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A Constraint-Based Approach to Chinese Speakers' Acquisition of English Consonant Clusters[1]

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This paper discusses Chinese speakers' acquisition of English word-initial consonant clusters within the constraint-based OT (Optimality Theory) framework. An experiment was conducted to elicit Chinese students' production of such clusters. Three significant findings were drawn from the results: (1) preference for the CV structure, (2) tendency to preserve the initial consonant, and (3) preference for *Cr* over *Cl* clusters. Neither of the two existing models on EFL onset consonant clusters, the Minimal Sonority Distance Parameter-Setting Model (Broselow and Finer, 1991) and Typological Markedness (Eckman and Iverson, 1993), is adequate in accounting for the results. It is demonstrated that the OT framework provides a more explicit analysis for such EFL structures and interlanguage variations since it (1) accounts for patterns in not only learners' *error rates* but also their *error types*, (2) explains both *how* and *why* such errors emerge, and (3) explicitly captures the notion of Interlanguage and its interactions with learners' Native Language and the Target Language.

Keywords: EFL consonant clusters, optimality theory, interlanguage phonology

1. Introduction

This paper investigates Chinese speakers' acquisition of English word-initial consonant clusters. Unlike English, which allows a wide range of consonant cluster types as both onset and coda, Chinese is far more restricted in its syllable structure. As can be predicted by the "Contrastive Analysis Hypothesis" (Lado, 1957), these English CC(C) onsets or CC(C)(C) codas will cause problems for Chinese learners as a result of Native Language Transfer. However, recent research on second language (L2) phonology reveals something more than native language transfer. For instance, certain structures are found to be easier to learn regardless of their absence in the learners'

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native language, while some L2 patterns, which are present in L1, often cause problems. The notions of "Universal Markedness", or "developmental effects" (Eckman, 1977), and "Interlanguage" (Corder, 1967; Selinker, 1972) have been introduced to interpret areas of L2 difficulties which are not transferred from L1, and a number of hypotheses and models have been proposed along this line, namely, Markedness Differential Hypothesis (Eckman, 1977; Anderson, 1987), Syllable Simplification Strategy Hypothesis (Weinberger, 1987, 1994), the Ontogeny Model (Major, 1987, 1994, 1996), Interlanguage Structural Conformity Hypothesis (Eckman, 1991), Minimal Sonority Distance Parameter-Setting Model (Broselow and Finer, 1991), and Typological Markedness (Eckman and Iverson 1993). However, although much attention has been drawn to the idea of Interlanguage (e.g., Beebe, 1987; Carlisle, 1991a, 1991b, 1994; Eckman, 1981; Major, 1987; Tarone, 1987), the exact interaction of the rules of the Native Language (NL), Interlanguage (IL), and Target Language (TL) cannot be captured within the rule-based generative phonology framework (Broselow, Chen, and Wang, 1998).

We are curious how the existing models or hypotheses account for Chinese students' acquisition of English consonant clusters, especially those that occur word-initially. In what follows, we will first review the two proposals concerning the general error rates of EFL onset consonant clusters, the Minimal Sonority Distance Parameter-Setting Model (Broselow and Finer, 1991) and Typological Markedness (Eckman and Iverson, 1993)[2], and then present our more comprehensive experimental study of the acquisition of English word-initial consonant clusters by 12 Chinese adult EFL learners. Errors produced by our students reveal both transfer and developmental effects, which cannot be interpreted by either of the two models. We then demonstrate the operation of the OT (Optimality Theory, Prince and Smolensky, 1993; McCarthy and Prince, 1993, 1994, 1995) mechanism in dealing with our findings. The main concept and operation of the OT framework will be provided in section 5. The OT account of L2

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all the students for their enthusiastic participation in the experiment.

2 Other models or hypotheses mentioned above investigate EFL coda consonant clusters (Interlanguage Structural Conformity Hypothesis) or extralinguistic factors such as context (Syllable Simplification Strategy Hypothesis) and number of years studying English (the Ontogeny Model), and are thus not

acquisition is found to provide a more adequate approach for such EFL structures and interlanguage variations since it (1) accounts for patterns in not only learners' *error rates* but also their *error types*, (2) explains both *how* and *why* such errors emerge, (3) explicitly captures the notion of Interlanguage and its interaction with learners' Native Language and the Target Language.

2. Recent studies on EFL onset clusters

2.1 Minimal sonority distance parameter setting model

Based on the Sonority Sequencing Generalization (1) and the Sonority Index (Selkirk, 1982) shown in (2), Broselow and Finer (1991) proposed the Minimal Sonority Distance (MSD) Model as a criterion in determining the degree of difficulty in L2 syllable acquisition.

1) Sonority Hierarchy (Broselow & Finer, 1991: 37)
Obstruents - Nasals - Liquids - Glides - Vowels
least sonorous ……………….. most sonorous

2) Sonority Scale (Broselow & Finer, 1991: 38)

Class	Value
stops	1
fricatives	2
nasals	3
liquids	4
glides	5

The SSG restricts the order of consonants in a cluster. Except for the '/s/ + Stop' sequence (e.g., /st/ in 'stop'), which is viewed by many as having a different structure from that of "true onset clusters" (e.g., Fudge, 1969; Selkirk, 1982; Ewen, 1982; Stemberger, 1986), English onsets generally obey this principle. However, not all combinations that conform to this principle are legal onsets in English (e.g., *#/*pn/*, **#/nl/*) and different languages allow different sets of onset clusters. The function of the MSD is thus to characterize the various types of onset consonant clusters permitted in different languages.

Given the values in the Sonority Scale (2), a language with the MSD setting of 5 does not allow any onset cluster because the largest difference between these consonant

included in the present study, which focuses on the acquisition of word-initial consonant clusters.

types is 4 (5-1=4), whereas a language with a MSD setting of 4 allows only one type of onset cluster, i.e., 'stop-glide' cluster, since stops and glides are the only classes of consonants that have the sonority difference of 4. The following table illustrates how the MSD setting determines the types of onset clusters allowed in a particular language.

Table 1. MSD setting and the range of onset types

MSD setting	**Onset types**
5	No consonant cluster
4	'stop-glide'
3	'stop-glide', 'fricative-glide', 'stop-liquid'
2	'stop-glide', 'fricative-glide', 'stop-liquid', 'fricative-liquid', 'nasal-glide'
1	All types of consonant combination

Within this model, difficulties in the acquisition of L2 consonant clusters can be accounted for in terms of both L1 transfer and developmental effects. First, since each language is assigned a particular MSD setting, L2 structures with a different setting will cause problem for the learner (L1 transfer). Second, since clusters with members closer in sonority are more marked than clusters whose members are further apart on the sonority scale, sequences with lower MSD settings will be more difficult to acquire than those with higher MSD settings (developmental effects).

2.2 Typological markedness

Another hypothesis concerning EFL onset consonant clusters is Eckman and Iverson's (1993) Typological Markedness.

The basic assumption of this hypothesis is as stated in (3), which yields the more specific markedness relationships for obstruents shown in (4).

