

# On the L2 Ultimate Attainment of Mandarin Additive and Distributive Operators by Cantonese Learners

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## 1. Introduction

Unlike the uniform and successful outcome of child acquirers in their acquisition of first language (L1), adult second language (L2) learners display variable outcomes, and more often than not end up with L2 competence that may be incomplete or divergent from the target language (Birdsong, 1992, 2004; Coppieters, 1987; Lardiere, 1998, 2007; Montrul, 2011). In other words, L2 learners are more likely to fail to represent or process the target grammar in a way similar to L1 learners. There have been active debates about whether such failures are attributed to difficulties in integrating knowledge at the interfaces. 'Interface' here refers to those domains of knowledge that involve interactions between different linguistic sub-modules or between language and other cognitive systems (Chomsky, 1995; White, 2011). The Interface Hypothesis as advanced by Sorace & Filiaci (2006) offers a refreshing direction of research into the end state grammar of very advanced, near-native L2 learners<sup>1</sup>. According to these authors, narrow syntactic properties of L2 may be ultimately acquired, whereas interface properties, especially those that lie between syntax and discourse or other cognitive modules, may not be amenable to full attainment. For the latter, the end state of L2 learners is more vulnerable to residual optionality (i.e., the co-existence of two or more variants of a given linguistic structure), instability and indeterminacy (Sorace & Filiaci, 2006). They cite a study on anaphora resolution in Italian especially, where they observe an asymmetry in terms of an overextension of use of overt pronouns to contexts requiring use of null subject pronouns.

Sorace (2011) summarizes two accounts for residual optionality. The representational account argues that possible underspecification of certain L2 linguistic structure in the learner's L1 may lead to cross-linguistic influence of the dominant language (Hopp, 2007). The second account is in terms of processing load, namely that integrating knowledge at interfaces causes computational difficulty, which may be reinforced by underspecification and cross-linguistic influence from the learner's L1 (Felser et al., 2003). Seen in this light, Sorace argues that integrating linguistic resources at the syntax and discourse interface in real time is bound to be costly. Under those circumstances, learners would resort to default strategies. The L2 learners in her studies use an overt subject as the default form to get round the problem of the inconsistency in mapping pronominal choices to satisfy pragmatic conditions. Sorace (2012) also suggests quantity and quality of input or continuous and active use of the target language to be factors influencing the properties of L2 ultimate attainment. Limited exposure to the target language or insufficient practice may reduce automaticity of linguistic processing, potentially affecting language performance at interfaces.

The Interface Hypothesis is not without challenge. Aside from the difficulty in delineating interface properties that are strictly constituted by two sub-modules but not others, empirical findings are still limited, especially in terms of the linguistic structures, language pairs, or bilingual populations being investigated (White, 2011). Counter-evidence has also been observed. For instance, Slabakova & Ivanov (2011) and Rothman (2008, 2009) find that very advanced or end state L2 speakers show native-like performance in their acquisition of external interface properties. Another study by Slabakova (2010) shows no real difficulty with L2 learners' acquisition of scalar implicatures, and their end state grammar

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<sup>1</sup> The Interface Hypothesis has been applied to account for simultaneous bilingual acquisition and L1 attrition. In this paper, we will focus on near native L2 ultimate attainment.

appears to be native-like. Slabakova (2006) reviews studies on L2 acquisition of phrasal/compositional semantics and argues that compositional semantics ‘comes for free’ and does not cause many difficulties for L2 learners. She therefore suggests there to be no critical period for phrasal semantic acquisition.

While most studies on L2 ultimate attainment at interfaces focus on late learners who are exposed to the L2 after puberty, there have been few studies that examine age of acquisition effects on early L2 learners. The Critical Period Hypothesis (Birdsong, 1999; Johnson & Newport, 1989; Lenneberg, 1967) supports a maturational constraint account for language development, suggesting that early L2 learners are more prone to achieving native-like competence than late L2 learners. In fact, literature also reports diverse critical periods for different linguistic domains. Therefore, it may lend support to the Interface Hypothesis as there may be no critical period effects with the acquisition of narrow syntax but possible effects with the acquisition of properties at interfaces, leading to a lack of convergence on native-like representations, and a higher degree of residual optionality and indeterminacy.

This paper aims to examine if very advanced L2 learners, despite early age of onset, demonstrate critical period effects in their acquisition of semantic-pragmatic interface properties. We also ask whether age of onset plays a role in determining levels of ultimate attainment. In this preliminary study, we conducted an experiment to examine the acquisition of two Mandarin semantic operators, YE and DOU, which exhibit properties relevant to the semantic-pragmatic interface. We will examine two groups of early learners. Both groups are Cantonese-speaking, but they differ in their onset of acquisition of Mandarin as an L2.

## 2. Linguistic descriptions of YE and DOU in Mandarin Chinese

According to the Alternative Semantics approach of Rooth (1992), the additive operator, being a kind of focus operator, associates with a focus and triggers a set of alternatives in the discourse. Krifka (1998) gives the semantic representation of the additive operator as follows:

$$[ADD_1[\dots F_1 \dots]]: [\dots F \dots](\exists F' \neq F[\dots F' \dots])$$

The alternatives can replace the focused constituent in the sentence, as is shown below:

JohnF ALSO attended the meeting.

The set of alternatives of John: Mary, Tom, Jack, Sue, etc.

In the example above, the additive operator ALSO in the sentence triggers a set of alternatives in interpretation, meaning someone besides John attended the meeting. The set of alternatives therefore serves as the domain of quantification of the operator.

