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Second language data and constraints on Manner: explaining substitutions for the English interdental*

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One of my favourite errors occurred in an American war film, subtitled in French. One of the soldiers peers into the distance, and another says, “Tanks?” The subtitle reads “Merci.”

John Edwards, *Multilingualism* (1994)

1. Introduction

The phonology of speakers learning a second language (L2) is well known to show imperfections, many of which are argued to be effects of interference from the grammar of the speaker’s first language (L1). The most straightforward effect in this “interlanguage” phonology is what is known as a *transfer* effect. This is the application of an obvious L1 rule to L2, such as when German speakers devoice the final obstruents of English words.

However, not all effects submit to this explanation. Consider the pronunciation of L2 sounds that don’t exist in the speaker’s L1. For example, the English interdentals, [θ, ð] are replaced either by [t] or [s] by speakers of different languages (with the voicing distinction maintained if L2 has a voicing contrast). Generally the substitution is consistent for speakers of a given language, so that, for example, speakers of German are reported to use [s] while Russian speakers use [t].

In a rule-based phonology such effects are disturbing on the face of it. Since there are no interdentals in the L1, there is no way the speaker as a child could have acquired a rule that changes the interdentals to anything else; there is no L1 data on which to base such a rule.

In an attempt to deal with such non-transfer effects, the second language literature has proposed two additional categories (see Ioup and Weinberger 1987 for a review.)

Developmental effects are changes that are argued to show the same phenomena we see in first language acquisition. And finally, *universals* are sometimes claimed to surface in interlanguage. For example, various studies have claimed that interlanguage shows a preference for open syllables even when both L1 and L2 allow closed syllables, due to the fact that CV syllables are universally unmarked.

But these additional categories do not solve the present problem: in fact, both universal and developmental principles appear to make the incorrect prediction that there should be only one pattern of substitution. All children acquire stops before fricatives, so if this were a

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developmental effect, all L2 speakers should substitute stops. Likewise, in a rule-based

framework universals are unviolated, so whatever universal is relevant, all speakers should do the same thing. This is clearly not the case.

Ioup and Weinberger claim that sound system substitutions show transfer effects, and the fact that there are different patterns, consistent for a given L1, suggest that this is indeed some kind of transfer.¹ But since there can be no L1 evidence for a rule changing sounds that do not occur in the language, these cannot be simple cases like applying the German final devoicing rule to get devoicing in L2. In cases like this arguments have been made for non-obvious transfer. A well-known case of this type of analysis is Broselow (1983). Broselow shows that the different patterns of epenthesis in English in speakers of two dialects of Arabic can be shown to be transfer under a more refined theory of syllabification. For the case at hand, Weinberger (1990) suggests that if we look at the sound system of each language and apply a certain mechanism of feature pruning, we can account for the different effects of interdental substitution in speakers of Japanese and Russian as an effect of the different L1 sound systems. This analysis was a considerable advance for its time. However, it requires a theory of underspecification that is not universally accepted (and it is unclear from Weinberger's paper how the learner can arrive at the correct underspecified representations). In addition, it requires an L2-specific mechanism of feature pruning.

I will argue that in OT we can achieve a more satisfactory analysis of this type of data. In this analysis we will need no L2-specific mechanisms at all. I will argue that in some languages we are seeing effects of "non-obvious" transfer and in others, of universals, but that both are an automatic result of the L1 constraint ranking. I will show that OT allows a precise formalization of the effects of universals in second language data. I will also show how the L2 effects are connected to those of L1 acquisition; thus all three types of interlanguage effects will be seen to come together in the analysis.

To be more specific, I will first argue that the changes differ in whether they

1. are faithful to the original manner: [θ] → [s]
2. result in a more unmarked segment: [θ] → [t]

I will then argue that:

1. [θ] → [s] only happens in languages where there is explicit L1 evidence for ranking of the constraints on Manner (so this is a "transfer" case)
2. [θ] → [t] in languages where there is no such evidence, and so shows the unmarked, default ranking of the relevant constraints (the "universals" case) - consistent with the facts from L1 acquisition.