3) Typological Markedness

Some segment type A is typologically marked relative to some other segment type B if the occurrence of A in a language implies the occurrence of B, but the occurrence of B does not necessarily imply the occurrence of A. (p. 240)

4) Markedness relationships for obstruents (p. 241)

Marked	Relative to	*Unmarked*
a) Fricatives		Stops
b) Voiced stops		Voiceless stops
c) Voiced fricatives		Voiceless fricatives

Eckman and Iverson further incorporate Clements' (1990) theorem on the cooccurrence of segments within a context, namely, the Sequential Markedness Principle (5).

5) Sequential Markedness Principle (p. 241, from Clements, 1990, p. 313)
For any two segments A and B and any given context X_Y, if A is less marked than B, then XAY is less marked than XBY.

The assumptions (3), (4), and (5), make the following predictions on the relative markedness of different types of consonant clusters:

6) Typological Markedness predictions of the relative markedness of different cluster types (L: liquid, G: glide)

(a) voiced stop + L/G	*is more marked than*	voiceless stop + L/G
(b) voiced fricative + L/G		voiceless fricative + L/G
(c) voiceless fricative + L/G		voiceless stop + L/G

3. Methodology

To see how well the average Chinese EFL student masters English onset clusters, we conducted an experiment, which features (1) a group of restrictively selected subjects, (2) a comprehensive set of onset clusters, and (3) a natural process of acquisition and production of the pseudowords.

3.1 Subjects

Unlike those in the above two studies (or in most studies) who are mostly volunteer participants, subjects for our present experiment are restrictively selected so as to represent the majority of college EFL students in Taiwan. Before the experiment proceeded, a background questionnaire and a Michigan listening test were given to the freshmen class of the department of Information Management, Chung Hua University. Only those that meet our requirements (Table 2) are chosen to participate in our test. Table 2 is a general description of the background of the 15 students finally selected as our subjects.

Table 2. Background information of our 15 subjects

Age	18-20
Mother tongue	Mandarin and Taiwanese[3]
Years studying English	6-7 years in high school
Experience of studying English: Never --	-attended any English class before high school or outside school -studied English from native speakers of English -went to any English-speaking country -studied other foreign languages -took any English course other than Freshman English in college
Michigan Test score	45-62%[4]

3 These are the two most prominent languages in Taiwan.
4 We did not take their JCEE (Joint College Entrance Examination) score into account because most of them answered "forgot" to the question.

3.2 Items

Possible combinations of consonants in English word-initial onsets are listed in Table 3, which yields the 25 clusters as shown in (7). (We exclude '/s/ + Stop' sequence for reasons already stated in section 2.)

Table 3. Possible consonant combinations in English onsets
(C_1 indicates the first, and C_2 the second consonant of the cluster.)

C_2 / C_1		Glide		Liquid		Nasal		Stop		
		w	j	r	l	m	n	p	t	k
Stop	p	-	+	+	+	-	-	-	-	-
	t	+	-	+	-	-	-	-	-	-
	k	+	+	+	+	-	-	-	-	-
	b	-	+	+	+	-	-	-	-	-
	d	+	-	+	-	-	-	-	-	-
	g	-	+	+	+	-	-	-	-	-
Fricative	f	-	+	+	+	-	-	-	-	-
	θ	+	+	+	-	-	-	-	-	-
	🌢	-	-	+	-	-	-	-	-	-
	s	+	+	-	+					
Nasal[5]	m	-	+	-	-	-	-	-	-	-

7) English Onset Cluster Types:

a. Stop-Glide: pj, kj, kw, tw, bj, dw
b. Stop-Liquid: pr, tr, kr, pl, kl, br, dr, gr, bl, gl
c. Fricative-Glide: fj, vj, sw
d. Fricative-Liquid: fl, fr, ❄r, 🌢r, sl
e. Nasal-Glide: mj

For each cluster, one pseudoword is designed with a definition, which, together with 4 other singleton words (with the onsets /r/, /l/, /w/, and /j/), amount to 29 items. To avoid complication, we focus on word-initial onset clusters for the moment. Appendix A is a complete set of the items.

3.2 Procedure and tasks

All the 15 subjects were asked to come to a quiet classroom, and were told that instead of being tested, they were going to help the teacher test the appropriateness of some teaching materials for students at CHU. They were then each distributed a sheet of the word list as in Appendix A.

5 The combination /nj/ found in some dialects of English is not inlcuded in our discussion since what students learn in Taiwan is American English, in which "coronalC + [ju]" sequences are prohibited (Borowsky, 1986).

3.2.1 Learning the pseudowords

To familiarize the subjects with the target pseudowords, we recorded the instruction of the words by a male native speaker of American English (who is a teacher in both Chung Hua University and Soochow University), and let the subjects practice pronouncing the words as they read the word list and listen to the instruction. The teaching of the words is not simply reading the word list (e.g., “dwek”, a kind of flower; “fleese”, a kind of sport.) Rather, the instructor was asked to talk about or make a couple of sentences for each word spontaneously. (e.g., “…The first noun is “*dwek*”. A *dwek* is a kind of flower. In my garden, there are many beautiful *dweks*.”) The purpose is to expose our subjects to these items in a natural context.

3.2.2 Grammaticality judgment test

The grammaticality judgment test in this study is similar to the one adopted in Hancin-Bhatt & Bhatt (1997). After listening to and practicing pronouncing the pseudowords, the students were then asked to get into another room one by one for the production task. They were instructed to listen to 29 pairs of sentences (Appendix B) each consisting of one of our target pseudowords. A written version of the sentences was also provided. Following is a sample pair of sentences in this task.

9) a. I need a dwek. Do you have *one*?
   b. I need a dwek. Do you have *it*?

The sentences were, again, pre-recorded by the native speaker of English who instructed the pseudowords. After listening to each pair, the subjects repeated twice the sentence which they judged to be grammatically correct. There are two advantages for this kind of production task. First, by forcing the subjects to focus their attention on grammar instead of pronunciation, we can obtain more natural speech. Second, it does not matter which sentence they choose since the target word appears in both sentences.

The subjects’ responses were tape-recorded using a low-noise microphone and a Sony TCM 5000 EV recorder. The target items were later transcribed in fine phonetic detail by the author and a graduate student at the Linguistic Institute of National Tsing Hua University, who is also well-trained in phonetic transcription. For items where the transcriptions disagree, a third transcriber was consulted. There were no items for which all the three transcribers disagree. The transcription which is agreed upon by at least two of the transcribers are then chosen for analysis.

3.3 Results

The tapes of three of our 15 subjects were not transcribed due to their low and unclear voice, and the clusters /❄r/ and /♠r/ are excluded from our discussion because, like most Chinese EFL students, our subjects have difficulty even with the single consonants /❄/ and /♠/. We thus have a total of 552 tokens (23 items x 12 subjects x 2 = 552 tokens).

Table 4 shows the number of errors and the error percentage for each type of cluster. As predicted, our subjects exhibit a pretty high error rate in pronouncing these structures. Over all, 255, i.e., 46.1% of the 552 items, are mispronounced.