In contrast, a distributive operator like EACH and EVERY makes the relevant verbal predicate P apply to all atomic members of the plural subject x, with the following semantic representation (Link, 1987):

$$DP(x) = \forall y[y \subseteq x \wedge ATOM(y) \rightarrow P(y)]$$

Therefore, the occurrence of a distributive operator implies that the verbal predicate is distributive instead of collective, as is shown in (1a) and (1b):

1. (a) John and Mary EACH got married.
- (b) John and Mary got married.

In (1a), the verbal predicate *getting married* is distributed atomically over John and Mary whereas this reading does not obtain in (1b). Also, different from the additive operator, the distributive operator does not trigger alternatives in the discourse, but requires a mass entity within the sentence to realize its distributive function. For example, the English distributive operator EACH always requires a noun phrase (NP) that involves a plural reading, as is shown in (2a) and (2b):

2. (a) These boys each ate an apple.  
 (b) \*The boy each ate an apple.

In Mandarin, there are several adverbs that play the role of additive operators, among which YE is the most common one (Hole, 2004; Liu, 2009). YE encodes a neutral additive meaning and emphasizes the meaning of similarity of two events. In (3a), two similar events *chi-le pingguo* ‘ate an apple’ are described, performed by two different agents, namely ‘John’ and ‘Mary’. In this sentence, YE scopes over the NP ‘Mary’ that precedes it. Alternatively, YE may scope over the verb phrase (VP) *he-le tang* ‘had some soup’ that follows it, as is shown in (3b).

3. (a) John *chi -le pinguo*, Mary YE *chi -le pinguo*.  
 John eat -asp apple Mary also eat -asp apple  
 “John ate an apple; Mary also ate an apple.”
- (b) John *chi -le pinguo*, YE *he -le tang*.  
 John eat -asp apple, also drink -asp soup  
 “John ate an apple, and had some soup as well.”

As in (3a), ‘John ate an apple’ becomes the presupposition for the statement ‘Mary also ate an apple’, when the focus falls on the noun phrase ‘Mary’. In (3b), ‘John ate an apple’ or ‘John did something other than having soup’ becomes the presupposition for the statement ‘John also had some soup’, and the predicate ‘have some soup’ is its focus.

The obligatory conditions of YE are determined by its discourse functions. Liu (2009) discusses the different obligatory conditions of YE and adopts a contrastive scalar implicature analysis to account for its obligatory conditions. In a coordinated structure like (3a) where the focus is the constituent that precedes YE (i.e., Mary), omitting the additive operator makes the sentence less well-formed, since the presupposition of the second clause will imply ‘no one else but Mary ate an apple’, which contradicts the first clause. Nevertheless, if the focus is the constituent that follows YE, such as *he-le tang* in (3b), omitting YE becomes more acceptable. When the shared subject is omitted, the second event is perceived as incremental by nature.

As for the distributive operator, Mandarin employs several quantificational adverbs, and according to some scholars (Lee, 1986; Lin, 1996; Lin & Landman, 1998; Lin, 2004; Liu, 1990) DOU is one of them<sup>2</sup>.

DOU requires a mass entity within the sentence to legitimate its distributive meaning. This entity can be expressed through plural NPs with a plural marker ‘-men’ (4a) or NPs with a universal quantifier such as *Suoyou* ‘all’ (4b) or *Mei* ‘every’ (4c). As such, DOU is incompatible with singular NPs (4d). According to Lin & Landman (1998), an NP with a universal quantifier requires it to be moved to the specifier position of a distributive phrase, and DOU must be present to project the distributive phrase. Therefore, omitting DOU in (4a) is more acceptable with the plural NP *tongxue-men* ‘students’, while in (4b) and (4c) with universal quantifiers *Suoyou* ‘all’ and *Mei* ‘every’, omitting DOU will make the sentence less acceptable.

4. (a) *Tongxue-men* DOU *mai -le yi -ben shu*.  
 Student -pl all buy -asp one -cl book  
 “Each of the students bought a book.”
- (b) *Suoyou ren* DOU *chi -le yi -ge pinguo*.  
 All person all eat -asp one -cl apple  
 “Everyone ate an apple.”

<sup>2</sup> Mandarin DOU also acts as a scalar focus marker in the LIANYE/DOU ‘even’ construction. Scholars are still debating about the generalized semantic analysis of DOU. It is alternatively analyzed as a sum operator (Huang, 1996), a universal quantifier (Cheng, 1995; Wu, 1999), and a maximality operator (Xiang, 2008). Since we focus on the contrast between additive and distributive contexts in the current study, a generalized semantic analysis for DOU is of less interest, and, following Lin (2004), we will call it a distributive operator.

- (c) Mei -ge ren DOU chi -le yi -ge pinguo.  
Every -cl man all eat -asp one -cl apple  
“ Everyone ate an apple.”
- (d) \*Zhe -wei tongxue DOU chi -le yi -ge pinguo.  
This -cl student all eat -asp one -cl apple  
“ \*This student each ate an apple.”

Moreover, in Mandarin, DOU can only quantify the constituent preceding it, but not the constituent following it. Hence (5b) is ungrammatical because the plural NP *tongxue-men* ‘students’ follows DOU, and the numeral phrase *yi ben shu* ‘one book’ that precedes DOU is singular, therefore the distributive meaning cannot be realized.

5. (a) Tongxue-men DOU mai -le yi -ben shu.  
Student -pl all buy -asp one -cl book  
“ Each of the students bought a book.”
- (b) \*Yi -ben shu DOU bei tongxue-men mai le  
One -cl book all -passive student -pl buy -asp  
“ \*A book was bought by each of the students.”

Similar to Mandarin, Cantonese also uses adverbs as additive and distributive operators. What differs between Cantonese and Mandarin is that Cantonese DOU is homophonous between the additive and distributive readings. It is a cognate to Mandarin distributive DOU, having the same orthographical form and pronunciation.

