Optimality Theory

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Background

- In the first part, of this course, we have studied subsegmental structure
- In later classes, we will mostly concentrate on higher-order structure
- But first we will do another thing: introduce a new view on the 'dynamics' of phonology; our view of this has been fairly static so far.
- But segments and higher-order sometimes demonstrably change under the pressure of neighbouring phonological material, and we need some way to describe this
- The way this was done in previous periods (with rules) has turned out to be problematic in some respects.

1 How phonological representations change

There is a difference between printed letters and hand-written letters: the former are all independent from each other on the paper — except in the case of so-called ligatures like 'fi' — but the latter are usually connected to each others by all kinds of small lines. A hand-written <n> looks a little different after a <n> (line is coming from below) than after a <o>.

Sounds tend to adapt themselves even more to each other than hand-written letters, both phonologically and phonetically. We have seen for instance that the last consonant of the prefix *in-* changes according to the context, witness words such as *impopular*, *inactive*, *impopular*, *i[ŋ]consistent*, *irregular*, *illegal*.

So far, we have given a rather static picture of phonology. We have not made explicit *how* assimilation works. In order to do this, we have to add a dynamic element to our theory, which can explain why certain things change and others do not. Remember from our very first class that such a theory

should also describe why certain changes are possible in some languages but not in others, even though they have to deal with the same problems.

In order to do this, we distinguish two types of phonological representations for every form: an **underlying representation** — the form as we assume it is stored in the mental lexicon of the speaker — and a **surface representation** — the phonological form which is closest to the actual speech sounds or articulatory instructions. One underlying representation (/ɪm/ for the prefix) can correspond to more than one surface representation ([ɪm], [ɪm], [ŋ], etc.) and it is not the case that underlying representation and surface representation are necessarily distinct: underlying /ɪm/ corresponds to surface [ɪm]. We will assume that underlying representations and surface representations have the same formal structure: they consist of features, autosegmental tiers, syllables, etc., in exactly the same way.

In this class, we will study one fairly simple process, **final devoicing** in Dutch, illustrated in (1):

(1) /hɔnd/ → [hɔnt]

The relation between these two forms, indicated by an arrow, is called a **derivational relation**: [hɔnt] is derived from /hɔnd/. In this class we study the most popular theory of derivational theories of today, **Optimality Theory** (OT).

According to this theory, a phonological derivation consists of a number of minimal operations:

- We can *add* or *delete* a feature – and in this way we may turn /hɔnd/ into [hɔnt] by deleting the feature [voice] at the end
- We can *spread* features such as tone, as we have seen for various Bantu languages in preceding classes
- We can *shorten* or *lengthen* consonants and vowels — we have seen an instance of this where we derived *cittá [*sː*]anta* from a form with an underlyingly short consonant in Italian
- We can **epenthesize** (insert) consonants and vowels — such as has happened for instance in the Axininca Campa word [noŋkomati] which is derived from /no-ŋ-koma-i/ ('he will paddle').
- We may *change syllable structure* as exemplified e.g. in the derivation between /hɔnd/ (where /d/ is in the coda of the first syllable) and [hɔn.də] (where it occurs in the onset of the second syllable).
- We may change the *stress structure* of the word, something to which we will return in later classes.

We could apply each and every one of these operations on any form. In actual practice, this only happens however if the form improves in some sense; if the output form becomes better than the input form. The only reason to delete

the feature [voice] in /hɔnd/, is in this way we can satisfy a requirement on syllable coda's:

(2) DEVOICE: Consonants at the end of the syllable should be devoid of the feature [voice].

We have already seen that (1) is probably an instance of a more general principle requiring coda consonants to have as few consonantal features as they can get.

We only delete [voice] in /hɔnd/ because DEVOICE asks for it. We would not delete [voice] in e.g. the word *dan* 'then' [dɑn], because there is no principle which requires deletion in this case. To the contrary, there is also a general principle of economy — as it is usually called in syntactic theory — or **faithfulness** — as it is called in OT — which states the following:

(3) FAIHFULNESS: The surface representation should be as close to the underlying representation as possible; do nothing.