Table 4. Number of Errors[6]

	S-G						S-L										F-G			F-L			n-g	
	pj	bj	kj	tw	dw	kw	pr	br	tr	dr	kr	gr	pl	bl	kl	gl	fj	vj	sw	fr	fl	sl	mj	sum
#	9	7	4	13	20	5	3	2	6	3	5	5	24	21	21	24	12	11	12	2	22	20	9	255
%	38	29	17	54	83	21	13	8	25	13	20	20	100	88	88	100	50	46	50	8	92	83	38	46.1%

(#: number of errors, %: error rate, i.e., number of errors/total occurrences of the items)

These errors can be categorized into six types, namely, (1) vowel insertion, (2) consonant insertion, (3) deletion of the initial consonant, (4) deletion of the medial consonant, (5) replacement of the initial consonant, and (6) replacement of the medial consonant. The actual number of errors for each error type that occurs for each cluster is shown in Table 5. The numbers (1-6) in the first column of the table denote the six types of errors, each of which is exemplified in the notations below the table.

6 We did not count the replacement of voiced stops by voiceless ones (/b/, /d/, /g/ → [p], [t], [k]) as errors for our present study since it is a general tendency for Chinese speakers to devoice stops regardless of their positions in a word. In other words, devoicing is not a strategy specifically applied to clusters.

Table 5. Error Types[7]

	S-G						S-L										F-G			F-L					%
	pj	bj	kj	tw	dw	kw	pr	br	tr	dr	kr	gr	pl	bl	kl	gl	fj	vj	sw	fr	fl	sl	mj	sum	/552
1	0	0	0	4	6	0	1	2	0	0	3	2	2	4	10	6	0	0	10	0	0	17	0	67	12.1
2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2	0	0	0	0	4	0.7
3	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
4	7	7	4	0	2	0	1	0	0	0	0	0	2	5	3	0	8	1	0	0	3	1	5	49	8.9
5	0	0	0	1	10	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	2.7
6	2	0	0	11	2	5	1	0	6	2	2	2	20	11	8	18	4	10	1	2	19	2	3	131	23.7
	9	7	4	16	21	5	3	2	10	3	6	5	24	20	21	24	12	11	13	2	22	20	8	268	

1. Vowel Insertion: Epenthesis of the vowel schwa to break up the cluster, e.g., /pli/→ [p★li]
2. Consonant Insertion: Addition of another consonant to the beginning of the word, e.g., /krin/ → [skrin][8]
3. Deletion of the Initial Consonant: #CCV → CV, e.g., /dripi/ → [ripi]
4. Deletion of the Medial Consonant: #CCV → CV, e.g., /frip/→ [fip]
5. Replacement of the Initial Consonant: e.g., /twipt/ → [t▪wipt]
6. Replacement of the Medial Consonant: e.g., /fli/ → [fri]

4. Discussion

The errors produced by our students exhibit both transfer and developmental effects, which we will discuss in turn in section A below. We then demonstrate how both Broselow and Finer's (1991) MSD model and Eckman and Iverson's (1993) Typological Markedness fail to account for our results (B, C), and finally propose our own OT analysis in 5.

4.1 Transfer and developmental effects

Three significant points can be observed from the above generalization of the error types:

4.1.1 Preference for CV structure

A lot of the errors result from the speakers' intention to break up the clusters. There are altogether 118 errors of this type (vowel insertion 67 + consonant deletion 51 = 118). Such a preference for CV structure can be attributed to the effect of native language transfer by which the #CCV sequence, which is illegal in their native

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7 As can be noted, the total number of errors in this table is larger than that in Table 4 (268 : 225). This is because that more than one type of error might occur for one single item. For example, /twi/ becoming [t★ri] exhibits both vowel insertion and medial consonant replacement.

8 This type of error is rare, but it is interesting that in three out of the four items, the consonant inserted is, invariably, [s].

language, is transformed to the accepted #CV(CV).

4.1.2. Salience of the initial consonant

In errors involving deletion or replacement, our students show a strong tendency to delete and replace the second while preserving the first consonant. Figure 1 shows the prominence of C_1 over C_2 in our students' deletion and replacement strategies.

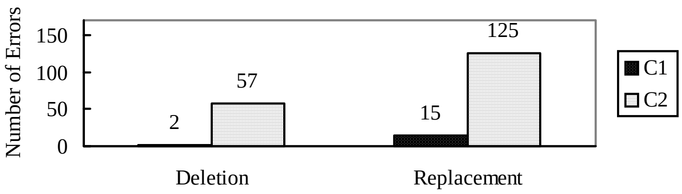


Figure 1. Preservation of C1

4.1.3 The /l/, /r/ asymmetry

Though they share the same degree of sonority and place of articulation, the two alveolar liquids /l/ and /r/ behave quite differently as the second consonant of a cluster. Of the 144 *Cl* clusters, 132 (i.e., 91.4%) are pronounced wrongly, whereas only 26 out of the 168 (i.e., 15.4%) *Cr* sequences are mispronounced by our subjects, as illustrated in Figure 2 below.

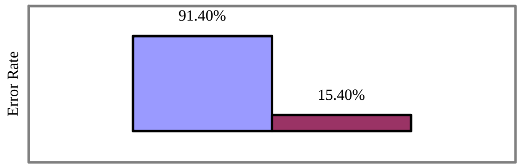


Figure 2 /l/, /r/ Asymmetry

Although point *i*, the preference for CV structure, can be deemed as an effect of L1 transfer, points *ii* and *iii* cannot since none of the preferred rules (C_2 deletion or replacement) or sequence (*Cr* over *Cl*) exists in the students' native language. On the other hand, these two tendencies can be regarded as a result of universal markedness, i.e., *Cr* is more marked than *Cl* (as will be discussed in detail in section 5 below) or developmental effects since the same phenomena are observed among native speakers of English (Kupin, 1982; Stemberger, 1986; Ingram, 1995).

4.2 The msd model

According to the MSD Model, the most difficult cluster type for EFL learners is the ‘nasal-glide’ combination since nasals and glides differ from each other by only 2 intervals on the sonority scale, which is the minimal distance allowed in English; while the least difficult is the ‘stop-glide’ sequence, which has a sonority distance of 4 and is thus the least marked. The hierarchy of the degree of difficulty predicted by the MSD Model is as follows:

10) MSD predictions:
Stop-Glide < Stop-Liquid, Fricative < Fricative-Liquid < Nasal-Glide
least difficult ……………………………………………………most difficult

At the first glance, our results seem to conform to the predictions. As shown in Figure 3, except for the slope between ‘F-L’ and ‘N-G’, ‘S-G’, which is predicted to be the least difficult, has a lower error rate (36.8%) than ‘S-L’ and ‘F-G’ (47.4%), whose error rate is, in turn, lower than that of ‘F-L’ (61%).

