

Vowel Harmony In Turkish :
Problems With Generative And Autosegmental Approaches

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ABSTRACT

This paper discusses the treatment of vowel harmony, particularly in Turkish. Although notable for its typological utility in classifying languages, vowel harmony exhibits less of an agreement among phonologists than meets the eye despite the general feeling that vowel harmony is a well-understood category of processes in the literature. This paper also traces the historical progression of debate and shows how different analyses may be applied in the treatment of vowel harmony.

1. Introduction

The process of vowel harmony is one of the oldest and most controversial issues in phonological theory and has been studied from several theoretical perspectives. For instance, this issue was given a great deal of attention by Firthian prosodic analysts as well as some linguists working within American structuralism in the 1950s. Despite the fact that these earlier approaches provided reasonable explanations for this phenomenon, they nevertheless, suffered from theoretical inadequacies. With the inception of Generative Phonology (GP) in the 1960s, various accounts of vowel harmony such as the "root marker", "quasi-root marker" and the "progressive assimilation" approaches were offered within this framework. Finally, the development of autosegmental theory in the 1970s also attempted to provide an explanation for the many types of irregular and exceptional behaviour of harmony systems.

The purpose of this article is to examine and show the inadequate descriptions of vowel harmony put forward within generative and autosegmental phonology and argue that

vowel harmony can simply be accounted for with a more general type of rule, precisely that of the process of metaphony. Although a significant portion of this paper is devoted to the treatment of vowel harmony in Turkish, other languages such as Finnish and Akan are also examined in order to determine the "best" analysis for vowel harmony.

2. Vowel harmony in generative phonology

In this section, I examine the question concerning whether vowel harmony is a segmental or suprasegmental property within the framework of generative phonology. Before doing so, I propose a general definition of vowel harmony:

"vowel harmony can be defined as a process in which the
vowels in a word agree in relation to a certain phonetic
o r a c o u s t i c f e a t u r e "

In cases where there is vowel harmony across a boundary (#), there is no need to posit an underlying representation for vowel harmony, since an affix vowel can be seen to assimilate to the neighbouring syllable. When there is vowel harmony within a morpheme, however, it is not apparent as to whether there is assimilation of one vowel to another or of a suprasegmental assignment of the shared vowel feature. Hyman (1975:235) gives examples from Finnish, which are characterized by front-backness harmony, to demonstrate this phenomenon. The two Finnish words [pöytä] 'table' and [pouta] 'fine weather' differ for the feature that all the vowels in the word 'table' are [-back], while all the vowels in 'fine weather' are [+back].

Within the framework of generative phonology, Vago (1973:579) outlines three approaches which have been put forward for the underlying representations of vowel harmony. The *first* approach which was put forward by Lightner (1965) suggests that all underlying vowels have an unspecified value for the harmonizing feature, and that a diacritic feature, such as [-back] and [+back] in the case of Finnish, be assigned to each morpheme. Thus, the words [pöytä] 'table' and [pouta] 'fine weather' would be represented as

/pouta/
 ([-back]) and /pouta/
 [+back]

respectively. This approach was also followed by Chomsky & Halle (1968).

The *second* approach, put forward by Zimmer (1967), proposes that in the lexicon one vowel, either the first or last vowel, is fully specified for the harmonizing feature while all other vowels are represented as archiphonemes, and vowel harmony fills in the unspecified values. With this analysis, the two Finnish words [pöytä] 'table' and [pouta] 'fine weather' would be represented as /pöUtA/ and /poUtA/, respectively. The archiphonemes /U/ and /A/, which have no specification for backness are converted to [ü] and [ä] after front vowels and to [u] and [a] after back vowels.

In the *third* approach, Kiparsky (1968) argues against the first two proposals and suggests that all vowels have fully specified underlying representations and the fact that all vowels agree in backness within a morpheme in Finnish is captured by means of a morpheme structure condition. In this last approach, the two Finnish words would be represented as /pöytä/ and /pouta/. Of the three approaches discussed, only the first treats vowel harmony as a suprasegmental property. In the second approach, features involved in vowel harmony are seen to be the property of, in this case, the first vowel of each morpheme, while in the third, it is seen to be a redundant property of morphemes. Despite the general feeling among phonologists that vowel harmony is a well-understood category of phonological processes, there is less of a consensus among phonologists as to just what the characteristics are that set vowel harmony apart from other types of rules. There does not seem to be any simple attribute that strictly characterizes vowel harmony systems. The most serious treatments of this issue have been put forward by Clements (1976) and Ultan (1973) postulating that this class of processes is defined by the intersection of several criteria; these properties include:

- a) phonetic motivatedness: this condition requires that vowel harmony systems typically operate in terms of the features [\pm back], [\pm front], [\pm high], and some features of tenseness, tongue-root position or the like.

