

Onset Transfer in Reduplication¹
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1. INTRODUCTION

A frequently noted property of reduplication is that the reduplicant is generally a contiguous substring of the base (e.g. Marantz 1982; McCarthy and Prince 1986, 1995; Lamontagne 1996). For example, Lamontagne (1996) identifies $[[ABC]_R[ABCDE\dots]_B]$ as a 'typical reduplication pattern', and $[[ACD]_R[ABCDE\dots]_B]$ as 'atypical'. In optimality theory, this property is enforced by the "no skipping" clause of the correspondence constraint CONTIGUITY (Kenstowicz 1994; McCarthy and Prince 1995), which prohibits base-reduplicant mappings of the type $ABC \rightarrow AC$.

The focus of this paper is on $ABC \rightarrow AC$ mappings in reduplicative onset transfer: specifically, cases in which a $[C_1C_2V_3\dots]$ base corresponds to a prefixed $[C_1V_3]$ reduplicant, as in the Klamath distributive form $[[t'_{1a_3}]_R[t'_{1w_2a_3}j_a]_B]$ 'dist. work for' (Barker 1964). I suggest that such mappings are actually characteristic in one case: when C_1 is an obstruent (O) and C_2 is a sonorant consonant (R). The typology of onset cluster simplification under reduplication, presented in §2, shows that $O_1R_2V_3 \rightarrow O_1V_3$ reduplication occurs even when other base clusters do not simplify under reduplication (§2.1), and even when other base clusters do not reduplicate at all (§2.2). I argue that $O_1R_2V_3 \rightarrow O_1V_3$ mappings have a privileged status in reduplication because the perceptual difference between O_1R_2V and O_1V is smaller than the difference between C_1C_2V and C_1V in the general case, and smaller than the difference between C_1C_2V and C_2V . Several lines of evidence in support of the perceptual difference theory are presented in §3. An analysis is proposed (§4) in which correspondence constraints sensitive to the magnitude of perceptual differences between correspondent strings, interacting with phonotactic constraints and a violable constraint demanding reduplication, determine whether a particular cluster will reduplicate, and if so, exactly what portion of the cluster will be copied.

2. PARTIAL ONSET TRANSFER PATTERNS

This section presents a survey of partial onset transfer, i.e. reduplication patterns in which, for at least one type of base-initial biconsonantal cluster, only one cluster member is copied. (Note that in every pattern presented, CV-initial bases take CV- reduplicants.) The data discussed extend slightly the typology of onset transfer presented by Steriade (1988).

In all of the data discussed below, the reduplicant is a prefixed CV or CCV syllable. Onsets of the base and reduplicant are underlined; a dash separates reduplicant from base. I make a distinction between obstruent + sonorant onsets (OR) and all other onset clusters (–OR); and further divide OR into stop + sonorant onsets (TR), and sibilant fricative + sonorant onsets (SR). The transfer patterns are grouped into 3 classes, which I will call *sufficient copy*, *selective copy*, and *blind criterion*; the meanings of these class labels are spelled out below.

¹ This paper presents work in progress. For helpful comments, thanks especially to Bruce Hayes, Colin Wilson, and Donca Steriade.

2.1 Sufficient copy

Under sufficient copy reduplication, all complex onsets other than OR are copied in full. Only OR is simplified, and always by failure to copy the sonorant.

In Gothic (Braune 1883; Wright 1910; Steriade 1988), a reduplicating C(C)V- prefix (with fixed vowel *e*) marks the perfect for a subset of the strong verbs:

(1) Gothic (data from Braune 1883)

- CV a. [he-het] 'called'
 TR b. [ge-grot] 'wept', [fe-fres] 'tried, tempted'
 SR c. [se-slep] 'slept'
 -OR d. [ste-stald] 'possessed', [ske-sked] 'separated'

All OR clusters are simplified under reduplication, with copy of the obstruent only (b, c). In contrast, /sp, st, sk/—the only -OR onset clusters of Gothic—are copied in full (d). This is "sufficient copy", in the sense that only as much of the base cluster is copied as is necessary to achieve the requisite degree of perceptual similarity between base and reduplicant: if less than full copy will satisfy the perceptual similarity requirement, then full copy is not necessary.