When used as an additive operator, according to Lee (2005), Cantonese DOU can only take the constituent preceding it into its scope, while it cannot quantify any constituents following it<sup>3</sup>, as is shown in (6a) and (6b).

6. (a) Aa John sik -zo jat go pinggwo, Aa Mary DOU sik -zo jat go pinggwo.  
John eat -asp one-CL apple Mary also eat -asp one-CL apple  
“ John ate an apple, and Mary also ate one.”
- (b) \*Aa John sik -zo jat go ping-gwo, DOU sik -zo jat go caang.  
John eat -asp one-CL apple also eat -asp one-CL orange  
“ \*John ate an apple and also an orange.”

When used as a distributive operator, Cantonese DOU can only take the constituent preceding it into its scope, and cannot quantify the constituent following it, similar to Mandarin Chinese, as shown in (7a) and (7b):

7. (a) Di hoksaang DOU maai -zo jat -bun syu.  
-pl student all buy -asp one -cl book  
“ Each of the students bought a book.”
- (b) Bun syu DOU bei di hoksaang maai -zo.  
Cl book also -passive pl student buy -asp  
“ (In addition to something else,) the book was also bought by the students collectively. ”

<sup>3</sup> However, we notice variation in the intuitions of native-speakers of Cantonese. Some accept the additive DOU to scope over the constituent that precedes or follows it while some others only accept the constituent preceding the additive DOU to be under its scope.

To briefly summarize, both languages use adverbs as semantic operators. Whereas Mandarin employs two separate adverbs, namely YE for additive meaning and DOU for distributive meaning, Cantonese only has one single adverb DOU for both meanings.

Given the analysis above, we argue that these two Mandarin semantic operators require integration of knowledge (i.e., intrinsic semantic meaning and presuppositions) at the semantic-pragmatic interface. The ambiguity of Cantonese DOU always requires its speakers to rely on discourse for either an additive or a distributive reading. Even though Mandarin has two distinct operators to encode such meanings, L2 learners still need to invoke presuppositions in order to assign an appropriate reading to the operator. The selection of an appropriate operator then is determined by information structure. Moreover, compared with distributive DOU, which restricts its scope to the constituent that precedes it, additive YE requires more information from discourse to decide which constituent of the sentence receives focus. As for the obligatory condition, additive YE relies on its discourse function while distributive DOU relies on the presence of the universal quantifier.

In sum, the cross-linguistic comparison above leads to interesting research questions, namely how Cantonese-speaking L2 learners delineate the additive and distributive readings and assign them to either YE or DOU in Mandarin appropriately, and whether there is an age effect on the acquisition of these adverbs that lie at the semantic-pragmatic interface. According to the Interface Hypothesis, properties of such interfaces are difficult to acquire.

### 3. Current Study

#### 3.1. Participants

Two groups of Cantonese-speaking learners of Mandarin participated in the experiment. One group consisted of undergraduates in Hong Kong (HK group), and the other group consisted of undergraduates in Guangzhou (GZ group). Two criteria were adopted to identify the Cantonese-speaking participants for the experiment: (a) they were born into Cantonese-speaking families and acquired Cantonese, the local dialect, as their L1, and (b) they differed in the age of acquisition and the extent of exposure to Mandarin Chinese. Both Hong Kong and Guangzhou City are primarily Cantonese speaking; the highly diglossic situation in China with Mandarin serving many social functions implies that children speaking the local dialects like Cantonese in Guangzhou are exposed to Mandarin earlier and more extensively than those in Hong Kong. While both groups of learners were born into Cantonese-speaking families, the Hong Kong learners could only be exposed to Mandarin when they entered primary education at age 6 whereas the Guangzhou learners were exposed to Mandarin as early as age 2 to 3 when they entered pre-school. Also they would be exposed to Mandarin through the mass media or daily interactions outside the home environment.

For the participants to be qualified as advanced learners of Mandarin, we adopted two measures: (a) a score on an independent Chinese proficiency test, and (b) frequency of use and exposure to Mandarin. We conducted a Chinese reading comprehension task with 19 questions. The proficiency test was adapted from a college entrance examination exercise. The participants were invited to complete it in order for us to obtain some background information on their Mandarin proficiency. Participants with a score higher than 14 out of 19 points were invited to take part in the study. Secondly, we scrutinized their Mandarin learning backgrounds especially their frequency of use of Mandarin. We identified those learners who had had more than 10 years of exposure to the target language. Likewise, a group of Mandarin-speaking adults was included as controls. They were born into Mandarin-speaking families and acquired Mandarin but not other dialects as L1. Detailed information of the three groups of participants are summarized in Table 1 below.

**Table 1:** Linguistic backgrounds of participants

<i>Group</i>	<i>No.</i>	<i>Age</i>	<i>Proficiency score</i>	<i>AoA</i>	<i>Input frequency (hr)</i>
GZ	21	19.52	15.76	2.71	8557.14
HK	21	19.29	15.81	6.29	1005.24
NS	21	23.90	15.95	-	-

### 3.2. Elicitation Procedures

The study involved an online acceptability judgment task, with five linguistic contexts sensitive to the use of Mandarin YE and DOU as discussed previously. It contained a series of communicative situations invoking either an additive or a distributive reading. Among the five linguistic contexts, two rendered additive contexts requiring YE, and three rendered distributive contexts requiring DOU (see examples below).