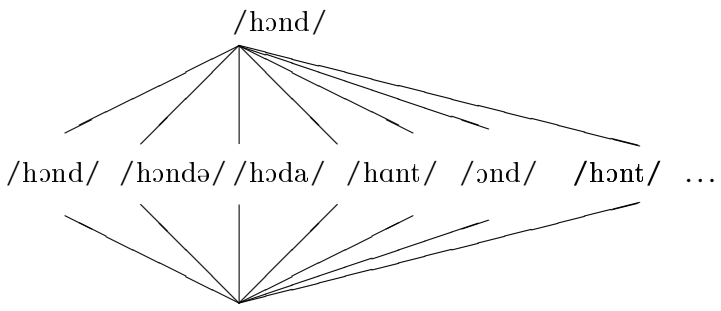
If DEVOICE is not operative, FAIHFULNESS is; therefore *[tɑn] is a bad output form for /dɑn/.

The (phonological) grammar consists of two functions, called Gen (Generator) and Eval (Evaluator). Gen takes an input form and blindly applies phonological operations to it in any conceivable combination. In this way it creates a very large number of possible output forms (called **candidates**). As a matter of fact, this number will be infinite. If we take the input form /hɔnd/, we can change all the features of all four segments, but we can also go on adding consonants and vowels to this structure indefinitely. Adding 5,000,000 consonants to this form will probably not improve the structure, but Gen is assumed to be blind to this.

The output of Gen thus is a very large set of candidates. The function Eval takes this set as its input and determines which single one of these best satisfies all grammatical principles, including the two we have just introduced, DEVOICE and FAIHFULNESS.

Schematically, the derivation can now be drawn as follows:

(4)



underlying representation

Generator

candidates

Evaluator

surface representation

In this case, Eval will choose [hɔnt] as the definitive surface structure for Dutch because it satisfies DEVOICE without making all kinds of unnecessary changes. For the principle of FAITHFULNESS, however, this is not the best possible form; that would have been [hɔnt].

This observation has a few implications; in the first place, the actual surface form is not perfect in the sense that it satisfies all possible constraints. It is not possible to be perfect in this sense, since constraints can impose conflicting demands. This is why the theory is called Optimality Theory: the 'winner' of the evaluation is not necessarily impeccable, but it is the best one can do.

Secondly we may observe that apparently DEVOICE has more weight in the grammar of Dutch than FAITHFULNESS. We can write this down as follows:

(5) DEVOICE ≫FAITHFULNESS
(pronounce: 'DEVOICE dominates FAITHFULNESS')

There are also languages in which the order of these constraints is reversed. There is no devoicing in the Yiddish word [hund] and we may assume that the reason for this is that in this language we prefer to be faithful rather than satisfy this requirement on syllable structure wellformedness. The crucial difference is that Dutch has the order in (5), whereas English has the ordering in (6).

(6) FAITHFULNESS ≫DEVOICE

An important assumption is that all constraints are universal; languages differ only in the relative ordering of the constraints. Phonology in all languages consist of a number of forces, and these forces are always the same. The only difference between languages is how powerful each and every one of these forces is.

Our analysis of final devoicing in Dutch is not completely ready yet. It is true that [hɔnt] satisfies DEVOICE, but this is true also for e.g. [hɑnt] and [hɔndə]. So why is the former the winner? The answer is relatively easy to give for [hɑnt]. Like [hɔnt], this form violates FAITHFULNESS, in that it has deleted a feature [voice], but it has done even more: it has also changed the specification for [round] on the vowel, and this is an unnecessary extra violation of FAITHFULNESS. Apparently, we do not just count whether or not a constraint is violated, but also how often this is the case.

