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## ON VOWEL-DIPHTHONG TRANSITIONS.

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Phonologists have long been aware that there exist principled relations between single vowels and diphthongs, in addition to more sporadic and non-systematic patterns. Such relationships occur in bicausal fashion, with single vowels evolving to diphthongs, while diphthongs reduce to single vowels. To meet the ends of a phonological investigation of diphthongs, the Romance languages provide an extremely fertile territory for data collection, as the history of all the Romance group has exhibited a wide array of diphthongal formation and reduction. In this study, attention will be restricted to falling diphthongs, for several reasons. First, the evolution of diphthongs is often complicated by changes in accentual patterns, leading to a change in the value of syllabicity from one element of the diphthong to the other; such shifts turn rising diphthongs into falling diphthongs and vice versa. By restricting the domain of discussion to a single class of diphthongs, one may avoid the technical problems that arise when contemplating situations of shifting syllabicity. Moreover, an overview of diphthongal reduction, not only in the Romance group but in other languages as well, confirms the view that considered as an ensemble, falling diphthongs behave with greater consistency than rising diphthongs. One need only to peruse the studies of the formation of rising diphthongs in a variety of languages to become convinced that we are much further from a reasonable complete

theory of rising diphthongs, and therefore that it may be premature to attempt to compress both classes of diphthongs into a single theory. Moreover, the data also suggest that two fundamentally different processes may be involved in the formation and dissolution of the two classes of diphthongs, thus nudging our investigation toward the exclusive study of falling diphthongs. Given the degree of consistency with which a model of the latter group may be formed, it is at the moment unlikely that any immediately gains would be realized from extending the model haphazardly to the class of rising diphthongs.

While there are no *a priori* restrictions on the phonetic composition of falling diphthongs, the data available to us militate in favor of considering only those diphthongs whose non-syllabic element is /+high/, that is, a non-syllabic version of one of the vowels /i/, /u/, /ɨ/, /y/, etc. Of this group of vowels, only /i/ and /u/ have consistently yielded semivocalic elements that stably coexist with a syllabic element to form a diphthong; one may occasionally find falling diphthongs whose non-syllabic mora is a /y/, and rarely if ever do we encounter stable diphthongs ending in a non-syllabic /ɨ/, although such combinations are often heard as fleeting transitional sounds, which virtually defy a detailed analysis.

Before going on to propose a model for the phonology of diphthongs, let us briefly consider a variety of cases of the formation and reduction of falling diphthongs, largely within the Romance group, to discover what kind of evidence might be available to aid in the formation of a more general model. Of the diphthongs ending in a /w/, only /aw/ survived the transition from Latin to Romance. In the overwhelming majority of cases, reduction of /aw/ yielded an /o/ or perhaps a slightly lowered /ɔ/. In Portuguese, /aw/ became /ow/ retaining the final semivocalic element in stressed position; later, in some words through a complex process of morphological analogy, /ow/ became /oj/; thus *causam--coisa*. In unstressed position, /aw/ simply reduced to /o/. Later cases of /aw/ in Romance, usually arising from the vocalization of syllable-final velar l, also yielded the same processes of reduction, giving /o/. In a

few dialects of Portuguese, /aw/ has reduced to /a/; this apparently anomalous development may be explained by the excessive durational prominence of the first mora in the dialects of these regions, a distribution clearly indicated in experimental studies. This in fact indicates a further point of indeterminacy in the study of (falling) diphthongs; accurate results may be consistently obtained only when a fairly equal distribution of acoustic energy and duration exists between the syllabic and non-syllabic morae; when one or the other enjoys excessive prominence, it tends to swallow up the other element rather than participating in a more equitable process of reduction.

The diphthongs /ow/ and /ɔw/, often indistinguishable in speech, exhibit a tendency to reduce to /o/, to a higher /o/ (in Galician) or to /u/ (for example, in French). One most frequently finds this diphthong in Portuguese, where reduction occurs in many areas, in Brazil, Portugal and many insular dialects. The same reduction also occurs in some dialects of Friulian. On the contrary, in modern English, for example, /ow/ is rather stable, in fact arising from an earlier simple vowel. The diphthong /uw/ is rarely observed in phonological opposition with /u/, at least in Romance, although it is heard, as in English, as a positional variant in various dialects. The only possible reduction of this diphthong is to the expected /u/; any other evolution would suggest the influence of non-phonetic factors. Reversing the order of causality, we also find spontaneous diphthongization of simple vowels, giving the diphthongs mentioned above. For example, the diphthongization of /o/ to /aw/ (or its nasal counterpart) has been observed in many dialects of Portuguese. It also occurred in English, yielding the diphthong in words like *house*, etc. English also provides ready examples of the diphthongization of /o/ and /u/, as discussed earlier. Portuguese also exhibits the same tendency, but here one must also contend with the all-pervasive influence of the already-existent diphthong /ow/, carrying over from Latin /aw/.