Section 2 will briefly review the basic data for both first and second language acquisition. Section 3 introduces the required constraints. In section 4, I will show how the constraints result in [s] in Japanese and [t] in Thai. In section 5 I will then turn to Dutch, a more complicated case where [t] is substituted in onset and [s] in coda, and show how this effect and a

¹Analyses such as Lado 1957 and Hecht and Mulford 1987 claim that the sound is chosen which is closer given the sound system of L1. But no formal definition of 'closer' is given, and there is no straightforward way to formulate one. Concentrating on Place rather than Manner does not help: although [θ] is dental, it does not appear to be that case that [t] is chosen when L1 [t] is dental, showing faith to Place outranking faith to Manner. This is contradicted for example by French where [t] is dental, while French speakers are generally reported to substitute [s] (Ritchie 1968) (Thanks to Mits Ota for pointing this out.)

similar effect in L1 acquisition are the result of the emergence of additional markedness constraints affecting codas only. Section 5 will also briefly treat Italian, which superficially presents a counterexample.

2. Data

The following shows a few examples of the attested substitutions made for English interdentals by speakers of various first languages. (Lado 1957, Schmidt 1987, Altenberg and Vago 1987, Ritchie 1968)²

- (1) [t] substitution: Thai, Russian, Hungarian
[s] substitution: Japanese, German, Egyptian Arabic

All of these languages have both [t] and [s] in their inventories. So why do some choose one segment and some the other when encountered with the forbidden [θ]?

If claims about universals are to be made, we hope that they would be the same universals that are supported by the first language acquisition evidence. The L1 acquisition facts are clear when it comes to substitution of stops and fricatives: Fricatives are learned later, and are replaced by stops early on (Locke 1973, Vihman 1996, etc.). This is consistent with the evidence from sound systems on the relative markedness of stops and fricatives, where stops are also less marked than fricatives:

- (2) Sound systems in Maddieson (1984): All languages have stops, but not all have fricatives
Stops 317/317 100% Fricatives 296/317 93.4%

Given these figures the implicational relation is trivially obvious: if a language has fricatives it must also have stops.³ Thus, stops are the less marked in manner.

In the next section, I will discuss the theory of faithfulness to Manner that is necessary for these different substitutions to be possible. Then in section 4 I will apply the result to two of the cases above, Japanese and Thai.

3. The analysis

3.1 Markedness and basic Faithfulness ranking

Given the facts in the last section, the first assumption I will make is that stops are universally less marked than fricatives, giving us the following ranking determined by UG:

- (3) *[cont] >> *[stop]

² I ignore for now the cases of /f/ substitution that we often see in non-standard dialects of English; I know of no cases like this in L2 accents. In fact Hughes and Trudgill (1987) argue that at least some of these dialects in fact have underlying interdentals, which is then quite a different situation.

³Also possibly relevant is that within a given language there are usually fewer fricatives than stops: languages may have more Place or Laryngeal distinctions for stops than for fricatives but not vice versa.

I will also simply assume a constraint against the relevant nonstrident interdental fricatives that I will simply state as:

(4) *θ

Clearly there are additional issues for the statement of this type of constraint but I will not deal with them in this paper⁴.

Also fundamental is the fact that all of these languages do have stop/fricative distinctions - recall that they all have both /t/ and /s/ in their inventories - even though they don't have the particular fricative that is causing the L2 problem. Thus for all of these languages, manner faithfulness must outrank the markedness constraints (however we formulate faithfulness, which will be the subject of the next section):

(5)

/s/	Faith manner	*cont	*stop
+ s		*	
t	*!		*

With the ranking reversed, fricatives would be impossible, being neutralized to stops; none of the relevant languages have this ranking:

(6)

/s/	*cont	*stop	Faith manner
s	*!		
+ t		*	*

Thus, our analysis of substitution must be one that retains the faithfulness over markedness ranking for all L1s in question. Violations of faithfulness to manner will only be optimal when the higher ranked constraint against the interdentals is violated.

3.2 Faithfulness and [t] substitution: the problem

In this section I will show that without the correct statement of the faithfulness constraints, it is in fact impossible for ANY language to change the fricative interdentals to stops, which is clearly incorrect. I will argue from this that we need a constraint Faith Manner defined the class of three manner features, stop, cont, and strident. I will begin by showing that the simpler alternatives that do not refer to the Manner set as a whole cannot get the correct results.

First assume that the faithfulness constraint is Ident on single binary feature [cont]. As

⁴ I will not use simply the constraint *[-strident] since this would make predictions about the behavior of additional sounds for which I have no evidence.

explained above, faithfulness has to outrank markedness because all the relevant languages have to be able to maintain a stop/fricative distinction. Thus as we see from (7) all of them should show the substitution [θ] -> [s], which is incorrect:

(7)

/ θ/	*θ	IdentCont	*+cont	*-cont
θ	*!		*	
t		*!		*
+ s			*	

The change from fricative to stop incurs an IdentCont violation, which is fatal.