- b) root control: this condition refers to the fact that vowel harmony systems operate generally in terms of the effects of root vowels on affixes, rather than the other way round.
- c) bi-directionality: harmonic influence spreads out in both directions from a determinant vowel.
- d) unboundedness: vowel harmony processes typically affect substantial stretches of a word or domain rather than being limited to a single vowel.
- e) non-optionality: vowel harmony is an obligatory process.

According to Clements (1976:112), these properties are supposed to be traits that are characteristic of all vowel harmony systems and these features regularly recur across historically unrelated languages. According to Clements (1976) the adoption of autosegmental phonology is advantageous in constructing phonological theory in such a way as to make the conjunction of these properties a natural consequence of general principles. However, as I will demonstrate, autosegmental theory, first developed by Goldsmith (1976) to deal with tone and intonation, should not be extended to describe the process of vowel harmony in Turkish.

3. "Root marker" approach

In this section, I describe and criticize some of the treatments of vowel harmony that have been put forward for Turkish within the framework of generative phonology. One type of analysis that has been favoured by some generative phonologists is the 'root marker' approach, which is the generative version of prosodic analysis adopted by Lightner (1965) and Chomsky & Halle (1968). The 'root marker' approach assigns stems to classes according to their harmonic properties. 'Root markers' are the same as segmental features except for the added property that they characterize *all* the vowels in a stem or word. In Turkish, vowels in a word harmonize according to palatality and labiality. The rules for palatality and labiality taken from Crothers & Shibatani (1980:64) are given below:

- (1) Palatality Harmony: the vowels in a word agree in palatality
- (2) Labiality Harmony: (a) a high vowel must agree with the preceding vowel in labiality,
(b) a low vowel in a non-initial syllable may not be labial.

If the representation of vowel harmony in (3) is to be accepted for Turkish,

(3)

	i	ü	ı	u	e	ö	a	o
high	+	+	+	+	-	-	-	-
palatal	+	+	-	-	+	+	-	-
low	-	+	-	+	-	+	-	+

(Zimmer, 1967:166)

then examples like **sonuç** 'result' belong to the {-palatal} and {+labial} class, **el** 'hand' to the {+palatal} and {-labial} class and **sekiz** 'eight' to the {+palatal} and {-labial} classes. These features are then factored out of the stem leaving an archiphonemic type representation for vowels, the only remaining feature being [±high]; thus **sonuç** 'result' is represented as {-palatal, +labial} /sEnIç/ where /E/ is specified as [-high, Opalatal, Olabial], and /I/ as [+high, Opalatal, Olabial]. In effect, the harmonic properties of the stem are extended to the entire word; that is, the root marker becomes a 'word marker'. In generative phonology this is handled by a rule like (4) which fills in the proper values for palatality and labiality in all the vowels of a word (the asterisk indicates that this is a mirror image rule).

$$(4) \quad \backslash\text{B}\backslash\text{C}\backslash (\backslash\text{A}\backslash\text{C}\backslash\text{C}\text{O}([+\text{vocalic}], \backslash\text{B}\backslash\text{C}\backslash (\backslash\text{A}\backslash\text{C}\backslash\text{C}\text{O}([-\text{consonantal}], <[+\text{high}]>)))) \\ \rightarrow \left[\begin{array}{c} \text{[a palatal]} \\ \text{[b labial]} \end{array} \right] / *\# \text{X_Y} \left[\begin{array}{c} \text{[a palatal]} \\ \text{[b labial]} \end{array} \right]$$

where X and Y contain no # (Crothers & Shibatani, 1980:65)