Turning now to diphthongs containing a front vowel plus /w/ we consider the pair /ew/-/ɛw/, again often indistinguishable. In the absence of contravening factors, the general

tendency is the production of front rounded vowels. French provides the most common examples of this route of evolution, with /ew/ evolving to /ø/, /ɛw/ becoming /œ/, presumably following a pattern in which the first stage was a diphthong with a rounded first element. The same evolution has been attested in various Surselvan and Italian dialects and in the rapid speech of some dialects of Spanish and Catalan. I have also observed this same reduction in Brazilian Portuguese, and in at least one continental Portuguese dialect restructuring along the lines of a front rounded vowel may have occurred at an earlier period. In Leonese, the intermediate stage /øw/ has been attested. In a few Portuguese dialects, /ew/ has reduced to /e/, most likely again due to the excessive durational prominence of the first mora. It is also possible, however, that the /e/ is the result of a process of delabialization of /ø/, particularly since these same dialects exhibit other instances of unrounding. The same hypothesis may also be valid in the case of the reduction of early Latin and Greek /ew/ to /e/. The same reduction, in favor of front-rounded vowels, is occasionally heard in some dialects of English, but the relative scarcity of this diphthong makes accurate data collection impossible. The diphthong /iw/ normally reduces to /u/, a process to be observed in widely scattered dialects, including Italian, Portuguese, old English, old Danish, and even French. English words borrowed from French or German forms containing /y/ normally substitute the pair /iw/-/ju/. One may also observe the spontaneous formation of diphthongs from front rounded vowels, although the complete delabialization of the first element is relatively rare, perhaps due to considerations of relative markedness of the elements involved. Faroese and Icelandic, for example, give evidence of turning front rounded vowels into diphthongs, as do some dialects of Chinese and Canadian French.

It is rather difficult to find usable data concerning falling diphthongs ending in /w/ whose first element is either a front rounded or back unrounded vowel. One may, however, offer a few extrapolations based on the preceding data, and such forms have frequently figured in posited reconstructions of historical processes. One would, for example, anticipate that /øw/ and /œw/ would reduce to

/ø/ or /y/, while /yw/ would reduce to /y/. I have observed, among some speakers of Rumanian, a tendency for /əw/ to reduce to /o/, and for /ɪw/ to reduce to /i/ or /a/. In addition, in some dialects of English, for example in Canada, where the diphthong /aw/ has been centralized to /əw/, it sometimes reduces to the centralized /ə/.

In general it appears that during reduction of a Vw type diphthong, the end result is a rounded vowel whose frontness value approximately matches that of the first mora of the diphthong and whose height value is at a point between the height values of the two moras of the diphthong. Conversely, spontaneous evolution of a simple vowel to a diphthong ending in /w/ follows the reverse process, implying the bicausality alluded to earlier. The situation is strikingly similar for diphthongs ending in /j/. Turning first to /aj/, one notices the general tendency to reduce to /æ/, /ɛ/ or /e/, both in Romance and in other language groups. Early Latin /aj/ reduced to /ɛ/ or /e/ in Romance. Later stages of French developed the diphthongs /aj/ or /æj/, which similarly reduced to vowels in the mid-front series. The identical process occurred in Catalan, and may be presently heard in the rapid speech of many dialects of Latin American Spanish. In some peninsular dialects of Portuguese, the diphthong /aj/, while not undergoing monophthongization, centralizes the first element /ə/.

The diphthongs /ɛj/ and /ej/ normally reduce to /e/ as well, as would be expected. Similarly, /ij/, rarely found in opposition to simple /i/, will reduce to the latter vowel. Turning the tables, one notices a significant quantity of spontaneous diphthongization which follows the reverse tendencies. In many dialects of Portuguese, for example, oral and nasal /e/ have diphthongized to /aj/, a process also typical of English. Spontaneous diphthongization of /e/ also occurs in Portuguese and English, while the full range of diphthongizations is found in English and many dialects of Canadian French. Romance offers few usable examples of purely phonetically-conditioned reduction of /ɔj/ and /oj/, or of /uj/. In most instances, where such diphthongs have suffered modification, the process of reduction has been contaminated by a shift of stress to the second mora, thus creating a