Next, we test whether there is a difference if we assume two privative features Stop and Cont (Lombardi 1990). First consider using Ident constraints. Since both Ident constraints have to outrank markedness to maintain the stop/fricative distinction elsewhere in the inventory, the fricative will again have to remain a fricative:

(8)

/ θ/	* θ	IdentCont	IdentStop
θ	*!		
t		*	*
+s			

The candidate [t] violates both IdentCont (it's not Cont, when the input was) and IdentStop (it's Stop, and the input wasn't). The candidate [s] violates neither. So no reranking will make [t] optimal.

Different assumptions about the features alone, then, do not solve the problem. We need also consider different formulations of faithfulness. The obvious alternative would be Max/DepFeature constraints (see Lombardi to appear and references therein). However, this results in the same problem. The change to a stop incurs two violations, by both losing Cont and adding Stop; the change to a fricative incurs none, so no ranking of faithfulness will make the stop optimal:

(9)

/ θ/	MaxCont	DepCont	MaxStop	DepStop
t	*			*
+s				

We see then that with these just two features, even varying the specific formulation of the features and of markedness, there seems to be no constraint ranking that will allow [t] as a substitution for [θ], which is clearly incorrect.

3.3 [strident] and the formal solution

In this section I will argue that part of the difficulty above is that an additional feature, Strident, is crucial to the analysis. But simply introducing an additional constraint demanding faithfulness to Strident is not sufficient to achieving an explanatory analysis. Recall that the problem was that no ranking would give the substitution [θ] -> [t]. It is possible to get this result with something like high ranked Dep Strident:⁵ it's forbidden to add Strident, so the lower ranked violation incurred by the change to a stop is no longer fatal.

(10)

/θ /	* θ	DepStrident	faith stop, cont
+t			*
s		*!	
θ	*!		

⁵ IdentStrident would only have this effect here if we assume that /t/ is [-strident], thus incurring no violation. I assume instead that that only fricatives have a value for [strident] by definition. But even if we made the former assumption, the approach has the same problem indicated in the text that the ranking seems to be unlearnable.

This assumes /s/ is marked [strident] even in languages with no stridency distinction, which could be a matter for argument. But the real problem is, what would be the evidence for ranking DepStrident over faithfulness to Stop and Cont in a language with no stridency distinction? It seems unlikely such evidence would be available to the language learner. Concluding that speakers that substitute [t] are using an unlearnable ranking is obviously not a clear advance over requiring them to be using an unlearnable rule.⁶

Concentrating on faithfulness alone seems not to be sufficient. Something other than faithfulness must be crucial. In order to solve this, consider again the parallel to first language acquisition. It appears that what is fundamental to [t] substitution is the same thing that we see in child language: the unmarked Manner is preferred. Thus what is needed is a grammar that will allow for emergence of the unmarked Manner: The markedness constraints must be lower ranked than faithfulness, because the languages do have stop/fricative distinctions, but when a higher ranked constraint forces violation of faithfulness, we see the effects of the low ranked constraint hierarchy *[cont] >> *[stop].

In order to achieve this we need a faithfulness constraint in the position of C in the following tableau that will give the indicated violation marks:

(11)

/θ/	*θ	C	*cont	*stop
θ	*!		*	
+t		*		*
s		*	*!	

I propose that the constraint is Ident Manner with stop, cont, strident as the Manner features.

(12)

/θ/	*θ	Ident Manner	*cont	*stop
θ	*!		*	
+t		*		*
s		*	*!	

Including [strident] as part of the class is crucial, because it is the reason [s] incurs a faithfulness violation. The problem with the approaches in the previous section was that the change to [s] was always more faithful than the change to [t], and it was not possible to rank the constraints so that [t] was optimal. This constraint solves the problem, as we see in the tableau.

⁶ Assuming this to be some kind of initial default ranking also seems unjustified; even if we assume such rankings to exist within faithfulness constraints, instead of just between markedness and faithfulness as assumed in the OT acquisition literature, why should faithfulness to the less common distinction, Strident, be initially ranked *above* faithfulness to the basic stop/cont distinction?