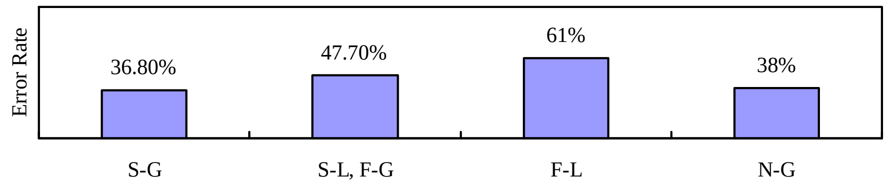


Figure 3. The error rates of the four types of clusters

However, such a conclusion is problematic. First of all, results of Kendall statistical computation, which compares the error rates in the four types of clusters on SPSS for MS Windows, show that only the difference between ‘S-L, F-G’ and ‘F-L’ is statistically significant ($p<.05$). (Comparison between ‘S-G’ and ‘S-L, F-G’: $p>.05$ ($p=.0833$), between ‘S-L, F-G’ and ‘F-L’: $p<.05$ ($p=.0209$)). Second, if we randomly choose one cluster from each type, as done by Broselow and Finer (1991), we will get a totally different result as shown in Figure 4, where the error rates of the clusters /dw/ (S-G), /dr/ (S-L), and /fr/ (F-L) are compared.

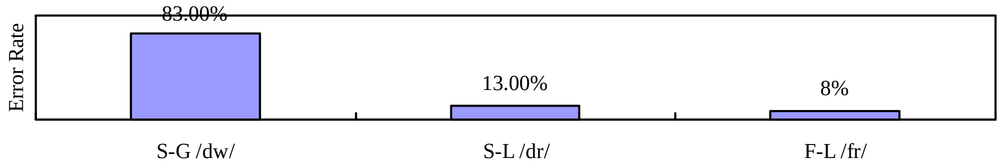


Figure 4. Comparison of the error rates of /dw/, /dr/, and /fr/

Another problem of the MSD Model is a theory-internal one. As also pointed out by Eckman and Iverson (1993), the sonority sequencing often incorrectly predicts the occurrence of impossible clusters (p. 240). For instance, in order to accommodate the 'nasal-glide' sequence, the MSD would propose a setting of 2 for Japanese, which at the same time, predicts the unaccepted 'stop-nasal', 'fricative-liquid', and 'stop-liquid'. 4.3 Typological markedness

As indicated in Table 6, none of the three assumptions made by the Typological Markedness correctly predicts the error rates in our study.

Table 6. Typological Markedness predictions for our study

TM predictions	Our results
vd stop-L/G > vl stop-L/G	vd stop-L/G < vl stop-L/G 63 errors < 81 errors
vd fricative-L/G > vl fricative-L/G	vd fricative-L/G < vl fricative-L/G 11 errors < 12 errors
vl fricative-L/G > vl stop-L/G	vl fricative-L/G < vl stop-L/G 68 errors < 85 errors

Apparently, neither of the two models makes correct predictions for our error rates, nor can either of them account for the three generalizations obtained from our results.

5. The OT analysis

In this section, we first briefly introduce the OT framework (Prince and Smolensky, 1993; McCarthy and Prince, 1993, 1994, 1995), then illustrate how OT deals with the syllable structures in both English and Chinese (To avoid complication, we will discuss only the constraints relevant to the present study.), and finally, examine how OT accounts for the results of our study.

5.1 A brief introduction of the OT framework

Unlike the rule-based approach, in which grammar is thought to consist of a set of ru les, OT assumes a set of **constraints**. All the constraints are universal and innate, i.e., th ey exist in every language. What a particular grammar is composed of is a special ranki ng of these existing constraints.

As an input enters the system, the GEN (generator) generates a set of potential candidates. These candidates are then evaluated by the Evaluator, or EVAL, which examines how they obey the universal constraints. The constraints in EVAL are violable and may conflict with each other. When the constraints conflict, the ranking becomes crucial. The systematic variation that we observe among languages is a result of the different rankings of such constraints. The candidate which violates the fewest or the lowest ranked constraints wins out to be the optimal output. The following sample tableau shows how constraints interact in generating the most qualified output from a given input.

Tableau 1

/Input/	Constraint 1	Constraint 2	Constraint 3
Candidate 1	*!	*	
Candidate 2		*	*!
☞ Candidate 3			*

The ranking between constraints 1 and 2 is crucial, as indicated by the solid line between them; whereas the dashed line between constraints 2 and 3 specifies that the ranking is not crucial. Such a ranking hierarchy is also shown as: Constraint 1 » Constraint 2, Constraint 3.

Constraint violations are represented by asterisks '*', and 'fatal' violations are indicated by '*!', which bans a candidate from being optimal. In Tableau 1, since Output 1 alone violates the highest ranked constraint (Constraint 1), which is thus a fatal violation, it is abandoned immediately. The shaded areas indicates that the constraints are no more relevant for Candidate 1 since it already violates a higher ranked constraint which is obeyed by other candidates. As for the unranked constraints 2 and 3, since Candidate 2 has more violations than Candidate 3 (2:1), Candidate 3 surfaces as the optimal output and is marked by the symbol '☞'.

5.2 OT constraints on English syllable structures

Basic OT constraints on syllable structures are the following (Prince & Smolensky, 1993, pp. 85-87):

11) **ONS**: Syllables must have onsets.
12) **-COD**: Syllables must **not** have a coda.
13) **NUC**: Syllables must have nuclei.
14) ***COMPLEX**: No more than one C or V may associate to any syllable position node.

There is a family of constraints, i.e., the FAITHFULNESS family, governing the relation between the input and output (PARSE and FILL), and another family, the DON’T ASSOCIATE family, which indicates the harmony of segments in specific syllable positions based on their sonority level (17 and 18) (ibid. p. 129).

FAITHFULNESS Constraints:

15) **PARSE**: Underlying segments must be parsed into syllable structure. (Deletion of segments is prohibited.)
16) **FILL**: Syllable positions must be filled with underlying segments. (Insertion of segments is prohibited.)

DON’T ASSOCIATE Constraints:

17) ***M/V**: Vowels may not associate to Margin nodes.
18) ***P/C**: Consonants many not associate to Peak (Nuc) nodes.

The constraints PARSE and FILL are later supplanted by **MAX-IO** (Every segment of the input has a correspondent in the output – No phonological deletion.) and **DEP-IO** (Every segment of the output has a correspondent in the input – Prohibits phonological epenthesis.) in the Correspondence model purported in McCarthy & Prince (1995). These two new terms are then to be used in the following discussion.

All the constraints are universal and violable; variations in syllable structure among languages is a result of the different rankings of the above constraints.

5.2.1 NUC, MAX-IO, DEP-IO, ONS, -COD, and *COMPLEX

In English, nucleus is obligatory whereas onset and coda are optional in a syllable. In OT, this means that the constraint NUC is unviolated and that MAX-IO and DEP-IO are ranked higher than ONS and -COD. The ranking of these constraints is:

19) NUC, MAX-IO, DEP-IO » ONS, -COD

The following tableaux illustrate the interaction of these constraints in selecting the optimal output for the inputs /aba/ and /bab/ in English.