This root marker approach must be abandoned for Turkish because it runs into a problem with the definition of labiality harmony given above. As Zimmer (1967) rightly points out labiality is not a property of a whole stem *soba* 'heater' or of a whole word *duyular-In* 'your senses', but of a sequence of high vowels following a labial vowel. A further criticism of the root marker approach has been offered by Kiparsky (1968), concerning the abstract nature of the 'root marker'. As Kiparsky (1968) notes 'root markers' do not have a universal interpretation as do most other features and that they do not identify an idiosyncratic class of forms that undergo a particular rule, but determine the way a rule (vowel harmony) applies to a form. Thus 'root markers' increase the abstractness of phonological theory to an undesirable extent. Crothers & Shibatani (1980:66) point out that while the formalism of prosodic analysis seems flexible to get around this problem, any solution amounts to changing palatality from a root marker to a segmental feature which assimilates progressively through a sequence of high vowels.

4. "Quasi root" marker approach

A more serious point about 'root markers' that should be taken into consideration concerns the treatment of exceptions to vowel harmony. Many loan words in Turkish violate the internal (stem) harmony, however they take suffixes by the regular rules, provided reference is made to the last vowel in a stem e.g. /pilot-lEr/ → **pilotlar** 'pilots'. Crothers & Shibatani (1980:67) state that the obvious problem to this analysis is that exceptional items do not have harmonic root markers, so there is no direct way of stating harmony in these cases. They propose a new device, 'a quasi root marker' to the last vowel of the stem. This creates another problem similar to the labiality harmony in Turkish, which amounts to the establishment of a segmental feature which assimilates progressively, thus not being a root marker at all.

5. Progressive assimilation

The problems confronted above can be removed by a different analysis, first proposed by Lees (1961) for Turkish, in which vowel harmony is stated as a progressive assimilation rule. In this approach, the first vowel of the stem is fully specified for all features including palatality and labiality: the remaining vowels are represented as archiphonemes; e.g. /sonIç-lEr-In/ for *sonuçların* 'your results'. The progressive harmony rule (5) fills in all the harmonic features starting from the left.

$$(5) \text{ V} \rightarrow \left[\begin{array}{c} \text{a palatal} \\ \text{b labial} \end{array} \right] / \left[\begin{array}{c} \text{V} \\ \text{a palatal} \\ \text{b labial} \end{array} \right] \text{ C}_0 \left[\begin{array}{c} \text{_____} \\ \text{<[+high]>} \end{array} \right]$$

(Crothers & Shibatani, 1980:67)

Labiality harmony now causes no problems; its sequential nature is directly stated in this sort of a rule. Exceptional forms require a slight modification of the harmony rule, but not a separate statement. In a stem like *pilot* 'pilot', the last vowel is marked [-Vowel Harmony]. As a consequence, the second vowel is not affected by left to right assimilation, and the harmony rule picks up again taking the last stem vowel as the starting point, with the outcome being *pilotlar* 'pilots'.

Although the progressive assimilation analysis appears to resolve some of the earlier problems which have been confronted, it triggers off new ones. Firstly, not all languages with vowel harmony are exclusively suffixing languages like Hungarian, Turkish and Finnish, but are bi-directional (prefixing as well as suffixing) as in Igbo, Ewe, and Kalenjin. The harmonic effect spreads outward in both directions from some determinant vowel. If harmony rules are to extend to prefixes as well as suffixes, the formalism must allow assimilation to project out from a stem in two directions. If, however, bi-directional assimilation is stated by the use of a mirror image convention, then, it is no longer possible to decide, in cases of polysyllabic harmonic stems, which vowel it is that the other vowels are assimilating to.

The assimilation approach gives rise to a second problem and that is related to the fact that generative phonological theory calls for specifying redundant information about lexical representations with lexical redundancy rules (or morpheme structure conditions). Crothers & Shibatani (1980:69) point out that if the progressive assimilation analysis of vowel harmony is applied to Turkish, lexical entries will have the phonological form mentioned earlier: the first vowel is fully specified, the following vowels archiphonemes. The fact that all and only initial vowels are specified for palatality and labiality, indicates that this itself is a redundant fact. The assimilation analysis of stem is undesirable, simply because no assimilation takes place. It is clearly an output of the progressive analysis that certain stem vowels are taken to be basic and others are taken to be unspecified for harmonic features.