[t] violates IdentManner because it changes [cont] to [stop], and loses or changes [+strident]. [s] violates IdentManner because the value for [strident] is changed. Since both violate this constraint, the effects of the lower ranked manner markedness hierarchy emerge, and the optimal output is the less marked stop.⁷

3.4 [s] substitution

The proposed constraints now allow a grammar that effects a change from [θ] -> [t]. We now must turn back to the alternation [θ] -> [s], and ensure that the proposed constraints still allow that as well.

It would of course be possible to achieve this by leaving the faithfulness constraint alone, and reranking the markedness constraints:

(13)

/ θ/	* θ	Ident Manner	*stop	*cont
θ	*!			*
t		*	*!	
+s		*		*

But recall that I have argued above that stops are universally less marked than fricatives. It is hard to see how this can be true if the markedness constraints are freely rerankable, which would mean that languages would get to choose whether stops or fricatives are less marked. This seems to be simply wrong.

Instead, in order to address this problem, I first turn back to the question how to categorize this effect as transfer/universal/developmental.

I suggest that since the change /θ /-> [t] is what we see in child language, we ought to view this substitution as a universal effect. In OT terms, then, I propose that this means that the child begins acquisition with the grammar that gives this result, and if no data to change this is ever heard, it will simply remain in the grammar for life. Thus, when English as an L2 is encountered, the effects of this initial state of UG will emerge with problematic segments like [θ].

Then, in contrast, languages that change / θ/ -> [s] must be different; since their ranking is *not* what the child starts with, the L1 data must contain evidence for the required ranking. Thus, this case will be a more typical transfer effect, but as seen in OT terms. L1 has some

⁷ Note that is not exactly Padgett's (1995a,b) conception of feature classes, which includes the notion of gradient violability. The latter would give [t] multiple violations of Ident in (12) -- at least two if violations are calculated as I do below for the components of this constraint-- and this would not give the correct result. But also note that as far as I can tell, the multiple violations of faithfulness in the Padgett (1995b) analysis make no difference to the results, in contrast to the crucial multiple violations of the constraints demanding assimilation. So a possibility is that this IS a Padgettian feature class, but that faithfulness constraints are not gradiently violable like markedness constraints.

phonology affecting stops and fricatives that prompted a reranking; this language-specific ranking is the one whose effects are being seen on the interdental in L2.

Of course, because we are formulating the analysis in OT, in some sense both kinds of effects are transfer effects: this is why we will not need any L2 specific mechanisms. The constraint rankings needed for L1 in each case will have an effect on L2 inputs without any additional rules or principles. But it is nevertheless also important to distinguish the two situations. Since languages that show the stop replacement retain the ranking of the initial state of the grammar, there need be no evidence in the L1 data for the speaker to have arrived at the ranking in (12). In contrast, languages with the fricative replacement must have some kind of L1 stop/fricative phonology that gave evidence that resulted in a reranking. We now turn back to the question of what the particular reranking is in the latter case.

Recall that we cannot rank the IdentManner constraint lower than markedness (because the L1 sound systems have a stop/fricative distinction) and we cannot rerank Markedness as in (13) (because the markedness ranking is universal). Therefore we can't simply rerank the constraints in the previous in order to get [s] as the optimal substitution, which seems at first glance rather disastrous.

But recall that we had many possible tableaux in section 3.2 that did allow this effect: all those with separate faithfulness to Stop and Cont. I propose then that the initial constraint ranking given by UG contains the unitary constraint IdentManner, but languages also have the option of exploding this constraint into its faithfulness constraints to its component features. This option will allow a grammar that gives the [s] output:

(14)

/θ /	* θ	IdentCont	IdentStop
θ	*!		
t		*	*
+s			

Thus, the prediction is that in languages that have some positive L1 evidence for splitting IdentManner into IdentCont and Ident Stop, we will see the transfer effect of [s] substitution.⁸

To sum up, then, at the first stage of L1 acquisition when markedness is ranked above faithfulness (see e.g. Gnanadesikan 1995), the child starts with the unitary IdentManner constraint. This gives the initial stage of child language with no stop/fricative distinction:

⁸ I assume that the change from /θ/ to /t/ incurs an Ident Strident violation: since only fricatives have a value for [strident] by definition, changing from [-strident] to a segment unspecified for [strident] is a faithfulness violation. This has the result that the relative ranking of IdentStrident and the other Faithfulness constraints has no effect on the outcome, since the marks of [s] are a subset of the marks of /t/. I thus omit the additional constraint here for simplicity.

