Segmental phonology in OT (part 1)

In the rule-based model of phonology that we were using before:

- We modeled **complementary distribution** by identifying a **basic form of the phoneme** (the allophone with the "elsewhere" distribution) and proposing a **phonological rule** to derive the **context-specific allophone**. We also had to include some kind of stipulation (or redundancy rule) in our grammar to allow **only basic ("elsewhere") allophones to appear in URs**.
- For cases of **contrastive distribution**, we proposed two distinct phonemes (and had no rules to neutralize them with each other).
- Finally, we saw that (contextual) **neutralization** is a situation that combines aspects of both complementary and contrastive distribution. The difference here is that the context-specific allophone of one phoneme happens to be the same as the allophone of a different phoneme in that same context.

(See the handout "Determining the distribution of segments..." to review these concepts.)

Here, we will consider how to model the complementary distribution pattern in the OT framework, with respect to the velar/palatal alternations in the Greek data set. In part 2 of this handout, we will consider the implications of our Greek analysis for factorial typology and other patterns of distribution.

1. Complementary distribution

A. The context-specific allophone

In the Greek problem, [k] is the elsewhere allophone and [c] is the context-specific allophone (it appears only before front vowels, [–back]). So if we start from an input like /keri/, we need to ensure that the surface form (output) is [ceri], not *[keri].

As we saw in class, this pattern motivates two constraints. One, IDENT[COR], is a faithfulness constraint for the feature [CORONAL]; there is a separate IDENT constraint for each individual feature in our phonological model. The other, NOVELAR+FRONTVOWEL, is a markedness constraint that penalizes a sequence of velar consonant followed by front vowel.

- IDENT[COR] — Assign one * for any case where an output segment and its input segment differ with respect to the feature value for [CORONAL]
- NOVELAR+FRONTVOWEL — Assign one * for any sequence of segments [DORS] [–bk] in which the [DORS] segment is not also [COR]

One piece of the constraint ranking that we need for the Greek pattern is NOVELFRV >> IDENT[COR]. This ranking ensures that in Greek, being palatal before a front vowel is given a higher priority than keeping the input specification for [COR] intact.

(1) [ceri], 'candle' *ranking argument for NoVelFrV >> Id[cor]*

/keri/	NoVelFrV	Ident[cor]
a. keri	* W	L
☞ b. ceri		*

Unsurprisingly, we still get the right result even if we start with an input that already contains the context-specific allophone in its surface context. (Why would we even consider this input, since it contains something other than the elsewhere form of the allophone? See section 1.B.)

(2) [ceri], 'candle' *right result is produced with current ranking*

/ceri/	NoVelFrV	Ident[cor]
a. keri	*!	*
☞ b. ceri		

B. The elsewhere allophone

At first, the ranking NoVelFrV >> Ident[cor] might seem to be making the right prediction for the non-palatalization context (everywhere except before front vowels) too, as seen below.

(3) [kori], 'daughter' *right result is produced with current ranking*

/kori/	NoVelFrV	Ident[cor]
☞ a. kori		
b. cori		*!

But if we try an input with the context-specific allophone [c] in the "wrong place," that is, in a non-palatalization (default, elsewhere) context, we get the wrong result. The candidate that has changed the "wrong" allophone [c] into the "right" allophone [k] cannot win here, since it incurs a violation of the faithfulness constraint Ident[cor]. This means that our current constraint ranking of NoVelFrV >> Ident[cor] is not a complete analysis of Greek, because it incorrectly allows an input /c/ to surface in a non-palatalization context.

(4) /cori/ → *[cori], impossible in Greek *wrong result is produced with current ranking*

/cori/	NoVelFrV	Ident[cor]
(☞) a. kori		*
☹ b. cori		

At this point, you may be wondering why this should even be a problem. After all, if we simply ensure that all input forms only contain elsewhere allophones, the input could only ever be

/kori/. There would be no input like /cori/, and therefore no need to change the input to get a [k] in a non-palatalization context. But we do need to take this question seriously, because of the principle of 'Richness of the Base' that we previously discussed in the context of a language with no codas.

The distribution of [k] versus [c] in Greek SRs is **predictable**, so the mental grammar of a speaker of Greek must **enforce** this distribution. The rule-based approach incorporates this factor into the phonological model by proposing that lexical entries are only allowed to contain elsewhere allophones, like /k/ in Greek, and can never contain specific allophones, like (*)/c/ in Greek.

Note that such a phonological model requires two completely different formal devices to model the [k]~[c] distribution in Greek. The distribution of the elsewhere allophone [k] is enforced by a restriction on the lexicon (no /c/), but the distribution of the specific allophone [c] is enforced by a phonological rule (/k/→[c]/__[-bk]). More generally, in a rule-based model, we have had to handle the predictable information about the phonology of a language by using phonological rules *and* restrictions on lexical entries *and* parameters on when/how rules can apply (as we saw in our rule-based model of syllabification), etc.

A constraint-based model could in principle take the same type of approach. For our analysis of Greek, we could continue to use a restriction on lexical entries (allowing only elsewhere allophones in inputs) to enforce the surface distribution of [k], while using the constraint ranking NoVelFrV >> Ident[cor] to account for the surface distribution of [c].