Tableau 2

	/aba/	NUC	MAX-IO	DEP-IO	ONS
	<a>ba		*!		
	◊a.ba			*!	
	ab.a				**!
☞	a.ba				*

(Where the angle bracket '< >' denotes an unparsed segment, '◊' an empty node to be filled by some segment, and '.' the right edge of a syllable.)

Tabeau 3

	/bab/	NUC	MAX-IO	DEP-IO	-COD
	ba.b	*!			
	ba<b>		*!		
	ba.b◊			*!	
☞	bab				*

As mentioned above, English also allows complex onsets. That is, the violation of *COMPLEX is less serious than the violation of MAX-IO or DEP-IO, as demonstrated in the Tableau 4, and the ranking of the constraints we have discussed thus far is as (20):

Tableau 4

	/pli/	MAX-IO	DEP-IO	*COMPLEX
	<p>li	*!		
	p<l>i	*!		
	p★.li		*!	
☞	pli			*

20) NUC, MAX-IO, DEP-IO » ONS, -COD, *COMPLEX

5.2.2 Constraints on onsets -- Associational Constraints

There is a family of associational constraints in OT, which specifies the harmonic occurrence of certain elements in specific syllable positions. As indicated in Prince & Smolensky (1993, pp. 140, 159), the variation in the sets of possible onsets, nuclei, and codas among languages are governed by the parameters, $\pi_{Ons,}$ $\pi_{Nuc,}$ and π_{Cod}, which designate the most sonorous segment that can occur in onset, nucleus, and coda position, respectively. Since the most sonorous consonants permitted to occur in English onset position are glides, /w/ and /j/[9], we may postulate the following

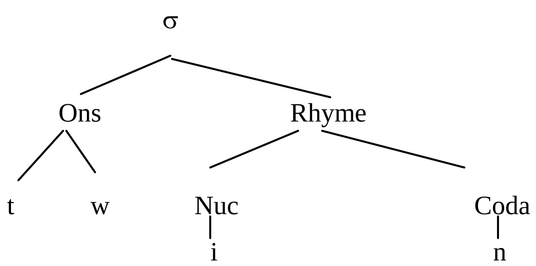
9 Due to limit of space, we will not go into detail for the asymmetry between the two glides /w/ and /j/

parameter:

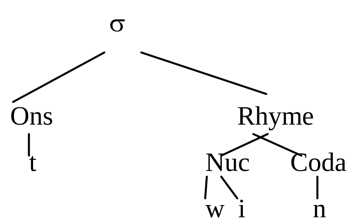
21) Onset Parameter π_{Ons} = /w, j/

Another set of associational constraints, or in a more constraint-based term, DON'T ASSOCIATE constraints, is encapsulated into the constraints: *M/V, which forbids vowels in the margin (onset and coda), and *P/C, which forbids consonants in the peak (nucleus). Except for word final position, where /l/, /n/, and /m/ may sometimes become syllabic, English obeys these two constraints. Thus for structures like /pjur/ or /fri/, the second consonants are automatically attached to the initial consonants to form onset consonant clusters. That is, for non-word-final position, *P/C is not violated and is ranked higher than *COMPLEX, hence the syllabification of /twin/ into (22) instead of (23).

22)



23) *



5.2.3 Constraints on complex onsets

(Barlow, 1997; Davis & Hammond, 1995; Harris, 1989; Wan, 1997; Wu, 1999) in the present study, but would like to leave this issue, especially its effects on L2 acquisition, for further research.

Possible combinations of consonants in word-initial onset position are listed in Table 3. As also noted above, except for those starting with /s/, all the clusters obey the Sonority Sequencing Principle (SSP) (Selkirk,1984), which requires onsets to rise in sonority toward nucleus (and codas to fall in sonority from the nucleus). We thus propose the Onset Sonority Sequencing Constraint (ONS SON), which is unviolated:

24) ONS SON: Onset should rise in sonority toward nucleus.

However, as revealed by the absence of clusters such as */pf/, */bm/ and */ks/, not all combinations that obey the SSP are acceptable onset clusters in English.

The MSD model cannot account for this, since, as mentioned above, it wrongly predicts the acceptability of 'stop-nasal' sequence, whose sonority distance is the same as the grammatical 'fricative-liquid". Adopting the associational mechanism in OT, we posit the following parameter setting for complex onsets, along with some revision of the Onset Parameter (21) that we set up in the previous section.

25) Onset Parameters (revised):

A. $\pi_{OnsC(1)}$[10] = /w, j/ B$\beta_{OnsC(2)}$ = /l, r/

where, unlike π, which denotes the most sonorous segment allowed as onset, β indicates the least sonorous sound that can occur as the second consonant (C_2) in a two-consonant onset cluster.

Another principle at work is the Obligatory Contour Principle (OCP), which bans combinations such as '*/pw/', '*/fw/', and '*/tl/'. With the exception of 'Cr' (/tr/, /dr/), which seems to be an unmarked combination (and which we will discuss in more detail later), we can formulate the following constraint, which forbids consonants with the same place of articulation to form onset clusters.

26) $*Ons/_{[PLA][PLA]}$

5.3 The OT account of the error types in our study

5.3.1 Language acquisition in OT

In OT, instead of rules, the grammar is composed of a set of innate and universal constraints, and language acquisition is the acquiring of the rankings of such constraints. Since the constraints are universal, when learning a second language, the learner does not have to learn new constraints. Instead, the learner's task is to 'rerank' the existing constraints, or, in other words, 'demote' certain constraints[11].

In the early stage of L2 learning, the constraint ranking of L1 may be transferred to L2, hence the effect of 'native language transfer', or both L1 and L2 rankings compete, i.e., sometimes it is the L1 ranking that is at work, and at other times, the L2 ranking is functioning. As the learner gradually masters the target language, the ranking is rearranged to more closely reflect the L2 grammar. The grammar or the ranking of the constraints that is in between the L1 and L2, and that develops between the initial stage of learning and the stage when the L2 grammar is fully acquired is referred to as "interlanguage".

As stated in our Introduction, such interaction of the NL, IL and TL cannot be captured within the rule-based generative phonology framework, in which the grammar of a specific language is a particular set of rules. Unlike OT constraints, all the rules are not universal. An L2 learners' NL might have a totally different set of rules from the TL, or, the two languages have similar sets of rules but different ordering. Thus according to the rule-based analysis, learning a second language is learning another set of rules. As for the interlanguage, observations from L2 errors reveal that learners might develop even another set of rules independent of either the NL or the TL. For instance, our subjects apply vowel insertion, consonant deletion, and consonant replacement in the IL, none of which exist in either their NL or TL. It is this "development of a new set of rules" that is problematic. Although these IL rules might be triggered by some universal preference for certain unmarked structures (e.g., CV or open syllable), the rule-based approach still provides no explicit account for *how* such IL rules are shaped, i.e., from *where* the learners *acquire* the rules (see Broselow et. al. 1998 for a detailed discussion of this issue.). Neither can it explain how these three *independent* sets of rules (NL, IL, and TL) interact, i.e., how the IL rules are transferred from the NL and finally developed to assimilate the TL rules.