(15)

/s/	*cont	*stop	IdentManner
s	*!		
+t		*	*

When the stop/fricative distinction is acquired, these basic faithfulness and markedness constraints are reranked:

(16)

/s/	IdentManner	*cont	*stop
+s		*	
t	*!		*

What we have here is the same ranking as tableau (12): the ranking that will give [t] as the substitute for forbidden fricatives like the interdental. If there is no further L1 evidence to change this grammar, then, what we will see in L2 is stops replacing []. But on further evidence in the L1 phonology, such as we will see in the next section, there may be explosion of the Manner constraint. This may result in the ranking in (14), and thus /s/ substitution in L2.

We now have a theory of manner faithfulness that gives the correct results. We have a default ranking that allows the change to [t], which is consistent with the markedness and child language facts. We also have a reranking possibility that gives the alternative [s] substitution that we see in some languages.

4. Exemplification

The conclusions of the previous section make empirical predictions about the relation of L1 phonology to L2 substitutions.

High ranking of IdentManner, a constraint violated by any change of Stop, Cont, or Strident, gives the L2 substitution [θ] -> [t]. This is the default ranking: the only L1 evidence needed to arrive at this ranking is any distinction between stops and fricatives.

It is possible on positive L1 evidence to explode the IdentManner constraint and rank the component faithfulness constraints individually. This may result in a ranking that gives [θ] -> [s] when the forbidden sound is encountered in L2.

Thus, the prediction is that if L1 has no evidence for exploding Ident Manner, because no phonological alternations involving stops, affricates and fricatives require it, speakers of such a language should substitute stops for English [θ]. In contrast, the substitution [θ]-> [s] should only arise when L1 has relevant alternations that require ranking the manner faithfulness constraints separately.

In this section I will look at two languages that confirm this prediction. Japanese shows [θ] -> [s] and has a stop/fricative alternation that requires the separate ranking, as predicted. The other, Thai, shows [θ] -> [t], and appears to have no phonology that would require the separate ranking of constraints. In the following section some more complicated cases will be addressed.

4.1 Japanese

Ito and Mester (1995) discusses the affrication of /t/ to /ts/ before [u] in Japanese. In both Core and Periphery (loan vocabulary) strata, /t/ is disallowed before /u/. This is analyzed as due to the interaction of a constraint on CV linkage (*TU below) and a markedness constraint against the affricate (*TS). The two strata differ in their treatment of /ts/ elsewhere: In the Core vocabulary /ts/ is allowed only before /u/ as an allophone of /t/; in the Periphery /ts/ is phonemic, allowed before all vowels.

Ito and Mester argue that the ranking of the relevant constraints in the loan vocabulary stratum is *TU >> FaithFeat >> *TS:

(17)

/tu/	*TU	FaithFeat	*TS
tu	*!		
+tsu		*	*

This ranking is enough if we only look at the candidates [tu,tsu]. But what about [su], which obeys both of the markedness constraints?

(18)

/tu/	*TU	FaithFeat	*TS
tu	*!		
tsu		*	*!
+su		*	

This gives the incorrect result that [su] is optimal. In order to correct this we must look in more detail at the precise implementation of the constraint they call “FaithFeat”.

Of the choices available to us under the proposal in this paper, it is clear that the unitary constraint IdentManner is not the correct featural faithfulness constraint to use: It would give the same violations as FaithFeat in the previous tableau. Rather, we must separate faithfulness to [stop] and [cont]:

(19)

/tu/	*TU	IdentStop	IdentCont	*TS
tu	*!			

+tsu			*	*
su		*!	*	

This gives the correct result. Changing /t/ to either a fricative or an affricate will give a form that obeys *TU. Both candidates violate IdentCont, as they have added a value of [cont] that was not in the input. But [su] has an additional violation of IdentStop, since it has lost [stop], that [tsu] does not have, since it has retained [stop] and merely added a new [cont] value. Thus the violation of IdentStop for candidate [su] is fatal ⁹.

Thus, with faithfulness to Stop and Cont evaluated separately, the correct optimal output is chosen when we consider the wider range of *TU-obeying candidates. This was not possible with a unitary manner faithfulness constraint as in (18). This ranking also allows underlying /ts/ to be retained elsewhere, as is correct in this stratum: since the only relevant markedness constraint in the context of other vowels is bottom-ranked *TS, no violation of faithfulness is allowed:

(20)

/tsi/	*TU	IdentStop	IdentCont	*TS
ti			*!	
+tsi				*
si		*!		

