Oversaturation and Difference in Degree

Characterizing Norwegian and Swedish High Vowels

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First Research Paper

Readers:

Prof. Schane
Prof. Elman
Prof. Chen

February 24, 1989

 La Jolla, California

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ABSTRACT

In particle phonology, the information which describes any given vowel system should be able to be encoded by the traits of the particles; furthermore, any given tier on which the particles appear will be used to focus on a different aspect of the particles' traits, so some of the description of the vowel system can be attributed to the qualities of the tiers as well; however, when a vowel system under analysis introduces a characteristic which is *not already fully represented* by the standard system, there exists the potential to encode the standard particles with too much information, wreaking various types of havoc with the analysis. This analysis examines some of the environments in which such oversaturation occurs, primarily the characterization of the Norwegian and Swedish high vowels, and proposes a way to alleviate the oversaturation problem.

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1.0. Difference in Degree

Any given vowel characteristic is fully represented *for the vowel system under analysis* if standard particle phonology can describe the *kind* of trait it is, such as aperture, as well as the *degree* to which it applies to any given vowel in the system, such as with the different degrees of aperture in the English vowel system. Therefore, a characteristic is *not* fully represented if it cannot be described by the stan-dard system in both of those ways. For example, the standard system *does* characterize rounding, which covers the *kind* of trait it is, but because it does not allow multiple occurrences of the [u] particle, it cannot fully describe the *degrees* of this quality necessary to appropriately analyze the Norwegian and Swedish high vowels.

2.0. Oversaturation

In a vowel system where more than two degrees of a trait are used (more than *presence* versus *absence*), a *single* occurrence of a particle cannot be used to represent each of the degrees of that trait. For example, a single occurrence of the [a] particle cannot be used to represent the degree of height found in |e| if it also has to represent, in a contrastive way, the degree of height found in |ɜ|. A particle which is put in such a position is said to be oversaturated because it is stuffed with so much information (e.g. high, medium, and low degrees), that were it to appear

singly in a vowel breakdown, it would not be possible to figure out what it was supposed to represent.

Oversaturation occurs when a particle is used to represent two or more different traits, but it is not necessarily a problem to be cured *when those traits are best left ambiguous*. For example, the [a] particle is used to represent two different *kinds* of traits, namely laxness *and* lowered height, in an analysis of Open Syllable Lengthening by Schane (1984); however, as will be shown, even though the two functions could be disambiguated, perhaps by putting one of the [a] particles on a higher tier, the ambiguity of the function of the [a] particle neatly explains why lax short vowels merged with their tense long counterparts one aperture step lower, so the ambiguity is perhaps best left alone.

3.0. The Standard Particle Phonology System

Since oversaturation is a problem which occurs when the standard system encounters qualities which it is *not* easily able to handle, it is helpful to mention those traits for which the standard system *is* equipped. Much in the way that complex colors have primary colors as their basic components, particle phonology analyzes the vowels of any given system by breaking down each vowel into a set of one or more primitives, the standard set being [i], [u], and [a]. I am working under the assumption that these particles can be assigned the following traits: [i] is more front than the other two particles, unrounded, and not low; [u] is rounded, farther back than the other particles, and not low; and [a] is lower than the other particles, neither front nor back, and not rounded.

The tonality particles [i] and [u] are not allowed to appear more than once in any given vowel breakdown, and no new particles are allowed to be created. It is important to note that this has the effect of allowing only one step between the vowels |i| and |u|, namely [iu] or [y], whereas there are several aperture gradations. The empty set, [ ], is used to represent |i|, since the vowel is seen as lacking all of the qualities encoded by the particles; that is to say, it is neither front nor round nor low, but then again, neither is it really back or unround or high.
The standard system is also equipped to handle tense/lax or length analyses since such information is described by the function of the CV tier, in combination with the information encoded by the particles, as is shown in Schane's (1984) analysis of Open Syllable Lengthening (OSL) in Middle English. For example:

```
                VV
                |/
|e:|    =  [ai  i]

            V          VV
            |          |/
|ɪ|     =  [ai], +OSL → [ai  i], which – |e:|.

             VV
             |/
|ɜ:|    =  [aai  i]

            V           VV
            |           |/
|E|     =  [aai], +OSL → [aai  i], which – |ɜ:|.
```