Matters are more difficult for the comparison with [hɔndə]. In order to get there from our underlying form, we arguable need to take only one step: insert an empty vocalic position. So why does this form loose from our winner [hɔnt]? We will have to split up our cover constraint FAITHFULNESS into a

more fine-grained structure of constraints which are all ordered. In particular, we will need at least the following two faithfulness constraints:

(7) a. KEEP-FEATURE: All features in the underlying representation must be present in the surface representation
b. *FEATURE: All features in the surface representation must be present in the underlying representation
c. (Dutch): *FEATURE≫KEEP-FEATURE

We can now consider [hɔnt] as a better surface structure than [hɔndə], because the former violates a lower-ranked constraint than the latter.

It is common practice to draw the evaluation of surface candidates in a so-called **tableau**; in the case at hand, this looks as follows:

(8)

/hɔnd/	DEVOICE	*FEATURE	KEEP-FEATURE
hɔnd	*		
☞hɔnt			*
hɔndə		*!	
hɑnt			**!

This should be read as follows. In the left-hand column you see the underlying representation. Immediately below it you see some of the more interesting output candidates. From left to right, you see the names of the relevant constraints, in the order in which the grammar (of Dutch, in this case) has them ordered. An asterisk in a cell indicates that the form in question violates a constraint (and two asterisks indicate that it violates the constraint twice). An exclamation mark behind an asterisk indicates that this violation is 'fatal' for the form in question; it is the reason why this form is not the ultimate winner. The pointing finger directs the reader's attention to the form which has no fatal violations and is therefore the optimal form and the actual surface structure.

2 Nasal assimilation

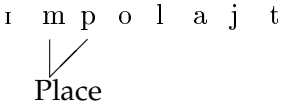
We have already mentioned the behaviour of the English prefix *in-*, which displays nasal assimilation, and we have seen in a preceding class that nasal assimilation is a phenomenon which is much more wide-spread in languages of the world. We have also seen that this type of behaviour argues in favour of an autosegmental representation. How are we going to integrate our findings in an OT framework? This section will be an exercise in formulating one constraint.

Let us consider the input representation /in+polite/ and the candidates { [inpolite], [iŋpolite], [impolite] }. The fact that [impolite] is the winner means that we prefer a structure in which the nasal and the following consonant share their Place node. Let us formulate the relevant constraint as follows:

(9) PLACEHARMONY (first version): A nasal has to bear the same Place node as a neighbouring consonant.

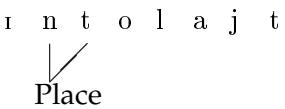
Clearly, *impolite* is the only form satisfying this constraint, if we assume that it has the following structure:

(10)



However, as soon as we make our set of candidates just a little bigger, we will see that there are more possibilities. Take for instance the form *intolite*, in which the stem consonant has adapted to the prefix, rather than the other way around:

(11)



Presumably, a nasal is more sensitive to harmony than a plosive is. There are two possible explanations for this difference. It could be that there is some internal difference in the structure of nasals and segments which causes the asymmetry; alternatively, this could point to a difference between affix segments and stem segments. Although the second explanation has something to say for it (as we will see later on in this course), there are also clear indications that there is something right about the first explanation. In English or Dutch place assimilation, for instance, there is always a nasal involved: there is no assimilation in words such as *actor* (*[ækkɔr], *[ættɔr]).

We can build this restriction into our theory in various ways. We could make this a matter of faithfulness, which somehow says that nasals tend to be less faithful to their underlying representation to other consonants. Alternatively, we may build the restriction into our definition of the constraint PLACEHARMONY:

(12) PLACEHARMONY (second version): A nasal at the surface structure has to bear the underlying Place node of a neighbouring consonant.

But we are still not completely satisfied. This second version suggests that every nasal will borrow the place of its nasal. This is not true for English or

for Dutch, witness words such as (Dutch) *pneumatisch* or *opnemen* in which there is no assimilation at all. Again, there are several possibilities. We could assume, for instance, that the difference with the previous case is that nasal occurs on the righthand side of the neighbouring consonant rather than on its left. We could now revise PLACEHARMONY in the following way:

(13) PLACEHARMONY (third version): A nasal at the surface structure has to bear the underlying Place node of a neighbouring consonant on its righthand side.

