Knowledge of perceptual similarity and its phonological uses: evidence from half-rhymes

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ABSTRACT

A study of half-rhymes (HR's) in Romanian poetry reveals that poets systematically prefer HR's corresponding to certain common phonological processes: final devoicing, post-nasal voicing, nasal-place neutralization, stressless vowel reduction, coda cluster simplification, nasalized vowel centralization, liquid metathesis. The striking observation is that none of these processes operates in Romanian phonology at a categorical level. But at least some have an identifiable phonetic basis: thus ɨ̃ and ũ which are involved in a large number of HR's, are closer on the F2 dimension than oral ɨ and u. It is suggested that poets' prefer these HR's based on their knowledge of perceptually-based relative similarity relations, not on their knowledge of sound alternations or distributions.

1. INTRODUCTION

In this study, patterns of half-rhyme preferences are investigated as reflecting relative similarity judgments. A half-rhyme (HR) is a pair of lines whose final accentual domains are similar but not strictly identical: *time/nine* (as *in a stitch in time/saves nine*) is a HR, while *sign/nine* is a perfect rhyme. Systematic frequency differences among HR's suggest that some pairs are perceived as closer to identity than others: m/n HR's like *time/nine* are frequent, while parallel b/d HR's like *vibe/side*) are very rare [1]. Relative similarity judgments implicit in this preference will be abbreviated here as Δ(m-n) < Δ(b-d): the perceived difference between m-n is smaller than that between b-d. The question we ask is: What are the sources of similarity knowledge? The class of HRs we have studied allows us to distinguish two potential sources: **phonological** knowledge of the categorical patterns of distribution of contrasting sounds or of alternations among them, as against **phonetic** knowledge of the relative effectiveness of the perceptual correlates for different contrasts. We argue that HR selection provides evidence of phonetic knowledge, in the sense defined.

The corpus analyzed is a set of 9 rhymed texts written in the Standard Literary Romanian of the mid 20th century. It contains 1016 HR's, out of a total of 19,014 rhymes. HR frequencies in individual texts range from a high of 18% to a low of .06%. (Further details in [2].)

2. P-MAP HYPOTHESES

We asked the following questions: Are similarity relations implicit in HR use context sensitive (e.g. are t-d more similar word finally than pre-vocalically or do they preserve the same degree of similarity across contexts)? Do speakers share a hierarchy of similarity, as evidenced by their common preferences for some HR's? If shared similarity hierarchies emerge, are mismatches for a particular feature more frequent in contexts known to impair the perceptibility of that feature?

Our starting hypothesis [3] is that speakers derive a partial hierarchy of context-sensitive sound similarity from their knowledge of the perceptual correlates of different contrasts, coupled with some understanding of general factors such as: (a) relative distance; (b) the subset effect; (c) cue duration. Relative distance refers to the case in which two contrasts, x-y and a-b, are expressed on a shared set of perceptual dimensions; if, on one of these dimensions, the distance between x-y is greater than that between a-b, then, all else equal, Δ(x-y) > Δ(a-b). An example illustrating this is the ranking Δ(i-u) > Δ(ɨ̃-ũ), documented by [4]. Both contrasts are expressed on the F2 dimension, but the F2 distance is greater between the oral i-u [5]. We assume that these two facts - the difference in F2 distances and the difference in similarity - are related: when all else is equal, the greater F2 distance between oral vowels causes them to be perceived as more dissimilar. The subset effect refers to the case in which a contrast, a-b, is expressed on a proper subset of the dimensions differentiating another contrast, x-y. Then, all else equal, Δ(x-y)>Δ(a-b). An example are the Romanian pairs u-ɨ and i-ɨ: their F2-F3 values appear below.

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	u	ɨ	i
F2	800	1500	2200
F3	**2500**		2900

Table 1: F2-F3 values for Romanian high V's [6]

The lack of an F3 difference between u-ɨ predicts Δ(i- ɨ) > Δ(u- ɨ), as discussed below.