8. (a) *Additive context - NP:*  
 George chi le pin-guo, John YE chi -le pin-guo  
 George eat -asp apple John also eat -asp apple  
 “George ate an apple, so did John.”
- (b) *Additive context - VP:*  
 John chi le pin-guo, YE he -le niu-nai  
 John eat asp apple also drink -asp milk  
 “John ate an apple and drank some milk.”
- (c) *Distributive context - Plural NP:*  
 Tongxue -men DOU chi -le yi -ge pin-guo.  
 Student -pl all eat -asp one -cl apple  
 “Each student ate an apple.”
- (d) *Distributive context - Suoyou ‘all’ + NP:*  
 Suoyou ren DOU chi -le yi -ge pin-guo.  
 All man all eat -asp one -cl apple  
 “Everyone ate an apple.”
- (e) *Distributive context - Mei ‘every’ + NP:*  
 Mei -ge ren DOU chi -le yi -ge pin-guo.  
 Every -cl man all eat -asp one -cl apple  
 “Everyone ate an apple.”

There are four tokens for each of the test conditions as well as ten fillers that require use of the restrictive focus operators CAI ‘only’ and JIU ‘just’ in Mandarin. In this judgment task, recordings of the situational conversations were read out by two native speakers. The written scripts of the conversations appeared individually on the computer screen for the participants to read while listening to the conversations. On the answer area, the target sentence was presented with a blank space inserted at where the adverb would occur. Three options are given for the blank space, namely the target adverb, the non-target adverb and a symbol for omission. Under these three candidates there are two rows of boxes, one stands for ‘Possible candidates for the blank’ and the other stands for ‘Unsure’. The participants is asked to tick the box ‘Possible candidates for the blank’ if they think the operator or the omission is possible based on the conversational discourse, tick the box ‘Unsure’ if they find it difficult to arrive at an appropriate judgment, and do not tick any box if they think the operator or the omission is inappropriate based on the conversational discourse. A training session is required before the real test to make sure all participants fully understand the task. Below is an example of the task. The original conversation is in Mandarin and is translated into English here.

*Johnny (Speaker 1):*

‘Anna, do you have any brothers or sisters?’

*Anna (Speaker 2):*

‘Yes, I have three elder sisters.’

Johnny (Speaker 1):

‘What do they do?’

Anna (Speaker 2):

‘My eldest sister is a professor of a university. My second elder sister is a librarian of a university. My third elder sister is a P.E. teacher of a university.’

Anna de jie-jie -men \_\_\_\_\_ zai da-xue gong-zuo.

Anna -de elder sister -pl \_\_\_\_\_ at university work

“ Anna’s elder sisters each works at a university.”

	YE	DOU	OMISSION*
Possible candidates for the blank:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unsure:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

\* In the experiment we used the symbol ‘Φ’ to stand for the omission condition.

In the above example, the conversational discourse demonstrates that a property (i.e., working at a university) is shared by a plural subject *Anna de jie-jie-men* ‘Anna’s elder sisters’. Therefore, distributive DOU yielding an ‘each/all’ meaning matches the context due to exhaustivity while additive YE should be excluded because there is no presupposition invoked in the context that someone other than Anna’s elder sisters works at the university.

### 3.3. Results

The distribution of raw responses by the three groups of participants is shown in Figure 1 (additive conditions) and Figure 2 (distributive conditions). To recap, YE is acceptable under the additive conditions while unacceptable under the distributive conditions, and DOU is acceptable under the distributive conditions while unacceptable under the additive conditions.

Responses for sentences with a matching operator (YE under the additive condition or DOU under the distributive condition) show convergence towards native-like representations across the three groups, with more than 90% of the responses indicating acceptance of either YE and DOU in their respective conditions. In contrast, responses for judging mismatched operators (i.e., DOU under the additive condition and YE under the distributive condition) show a high degree of variation across groups. Participants from the GZ group and the NS group gave more than 90% of ‘Reject’ responses, while participants from the HK group did not show such a strong tendency. Under the distributive conditions with universal quantifiers, they actually accepted a wrong operator, the additive YE, more frequently than rejected it (i.e., 55.95% of ‘Accept’ responses for YE under the *Suoyou* ‘all’ condition; 71.42% of ‘Accept’ responses for YE under the *Mei* ‘every’ condition). All groups converged on rejecting the sentences with no semantic operators under the NP condition for YE and the *Suoyou* ‘all’ condition and the *Mei* ‘every’ condition for DOU. However, there was variability in their responses under the VP condition for YE and the Plural NP condition for DOU. The HK group and the NS group had more acceptances with the omission of operators under these two conditions, while the GZ group showed relatively lower acceptance towards omission, inconsistent with their judgment in other conditions. We also noticed that participants from the GZ group and the NS group seldom gave ‘Unsure’ responses, while participants from the HK group tended to give more ‘Unsure’ responses for those test conditions in which the use of an inappropriate semantic operator or its omission was unacceptable, suggesting that the HK group demonstrated a higher degree of indeterminacy than the GZ and the NS groups.

To further analyze the data, we adopted a scoring scheme to calculate the attainment scores of each participant, assigning 1 point to the correct responses (i.e., accepting the matching operator, rejecting

