

The participants were instructed to read each sentence as quickly as possible on a computer screen. A judgment question followed each sentence, in order to ensure that they read the sentences carefully. The on-line experiment was controlled and recorded by the software package LINGER (Rohde, 2001). Reading times (RTs) for each region were recorded in milliseconds (ms) and analyzed in mixed model ANOVAs.

3. Results

Since the learners performed alike regardless of L1 background across tasks, the results are reported only by proficiency level (i.e., the Low group and the High group).

3.1. Film retell task

In foreground clauses, verbal predicates were marked predominantly in the simple past, regardless of proficiency levels. The distribution of simple past morphology *-ed* across activities (ACT) and accomplishments (ACC) did not differ by level either (Figure 2). On the contrary, in the background, the High group associated *-ing* more frequently with ACT (85%) than with ACC (71%) in the background. The Low group did not display such clear asymmetry (Figure 3). The High group used *-ing* with activity predicates more frequently than the Low group.

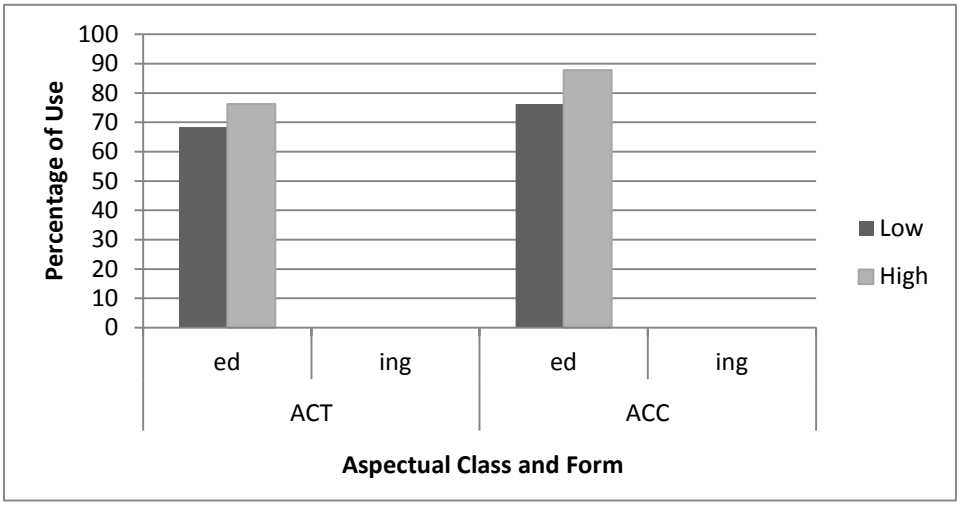

Figure 2. The distribution of *-ed*/*-ing* associated with ACT and ACC in foreground

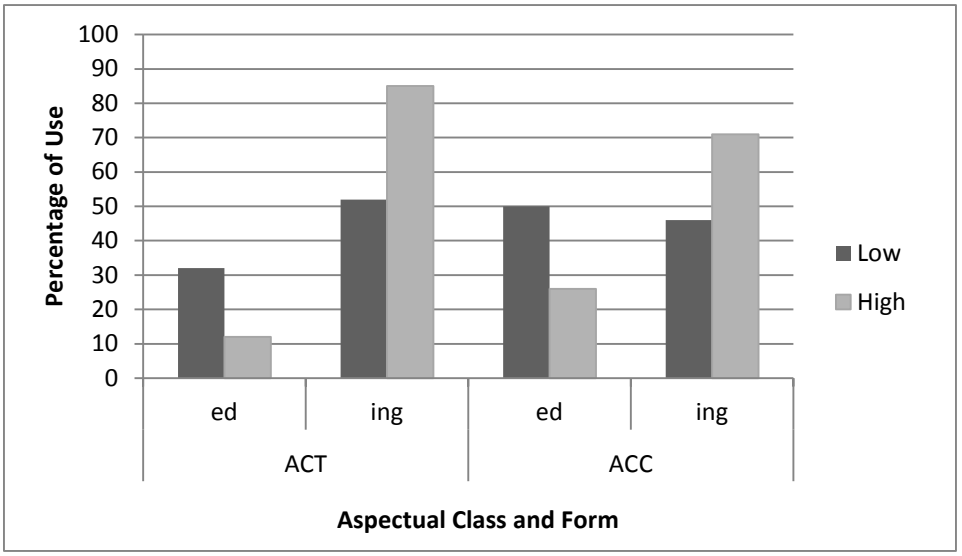

Figure 3. The distribution of *-ed*/*-ing* associated with ACT and ACC in background