Cue duration refers to the conjecture that reduced exposure to one or more cues for a contrast may cause it to be less distinctive. Thus i-u may be perceived as more similar than i:-u: simply because the listener, who is exposed for a shorter time to the properties differentiating i-u, is less able to evaluate the difference between them. Although a complete model of similarity is not being offered, reference to the similarity factors listed above provides explanations for the HR patterns we report.

How does knowledge of perceptual similarity relate to phonology? Speakers may prefer more similar mappings between an input and its output. We propose that knowledge of relative similarity serves as a guide in the speakers' search for an output that minimally deviates from input. A concrete example is the ranking, documented in [4], Δ(D-N)> Δ(D-T); D= voiced, N= nasal, T= voiceless. If the D-N pair is more dissimilar, it should correspond to a dispreferred input-output mapping compared to the more similar D-T. This prediction is supported by the finding that constraints which could be satisfied either by turning D into N or D into T are in fact systematically satisfied by the D-to-T mapping [3].

3. SHARED SIMILARITY RANKINGS

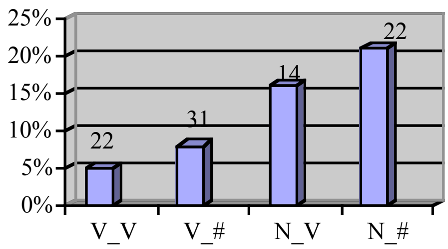
Two aspects of the Romanian HR corpus suggest a shared similarity hierarchy across poets. First, all poets draw on a core set of HR types, seen below.

Mismatch		Common context	HR Example
i	Voice	[+nas]_	pʌmínt - striŋgínd
ii		[-nas]_#	pantóf - popóv
iii	j-Ø	C_#	ázj-obráz
iv	Back(u-ɨ)	/_[+nas]C	súnt-pʌmínt
v	Front (i-ɨ)	/_[+nas]C	strɨ́mte-sɨ́mte
vi	Place	Coda nasals	strɨ́mt-vɨ́nt
vii	Height	Post-tonic	lumíle-númele
viii	Liquid-Ø	V_C/C_V	ɑle̯árgʌ-intre̯ágʌ

Table 2: HR types common to all poets in the corpus

These HR's are shared by all poets and account for the highest percentages of HR's in each text, [2]. Other HR types, such *tʃeáʃʌ-ápʌ,(*a [±continuant] mismatch) or *kalm-alb* (a [±nasal] mismatch) are infrequent overall and absent in most texts. The difference between well-attested T-D HR's and virtually unattested D-N HR's supports the ranking Δ(D-N) > Δ(T-D) discussed earlier. A shared similarity hierarchy is further suggested by the fact that the relative frequency of HR's in different contexts is the same across poets. Thus voicing HR's are more common after nasals than in the V_# context in all texts. This is shown by taking for each text the ratio of voicing HR's in a given context (say N_V) to the overall number of rhyming pairs containing obstruents (which contrast for voicing) in the rhyme domain, *in that context*. This allows a frequency comparison of voicing mismatches across contexts, normalizing for frequency differences between sequences: thus Fig.1.a shows that in C.Teodorescu's translation of Maiakovsky, 22 voicing HR's in the context V_V account for only 5% of the rhymes containing D/T in V_V contexts. However, because NT and ND codas are much less frequent sequences than VCV, 22 voicing HR's in the N_# context account for over 20% in the rhyming domains that contain obstruents in the N_# context.

1.a Voicing HR's in Teodorescu 1970



1.b Voicing HR's in Arghezi 1956

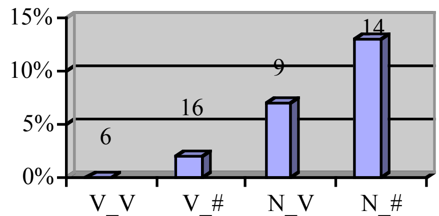


Figure 1: Frequency of voicing HR's (% of HR's from total rhyming domains containing obstruents) in 2 rhymed texts.