Turning to the Core vocabulary, where /ts/ is allowed only before /u/, Ito and Mester give the ranking *TU >>*TS >> FaithFeat. In the revised analysis here, we will get this result slightly differently with *TS outranking just the faithfulness constraint IdentCont¹⁰:

(21)

/tu/	*TU	IdentStop	*TS	IdentCont
tu	*!			
+tsu			*	*
su		*!		*

⁹ As the reader can see from (19), it is not crucial for IdentStop to be ranked above IdentCont, but the comparison to (18) shows that it is essential for them to be *separate* constraints.

¹⁰ In later work (Ito and Mester 1999) and in the work of Fukazawa (1999), differences in vocabulary stratum are argued to be the result of having different faithfulness constraints that apply to different stratum, rather than the same faithfulness constraints in different rankings. This proposal allows us to retain the assumption that the grammar of any language is a single total ranking of constraints. As the effect is the same - the relevant faithfulness constraint is differently ranked with respect to markedness - for simplicity I will just show the different rankings in the text without adding the relativization of the constraint names to different strata.

Again, the revision is necessary because Ito and Mester do not consider the candidate [su]. It will incorrectly win if both featural faithfulness constraints are below *TS:

(22)

/tu/	*TU	*TS	IdentStop	IdentCont
tu	*!			
tsu		*!		*
+su			*	*

The ranking I propose for this stratum will also give the correct effect that /ts/ will neutralize to /t/ elsewhere:

(23)

/tsi/	*TU	IdentStop	*TS	IdentCont
tsi			*!	
+ti				*
si		*!		*

Thus, Japanese does have L1 phonology that requires the language learner to ranked IdentStop and IdentCont separately, rather than retaining a unitary high-ranked IdentManner. And, as predicted with such a grammar, Japanese speakers substitute [s] for [θ].

4.2 Thai

In Thai (Noss 1964), the stop [t] is substituted for [θ]. The analysis predicts that therefore this should be a language that retains the unitary IdentManner constraint rather than exploding it into separately ranked constraints on the individual features. The only relevant L1 segmental phonology that I am aware of is that fact that there is no stop/fricative distinction in the coda. There are various ways to formulate this restriction, but as I will show, all are successful when using unitary IdentManner.

A restriction on fricatives in coda seems to be fairly common cross-linguistically, and makes sense as a requirement that codas be unmarked in Manner (see more discussion in section 5). Some other languages that forbid [+cont] in coda are (Lombardi 1995): Korean, Sui (China), and Lushai (Tibeto-Burman).¹¹ This effect could be formalized as either the result of positional faithfulness or positional markedness.

In a positional faithfulness approach (Beckman 1998, Lombardi 1999), high ranked IdentOnsetManner will preserve the stop/fricative distinction in the onset, but it will be neutralized in the coda to the less marked stop:

¹¹ Additional evidence for this preference is found in Kiowa in the analysis of Zec (1995) who proposes a coda condition; Steriade's (1988) analysis of Nancowry shows a similar effect.

(24)(hypothetical input)

/pis/	IDOnsManner	*cont	*stop	IdentManner
pis		*!		
+pit			*	*

A positional markedness approach would entail a CodaCondition on Manner, like the Coda Condition on Place proposed by Ito (1986) (see also e.g. Ito and Mester 1994, Lombardi to appear for OT uses):

(25) CodaCondition on [cont]:

/pis/	CondCond[cont]	IdentManner
pis	*!	
+pit		*

A slightly different way to formulate this would be to a coda constraint on the Manner class, which would then result in a change to the unmarked Manner (see Lombardi to appear for a similar analysis of Place neutralization):

(26) CodaCondition on Manner:

/pis/	CodCndManner	*cont	*stop	IdentManner
pis	*	*!		
+pit	*		*	*

As these tableaux show, all of these approaches give the correct result with a unitary IdentManner constraint; there is no need to ranked faithfulness to manner features separately. And as this predicts under my analysis, Thai shows [t] as a substitute for the English interdental.

5. Additional cases

5.1 Dutch.

All of the examples so far show uniform substitutions regardless of position. In contrast, Dutch is reported to show differential substitution of the stop in onset and the fricative in coda. (James 1984). Interestingly, a similar effect is also reported in Dutch L1 acquisition: Fikkert (1994, 1998) claims that children acquire fricatives in coda before they acquire stops in coda, although stop and fricative onsets are acquired at the same time.