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10 By C(1), we mean the single consonant or the first consonant in a two-consonant cluster.
11 According to Tesar and Smolensky (1996), all movements of constraints is downward, i.e., constraints

On the other hand, the above OT interpretation of language acquisition provides a clear picture of this interaction, which we will illustrate in more detail with the results of our study.

5.3.2 Basic syllable structure: *COMPLEX, MAX-IO, DEP-IO

Like English, Mandarin[12] allows onsetless syllables, hence the same ranking of the constraints MAX-IO, DEP-IO, and ONS[13] (27) as in English. Tableau 5 illustrates the derivation of the word '/ta.i/' (overcoat) in Mandarin:

27) MAX-IO, DEP-IO » ONS

Tableau 5

	/ta.i/	MAX-IO	DEP-IO	ONS
	ta.<i>	*!		
	ta. ◊i		*!	
☞	ta.i			*

As for the constraint *COMPLEX, the question of whether Chinese allows complex onsets is still hotly debated. While some consider the pre-nucleus glides (/w/, /j/, /y/) as part of the nucleus (Cheng, 1973), others suggest that they be associated with the onset (Bao, 1990; Duanmu, 1990; Lin, 1989) or both, i.e., they are part of the C slot dominated by an onset and also the V slot dominated by a nucleus (Chung, 1989; Yin, 1989). However, although data from Chinese L1 acquisition seem to support the onset hypothesis (Wu, 1999), our EFL production of the C-glide clusters suggest a different pattern. The stop-glide (/pj/, /kj/, /tw/, /dw/, /kw/), fricative-glide (/sw/), and nasal-glide (/mj/) onsets, which are supposed to exist in Chinese according to the onset hypothesis for Chinese glides, are simplified 36.8%, 54%, and 38% of the time respectively. It is improbable for students to make such high error rates for combinations that are legal in their native language. One possibility is that the structure of Chinese C-glides is different from that of their English counterparts. Therefore, although the status of glides in Chinese still needs further investigation, we would, based on our EFL data, assume the nucleus hypothesis, and tentatively propose the constraint ranking (28b) for

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can only be 'demoted', rather than 'promoted'.

12 Participants in the study are all native speakers of both Mandarin and Taiwanese. However, since variations between these two dialects do not affect our analysis, we will only discuss the structure of Mandarin for this moment.

Chinese. Thus, unlike English, in which MAX-IO and DEP-IO are ranked higher than *COMPLEX, they are ranked in the reverse order in Chinese, or at least in Taiwan Mandarin.

28) a. English ranking: MAX-IO, DEP-IO » *COMPLEX
b. Mandarin ranking: *COMPLEX » MAX-IO, DEP-IO

Such a difference in constraint ranking accounts for the high error rate (255/552 = 46.1%) in Mandarin speakers' production of English consonant clusters.

5.3.3 MAX and DEP

One of the strategies adopted by Mandarin speakers to avoid the unacceptable CC structure, or, to satisfy the *COMPLEX constraint, is to insert a vowel between the two consonants (#CCV → #CVCV). Among the 255 incorrect tokens produced by our subjects, 67, i.e., 26.2% of them exhibit errors of this type, which reveals that the ranking of their native language is still at work. However, while we see no effect of the ranking between MAX-IO and DEP-IO in native Mandarin forms, these two constraints are ranked as MAX-IO » DEP-IO for speakers who adopt vowel insertion. Compare the tableau of the target English ranking (Tableau 6) and the Mandarin ranking (Tableau 7):

Tableau 6. English ranking: MAX-IO, DEP-IO » *COMPLEX

/pri/	MAX-IO	DEP-IO	*COMPLEX
p<r>i	*!		
p★.ri		*!	
☞ pri			*

Tableau 7. Mandarin ranking for vowel insertion: *COMPLEX » MAX-IO » DEP-IO

/pri/	*COMPLEX	MAX-IO	DEP-IO
pri	*!		
p<r>i		*!	
☞ p★.ri			*

This tendency of Mandarin speakers to insert a vowel to avoid consonant clusters is also reflected in their translation of English names, as depicted in Tableau 8 for the derivation of the optimal form from English /kl☜r/ (Clare).

13 We will skip the discussion of coda since it is not relevant with our present analysis.

Tableau 8

	/kl☜(r)[14]/	*COMPLEX	MAX-IO	DEP-IO
	kl☜(r)	*!		
	k<l>☜(r)		*!	
☞	k<u>★</u>.lay.(r)			*

Another method utilized by Mandarin speakers to prevent consonant clusters is to delete one of the consonants (#CCV → CV) (59/255= 18.9%). Errors of this type is a reflection of the constraint ranking *COMPLEX » DEP-IO » MAX-IO. Compare the English ranking (Tableau 9) and the ranking of the Mandarin speakers who adopt consonant deletion (Tableau 10):

Tableau 9. English ranking: MAX-IO, DEP-IO » *COMPLEX

	/pri/	MAX-IO	DEP-IO	*COMPLEX
	p<r>i	*!		
	p★.ri		*!	
☞	pri			*

Tableau 10. Mandarin ranking for consonant deletion: *COMPLEX»DEP-IO»MAX-IO

	/pri/	*COMPLEX	DEP-IO	MAX-IO
	pri	*!		
	p★.ri		*!	
☞	p<r>i			*

5.3.4 Salience of the initial consonant:

As mentioned above, one of the strategies adopted by Mandarin speakers to make the #CCV structure conform to their native *COMPLEX constraint is to delete one of the consonants. As for which consonant to delete, our subjects show a strong tendency to delete the second (C_2) while preserving the first (C_1). In the 59 cases of consonant deletion, 57 delete the second whereas only 2 delete the first consonant. Such a tendency to preserve the initial consonant is also revealed in the replacement strategy. While there are as many as 123 occurrences of medial consonant replacement, only 15 tokens exhibit replacement of the initial consonant. Table 7 shows the prominence of C_1 over C_2 as we combine these two effects. (See also Figure 1.)

14 We ignore the singleton coda /r/ and the alternation of the vowel , since they are not our main concern (complex onsets) here.

Table 7. Salience of C_1

preservation of C_1	C_2 deletion	57	180/ 197 = 91.3%
	C_2 replacement	123	
preservation of C_2	C_1 deletion	2	17 / 197 = 0.8%
	C_1 replacement	15	

As depicted in the above table, of the 197 cases of consonant deletion or replacement, 180 (91.3%) display C_1 preservation while only 17 (0.8%) of them preserve C_2.

Such a resistance of C_1 to deletion and alternation is also observed in Cantonese loanwords by Yip (1993). Following Silverman's (1992) claim that sounds that are perceptually more salient (e.g., [s], and stops) are less likely to be overlooked than the less salient ones (e.g., [l], [r]), Yip proposes the constraint 'PARSE' with the definition 'Parse salient segments.' According to this constraint, liquids are underparsed when occurring after another consonant because in this position (*Cr*, *Cl*), they are 'faintly visible (or rather, audible)' (Yip, 1993, p. 278).