6. "Two-pronged" analysis of vowel harmony

Kiparsky (1973) realized the importance of the aforementioned properties, and tried to resolve them by using what he calls a 'two-pronged analysis' of vowel harmony. With this analysis, a distinction was made between the purely static harmony found in stems and the assimilatory harmony of suffixes, the first being handled by morpheme structure conditions, the second by phonological rules. This approach required that all morphemes have fully specified lexical representations, stems with their invariant vowels, suffixes with the *least marked* vowel of their several phonetic realizations. Consequently the example, *evler* 'houses' is phonologically represented as /ev-lar/, with a rule rewriting the plural suffix vowel [a] to [e]. Crothers & Shibatani (1980:69) indicate that there are two advantages of this treatment, the first is that arbitrariness is eliminated in the representation of stem vowels and secondly that exceptional items like *pilot* 'pilot' no longer need to have a special feature [-Harmonic] attached to each vowel, as in the assimilation analysis. To indicate the exceptional nature of such stems, the whole item is marked as an exception to the morpheme structure condition.

Despite its advantages, there are, however, two problems associated with the two-pronged analysis of vowel harmony. The first is that the decision to choose the least marked suffix vowel as the lexical representative does not lead to a definitive solution

(Zimmer 1969). In Turkish, for suffixes with high vowels which have the following four realizations [i ü I u], the first and the last are considered equally marked in the theory of markedness. The second problem with the two-pronged analysis of vowel harmony, which was open to the objection of generative phonologists, calls for completely separate statements of stem and suffix harmony in spite of the close relation between these two harmony systems.

Constructing a valid phonological theory which provides a framework within which the data can be correctly described has been an extremely difficult requirement to satisfy in the case of vowel harmony. Although vowel harmony may be generally formulated as that "the vowels in a word agree with respect to a certain phonetic and acoustic feature category", the difficult task is to provide an explanation for the many types of irregular and exceptional behaviour of harmony systems.

7. Autosegmental treatment of vowel harmony

In this section I outline the autosegmental theory of phonology first developed by John Goldsmith to treat problems in the analysis of tone and intonation, in the analysis of vowel harmony. Autosegmental phonology takes its point of departure from the observation that certain phonetic features behave with relative independence with respect to others. Unlike standard versions of generative phonology, it permits such features and feature clusters to be assigned to separate concurrent levels or "tiers" in phonological representations.

Clements (1976) integrates Goldsmith's (1976) Well-Formedness Condition, which was originally developed to handle tone, to vowel harmony. He does this by extending the Well- Formedness Condition to the description of vowel harmony with no essential modification. In the specific case of vowel harmony, two levels are postulated (Clements 1976):

- Level 1, The level at which P-bearing units are represented; in this case, units which bear the P-segments or features. It is the P-base: level at which vowels (which bear harmonic features) and intervening consonants are represented (#CVCVCV#).
- Level 2, The level at which the harmony autosegment or harmonic feature (\pm back, \pm round, \pm ATR, etc.) is represented.
- P-Level:

Mediating between these two levels in the course of derivations is the well-formedness condition for vowel harmony, similar to the condition postulated for tone by Goldsmith (the changes to Goldsmith's version are in bold type):

Well-Formedness Condition (Vowel Harmony)

- a) All vowels are associated with at least one **harmony** feature; all **harmony** features are associated with at least one vowel.
- b) Association lines do not cross.

In the next section, I consider how adequate this approach is for accounting for vowel harmony and I also demonstrate how the Well-Formedness Condition functions throughout the course of derivations, correcting ill-formed representations that may arise as a result of rule application in Akan.

8. Autosegmental treatment of vowel harmony in Akan

To demonstrate how the Well-Formedness Condition applies in the description of vowel harmony, Clements (1976:113) gives an example from the Asante dialect of Akan, a West African language whose vowel harmony system is based on the feature category of root advancing. The regular root *fiti* 'to puncture' belongs to the category of root advanced or [+ATR]. Therefore, it is assigned to the representation below. (Upper case letters are used to designate vowel autosegments that have not yet been associated with all vowel features).