3.2. Self-paced reading task

A mixed model ANOVA was performed on the RTs for the main clause verbs and revealed that the interaction among Morphology, Proficiency, and Sentence Structure was significant, $F(1, 604) = 16.165$, $p < .001$. The High group demonstrated significantly shorter RTs for the main clause verb with *-ing* in IMP-GP condition versus *-ed* in PERF-GP condition ($t(21) = 11.11$, $p = .001$), suggesting that their identification of the semantics of *-ing* favors [−telic] predicates (Figure 4). However, the Low group displayed the opposite pattern. Significantly longer RTs were observed for the main clause verb with *-ing* in IMP-GP condition versus *-ed* in PERF-GP condition ($t(21) = 21.35$, $p < .001$), suggesting their identification of the semantics of *-ing* favors [+telic] predicates (Figure 5).

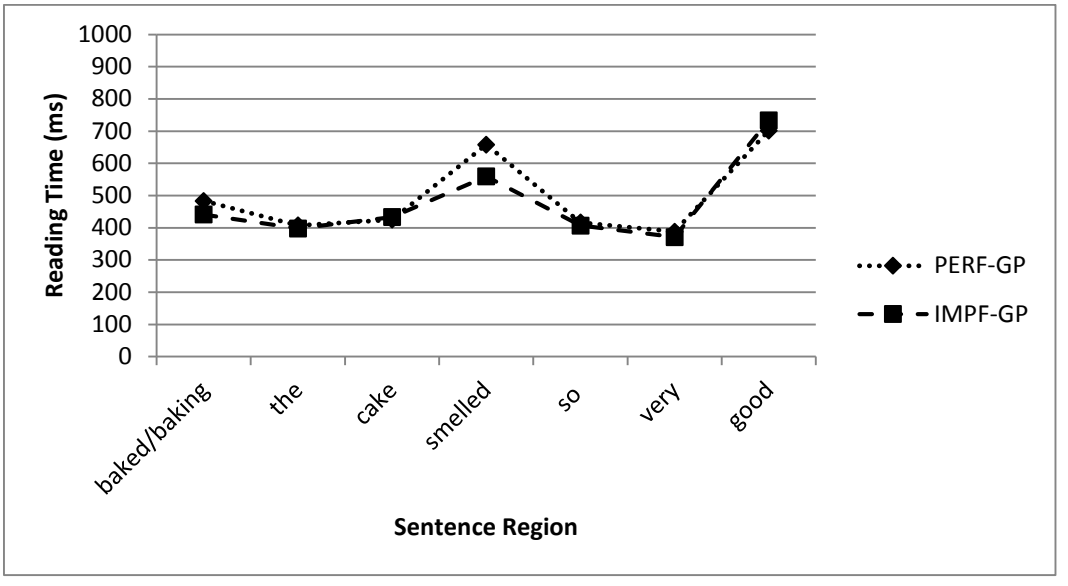

Figure 4. RT profiles for the High group

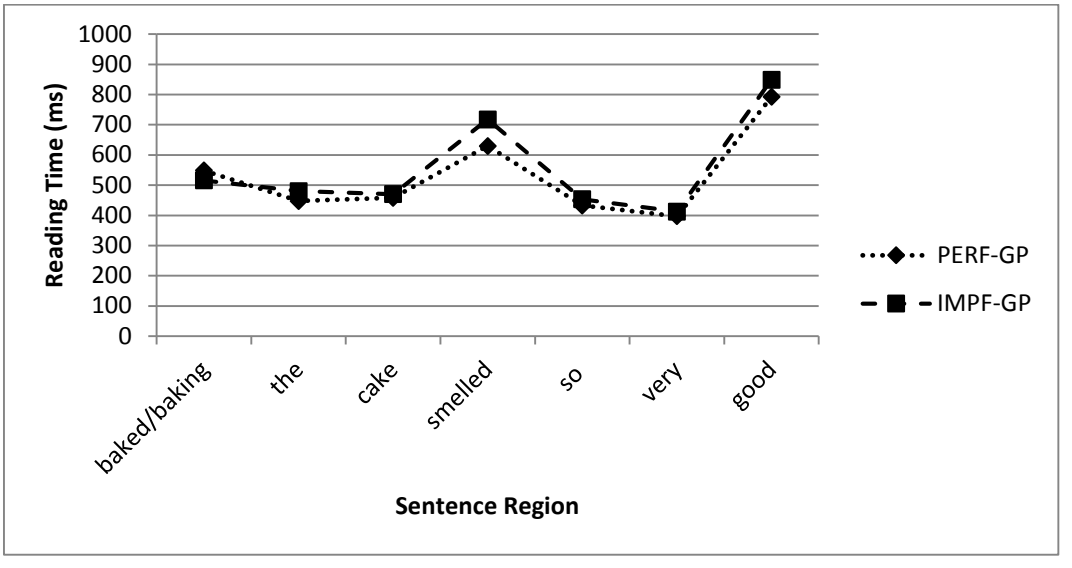

Figure 5. RT profiles for the Low group

4. Discussion

L2 learners' online processing of garden-path sentences suggests distinct semantic computations for *-ing* at different stages of acquisition. Under Hypothesis 1 (Predicate-Based Feature Specification Hypothesis), on the basis of [+homogeneous] imperfective semantics, it was predicted that the parser encountering *-ing* (e.g., *was baking*) would be led to prefer [−telic] VPs with no culmination to [+telic] VPs. The expected results were found in the High group. However, the Low group's semantics of *-ing* seemed to prefer [+telic] VPs with culmination, contrary to the predictions of Hypothesis 1.

Rather, the Low group's parsing behaviors are compatible with Hypothesis 2 (Transition-Based Operator Selection Hypothesis). That is, their processing behaviors are compatible with the single transition from *culminated processes* to *processes*, removing the culmination from an event. The relevant aspectual operator in this transition is the PROC operator, which shifts *events* to *processes* (de Swart, 1998; Vlach, 1981). Under Hypothesis 2, the most relevant aspectual operator to the required transition(s) would be selected; the value of *-ing* might be selected from operators such as PROG (which maps dynamic eventualities to *progressive states*) and PROC (if a *progressive state* target is not identified). PROC allows learners to avoid the costs of the multiple transitions inherent in *-ing*. The results suggest that the Low group learners could not compute all the aspectual transitions relevant to the semantics of *-ing* with their current grammar. Hypothesis 2, thus, offers a way to understand both groups in terms of how far L2 learners get in the steps of processing.