In the particle representation of |I|, [a] represents laxness, for |e:| and |ɜ:| it is lowered height, but for the pre-OSL |E|, one [a] particle must be for laxness, and the other lowered height. After the lengthen-ing, the [a] particles all *only* represent lowered height. In this case, oversaturation is desirable because it explains why the vowels merge, namely there is no way to tell which aperture function [a] is serving. Laxness disappears when shortness disappears, and the vowels merge. This is one of the motivations for the use of multiple [a] particles to represent degrees of lowered height.

As mentioned, the functions of the [a] particle could be disambi-guated by placing the "laxness" representation on a new tier above the CV tier (as shown in the second part of the example, below), but it doesn't really help; in fact, it obscures the explanation of the vowels' merging. There would have to be a good reason why the vowel on the upper tier would gravitate to the breakdown tier, becoming lowered height instead of laxness.

```
             VV
             |/
|ɜ:|    =  [aai  i]

            a           a
            |           |
            V           VV
            |           |/
|E|     =  [aai], +OSL → [aai  i], which – |ɜ:|?
```

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Therefore, oversaturation is not a problem when the various traits represented by a single occurrence of the particle do not need to be kept separate.

4.0. Oversaturation and the Norwegian and Swedish High Vowels

The inability to create more than one tonality step between |i| and |u| (cf. §3.0) causes an oversaturation problem in both Norwegian and Swedish, each of which has two tonality steps between |i| and |u|, namely |y| and |ʉ|. In these cases, the difference is not one of tongue position, but one of rounding, phonetically. Haugen (1965:40) describes two vowel systems for Norwegian, the first of which is presented as an older or preserved system, where he says, "in some dialects of the Midland and West Norway an older Norwegian system is preserved, which is similar to that of Danish (or German)." In the following table, rounded vowels are parenthesized:

		Front				**Back**	
	High	i		(y)		(u)	
	Higher mid		e		(ø)		(o)
	Lower mid	æ				(å)	
	Low			a			

He goes on to say:

> "In comparison with this system, the typical East Norwegian (Oslo) system is markedly skewed (in the same direction as Swedish):... [å] and [o] are raised, [u] is advanced, [y ø] are partially unrounded. In addition, [o u] are 'overrounded,' i.e. pronounced with a narrow, puckered rounding which is quite different from the rather relaxed rounding of [y ø å]."

In the following table, rounded vowels are parenthesized, and overrounded vowels are doubly parenthesized:

		Front			**Back**	
	High	i	(y)	((u))		((o))
	Mid	e	(ø)			(å)
	Low	æ			a	

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There is a general counterclockwise rotation, except for |i|, but I am only going to pay attention to the portion of the shift which generated the high vowel series.

Lindau (1978) describes the new, narrowed rounding as “compressed,” using it only for the Swedish vowels, and basically states that because the Norwegian vowels all have the same rounding, then they must be dif-ferentiated by the feature Back, evidently choosing that feature by default. However, because Haugen (1982) supports a difference in rounding for Norwegian vowels, despite Lindau, and because Lindau characterizes them as differing in the feature Back merely by default, I will proceed as if the Norwegian and Swedish vowels both contrast rounding, and not tongue position, to differentiate their three front high vowels.

The previous chart shows the etymological vowels in their current positions, and the chart below shows the current orthographic represen-tations, with Swedish symbols given in curly brackets where they vary from Norwegian (Haugen, 1976):

		Front			**Back**	
	High	i	y	u		o
	Mid	e	ø {ö}			å
	Low	æ {ä}			a	

With this orthography, some minimal pairs from Norwegian (with close or equivalent Swedish pairs) are as follows:

sit	pr. of sitje, “to sit”
syt	“whimpering”
sut	“whimper”
sot	“soot”

ni	“nine”
ny	“new”
nu	“now”
no	nt. of noen, “some”

sin	“his/hers…”
syn	sight
sun	-----
son	“son”

mir	-----
myr	“bog, marsh, swamp”
mur	“wall”
mor	“mother, sausage”

The problem, then, is to find a particle phonology solution which represents the three degrees of rounding found amongst the front high vowels, without oversaturating any of the particles.