- (6) *æfeleteeI*
 [ee≤

μ
+A -A

The Well-Formedness Condition applies in the following way, dashed lines indicate those associations which result from a given application of the Well-Formedness Condition:

(9) O+belese+I
 √ee~ Jee≤
 +A -A i.e. [obisai] 'he asked'

Examples of this sort demonstrate that they cannot be treated in an insightful way within the framework of most earlier generative treatments of vowel harmony such as that of Lightner (1965). Such theories were unable to account for the fact that a root may contain two or more harmonic domains, each belonging to a different harmonic category. The autosegmental approach has no difficulty in handling such facts, roots like *bisa* 'to ask' are treated as belonging, in effect, to two successive harmonic categories, which determine the harmonic behaviour of prefixes and suffixes respectively.

9. Autosegmental treatment of vowel harmony in Turkish

From this analysis, it is easy to see how disharmonic roots may be treated, that is, roots which do not conform to vowel harmony internally. All vowels in such roots may be considered as opaque. The following example which is a Turkish loan root *pilot* 'pilot' is exceptional with respect to both backness and rounding harmony. The important generalization concerning such roots is that it is the final vowel that controls the harmonic behaviour of suffixes. This fact follows as a formal consequence of the structure of the (autosegmental) theory; since only one association can be entered by the terms of the Well-Formedness Condition:

(10) peieleoet+leaer
 μ √ee≥
 -B +B i.e. [pilotlar] 'pilots'

The alternative possibility, an association between the initial harmony autosegment -B and the suffix vowel, would of course constitute a violation of the condition that no lines may cross (Goldsmith 1976).

Autosegmental phonology could be regarded, in part, as an attempt to construct a formal theory capable of expressing some of the insights about prosodic structure. The extension of autosegmental phonology to vowel harmony suggests the possibility of likeness of tone to vowel harmony.

10. Arguments against an autosegmental treatment of VH in Turkish

There is *no positive* argument in favour of an autosegmental approach at least in the case of *labial* and *palatal* harmony in Turkish. Here labial harmony is defined by Anderson (1980:21) as: a vowel after the initial syllable is [+round] if and only if it is a) also [+high]; and b) preceded by a [+round] vowel in the syllable immediately before. In addition to a large number of forms with vowels that are exceptional with respect to harmony, Turkish contains suffixes which also behave irregularly with respect to labial harmony. One striking example is the suffix /-Iyor/ which marks the progressive and which contains the invariant /o/ which never assimilates to its left, regardless of the source of any preceding autosegments. This example seems to suggest that, at least in Turkish, labial harmony propagates only to the right, never to the left. This seems to remove one of the *major* motivations for an autosegmental treatment of vowel harmony. This fact is also supported by Clements (1977:116) who states that:

"the characteristics of bi-directionality, non-optionality, and unboundedness follow from the form of the Well-Formedness Condition. Harmony systems which do *not* display these characteristics are simply *inexpressible* within the vocabulary of autosegmental phonology."

As Clements (1976) mentions above, the bi-directional nature of harmony is captured as an essential consequence of the basic principles of the autosegmental theory and harmony systems which do not exhibit these characteristics, as in the example of the Turkish

progressive suffix /-Iyor/, cannot be expressed within the framework of autosegmental phonology.

ıA/
with

The definition of labiality; a vowel after the initial syllable is [+round] if and only if it is a) also [+high]; and b) preceded by a [+round] vowel in the syllable immediately before implies that vowels in the initial syllable can be freely [+round] regardless of height. Anderson (1980:21) states that this process which extends its applicability as far as possible across the word can be described as an assimilatory rule as in (11):

$$(11) \left[\begin{array}{c} +\text{syllabic} \\ +\text{high} \end{array} \right] \rightarrow [+round] / \left[\begin{array}{c} +\text{syllabic} \\ +\text{round} \end{array} \right] C_0 \underline{z \ xz \ xz}$$

This rule (11) assumes that other vowels ([-high] vowels after the initial syllable, etc.) are specified as [-round] unless lexically (i.e. idiosyncratically) [+round]. Rule (11) applies progressively to its own output; since it feeds itself in to the right, no special assumptions about directionality of application are necessary.