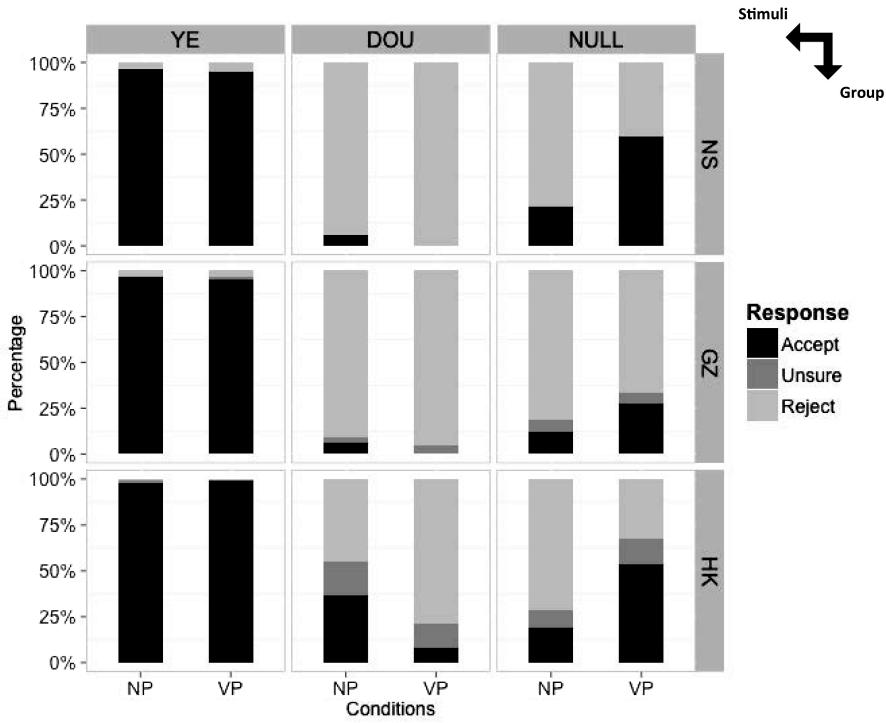


Figure 1: Responses under the additive conditions

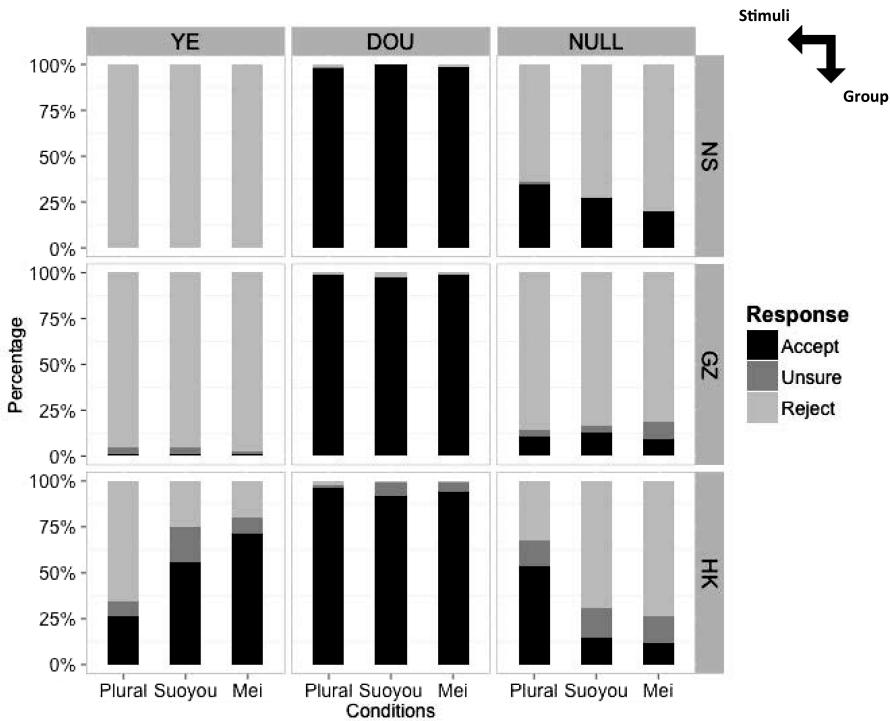
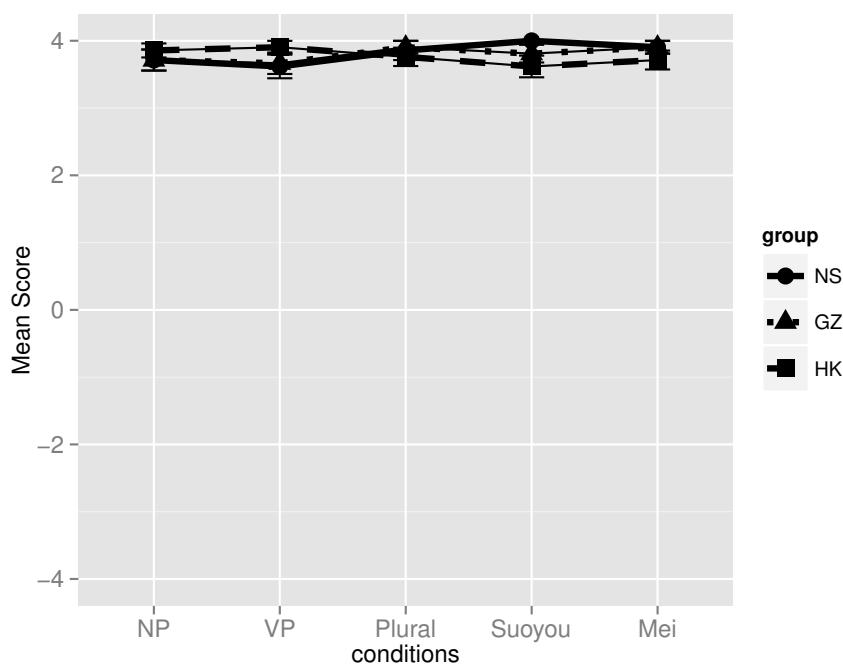


Figure 2: Responses under the distributive conditions

the mismatched operator or rejecting ‘omission’ of an operator), -1 point to the incorrect responses (i.e., accepting the mismatched operator, accepting the ‘omission’ of an operator, or rejecting the matching operator), and 0 point to the ‘Unsure’ responses. Using these procedures, we calculated the total score for each type of stimulus ranging from -4 to 4. Note that the native controls’ judgments varied with sentences showing omission of a semantic operator, as some tended to accept the omission of an operator. In other words, there was variability in the use of semantic operators even among the native speakers of Mandarin. Therefore, for the ‘omission’ condition, a higher score only indicated a higher tendency to reject such sentences. Figure 3 shows the mean scores and standard errors of the stimuli with the matching operators (YE under the additive condition and DOU under the distributive condition).