In Klamath (Barker 1964; Steriade 1988), a reduplicating C(C)V- prefix marks distributive action in verbs:

(2) Klamath (data from Barker 1964)

- CV a. [so-so:tʃa] 'dist. light a fire'
 TR b. [t'a-t'wa:ʃa] 'dist. work for', [go-gmtʃa]² 'dist. get old'
 TR c. [q'ja-q'japga] 'dist. lie on their sides', [p'na-p'nandi:la] 'dist. bury underneath'
 TR d. [qni-qnj'a] ~ [qi-qnj'a] 'dist. have an erection'
 SR e. [sl'o-sl'q'a] 'dist. shed hair', [sn'o-sngis] 'policeman'
 -OR f. [sti-sti:q'a] 'dist. have a cramp', [pse-pse:jisap] 'dist. uncles, father's brothers',
 [lwo-lwasga]³ 'dist. take off clothes', [wqe-wqe:w'a] 'dist. break plural objects in two with long instruments'

Stop + sonorant (TR) clusters are simplified in some reduplicated forms, with copy of the stop only (b). In other reduplicated forms, TR is copied fully (c), and there is at least one case of free variation between full copy and simplification of TR (d). All clusters other than TR, including

² The base of [go-gmtʃa] is /gmtʃa/; for some C₁(C₂)V₁C₃V₂ stems, the first stem vowel deletes in reduplicated forms (Barker 1964:84). This process also applies to the forms in (2)d,e (their bases, in order: /qni'ja/, /sl'oq'a/, /sn'ogjs/).

³ The base of [lwo-lwasga] is /lwosga/; the change in stem vowel quality is accounted for by Barker (1964:89) as the result of a rule mapping /V_{RED} + CGV₁CC/ → [V₁ + CGaCC], where G = /w, j/ — i.e. the base vowel is overwritten by [a], but its quality survives in the reduplicant.

SR and Klamath's rich set of obstruent + obstruent, sonorant + obstruent, and sonorant + sonorant clusters (e, f), always show full onset transfer.⁴

Note that in the view taken here, there is only one important difference between the patterns of reduplicative onset transfer in Klamath and Gothic: in Gothic, all OR onsets allow the $O_1R_2V \rightarrow O_1V$ mapping, whereas in Klamath only a subset of the OR onsets—namely, only TR—allow this mapping. The fact that Klamath has a vast array of –OR cluster types, while Gothic has only /sp, st, sk/, is not relevant.

2.2 Selective copy

Under selective copy reduplication, only the obstruent of a base OR cluster is copied. No complex onset other than OR is reduplicated at all.

In Attic Greek (Steriade 1982, 1988), a reduplicating (C)V- prefix (with fixed vowel *e*) marks the perfect:

(3) Attic Greek (data from Steriade 1982)

- CV a. [l̥e-lu:ka] 'untied'
 TR b. [ge-grap^ha] 'wrote', [pe-pneuka] 'breathed'
 SR c. [e-smɛ:gmenos] 'wiped off with soap', [e-smugmai] 'smoldered away'
 –OR d. [e-sparmai] 'sowed', [e-ktona] 'killed', [e-psauka] 'touched', [e-ɲnɔ:ka]⁵ 'knew'

Only TR clusters participate in reduplication, and just the stop of these clusters is copied (b).⁶ Clusters other than TR, including SR (c), and all clusters other than OR (d)—namely, fricative + stop, stop + fricative, stop + stop, and nasal + nasal—do not reduplicate, either in whole or in part. This is "selective copy", in the sense that reduplication applies only if the requisite degree of perceptual similarity between base and reduplicant can be achieved: given that cluster simplification is mandatory, if partial copy cannot satisfy the perceptual similarity requirement, then neither portion of the base cluster is copied.

2.3 Blind criterion

Blind criterion reduplication patterns disallow complex onsets in the reduplicant, and in selecting a single consonant to be copied from a base cluster, do not make a distinction between OR and other onsets.

In Sanskrit (Steriade 1982; Gnanadesikan 1995; Morelli 1999; Steriade 1988), a reduplicating CV- prefix marks the perfect (and intensive, not shown here):

⁴ With one exception: [qa-qt̪a] 'dist. sleep' (Barker 1964:85).