5.0. Historical Background

5.1. |y| from I-Umlauting and U-umlauting

It looks like Proto-Scandinavian (PSc) started out with a five vowel system, and the first change which concerns the generation of the four high vowels was the production of |y| through both I-umlauting and U-umlauting. According to both Kock (1978) and Haugen (1982), there were overlapping periods of different kinds of both umlautings, where the process went something like this:

1. 550 AD:
    a. An older U-umlauting process begins, along with the loss of the final vowel which caused the umlauting.
2. 600 → 700 AD:
    a. An older I-umlauting occurred in long syllables, also with the same sort of final vowel loss.
    b. The older U-umlauting process is complete.
3. 700 → 800 AD
    a. I-umlaut does not occur in short syllables before lost |i|.
    b. The younger U-umlaut begins.
4. 800 → 1000 AD
    a. I-umlaut occurs before |i| that was not lost.

	PSc	**Common Sc**	**Gloss**
I-umlaut	ungirRa	yngRe	younger
U-umlaut	trigguR	tryggR	safe

Umlauting, therefore, generated the vowel |y|, before the vowel |ʉ| had been created.

5.2. Backrounding of |a| to |å|

The next step, according to Haugen (1982), occurred around 1200, or possibly as late as 1400 for Swedish. The vowel |a| was backrounded to |å| as follows:

ba:tr → bå:tr “boat”

ma:l → må:l “speed”

This started to push the back vowels counterclockwise, forcing |o| into |u|, which forced |u| forward into the environment of |y|.

5.3. The Vowel Shift

Bergman (1947:36) briefly discusses part of the Swedish vowel shift, namely the shift from |o| to |u| and from |u| to |ʉ|, saying that it occurred by the first decade of the fourteenth century, but he notices that since spelling changes fall far behind changes in pronunciation, the shifts probably occurred quite a bit earlier. The other sources also indicate that the vowel shift was well under way before 1500. As far as the generation of the new vowels is concerned, the net result was that the new |y| was shifted forward, becoming "a slightly round high front vowel," and the old |u| became |ʉ|, "a high mid vowel" (Haugen 1982:40), where "mid" must mean something like "central." The new high back vowel, |u|, formerly |o|, has already been said to agree in rounding with the next most forward vowel, |ʉ|, but not with that of the new |o| or new |y|.

Haugen goes on to comment about the new lip position required for |ʉ| and |u|, stating, "By this new labialization (which in Swedish may even reach a consonantal quality) three rounded vowels can be produced with the tongue in a high position." This also seems to favor the rounding difference over Lindau's (1978) use of the feature Back, especially since the only hint of tongue position difference points to cen-trality, not backness; furthermore, since |ʉ| and |u| agree in both rounding and height, Lindau would have no way to differentiate them if she characterized them both as Back.

5.4. Historical Summary

The old high back vowel moved forward (that is to say, |u| became |ʉ|), and |y| and |ʉ| must have had degrees of rounding similar enough to one another that one or both of them had to change in order that they could be differentiated. Whether the old vowel lost rounding or the new one gained rounding, or both, the net effect was that |ʉ|, the new vowel, ended up with a greater degree of rounding than the old one, |y|. Furthermore, the new high back vowel (the new |u|), which had been |o|, took on a degree of rounding which was equivalent to that of the new front rounded vowel, |ʉ|. It doesn't really matter whether the different degrees of rounding are called *in-rounding* and *out-rounding*, *over/under*, *full/half*, *not compressed/compressed*, or whatever, just so long as it is recognized that the new quality to be characterized is a difference in the degree of rounding, and not a new kind of attribute altogether.

6.0. Multiple Particle Solutions

Whenever a vowel system under analysis requires the characterization of a new quality which merely differs in degree with an attribute that is already represented by one of the particles, it seems natural to use increased occurrences of that particle to describe an increase in degree of the quality; in other words, in a vowel system where different degrees of a trait are used, a *single* occurrence of a particle could not be used to represent each degree of that trait. As previously stated, such a particle is oversaturated because it holds too much information, making it difficult to figure out what it is supposed to represent when it appears in a vowel breakdown. One easy way to offload some of the burden of information is to encode a single occurrence of the particle such that it only represents the presence of the least degree of the trait, then multiple occurrences of the particle can be used to represent increased degrees.