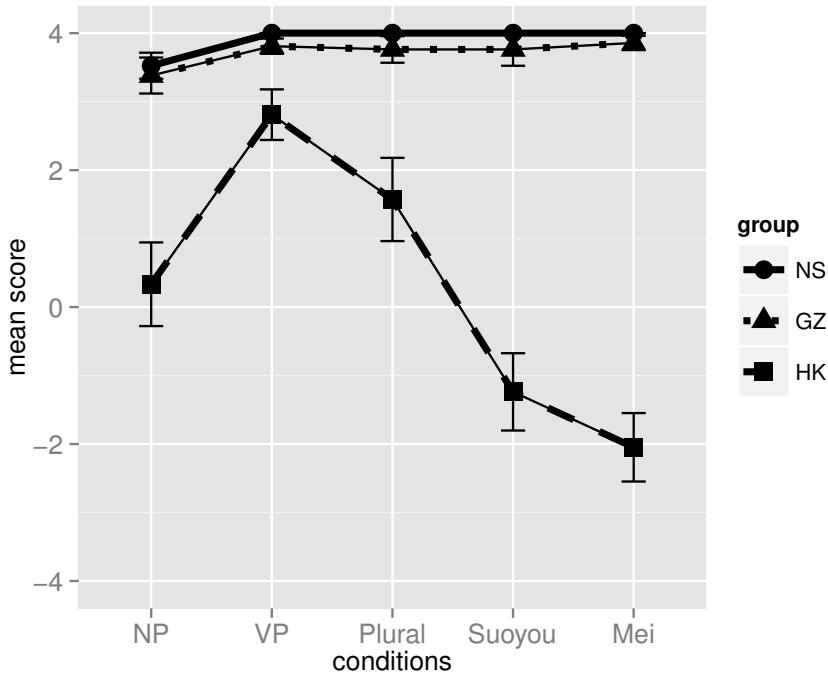
**Figure 3:** Mean scores and standard errors of the target sentences: YE under the additive conditions (NP and VP) and DOU under the distributive conditions (Plural NP, Suoyou and Mei conditions)

As shown in Figure 3 above, both L2 groups perform quite native-like in all conditions. Results from ANOVA test show no significant differences between the L2 learner groups and the NS group [ $F(2,300)=0.169$ ,  $p=0.844$ ], no significant differences across conditions [ $F(4,300)=0.432$ ,  $p=0.785$ ], and also no significant interaction between groups and conditions [ $F(8,300)=1.194$ ,  $p=0.302$ ].

Next, we turn to the participants’ performance on judging mismatched operators (i.e., DOU under the additive condition and YE under the distributive condition). The patterns thus produced are quite different, and it is the HK group that shows a strong divergence from the GZ group and the NS group, as shown in Figure 4.

While the GZ group performed similarly to the native controls, the HK group showed an obvious divergence. ANOVA results show significant differences between the three group [ $F(2,300)=186.29$ ,  $p<0.001^{***}$ ], significant differences across conditions [ $F(4,300)=12.09$ ,  $p<0.001^{***}$ ], and also significant interaction between groups and conditions [ $F(8,300)=12.05$ ,  $p<0.001^{***}$ ].

Further analyses show slight differences between the GZ group and the NS group [ $F(1,200)=4.069$ ,  $p=0.045^{*}$ ] and differences across conditions ( $T=2.255, P=0.025$ ) [ $F(4,200)=3.611$ ,  $p=0.007^{**}$ ], but no interaction between groups and conditions [ $F(4,200)=0.051$ ,  $p=0.995$ ]. As for the HK group, results show significant differences from the native controls [ $F(1,200)=220.73$ ,  $p<0.001^{***}$ ], significant differences across conditions [ $F(4,200)=13.42$ ,  $p<0.001^{***}$ ] and also interaction between groups and conditions [ $F(4,200)=13.50$ ,  $p<0.001^{***}$ ].



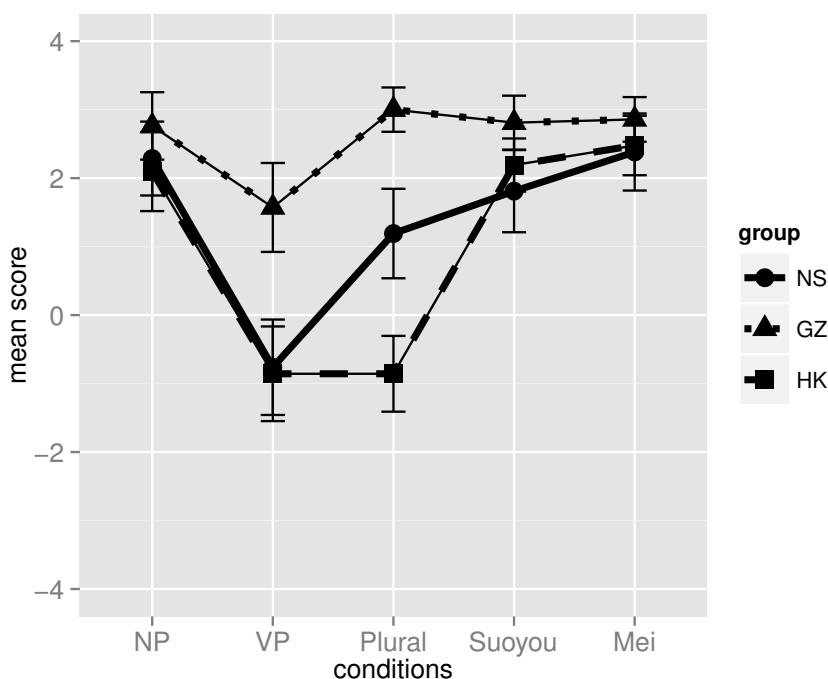
**Figure 4:** Mean scores and standard errors of the non-target sentences: DOU under the additive conditions (NP and VP) and YE under the distributive conditions (Plural NP, Suoyou and Mei conditions)