⁵ Following Devine & Stephens (1994), I assume that γ in γν- (as in ἐγνῶκα <egnoka>) represents [ŋ], not [g].

⁶ TR clusters *bl-* and *gl-* are mildly atypical. Steriade (1982:207) notes that of 5 *bl-* initial forms with attested perfects, 3 have both reduplicated and non-reduplicated attestations, and 2 have only reduplicated attestations; of 2 *gl-* initial forms with attested perfects, one has both reduplicated and non-reduplicated attestations, and one has only a non-reduplicated attestation.

(4) Sanskrit (data from Steriade 1982)

- CV a. [tu-tud] 'pushed', [ru-rudh] 'obstructed'
 TR b. [pa-prac^h] 'asked', [du-druv] 'ran'
 SR c. [si-smi] 'smiled', [a-rat^h] 'slackened'
 -OR d. [tu-stu] 'praised', [pa-psa:] 'devoured'
 -OR e. [ma-mna:-u] 'noted'

Base clusters are simplified by copy of the less sonorous cluster member only (b, c, d). If there is no sonority difference between the two members of the cluster, as with nasal + nasal clusters (e), the leftmost segment is copied—although as Steriade (1982) notes, this form is prescribed by Sanskrit grammarians but not actually attested.

This pattern seems to be shown by ancient Greek nominal reduplication as well (Steriade 1988): [ka-skandiks] 'wild chervil', [ko-skulmat-ia] 'leather cuttings'; however, as there are no attested reduplicated forms for OR-initial bases, this cannot be stated conclusively.

In Old Irish (Thurneysen 1961; Kuryłowicz 1971), a reduplicating CV- prefix (with fixed vowel *e*) marks the perfect (and future, not shown here). In the data below, reduplicated perfect forms are followed by unaffixed present forms, presented for clarification of the pattern with respect to SR clusters:

(5) Old Irish (data from Thurneysen 1961)

- CV a. [me-mad-] 'broke'
 TR b. [be-brag-] 'farted' cf. [braigid] 'farts, bleats', [ge-glann] 'learned' cf. [gleinn] 'learns'
 SR c. [se-laig] 'felled' cf. [sligid] 'fells', [se-naig] 'dripped' cf. [snigid] 'drips'
 -OR d. [se-scann-] 'flew off' cf. Modern Irish [sceinnim] 'I spring off, fly off'

Base clusters are simplified by copy of the leftmost cluster member (b, c, d), although this becomes clear in the case of SR (c) only on inspection of morphologically related forms. Thurneysen (1961:132) notes that "after reduplication syllables *-sn-*, *-sl-* gave single *n*, *l*"; generally, underlying intervocalic *sm*, *sn*, *sl* are realized as *mm*, *nn*, *ll* respectively.

Ancient Greek present reduplication (Steriade 1982) is also characterized by copy of the leftmost base consonant: e.g. [ki-k^hrɛ:mi] 'borrow', [ɲi-ɲno:sko:] 'know'.

Finally, note that a logically possible type of blind criterion pattern is apparently unattested (Steriade (1988) did not find such a case, and neither have I): one in which just the rightmost member of a base cluster is copied, as in the hypothetical system *re-pre*, *li-sli*, *ta-sta*. Such a pattern would parallel Old Irish, differing only in that *C*₂, not *C*₁, is the sole member of a base *C*₁*C*₂ cluster that survives simplification.

2.4 Data not addressed by this analysis

Before concluding this section, a reduplicative pattern that will not be addressed further in this paper should be noted. This pattern gives the appearance of infixing $C_2(V)$ after an initial C_1C_2V string, for at least some type of C_1C_2 cluster. I am aware of three such patterns: Pima (Riggle 2001; Marcus Smith, p.c.), Latin (Steriade 1988), and Old High German (Jasanoff 2001; Helfenstein 1870). It is because each of these three cases is evidenced by extremely sparse data, and because two of the three (Latin and Old High German) are open to alternative interpretations, that this data pattern is not given further attention.