6.1 Precedent: Great Vowel Shift Analysis

Such is one of the motivations for the use of multiple aperture particles. Schane's (1984) analysis of the Great Vowel Shift sets a precedent for the use of multiple aperture particles by describing an independent process of movement over time in an elegant way. Those vowels which shifted downward in height simply gained an aperture particle, and those which moved upward did so by losing an aperture particle (where the Early Modern English entries are per John Hart):

Downward		
Middle English	**+[a]**	**Early Modern**
|u:| = [u u]	[au u]	|ou|
|i:| = [i i]	[ai i]	|ei|

Upward		
Middle English	**-[a]**	**Early Modern**
|e:| = [ai i]	[i i]	|i:|
|ɜ:| = [aai i]	[ai i]	|e:|

|o:| = [au u]	[u u]	|u:|
|ɔ:| = [aau u]	[au u]	|o:|

The [a] particle is used to represent the least increment of lowered height, which allows multiple occurrences of [a] to represent greater degrees of lowered height. Since one occurrence of the [a] particle does not have to represent each of the degrees of height, it is not oversaturated.

6.2 Precedent: Diphthongization Analysis

Furthermore, analyses of diphthongization by both Schane (1984) and Hayes (1990) show the need to represent degrees of aperture with multiple occurrences of the [a] particle. For example, Hayes gives the following long vowel inventory which diphthongizes in the Lund dialect of Swedish:

	|:i| → |ei|	|y:| → |ey|	|ʉ:| → |eʉ|	|u:| → |eu|
	|e:| → |ɜe|	|ø:| → |ɜø|		|o:| → |ɜo|
	|ɜ:| → |æɜ|			|ɒ:| → |æo|

The main point to note here is that the first half of the diphthong is one aperture step lower in height than the first half of the long vowel from which it came. This can only be adequately characterized with a system which allows for the representation of stepwise changes of degree in height, which particle phonology does by using increased occurrences of the [a] particle for increased degrees of lowered height. In other words, the first half of any long vowel receives an [a] particle when it diphthongizes.

6.3 Potential Drawbacks to a Multiple Particle Solution

A scalar solution involving *tonality* particles, however, has the potential to be easily abused in those vowel systems where there are more degrees of rounding or tongue position than are fully represented by the standard system. A trivial solution presents itself in which the [i] and [u] particles can be used, in effect, merely as coordinates which mark the positions of the described vowels in a grid. Greater forward position could be represented by using additional occurrences of [i], and [u] could likewise be used to mark greater degrees of rounding. The

vowel [i̶] would no longer be represented by [ ] (cf. §3.0), that is to say, as the lack of any particle components, or the null set, but rather by the middle position of the [i] particle series.

The problem with such a solution is that it says nothing about the language processes that occurred to generate the vowel system under analysis. Such solutions, therefore, merely provide a handy notation without necessarily treating the relationship between rounding and tongue position in the analyzed vowel system, not even so far as to say whether any such relationship exists in the first place. Care must be taken when choosing a multiple particle solution to make sure that it reflects the natural process of vowel movement over time. In other words, the system that is used to characterize the present set of Norwegian and Swedish high vowels should take into consideration the historical shift from the old vowel set to the new vowel set (as described in §5.0).

6.4. Multiple Tonality Characterization of the Four High Vowels

There are two ways that the old vowel system might be represented, depending upon whether the new system is supposed to have come about by (1) |y| losing some of its rounding or (2) |u̶| gaining extra rounding, with |o| gaining a similar degree of rounding upon becoming the new lul. The first system given below is conducive to the generation of a new vowel system by the process described by option #1, and the second is likewise for option #2 (where rounding increases as you move from front to back):

	Front		**Back**
	|i|	|y|	|u|
#1	[i]	[iuu]	[uu]
#2	[i]	[iu]	[u]