Furthermore, Hypothesis 2 provides new insights not only into L2 aspect processing mechanisms, but also into L2 aspect production mechanisms. The study found a strong link between production and processing for associating *-ing* with activities (denoting *processes*) in the High group. In processing, the High group's identification of the semantics of *-ing* favored [−telic] predicates. In production, the High group also favored *-ing* use associated with activities over accomplishments in backgrounded clauses. This converging evidence from production and processing seems to provide a reflex of target-like identification of PROG as an operator that shifts process sentences into stative sentences (Moens & Steedman, 1988; Vlach, 1981).

In contrast, the Low group's processing behaviors were found to be compatible with the single transition involving PROC, which removes the culmination from an event eventuality. It seems that the targetlike PROG operator has not yet been identified by these learners. In production, *-ing* was not robustly observed in this group and the association patterns of *-ing* with activities compared to accomplishments in the background were not so different. Yet again, the Low group's film retell results can be explained by aspectual transitions from *events* to *progressive states*. In production, the transition from *processes* to *progressive states* across the [±dynamic] dimension is probably the least necessary operation for them to achieve an imperfective point of view, which might be why *-ing* was not robustly observed in the Low group's retells.

5. Conclusion

This study compared production and processing systems in the domain of aspect acquisition, providing significant implications for L2 acquisition. This study argues that L2 processing and production of progressive morphology match across the board if aspectual transitions in the semantics of *-ing* are used as a basis of comparison (Hypothesis 2: Transition-Based Operator Selection Hypothesis). Whether or not the learners can compute the full transitions in the progressive is a key to understanding the mechanisms of form-function and function-form mappings of *-ing*. The findings indicate the identification processes for *-ing* values by the intermediate level learners; PROC first, and then PROG. The role of the parser is crucial in the identification processes, and Fodor's (1998) *Learning to Parse* account can be unified with accounts of L2 tense-aspect production systems. The role of aspectual transitions in the L2 acquisition of aspect remains to be thoroughly investigated in future research with different L1-L2 combinations or different types of sentence structures.

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