But one of the major arguments in favor of moving to a constraint-based model like OT is that it gives us the opportunity to model **all aspects of predictable information** in a language's phonological system with **one type of formal device**, namely, a ranked set of constraints. So to be consistent with this view of predictable information, we need to find a way to enforce even the distribution of the elsewhere allophone by means of the constraint ranking, rather than by relying on restrictions on which input forms we are allowed to consider.

This is why OT includes **'richness of the base'**, the principle states that there are *no language-particular restrictions on possible input forms*. In other words, if a certain type of phonological representation is a legitimate input in one language, then it is a legitimate input in every language, and it is the job of the constraint ranking for each language to screen out all phonological properties that are ungrammatical in that language. This includes, for Greek, cases of the specific allophone [c] in a non-palatalization context.

For practical purposes, what richness of the base means is that whenever we have complementary distribution in some language, we need **a constraint that penalizes the specific allophone in favor of the elsewhere allophone**. When appropriately ranked, such a constraint directly accounts for the status of the elsewhere allophone as a default, because it makes the other allophone a "last resort" option that you only use in the specific context that requires that allophone.

For the analysis of Greek, we can make use of a markedness constraint, *Cor-Dors, which penalizes palatal consonants (because of their complex [cor, dors] place specification). This

constraint is justified on typological grounds, because there are many languages that have no palatal consonants at all. (For more on the connection between elsewhere allophones and cross-linguistically preferred segments, see section 4 in part 2 of this handout.)

- *COR-DORS — Assign one * for any segment that is [COR, DORS]

If we rank this new constraint above the faithfulness constraint IDENT[COR], we correctly force an input like /cori/, with the specific allophone in the "wrong" context, to have an output containing the elsewhere allophone.

(5) /cori/ → [kori], as desired *ranking argument for *C-D >> ID[COR]*

/cori/	NOVELFRV	*COR-DORS	IDENT[COR]
☞ a. kori			*
b. cori		* W	L

Note that the above tableau only proves that *COR-DORS outranks IDENT[cor]. To explicitly rank *COR-DORS with respect to NOVELFRV, we need to consider a form with a [–back] vowel, where [c] actually does appear in Greek.

(6) /keri/ → [ceri] *ranking argt for NOVELFRV >> *C-D and NOVELFRV >> ID[COR]*

/keri/	NOVELFRV	*COR-DORS	IDENT[COR]
a. keri	* W	L	L
☞ b. ceri		*	*

Finally, we can confirm that the correct results still obtain for the palatalization context even if the input contains a /c/.

(7) /ceri/ → [ceri] *right result is produced with current ranking*

/ceri/	NOVELFRV	*COR-DORS	IDENT[COR]
a. keri	*!		*
☞ b. ceri		*	

To summarize, we have shown that the constraint ranking that is needed in order to model the complementary distribution of [k]~[c] (and [x]~[ç]) in Greek is this:

(8) NOVELFRV >> *COR-DORS >> IDENT[COR]

Inputs with either allophone in the palatalization context (/keri/, /ceri/) surface with the context-specific allophone [c], and inputs with either allophone in the non-palatalization context (/kori/, /cori/) surface with the elsewhere allophone [k].

It is important to note that during this discussion we have not considered competing candidates that satisfy the markedness constraints NoVelFrV and/or *Cor-Dors in other ways, such as by deleting the dorsal consonants, changing the vowel to [+back], etc. Our model predicts that these kinds of candidates may also occur. But since these candidates do not win in Greek, we know that the constraints that they would violate — such as NoDeletion or Ident[±back] — are ranked high enough in this language to eliminate such candidates. (Specifically, at least one constraint violated by each of these candidates must outrank Ident[cor].)

C. A general approach to complementary distribution in OT

We can generalize the results of our analysis of Greek to a basic understanding of the kind of constraint ranking that will give rise to a language with complementary distribution between two allophones. (For phonemes with more than two allophones in complementary distribution, similar considerations hold, but additional markedness and faithfulness constraints are involved.)

First, note that the ranking involves two markedness constraints, but they are somewhat different in character. What we have in the ranking NoVelFrV >> *Cor-Dors is a situation in which a **context-specific markedness constraint** (which penalizes some class of segments *when they occur in a particular environment*) dominates a **context-free markedness constraint** (which penalizes some class of segments, *regardless of their phonological environment*).

Informally, a context-free markedness constraint says, "Don't have this kind of segment (in general)" — so, in a case of complementary distribution, its job is to prefer the default allophone. A context-specific markedness constraint says, "Don't have that other kind of segment in some particular environment" — its job is to prefer the specific allophone when the relevant environment occurs. So with this ranking, you have a language that generally avoids a certain type of segment (here, palatals), *except when* some environmental factor (here, front vowels) insists on that type of segment being present. This is precisely what we need in order to have a default or "elsewhere" allophone and a specific allophone.

Dominated by both of the markedness constraints is Ident[cor], the **faithfulness constraint** for the feature that distinguishes between the two allophones. This means that faithfulness to that particular feature is less important than either of the markedness considerations, and therefore that the allophones in output forms will be distributed according to the relevant environments **no matter which of the allophones is present in the input**.

(9) General ranking for **complementary distribution**:

Context-specific M >> Context-free M >> F

Note: The fact that we get the correct complementary distribution no matter which allophone is in the input means that *it doesn't actually matter* which allophone we choose to represent the UR!