The vowel |u| shifts forward and becomes |u̶|, |o| takes the place of |u|, and either (1) |y| loses rounding to distinguish it from |u̶| or (2) |u̶| gains rounding, as does |o| when it becomes |u|. In any case, the net result is the same, and the present high vowel set can be character-ized as follows:

Front			Back
unround	**out-round**	**in-round**	
|i|	|y|	|ʉ|	|u|
[i]	[iu]	[iuu]	[uu]

Notice that there are still only two tongue positions, namely "front" and "back," so [i] does not need to be modified to account for "centrality"; however, there are three degrees of rounding (including its absence), and they are not directly correlated with tongue position. The vowel |i| is unrounded, |y| is "out-" or "half" rounded (or "compressed") and both |ʉ| and |u| are "in-" or "fully" rounded. Lindau (1978) states, "there is no alternation between [ʉ] and [u], nor between [u] and [o]," so there is no pressing structural need to represent |u| with two [u] particles, other than to show that it has the same rounding as |ʉ|, and not |y|; nonetheless, in order to differen-tiate the three front vowels, the particle [u] needs to be modified to the extent that it is able to display three different degrees of rounding.

7.0. Alternative Solutions

7.1. Four-Particle Solution

Suppose, however, that the standard system could not be modified to allow for multiple [u] particles. Another approach, although also non-standard, would be to create a new particle, probably [ʉ] since |y| is easily characterized as [iu]. This misses the whole point by treating the problem as a difference in *kind* with a different *kind* of particle. This solution does not allow |ʉ| to be treated as either a front or a rounded vowel to any degree since its only component, as a particle in its own right, would be itself.

7.2. Additional Tier

After thus disallowing the four-particle solution, the only solu-tion left to standard particle phonology would be the creation of a separate tier in addition to (and above) the CV tier, placing the duplicated tonality particle at the higher level. Such a solution would require that on the particle tier, the representations [i], [iu], and [u], would be used to mark the three basic tongue posi-tions with their correlated rounding, and a higher tier would have to be created to mark rounding modifications of these basic representations; for example, if [iu] were on the

particle tier and if it were attached to an [u] on the newly created tier, it might represent a centrally located vowel modified by extra rounding, namely |ʉ|. This is a lot of convolution just to avoid having multiple [u] particles, especially when the rule has to be bent so far that [u] on a different tier is not supposed to be seen as another occurrence of the [u] particle.

In this case, the new tier solution is not very useful other than as a device to strictly follow the guidelines of standard particle phonology. So much information gets encoded into the function of the tier itself that the nature of the particle which exists in that tier is superfluous. In the case of Norwegian and Swedish high vowels, only the [u] particle would exist on the new tier, so the node might just as well be marked with an "X" as anything else. The use of the new tier might be justified if more than one particle could exist within it, each serving to identify a way in which the tier's function applied, which is what happens in the CV and particle tiers, or if other languages used the same tier with other (or more) particles, such as the harmony tier.

Old Norwegian and Old Swedish did have vowel harmony from about 1100 to 1400, but it faded out, leaving behind remnants such as *systir* and *broðer*. The harmony caused suffix vowels to agree in *height* with the vowels of the root to which they were attached. If it had been some sort of *rounding* harmony, rather than height, then there might be some marginal reason to suggest that the function of the harmony tier shifted to mark |u| and |ʉ| as overrounded; but the harmony was *not* rounding. Furthermore, the vowel shift and the harmony evidently occurred simul-taneously, which means that the tier would have had to overlap functions. Therefore, as things stand, a new tier would be no more than a fourth particle in disguise, and it would suffer from the same problems as the four-particle solution detailed above.

8.0. Conclusion

In this characterization of Norwegian and Swedish high vowels, the new quality which is introduced into the standard system is merely different in degree from an existing property, and it is handled by allow-ing the corresponding standard [u] particle to occur multiple times within the same vowel characterization. This observation applies equally to those cases in which multiple [a] particles are used to characterize aperture gradations in all sorts of languages. Finding a language that requires the use of multiple [i] particles would more strongly suggest that whenever the new characteristic to be analyzed is merely different in degree from one which is already represented by the standard system, then the oversaturation problem can be solved by using multiple particle occurrences.

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