Other languages demonstrate this preference in L1 acquisition for at least some children as well. Velleman 1996 discusses processes of metathesis in children language that result from

a preference for fricatives to be word-final, and cites references to data in English, German, Dutch and French. Studies that report a preference for word-final fricatives in acquisition of English include Edwards 1996, Dinnsen 1996 (and many references therein)¹²

Thus, there seems to be a preference for coda fricatives over coda stops that sometimes emerges in acquisition, and that is demonstrated by the Dutch L2 pattern of substitution for the English interdental.

This effect can be seen as the result of the emergence of additional markedness effects on stops and fricatives. In addition to context-free markedness constraints like *cont and *stop, features may be subject to different positional markedness effects. In this case, what is relevant is that codas are arguably subject to two conflicting types of markedness constraints:

They are moraic: so prefer to be sonorous
 They are codas: so prefer to be unmarked

Essentially, the first requirement makes codas want to be [cont]; the second, which we saw above in the analysis of Thai, makes them want to be [stop]. As I will show, the former requirement is what causes the effect we see in Dutch, and the latter why we don't see the same effect in all languages.

The preference for moraic consonants to be more sonorous is formulated as a markedness hierarchy by Moren (1999) the relevant part of which is given in (27):

(27) *Mora[stop] >> *Mora[cont] >> *Mora[son].....

Because this hierarchy will not affect onsets, which are not moraic, it is possible for there to be a stop/fricative distinction in onset at the same time that only fricatives are allowed in coda, if the hierarchy is ranked above context-free markedness, and faithfulness is below it:

(28)

/pit/	*M[stop]	*M[cont]	IdManner	*cont	*stop
pit	*!				*
+pis		*	*	*	

Either IdentManner >> *cont is required to maintain the stop/fricative distinction in onset, or else high ranked positional IdentOnsetManner. In either case, since onsets are not affected by the moraic hierarchy, a change will be fatal:

(29)

/pi/	*M[stop]	*M[cont]	IdManner	*cont	*stop

¹² Not all studies of Dutch L1 acquisition show this order effect, and Fikkert attributes this to methodological differences. However, this may just be one of the cases in which there is some variability in acquisition sequence for different children; for example, not all English-learning children show this effect either, e.g. Amahl in Smith (1973) does not.

fi			*!	*	
+pi					*

In the adult grammar, both coda stops and fricatives are permitted, so IdentManner has been promoted above the moraic hierarchy. However, the effect of the hierarchy will emerge when the L2 learner is presented with the forbidden English interdental fricative in coda:

(30)

/boθ/	* θ	IdManner	*M[stop]	*M[cont]	*cont	*stop
boθ	*!			*		*
bot		*	*!			*
+bos		*		*	*	

But again, in onset position, the moraic hierarchy is irrelevant. Thus, context-free markedness will make the decision, and the substitute will be a stop:

(31)

/θ i n/	* θ	IdManner	*M[stop]	*M[cont]	*cont	*stop
θ in	*!				*	
sin		*			*!	
+tin		*				*

The emergence of this universal effect of moraic consonant preference is visible in the Dutch L2 data, but we do not see it in the other languages above. This is due to independent properties of the languages in question. As noted above, the moraic markedness scale is not the only type of constraint that may affect coda consonants. As we saw above in the analysis of Thai, there are languages that do not allow coda fricatives. Thus the constraints preferring the coda to have an unmarked manner take priority over those that prefer it to be more sonorant. This L1 ranking in Thai, applied to the L2 data, means that stops will be the preferred substitute in the coda as well as the onset, in contrast to Dutch.

Different considerations account for the absence of such an effect in Japanese. Japanese does not allow syllable-final obstruents (except for geminates). We will obviously not see an order of acquisition effect in the L1 data for syllable final stops and fricatives because syllable final stops and fricatives are never acquired. And for the L2 data Japanese has exploded reranked the Manner faithfulness constraints so that ALL substitutes are [s], in both onset and coda, so it is obviously not possible to see a differential preference for fricatives in coda.

Thus, a number of factors need to coincide for the moraic markedness effect to be visible,

and these factors are absent from the other languages discussed¹³.