Figure 1 illustrates the idea of a shared similarity hierarchy through a comparison of relative frequencies in voicing HR in four contexts between two of the texts studied. Differences between V_V and N_V contexts, and V_# and N_# contexts are significant (p=.01 and .004 respectively). The rankings of similarity emerging from both comparisons are identical: Δ(D-T)/V_V ≥ Δ(D-T)/V_# > Δ(D-T)/N_V > Δ(D-T)/N_#. This is true not only for this pair of texts but for all texts studied: it is an example of a similarity hierarchy shared by poets and, most likely, by their intended audiences.

A distinct similarity hierarchy involves front-central and back-central pairs of high vowels, in their nasalized, oral and contextually shortened versions. All poets admit u-ɨ and i-ɨ mismatches before a nasal-C cluster: examples are *karímb-plumb* 'sole; lead' and *simt-strɨmt* 'I feel; narrow'. Romanian vowels are audibly nasalized before nasals [7] and shorter before CC clusters, including NC [8]: the vowels in the previous examples are thus both relatively short and nasalized. A subset of the poets admit u-ɨ and i-ɨ HR's before single nasals, as in *súnʌ-tsʌrínʌ* 'sounds; soil'. In this context, the vowels are nasalized, not shortened. For all poets, however, there is a frequency difference: the *karímb-plumb* HR's are systematically more frequent.

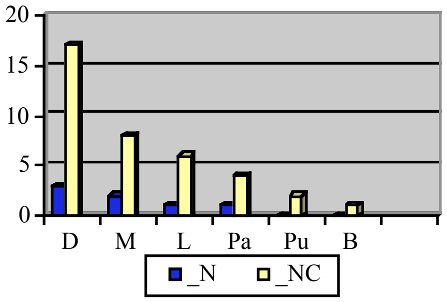


Figure 2: frequency of back-central and front-central HR's before NC and N in 6 texts

The sequences VNC(V) are considerably less frequent overall than VNV: thus higher numbers of vowel-quality HR's in the _NC context can only be explained by reference to the similarity rankings Δ(longer ũ-ɨ̃)> Δ(shorter ũ-ɨ̃); Δ(longer ĩ-ɨ̃)> Δ(shorter ĩ- ɨ̃). HR's with oral u-ɨ, i-ɨ (e.g.*intíj-gutúj* 'first-quinces') are even more infrequent than the *súnʌ-tsʌrínʌ* HR type and they tend to occur only next to j or r. Oral V mismatches like *hídʌ-údʌ* occurring outside of these two contexts are very rare.

Finally, some poets allow considerable numbers of ũ-ɨ̃ HR's but few or no ĩ-ɨ̃ mismatches. The similarity relations suggested by this data are then: Δ(ɨ-u) > Δ(ɨ̃-ũ); Δ(longer ɨ̃-ũ) > Δ (shorter,ɨ̃-ũ); and finally: Δ(ɨ̃-ĩ) > Δ(ɨ̃-ũ).

4. SOURCES OF SIMILARITY JUDGMENTS

We turn now to the source of this extensive body of shared knowledge demonstrated by the HR data. What do poets know which causes them to avoid HR's like *hídʌ-údʌ* and to favor HR's like *karímb-plumb*? We have mentioned earlier possible sources in phonetic knowledge: the ranking Δ(longer ɨ̃-ũ) > Δ (shorter ɨ̃-ũ) is a cue duration effect. This means that poets factor into their similarity judgment knowledge of the gradient pre-cluster shortening effect that causes vowels to be shorter in NC position. The ranking Δ(ɨ-u) > Δ(ɨ̃-ũ) is a relative distance effect: poets know that nasal vowels are more similar than oral vowels. Finally Δ(ɨ̃-ĩ) > Δ(ɨ̃-ũ) is a subset effect, as discussed earlier.