The problem remains as to how these facts would be dealt with by a rule of prosody assignment. Such a rule would have to assign an autosegment, either [+round] or [-round], with some element of segmental structure, and then invoke a convention of association in order to align this with the full range of vowels in the word. In the simplest instance, this could be associated with the root as a whole:

$$(12) \begin{array}{ccc} [+round] & \text{association} & [+round] \\ & \longrightarrow & \text{æeðee'ee-} \\ /teAereIen+I+meI/ & & /teAereIen+I+meI/ \\ & & = \text{torunumu} \quad \text{'is it his/ her} \\ & & \text{grandchild?}' \end{array}$$

As a result, the autosegment [+round] is associated with each vowel of the word. When one of the vowels is [+high], however, harmony must not associate [+round] with it, or with any subsequent vowel: thus, **torunlarınız** 'your grandchildren' displays harmony stopping at the vowel of the plural suffix /lAr/. In an autosegmental treatment, however, this could be adjusted by saying that all [-high] vowels after the first syllable are automatically associated with [-round] autosegments: the operation of labial harmony would be exemplified as in (13):

(13)	[+round]	[-round]	→	[+round]	[-round]
an		İ		fee'	æefee'
may	/teAereIen+leAer+Ien+Iez/			/teAereIen+leAer+Ien+eIez/e	
				= torunlarInIz	
				'your grandchildren'	

The [+round] autosegment attached to the root vowel is thus associated with the two vowels of the root, but not to the vowel of /lAr/, since this latter is already associated with a [-round] autosegment. This [-round] autosegment is then associated with the following vowels; it is only this autosegment that can be associated with them, due to the principle, which is a significant part of the theory, that association lines do not cross.

This analysis poses the crucial question of how we know that the second vowel of this form should be associated with [+round], rather than [-round]. Despite the fact that both of the representations in (14) below are well-formed, there must be a way of deciding the direction of association that is to prevail:

(14)	a. [+round]	[-round]	b.	[+round]	[-round]
	fee'	æefeeΔ		©	æefeeΔ
	/teAereIen+leAer+Ien+Iez/			/tArIn+lAr+Ien+Iez/	
	= torunlarInIz			= *torInlarInIz	

In this situation, the following principle is suggested by the theory: "unbound segments [...] take priority over bound segments" (Clements 1976). Thus, since [+round] is not bound to any particular segment, it takes precedence over the already bound [-round].

The second argument against an autosegmental treatment of vowel harmony in Turkish is related, as mentioned earlier, to the exceptional stems and affixes, which indicate that the process of vowel harmony is not bi-directional in Turkish. If we consider the form **hiza+da+ki+ler** 'those that are on the same level', we observe that the stem **hiza** 'level' violates backness harmony internally. Since there is an internal violation of backness harmony within the stem, the feature [+back] is presumably associated with its final vowel [a]. The following locative suffix /dA/, harmonizes with this [+back] vowel. This is followed by the 'relative' suffix /ki/, which is invariant with respect to backness

harmony and the following plural suffix /lAr/ harmonizes with this. In each case, harmony is exclusively progressive. It is interesting to note that the locative suffix /dA/ which comes between two conflicting invariant vowels ([a] and [i]) harmonizes *only* with the vowel to its left. In Turkish then, there is exclusive evidence for a progressive, as opposed to bi-directional rule of palatal harmony.

11. Conclusion

In this paper, I have traced the historical progression of debate on vowel harmony. After outlining and describing the inadequacies of the treatments of vowel harmony within generative phonology, such as the "root marker", "quasi root marker", "progressive assimilation" and the "two-pronged" analysis of vowel harmony in Turkish, I next demonstrated that the adaptation of Goldsmith's (1976) Well-Formedness Condition for tone is also inappropriate for the treatment of vowel harmony in Turkish. I made this statement on the grounds of the example I gave of the progressive suffix /-Iyor/ which contains the invariant /o/ and shows that labial harmony in Turkish propagates only to the right, never to the left and the locative /dA/ in the example **hizadakil** 'those that are on the same level' which harmonizes with the vowel to its left despite the fact that it occurs between two conflicting vowels. This suggests that there is exclusive evidence to support the case for a progressive rule of palatal harmony in Turkish.

The complications in the treatment of vowel harmony described in this paper indicate to me that vowel harmony should be incorporated as an instance of a more general type of rule, precisely that of the process of *metaphony* in which "the quality of a vowel is dependent on that of a neighbouring syllable" (Anderson 1980:3). The examples I have given indicate that vowel harmony is simply an instance of an ordinary sort of process, that of metaphony, and need not be treated in such a complex way, as within generative and autosegmental phonology, especially for a language like Turkish.

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