rising diphthong or hiatus. In listening to the modern spoken dialects, however, one may at times hear evidence of a more balanced reduction of /oj/ or /uj/ in which phonetic reduction has occurred before or instead of, a shift of syllabicity. In Brazilian Portuguese, for example, /oj/ may reduce to a back or centralized /ə/ or /u/. Similarly, Spanish /uj/ may become /i/ in rapid speech. In modern Lithuanian, which has no back unrounded vowels, Russian /ɨ/ is borrowed as /uj/. Evidence from various dialects of modern English also suggests that the reduction of /uj/ and /oj/ will lead, *ceteris paribus*, to the formation of back unrounded vowels. Regarding diphthongs ending in non-syllabic /y/ or /ɨ/, few accurate data may be brought forward, but one would hazard the prediction that diphthongs ending in /y/ would reduce to yield rounded vowels and those terminating in /ɨ/ would produce unrounded vowels. Significantly, in such languages as Canadian French and Faroese where 'mixed' vowels have diphthongized, the same process has occurred in the reverse direction, thus supporting our supposition.

We must now address the crucial question of the incorporation of such a model of diphthongal structure into modern phonological theory. The issue involves more than the empty question of formalization; indeed, since no single model of phonology has so far proved adequate to account for all available data on diphthongal evolution, one must consider a few competing variants. Remaining within the framework of generative phonology (if there is any such single theory these days), one could attempt to rewrite the prose statement as a single rule, a diachronic statement embodying the structure of all possible falling diphthongs and simple vowels. It is quite possible to write such a rule to describe diphthong reduction, although the resultant configuration is a notational nightmare. Proceeding in the reverse direction, however, one encounters several problems, since current generative phonological metatheory contains no formal machinery for describing the potentially many-to-one relation between simple vowels and associated diphthongs. One would either have to generate a complicated series of individual cases by a brute-force method, or possibly invoke some considerations of relative markedness of certain combinations, perhaps in the form of irreversible implicational statements.

In general, the theory of markedness has encountered considerable difficulty in contemporary phonology, since while most would agree on the intuitive notion of some segments being in a sense more 'marked' or less common than others, formalization and incorporation of such notions into a rigorous framework has so far proved an impossible task, Chomsky and Halle notwithstanding. In the case of diphthongization, however, some interesting attempts have been offered. Most significant is the well-known paper by Henning Andersen, who considers each diphthong (in the most general sense) to be the result of the change in the value of one particular (necessarily binary) distinctive feature, regarded as the primary diphthongization, while any other feature differences between the two morae become secondary differences. Andersen proposes that 'in a primary diphthongization, the opposite values of the feature with respect to which a segment is diphthongized are distributed over the duration of the segment in the order unmarked-marked.' Andersen also claims that this proposal accounts for the motivation between the structuration, in individual child and adult grammars, of diphthongs and the corresponding monophthongs. The proposal, intriguing as it is, especially in view of the wide range of data which have been considered, in addition to the obvious lack of common consensus on what constitutes 'marked' segments. Andersen is unable to offer an *a priori* method of determining which feature defines the primary diphthongization. His method in fact reduces to an *ex post facto* determination based on already existing diphthongs; it would appear from his examples that any feature that can be specified as 'unmarked' in the first segment and 'marked' in the second will qualify. Thus, the diphthong /iw/ is regarded as diphthongized with respect to the feature (+grave), while the corresponding /ju/ is diphthongized with respect to the feature of *intensity*. /uj/ is diphthongized with respect to (flat), since (+flat) is the unmarked value for (+grave) vowels. However, the same marking conventions specify (-flat) as the unmarked value for /-grave/ vowels; thus both morae of /uj/ should be 'unmarked' by these criteria. The same holds true for /iw/, if one chooses to consider (flat) as the defining feature. Remaining within the same system, it is difficult to see how an unmarked-marked configuration could be arrived at for a diphthong such as /øj/, unless one were to choose some very general

feature such as syllabicity, in which case /wi/ and /ji/, among others, would have to be considered marked-unmarked. The list could be continued indefinitely but the point is obvious; more than a posteriori considerations of markedness will have to be invoked to account for the interaction between single vowels and corresponding diphthongs. There is obviously a great deal of merit in incorporating some general considerations of naturalness in theories of diphthongization, but they will have to go far beyond the rather limited boundaries of the presently available theories of markedness.