However, this constraint cannot account for the error types in our present study. As will be discussed in the next section, our subjects treat these two liquids /r/ and /l/ quite differently. Of the 144 *Cl* tokens, only 12 are correct; the error rate is 132/144 = 91.6%. As for *Cr* clusters, only 26 errors are found out of the 168 tokens (26/168 = 15.4%). More surprisingly, among the 132 *Cl* errors, 78 are of the type 'replacement of medial consonant' where 61 of them replace /l/ by [r] (or [r]-like sounds) (*Cl* → *Cr*). One might suggest that we revise Yip's proposal by saying that for some reason, /r/ is more salient for Mandarin speakers than /l/. Yet, as revealed by our subjects' production of word initial /r/ and /l/, 20 out of the 24 *r*-initial tokens are pronounced wrongly (the error rate: 20/24 = 83.3%), whereas no error is found for *l*-initial words. What is more, if /l/ and /r/ are 'faintly visible or audible', we might expect them to be deleted, however, only 14 of the /l/ (i.e., 14/144 = 0.9%) and 1 of the /r/ (1/168 = 0.05%) in the *Cl* and *Cr* are deleted. Obviously, the 'Parse salient' constraint cannot account for the preference for *Cr* and word initial /l/ over *Cl* and word initial /r/.

The salience of the word initial element can be analyzed in terms of another family of OT constraints, namely the "Alignment" constraints (McCarthy and Prince, 1993), which require that a designated edge of a prosodic or grammatical (morphological or syntactic) category be aligned or coincide with a designated edge of some other prosodic or morphological category. Following this alignment convention, we posit the constraint "ALIGN LEFT" as stated below to describe the "salience of word initial elements" phenomenon:

29) ALIGN-L: $[_{Stem} = [_{PrWd}$ (The left edge of the stem must coincide with the left edge of the prosodic word.)

This constraint also captures Yip's observation that even the least salient liquids exhibit a resistance to deletion when they occur word initially.

This constraint is ranked highly, and is never violated in either Chinese, English, or the Chinese-English Interlanguage. The following tableau illustrates how this alignment constraint elicits the form [pi] while inhibiting its competing candidate [li] when the constraints *COMPLEX and DEP-IO are still ranked highly in our subjects' interlanguage:

Tableau 11. The Interlanguage constraint ranking for the output [pi] :

/pli/	ALIGN-L	*COMPLEX	DEP-IO	MAX-IO
pli		*!		
p★.li			*!	
<p>li	*!			*
☞ p<l>i				*

Again, the alignment constraint is more adequate in capturing this general interlanguage or loan word pattern than the rule-based analysis, which needs at least two major rules (1. deletion of the second consonant, 2. replacement of the second consonant) to account for this phenomenon.

5.3.5 The /l/, /r/ asymmetry

The /l/, /r/ asymmetry discussed above can be summarized in the following table.

Table 8. Error rates for *Cl, Cr, #/l/, and #/r/*

	Error Rates
Cl	132/144 = 91.4%
Cr	26/168 = 15.4%
#/l/	0
#/r/	20/24 = 83.3%

Since Chinese has word-initial /l/ but lacks word-initial /r/, the asymmetry between word-initial /r/ and /l/ can be attributed to the effect of native language transfer, and the transfer comes from an associational constraint for onsets which is ranked highly in Mandarin (but not in English).

30) $*Ons_{/r/}$: The sound /r/ cannot occur as the onset of a syllable.

However, the discrepancy between /r/ and /l/ as C_2 cannot be explained in the same fashion because Chinese has neither *Cr* nor *Cl.* Rather, the difficulty of *Cl* and preference for *Cr*[15] may be due to some universal articulatory factors since the same effect is found among native English speakers. For instance, as indicated by Ingram (1995), children tend to replace the /l/ as in /ple/ by [w] ([pwe]). In OT, this *Cl* difficulty can be accounted for by constraint (31), which prevents the lateral [l] from occurring after another consonant in the onset position. This constraint is ranked highly in Chinese (though it's effect may not be observable in other languages like Brazilian[16]).

31) $*ONS_{C[lateral]}$: The lateral /l/ can not occur after another consonant in the onset position.

On the other hand, *Cr* is less marked. The unmarkedness of *Cr* is also reflected in the existence of clusters /tr/ and /dr/ (but not */tl/ and */dl/) which are supposed to be banned by the OCP effect (cf. Constraint (26)).

With the above assumption, it is understandable why most of our students choose to replace *Cl* by *Cr*. According to McCarthy and Prince (1994), this is the effect of the "Emergence of the Unmarked". Although both clusters are absent in their native language, at the early stage of Chinese L2 learners' acquisition of English, since the constraint *C[lateral] is still ranked highly, the learners automatically transfer the more marked *Cl* to the less marked *Cr*.

This constraint, however, is potentially conflicting with another correspondence constraint, IDENT-IO(F) (McCarthy and Prince, 1995), which demands that the features of the output segment be identical to the features of the input:

32) IDENT-IO(F): Output correspondents of an input [☞F] segment are also [☞F].

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15 or 'C + [r] like sound' since sometimes, this [r] is not a clear [r], but something between [r] and [w].
16 As pointed out by one of the anonymous reviewer, Brazilian children typically substitute [l] for /r/ even in consonant clusters.

For Chinese speakers who substitute *Cl* by *Cr*, the constraint *C[lateral] is ranked higher than IDENT-IO(F), and the constraints concerning syllable structures are reranked to more closely assimilate the target English ranking -- with the constraint *COMPLEX being demoted to become lower than DEP-IO and MAX-IO. Tableau 12 displays such constraint interaction:

Tableau 12. The Interlanguage constraint ranking for the output [pri] from /pli/:

/pli/	*C[lateral]	MAX-IO	DEP-IO	*COMPLEX	IDENT-IO
pli	*!			*	
p★.li			*!		
p<l>i		*!			
☞pri				*	*

5.3.6 The strength of OT in accounting for interlanguage variations

The constraints discussed above and their rankings in Mandarin, English, and the Mandarin-English Interlanguage are summarized below:

33) a. Mandarin ranking: *COMPLEX, $*Ons_{/r/}$ » MAX-IO, DEP-IO
 b. English ranking: MAX-IO, DEP-IO » *COMPLEX
 c. Interlanguage ranking:
  (i) *for those who insert a vowel between the two consonants*
  *COMPLEX, ALIGN-L ($[_{Stem} = [_{PrWd}$), MAX-IO » DEP-IO
  (ii) *for those who delete one of the consonants*
  *COMPLEX, ALIGN-L, DEP-IO » MAX-IO
  (iii) *for those who replace Cl by Cr*
  $*ONS_{C[lateral]}$, ALIGN-L, DEP-IO, MAX-IO » *COMPLEX, IDENT-IO(F)

The above interlanguage classification is an idealized picture of the constraint rankings, for, as we examine more closely the errors made by our subjects, many of them apply vowel epenthesis to some words and deletion or replacement to others. That is, at the time when the experiment took place, all the three interlanguage rankings stated in (33) might exist in a certain speaker's grammar. When an input #CCV enters the system, sometimes it is ranking (i) and at other times ranking (ii) or (iii) that works to generate the output. Such a discrepancy cannot be accounted for in terms of number of syllables (Broselow, Chen, and Wang, 1998; Lin, 1999, 2001; Wang, 1995), "recoverability of linguistic context" (Weinberger, 1987, 1994)[17], or task formality (Lin, 2001) since except for two items ('dreepy' and 'greepy') all the pseudowords are monosyllabic and all of them appear in the same type of the elicitation task (grammaticality judgment test).