Last, we examine the participants' performance on the omission of semantic operators. As previously mentioned, there is variation in terms of accepting sentences without an appropriate semantic operator among the native controls, suggesting that it is a relatively soft constraint, compared to the very consistent rejection of inappropriate semantic operators shown in Figure 4. Figure 5 summarizes the performance of the three groups of participants on this category of responses.

Generally speaking, variation in performance is observed among the three groups of participants. In particular, the NS and the HK groups diverge quite significantly from the GZ group as regards judging YE in the VP condition and DOU in the Plural NP condition. Surprisingly, it is the GZ group that shows the most 'compliance' with the target grammar. ANOVA results show significant differences between the L2 learner groups and the NS group [ $F(2,300)=11.892$ ,  $p<0.001^{***}$ ], significant differences across conditions [ $F(4,300)=12.451$ ,  $p<0.001^{***}$ ], and a small interaction between groups and conditions [ $F(8,300)=2.225$ ,  $p=0.026^*$ ]. Further analyses show significant differences between the GZ group and the NS group [ $F(1,200)=12.766$ ,  $p<0.001^{***}$ ] and significant differences across conditions [ $F(4,200)=5.681$ ,  $p<0.001^{***}$ ], but no interaction between groups and conditions [ $F(4,200)=1.178$ ,  $p=0.322$ ]. As for the HK group, ANOVA results show no differences from the NS group [ $F(1,200)=1.034$ ,  $p=0.31$ ], significant differences across conditions [ $F(4,200)=12.346$ ,  $p<0.001^{***}$ ] and no interaction between groups and conditions [ $F(4,200)=1.387$ ,  $p=0.24$ ].

#### 4. Discussion

In general, participants from the HK group and the GZ group both showed native-like performance with sentences containing a matching semantic operator. However, the HK group had a much lower score than the other two groups in judging sentences with a mismatched operator. In addition, there was high variability in the judgments of sentences that omit a semantic operator. As far as comparison between the GZ and the NS groups is concerned, while there was a high convergence between judging the appropriate use of YE and DOU in the additive and distributive conditions, there was a divergence in terms of omission of semantic operators, especially for omitting YE in the VP condition and DOU in the Plural NP condition. The HK group, on the other hand, converged only in the matching operators



**Figure 5:** Mean scores and standard errors of the sentences without operators: omission of YE under the additive conditions (NP and VP) and omission of DOU under the distributive conditions (Plural NP, Suoyou and Mei conditions)

conditions, but diverged significantly from the other two groups in all other conditions. In Figure 4, the rejection of DOU under the VP condition was the only category of stimuli that showed approximation towards near-native performance. In the ensuing discussion, we will try to address these observations by focusing on group differences, which aligns with our main research question – age of acquisition effects on the acquisition of semantic-pragmatic interface properties.

Given the significant group effect between the HK and NS groups with the mismatched operator sentences and the significant group effect between GZ and NS with the omission of operator sentences, we conclude that both L2 groups fail to achieve complete knowledge of the additive and distributive operators in Mandarin. However, we found relative degrees of achieving near-native performance between the GZ and HK groups. The GZ learners' performance shows more convergence on the target grammar than the HK learners grammar. This finding is surprising because both groups of L2 learners were exposed to Mandarin quite early, as early as 2-3 years old (i.e., sequential bilinguals, Meisel 2010) for the GZ group and as early as 6 years old (i.e., early L2 learners) for the HK group. What is common between them is the fact that early input and long years of exposure to Mandarin have enabled them to achieve native-like competence with sentences containing the matching semantic operator, that is, YE under the additive contexts and those containing DOU under the distributive contexts.

What is faced by the HK learners in terms of 'residuals' of L2 acquisition seems to be the knowledge of constraints involved in delineating DOU as having a distributive reading only, which differs from YE with the additive reading. As DOU in their L1 is homophonous and renders an additive or a distributive interpretation based on their entailed presuppositions depending on the context, this L1 knowledge seems to cause a higher degree of 'residual optionality', impacting their L2 ultimate attainment. The inappropriate acceptance of DOU in the additive NP condition (mean = 0.33, se = 0.61) is a case in point (see Figure 4), where DOU in Mandarin is incompatible with the required presupposition of a shared property and at the same time requires that the grammatical subject be plural. The HK learners' poor performance in this category clearly indicates their difficulty in developing knowledge of such semantic and pragmatic constraints. Therefore, we argue that the lack of convergence is an outcome of the relative

difficulty in acquiring the properties involved at this semantic-pragmatic interface, reinforced by the L1 transfer effect. This is reflected in their responses to the mismatched sentences under the NP condition, with only a slightly higher percentage of 'Reject' response (45.23%) when compared with the 'Accept' responses (36.90%), in addition to a high percentage of 'Unsure' response (17.86%), when compared with the other two groups under this category.