In the case of the T-D mismatches, the major similarity factor appears to be poets' awareness of a gradient but systematic process of post-nasal voicing [8]: the voiceless closure period is abbreviated after a nasal, compared to a post-oral context. Thus the portion of closure expressing a voicing contrast is shorter after N than after V: the perceived similarity ranking Δ(D-T)/V_# >Δ(D-T)/N_# may thus be viewed as a cue duration effect.

We consider now the possibility that speakers of Romanian have phonological sources for their knowledge of similarity relations. What could these be? If two sounds alternate, in at least some contexts, then their alternating status may promote a sense of functional equivalence among them and thus contribute to the perception of similarity. If complementary distribution between sounds might train listeners to disregard differences among them, as the context is sufficient to predict their occurrence. But in the case of the Romanian similarity relations implicit in HR use, both alternations and static distributions can be excluded as significant sources of similarity knowledge. First, none of the major HR types listed in Table 2 correspond to actual phonological processes of Romanian: there are no alternations, even lexically restricted ones, corresponding to the HRs in Table 2. Conversely, phonological processes active in Romanian lead to alternations that lack HR counterparts: two of the most productive among these are listed below, along

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with the types of HR's one might expect if the very fact of alternation would enhance similarity: but none of these HR's are among the systematically attested types.

Process	Example	HR reflex?
t -> t^s / _ i	*frate / frat^s-j* 'brother-brothers'	*lut-put^s* *fete-bet^{s}e*
s -> ʃ/ _i	*pas/ paʃ-j* 'step-steps'	*kos - moʃ* *waste-paʃte*

Table 3: Productive Romanian rules, resulting alternations and conceivable HR's based on the alternating pairs

A related point can be made by observing that the pair i-ɨ stands in quasi-complementary distribution: ɨ is rare in general, but frequent after r, while i, normally frequent, is rare after r. Related alternations cause i-suffixes to become ɨ after an r-final stem: compare *jub-í* 'love-inf.' with *ur-ɨ́* 'hate-inf.' But a look at the contexts in which i-ɨ HR's occur shows that these are mostly limited to the nasalizing, shortening environments mentioned above: as a result, forms like *jub-í* rarely rhyme with *ur-ɨ́*, despite the complementary distribution of i-ɨ and their alternating relation. Moreover, the ɨ-u HR's (with vowels that do not alternate or stand in complementary distribution) are more frequent than the ɨ-i HR's, a fact explained earlier: there is an F3 difference between ɨ-i, but none between ɨ-u.

5. SIMILARITY RANKINGS AND INPUT-OUTPUT MAPPINGS

It was suggested earlier that knowledge of relative similarity has a potential use in phonology: that of guiding the speaker in search of the minimal deviation from a given input. The HR study establishes shared knowledge of similarity rankings rooted in phonetic factors. How do such rankings relate to phonological mappings of input-to-output? A relevant observation is that the list of core HR types (Table 2) reads like a list of common phonological processes, that is, of *common input-output pairings*. We find in it the HR equivalents of the processes of post-nasal voicing (i), final devoicing (ii), nasal vowel centralization (iii), coda cluster simplification (iv), nasal place-assimilation (v), post-tonic vowel reduction (vi) and liquid metathesis (vii). The close coincidence between HR types and phonological processes suggests that both involve similarity-based choices: if Δ(x-y) > Δ(a-b) then a-b is both the better HR and the better input-output pair. But while it seems clear that poets can choose one HR type over alternatives, it is not equally clear that speakers get to exercise a choice in the matter of input-output mappings. In fact, our own data suggests either that they cannot always so choose or, alternatively, that the choice cannot be based on similarity alone: recall that the most productive processes of Romanian phonology yield input-output pairs which must be quite dissimilar, if one were to judge from their lack of HR equivalents. It is possible that this difficulty arises only in the study of lexicalized alternations, which frequently represent the telescoped effect of distinct diachronic steps of minimal deviation from an input. Our prediction is that on-line processes of loan adaptation, which operate to a considerable extent independently of the lexically entrenched system of alternations, are a better means of testing the idea that perceptual similarity determines the choice of input-output mapping [2].

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