Apparently, the rule-based approach cannot explain this inconsistency. First of all, it cannot account for where these rules originate, or, from where these rules are acquired since none of the rules (vowel epenthesis, consonant deletion and replacement) exist in either the students' native language or the target language. Second, it cannot explain why sometimes the speakers adopt vowel epenthesis while at other times it is consonant deletion or replacement that is applied at the same point of acquisition.

Within the output-oriented OT framework, however, this problem can be readily

17 although these two notions are very probable factors in determining EFL learners' choice of the two strategies vowel insertion and consonant deletion.

solved. Since the task of the learners is not to learn a new set of rules, but rather, to rerank the already existing constraints to conform to the grammar of the target language, at the early stage when the L1 grammar is still prominent and the L2 grammar is not yet mastered, all kinds of ranking are logically possible as long as the output reflects the preferred structure of L1. For instance, for outputs that exhibit a preference for CV structures, since both rankings *COMPLEX » MAX-IO » DEP-IO and *COMPLEX » DEP-IO » MAX-IO result in CV, these two rankings are equally probable. Although interlanguage is in fact, language (Adjemian, 1976), it is in a state of flux (Tarone, 1979), and this state of flux is best interpreted by the OT framework, but not the rule-based mechanism.

6. Conclusion

To see how well the average EFL Chinese speaker acquires English word-initial consonant clusters, we conducted an experiment to elicit the natural production of such structures by our restrictively selected subjects. Errors produced by our subjects exhibit both native language transfer and developmental effects. Three significant points can be drawn from the error rates and error types, namely, *preference for CV structure*, *salience of the initial consonant*, and *the /l/, /r/ asymmetry*. However, both hypotheses on EFL onset clusters, Broselow and Finer’s (1991) MSD Parameter-Setting and Eckman and Iverson’s (1993) Typological Markedness, make incorrect predictions for our error rates, and neither of them is capable of accounting for the error types found in our study. Our illustrations above applying the OT mechanism in accounting for our findings lend support to the now widely acknowledged notion of OT being a more encompassing model for such L2 phenomena or interlanguage variations (e.g., Broselow et al., 1998; Hancin-Bhatt & Bhatt, 1997; Hancin-Bhatt, 2000). With the assumption that the grammar of a particular language is a special ranking of universal constraints and that the task of an L2 learner is to rerank the already existing constraints, the OT framework explicitly captures the NL, IL, and TL interaction as well as the fluctuating state of the interlanguage, which cannot be accounted for within the rule-based generative phonology framework.

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Appendix A: PSEUDOWORDS

Nouns:

1. dwek: a kind of flower
2. preek: a kind of flower
3. treese: a kind of pen
4. freep: a kind of fruit
5. sleed: a kind of fruit
6. mupe: a kind of drink
7. threek: a kind of food
8. cleep: a kind of musical instrument
9. vute: a kind of drink
10. pute: a color
11. cupe: kind of musical instrument
12. buse: a kind of drink
13. blee: a kind of car
14. leet: a kind of clothing
15. weel: a kind of flower

Verbs:

1. fleese: a kind of sport
2. sween: a kind of sport
3. creen: a kind of sport
4. plee: a kind of sport
5. breeg: a kind of sport

Adjectives:

1. gleer: happy
2. dreepy: a color
3. shreek: frightened
4. twipt: tired
5. fute: a color
6. greepy: sleepy
7. kweel: spoiled
8. reep: sad
9. yeep: excited

Appendix B: THE TASK: GRAMMATICALITY JUDGEMENT TEST

You will hear 29 pairs of sentences. Listen to both and repeat the correct sentence.

1. a. I need a dwek. Do you have *one*?
   b. I need a dwek. Do you have *it*?
2. a. *We* like to fleese.
   b. *Us* like to fleese.
3. a. I like preek, but *he* likes rose.
   b. I like preek, but *his* likes rose.
4. a. John and *I* like to watch gleer movies.
   b. John and *me* like to watch gleer movies.
5. a. Where's the treese? I can't find *it* anywhere.
   b. Where's the treese? I can't find *one* anywhere.

a. Do *your* like freep or banana?
   b. Do *you* like freep or banana?

a. There *is* a dreepy cat in the room.
   b. There *are* a dreepy cat in the room.

a. There *is* one sleede and two apples on the table.
   b. There *are* one sleede and two apples on the table.

a. How much muke *is* there in the bottle?
   b. How much muke *are* there in the bottle?

a. *What* makes you so shreek?
   b. *How* makes you so shreek?

a. *Who* will you go to sween?
   b. *When* will you go to sween?

a. *How* often do you play creen?
   b. *What* often do you play creen?

13. a. *Why* do you like threek?
    b. *What* do you like threek?
14. a. *How* well can he play cleep?
    b. *What* well can he play cleep?
15. Q: a. Do you like to plee?
       b. Are you going to plee?
    A: Yes, I do.
16. Q: a. Are you twipt?

b. Is he twipt?

A: No, he isn't.

17. Q: a. Do you like this fute hat?

b. Does he like this fute sprill?

A: No, he doesn't.

18. Q: a. Is the vute in the kitchen?

b. Are the vutes in the kitchen?

A: Yes, it is.

19. Q: a. Can you find the colors pute and in this picture?

b. Have you found the colors pute and buse in this picture?

A: Yes, I can.

20. a. I like to breeg. It's so **exciting**!

b. I like to breeg. It's so **excited**!

21. a. The speech is so **boring**. It makes me greepy.

b. The speech is so **bored**. It makes me greepy.

22. a. Playing the cupe is so **interested**!

b. Playing the cupe is so **interesting**!

23. a. I **bought** some buse this morning.

b. I **will buy** some buse this morning.

24. a. Mark **buys** a new blee two days ago.

b. Mark **bought** a new blee two days ago.

25. a. Jane **ate** some kweel apple last night.

b. Jane **will eat** some kweel apple last night.

26. a. What's wrong with Jane? She **looks** reep.

b. What's wrong with Jane? She **looks like** reep.

27. a. **Do you like** leet? No, but I like hat.

b. **Are you like** leet? No, but I like hat.

28. a. Sam never eats weel. He only **likes** tulip.

b. Sam never eats weel. He only **is like** tulip.

29. a. John **look like** yeep. He just got a big prize.

b. John **look** yeep. He just got a big prize.