5.2 Italian¹⁴

The hypothesis in this paper is difficult to absolutely confirm because to some extent it requires us to prove a negative. In the case of [s] substitution we expect to find positive evidence of relevant phonology involving Manner. But in the case of [t] substitution the prediction is that we will *not* find phonology involving separate ranking of Manner faithfulness. In such cases there is always the worry that further investigation might reveal a disconfirming process. Italian is interesting in this respect because there is a within-language contrast of phonology relevant to the Manner constraints.

Italian is reported to show the stop substitution. (Flege, Munro and MacKay 1996; for similar data on loans used by bilingual Italo-Canadians, Danesi 1985). The phonology of the languages shows some familiar affrication of stops.

(32) [amiko, amiç i] ‘friend, msc sg, pl’ [porko, porç i] ‘pig, id.’

As we saw in Japanese, a language with affrication needs to have separate ranking of the Manner constraints, and thus is predicted to have the fricative [s] substitution. Why, then, does Italian use the stop?¹⁵

In fact, the affrication process in Italian is not at all general. In Japanese, it is totally impossible for unaffricated /t/ to occur before the relevant vowel in the relevant stratum. In Italian, in contrast, there is no general restriction of [t] before [i]; what’s more, the process does not even occur in all derived environment contexts:

(33) [poko, poki] ‘small, msc sg, pl’ [varko, varki] ‘stage, id.’
[ki] ‘who’

As we see from these examples, not even all words undergo affrication when the masculine plural suffix is attached.

How to account for this kinds of different behavior of specific roots in OT is beyond the scope of this paper (it is not a consistent difference in vocabulary stratum as in Japanese, as we see the same prefix behaving inconsistently). It may require faithfulness constraints specific to certain roots - these would have to be exploded Manner constraints, but ones that would have no effect on phonology outside these roots. It may require something special about the

¹³Another consideration is that this effect should obviously only be visible in languages where codas are moraic. The stress system of Dutch treats closed syllables as heavy, indicating that they are moraic. (There are unresolved problems, such as the fact that the stress system seems to treat long vowels as light, but this is irrelevant for the present purpose.)

¹⁴ Thanks to Frida Morelli for data and discussion.

¹⁵Unlike Japanese, there is also a change of major Place here, so the constraints on Place faithfulness would be ranked differently, but separate ranking of the Manner constraints are still required to result in the change to an affricate.

representation of these roots. Or it may simply be the case the the process is not productive and is memorized for particular forms.

Whatever the solution to the exceptional roots, the contrast with the more general phonology of the language shows that Italian must have the ranking in (12) like Thai, in order to preserve the stop/affricate contrast in all positions in cases other than the specific roots that alternate. English words submitted to this grammar by the L2 speaker will thus be affected by this ranking, and we expect to see the stop substitution.

6. Conclusion

In this paper, I have argued that OT allows a more explanatory approach to second language phenomena than was allowed by rule-based phonology. The latter often required additional rules to account for second language accent, rules which often were unlearnable on the basis of first language data. In contrast, an OT ranking of constraints can account for second language data without additional assumptions.

In the case of the substitutions for English interdental, I have argued that we must see the stop substitution as the primary, universal approach: This is the substitution used by children, who pass through a stage with no fricatives; this is a result of a universal markedness relationship, that stops are the less marked manner compared to fricatives.

Thus, L2 speakers who substitute stops are showing a universal effect. Their grammars are using the initial ranking supplied by UG; it must be that nothing in their L1 data led them to rerank the relevant constraints. L2 speakers that substitute fricatives, in contrast, must be showing a more explicit transfer effect: something in the phonology of their language prompted a change from the default ranking.

I argue on this basis that we must adopt a particular formulation of constraints on faithfulness to Manner. The initial state of the grammar must contain a unitary IdentManner constraint, including faithfulness to Stop, Cont, and Strident. Furthermore I argue that one reranking possibility is that this constraint may be exploded into three separate constraints regulating faithfulness to the individual features. I show that only this assumption allows us to construct any grammar that will allow the fricative /θ / to change to the less marked stop manner.

Obviously much more work remains to be done, but I hope to have shown that OT has the potential to allow a satisfying analysis of an area of L2 phonology that has never made sense in rule-based phonology in terms either of transfer or of universals; in an OT analysis we can show that one type of output, [t], shows the action of universals (the universal, and that the other, [s], shows transfer. I also hope to have shown that second language phonology is phonology - that is, that at least some of the data can lead to hypotheses about UG (the IdentManner constraint) that can be tested on L1 data.

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