Returning to the initial question, the incorporation of the bicausal relations between simple vowels and diphthongs into phonological theory, let us (perhaps only temporarily) abandon the battlefield of feature designations and markedness, and look more closely at the phonetic facts themselves. A diphthong ending in /w/ is a heterogeneous vocalic segment terminating with rounded lips; similarly a diphthong ending in /j/ terminates in an unrounded gesture. The simple vowels resulting from such diphthongs also end with the lips in identical configurations. Conversely, diphthongs resulting from rounded vowels end in a rounded offglide, while those arising from unrounded vowels contain an unrounded semivocalic segment. The onset of a falling diphthong finds the tongue in a specified front-back position which is not significantly altered by the following glide, although due to the greater tongue movement involved, the glide /j/ may exert a slight assimilatory pressure. Thus the end product of diphthong reduction is a vowel whose frontness value is roughly that of the onset element. Finally, diphthongs involve a progressive change of aperture across the entire duration; the reduction of diphthongs yields a vowel of intermediate aperture, representing the movement of two poles toward the center, with both segments of the diphthong combining to characterize the final vowel. Thus, features of the onset, middle and offset of diphthongs appear in the reduced end product. Similarly, spontaneous diphthongization involves a constant change of aperture, centering about the point of the initial vowel. One need only view the spontaneous diphthongizations in Brazilian Portuguese, Canadian French or many dialects of English,

particularly in the American south, to observe the tremendous potential for vocalic over-differentiation through diphthongization. The same bilateral causality has also been postulated for many dialects of Chinese, and has been seen in certain Scandinavian dialects. It suggests that in the overall phonological structure of diphthongs and corresponding simple vowels, certain features are more heavily weighted in terms of the eventual outcome. There appears to be a hierarchy of feature weightings which determine the eventual outcome of monophthongization and also diphthongization. Ideally, it should be possible to represent not only simple vowels but also diphthongs as somehow more unified than they are depicted by present theories. If one remains only within the class of diphthongs undergoing reduction, it might be possible to assign weight values to the various diphthongal elements via a series of functions which would be considered part of the phonological meta-theory. It is quite difficult, however, to portray the opposition direction of causality, which allows simple vowels to diphthongize. It is apparent that there exist principled routes of evolution between simple vowels and diphthongs, which suggests that each vowel, at the phonological level, is not merely a simultaneous bundle of distinctive features, but a set of features divided into sequential clumps, indicating the manner in which the vowel may be phonetically realized; superficially, a simple vowel would be a completely simultaneous realization of the underlying phonological data, while a diphthong would be a sequential realization. Clearly, the moment is not yet mature for the proposing of another complete theory, since we are already beset by a surfeit of theories based on inadequate evidence, which nonetheless offer all-inclusive claims. I would, however, like to modestly propose that the phonological representation of all simple vowels be amended to distribute the features as sequential arrays, paralleling the phonetic structure of equivalent diphthongs. Since, according to the data, several diphthongs may reduce to the same vowel, it will be impossible to depict vowels at the phonological level as fully specified diphthongs, nor would it be wholly appropriate to do so. A more appropriate representation would be to divide the phonological schmata into two successive columns of features. The first column would represent those features normally present in the

first mora of equivalent diphthongs namely values of frontness, while the second column would represent those specifications present in the off-glide of equivalent diphthongs, or values of lip-rounding. The remaining principal feature, tongue height, would be specified in both columns, or as part of the entire segment. Since under normal patterns of evolution diphthongs emerge with a high offglide, all diphthongs, even those with (+high) first morae, involve a progressive raising of the tongue across the expanse of the diphthong. Diphthongs may thus be represented as the same as simple vowels, except that each column would contain a distinct value for tongue height. It has been suggested that when a diphthong reduces to a simple vowel the tongue height of the resulting vowel is approximately mid way between the two morae of the diphthong; therefore the two-column phonological representation of simple vowels must be supplemented by a universal meta-constraint which asserts that in equivalent diphthongs the height values of the two morae must be an equal quantity both above and below the height value of the simple vowel. This could easily be done employing numerical coefficients of vowel height; diphthongization could then be represented as merely a height-varying function, with monophthongization being the opposite process.

The values of lip-rounding for the first element and of frontness for the second would, under normal circumstances, be specified by language-specific or universal redundancy rules which dictate, for example, that front vowels are unrounded and back vowels are rounded, as well as specifying the most common glides /j/ and /w/. Only when redundancy rules are violated would it be necessary to specify the values directly in the representation of the diphthongs, but even in such cases the added features would not appear in the representations for the equivalent simple vowel, since only the frontness value of the first mora and the rounding value of the second are directly tied to the phonological structure of the equivalent vowel. At the phonological level, *en*, vowel features would remain the same as in current descriptions, except for the two-column format. Diphthongization would be regarded as a universal process which in effect phonetically separates the two columns of underlying features through a dynamic change in aperture, and perhaps through other features as well.

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