Similarly, the HK learners wrongly accept use of YE in the distributive contexts, leading to residual difficulty in their L2 ultimate attainment. It is reflected by their relatively lower scores in rejecting YE under the Plural NP distributive (mean = 1.57, se = 0.61), and the very low scores in rejecting YE under the *Suoyou* 'all' distributive condition (mean = -1.24, se = 0.56) and the *Mei* 'every' distributive condition (mean = -2.05, se = 0.50) (see Figure 4). These results indicate their lower tendency to reject additive YE under these distributive contexts. In addition, they seem to attribute a distributive meaning to YE when the sentence includes a universal quantifier.

Are there L1 transfer effects in the distributive contexts? Recalling that Mandarin YE and Cantonese DOU share equivalent additive meaning, it is highly possible that L2 learners initially assume that Mandarin YE shares similar semantic-pragmatic interface properties as Cantonese DOU. Figure 2 shows their high percentages of wrongly accepting mismatched sentences with YE under the distributive conditions (i.e., Plural NP = 26.19%; *Suoyou* 'all': = 55.95%; *Mei* 'every'=71.43%). In fact, it seems that the transfer effects are much more severe with sentences including a universal quantifier. A closer analysis of the distribution of such responses suggests that, for the Plural NP condition, the HK learners tend to accept omission of the operator, or they are not sure if it may be omitted (see Figure 1). For sentences with a universal quantifier, a majority of the errors come from the learners wrongly accepting YE, assuming that YE is similar to Cantonese DOU, causing violation of the semantic-pragmatic interface in Mandarin. In other words, the exhaustivity of the universal quantifier runs counter to the presuppositions of the shared property of YE, properties that L2 learners need to acquire in order to distinguish use of YE and DOU as semantic operators for different semantic-pragmatic functions.

Also, our findings on the acquisition of YE and DOU interpretations in Mandarin, which we argue entails integrating knowledge of the semantic-pragmatic interface, furnish counter-evidence to the L2 studies on the acquisition of bare noun/proper noun interpretation reported in Slabakova (2006) or aspectual tense interpretation in Montrul & Slabakova (2004). While these researchers argue for no critical period effects for the acquisition of semantics, our data suggest that semantic-pragmatic interface properties may ultimately remain vulnerable to residual optionality and indeterminacy.

As for the GZ learners, the window of opportunities for delineating the semantic and pragmatic constraints of YE and DOU seems to fall at a much earlier age of acquisition. Another important ingredient for more successful ultimate attainment is long and constant exposure to Mandarin input. However, their L2 ultimate attainment still diverges from the natives' representations, in particular with the higher tendency to reject sentences without YE and DOU. A carefully scrutiny of the data reveals that omission of YE under the NP additive and the VP additive conditions and omission of DOU under the Plural NP distributive, *Suoyou* 'all' distributive and *Mei* 'every' distributive conditions are perceived to be optional by some of participants from the HK group and the NS group, while GZ learners generally find covert YE and DOU less acceptable when compared to the NS group.

The observation that the GZ group tend to reject the omission of semantic operators is novel and not predicted by previous L2 acquisition theories. As discussed, the native controls show gradient judgments of the omission of YE under the VP condition and omission of DOU under the Plural NP condition. Obviously, such gradient judgments also imply that omission of the semantic operators will occur in the input. Surprisingly, our data from the GZ group does not show residual optionality but less gradient judgments when compared with the native controls. One possibility is effects of formal instruction, since Mandarin was taught as a subject when the learners entered school and these adverbs will have been taught intensively. Nevertheless, the performance of participants from the GZ group is more native-like when compared with the HK learners. They show clear semantic distinctions between the additive YE and the distributive DOU and are aware of their mutually exclusive presuppositions. They only differ from the native controls with omission of YE under the VP condition and omission of DOU under the Plural NP condition.

Assuming both groups of L2 learners share similar developmental processes given their similar L1 (Cantonese) backgrounds, that only the GZ learners overcome the semantic transfer effects ultimately

may be attributable to their earlier age of acquisition and input conditions, in terms of quantity and quality. However, it is very hard in this study to tease apart these two factors, since an earlier age of acquisition always brings more input quantity. Another concern is whether the HK learners have actually reached their end states of Mandarin grammar at the time of the study or before, or they are still undergoing L2 acquisition. In this regard, longitudinal data probing into the acquisition phenomena over time may give us some insights on properties of the end state grammar as well as ultimate attainment. Another procedure may be to collect cross-sectional data from both populations to examine what happens during the intermediate stages, possibly to verify if fossilization occurs earlier among the Hong Kong learners than the learners from Guangzhou.

Getting back to the Interface Hypothesis, although the current study does not examine directly L2 learners' processing abilities in terms of integrating knowledge at interfaces, the results suggest a lack of L2 ultimate attainment of the semantic-pragmatic interface properties involved in YE and DOU, as even the GZ group whom we would categorize as sequential bilinguals, defined as acquiring the L2 before age 5 and after fully acquiring the L1, show some divergence from native performance. Our observations with the HK learners challenge Slabakova's (2006) hypothesis of no critical period effects for phrasal semantics in L2 acquisition.

## 5. Conclusion

The study examined two semantic operators YE and DOU in Mandarin in the end state knowledge of two groups of Cantonese-speaking learners who differ in the age of acquisition and input frequency and quality. The results suggest that although the end state grammar of YE and DOU in the HK and GZ learners still diverges from the native representations, there is a relatively higher degree of convergence with the end state grammar of the GZ learners, suggesting that onset of acquisition before three years old positively impacts the chances of achieving native-like representations. In addition, acquisition of properties at the semantic-pragmatic interface actually interacts with age of acquisition and input condition, to the extent that when these two conditions are not met, these interface properties may ultimately not be fully acquired.

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