This version will work sufficiently well for Standard Dutch or for English, even though the question remains open what is so special about the righthand side of the nasal. Yet if we consider dialects of Dutch, we discover soon enough that 'righthand side' and 'lefthand side' are not the right concepts to be used.

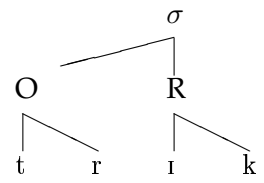
We will have a brief look at dialects in the north and in the east of the Netherlands. Many of these dialects — we take Hellendoorn as an example — show syllabic nasals, for instance as the infinitival ending: *eten* 'to eat' [ɛtn̩]. The nasal forms the nucleus of the syllable on its own in cases such as these. Interestingly enough, also this nasal is sensitive to place assimilation:

(14) roe[pm̩] 'call'
wer[kŋ̩] 'work'
po[fŋ̩] 'roast'

Syllabic nasals can also borrow their place from their neighbour on their righthand side, for instance if they function as indefinite determiner clitics:

(15) [n̩] doeve 'a pigeon'
[ŋ̩] fietse 'a bicycle'
[m̩] bal 'a ball'
[ŋ̩] keer 'once (a time)'

Apparently, left and right are not the relevant categories, at least not in Hellendoorn Dutch. Still, also in *opnemen* or *pneumatisch* we would not find assimilation in this dialect. We propose that the correct definition of the (universal) constraint on Place assimilation is not sensitive to these categories, but in stead of this to syllable structure. From your introductiory class to phonology you may recall that it is usually assumed that syllables form constituents of the following type (disregarding various details):

(16)


The generalisation now seems to be that nasals within the rhyme assimilate, but nasals within the onset do not. An improved version of PLACEHARMONY will therefore say:

(17) PLACEHARMONY (fourth version): A nasal in the rhyme has to bear the underlying Place node of a neighbouring consonant.

We could speculate why a nasal in the rhyme has this peculiar property. It seems reasonable to relate it to the effect of DEVOICE and other constraints we have seen, which all state that independent consonantal features in the rhyme are undesirable. In some sense, rhymes are the domain of vowels and vocalic material and consonants are aliens in that domain; consonants belong to the onset, where they are much less restricted: they do not have to devoice and they do not have to assimilate. We could now go on to find a general constraint of this sort which will give us all the right results, but that is not something we can go into here.

It is still (intentionally) unspecified in our constraint which of the two neighbours is going to lend its place in case of a choice. Hellendoorn facts shed light on this issue as well:

(18) a. *loop [ŋ] keer* 'walk one time'
b. *(ik heb) de kat [m] bettien (gevoerd)* '(i feeded) the cat a little bit'
c. *(ik heb het) rek [m] verfien (gegeven)* 'I painted the rack (I gave the rack a little paint)'

In these cases there seems to be a preference for the consonant on the right-hand side. Does this mean we will have to build the notions 'left' and 'right' into our theory after all? An important observation is that in these cases we are considering a determiner which entertains an intimate relationship with the noun on its righthand side and a much less intimate relationship with the word (verb or noun) on its lefthand side. The former is within the same syntactic XP, but the latter is not. It thus is not necessary to distinguish between left and right; we just have to understand that the nasal attracts place from its closest neighbour.

Exercise 5

Het is onwaarschijnlijk dat /hɔnd/ ooit de onderliggende vorm is van [kɑt]. Leg dit uit. Verklaar ook hoe het kan dat [kɑt] toch in de kandidatenverzameling zit bij de afleiding van /hɔnd/. Wat zorgt er technisch voor dat deze kandidaat waarschijnlijk in geen enkele taal van de wereld de 'optimale' kandidaat zal blijken te zijn?