In Pima plural and distributive reduplication (Riggle 2001; Marcus Smith, p.c.), the reduplicant is an infix CV or bare C: e.g. [go-go-gs] 'dogs', [ce-c-mait] 'cakes'. Complex onsets appear only in three words known to Riggle and Smith: [trogi] 'truck', [trampi] 'tramp', and [skaitʃ] 'rich ones'; the first two are obviously borrowed. [trogi] reduplicates as either [tro-ro-gi] or [tro-r-gi]: that is, with an infix $C_2(V)$ string. [trampi] can reduplicate as [tra-ra-mpi], also with infix C_2V ; however, Riggle and Smith's consultant also uses unreduced [trampi] in plural constructions. Finally, [skaitʃ] does not allow reduplication; Riggle and Smith's consultant explicitly rejects [skai-kai-tʃ].

Latin perfect reduplication (Steriade 1988) is attested only by the three following forms, all with initial $s + \text{stop}$ clusters: [ste-t-i:], base [ste-]; [spo-po-nd-i:], base [spond-]; and [sci-ci-d-i:], base [scid-]. It is of course not obvious what reduplicative behavior OR clusters would show in Latin; however, Helfenstein (1870: 409) notes that "forms arose such as [cēpi] from *[ca-capi], [fēci] from *[fa-faci], [frēgi] from *[fra-fragi] or rather *[fra-fagi]" [emphasis added]. This statement seems to suggest that the Latin reduplicant is not an infix C_2V string, regardless of the content of the base cluster; but rather that Latin is essentially the infixing counterpart of Sanskrit, with copy of only the less sonorous member of the base cluster: the stop of $s + \text{stop}$ clusters, but the obstruent of OR clusters.

Old High German (Jasanoff 2001; Helfenstein 1870) contains several relics of proto-Germanic perfect reduplication: [steraz] 'pushed', from *[ste-zaut], and [pleruz] 'sacrificed', from *[ble-lōt]. These forms give the appearance of infixing copy of the more sonorous member of the base cluster; however, this appearance may be misleading. Jasanoff and Helfenstein both argue that *[ste-zaut] and *[ble-lōt] are derived from *[ste-staut] and *[be-blōt], respectively, and Jasanoff proposes that these forms reflect a strategy which "concentrate[s] lexically relevant information in the reduplication syllable (e.g., *b...bl- > *bl...l-), while allowing all but the coda of the root syllable to become opaque through sound change, sporadic dissimilation, and irregular shortening."

Finally, note that there are of course many other reduplicative patterns which fall outside the scope of the present analysis. For example, in Ilokano (Hayes and Abad 1989), bases with an initial consonant + glide sequence often allow two reduplicated outputs: one with full copy of the base-initial cluster, and one in which the vowel of the reduplicant corresponds to the base glide (e.g. [bwája] 'crocodile' reduplicates as either [na-ka-bwaj-bwája] or [na-ka-bu-bwája]). In Nuxalk (Bella Coola) (Carlson 1997), the reduplicant is located before the first vowel or

sonorant consonant of the base, copying that segment, the segment preceding it, and occasionally the segment following it: e.g. [s-qm-qma-i], [p'-ḷa-ḷa].

2.5 Local summary

Of the three partial onset transfer patterns presented above, blind criterion reduplication lends itself most readily to explanation: the reduplicant allows only a single-consonant onset (enforced by the ranking of a phonotactic constraint banning clusters above MAX_{BR-C} , but below MAX_{IO-C}), and the simplification strategy employed is independent of cluster type. In Sanskrit, the least sonorous cluster member is copied, presumably because less sonorous consonants make better onsets (Gnanadesikan 1995; Morelli 1999). In Old Irish, the leftmost cluster member is copied, an effect that might plausibly be attributed to facilitation of lexical access, since C_1 -reduplication in effect provides advance notice of the first segment of the stem (on the role of word onsets in lexical access, see Marslen-Wilson and Zwitserlood 1989).

In contrast, the sufficient and selective copy patterns are more puzzling, as both are characterized by $O_1R_2V \rightarrow O_1V$ mappings that seem "unnecessary" in the following sense. Under sufficient copy, cluster simplification under reduplication is clearly not uniformly mandatory, since clusters other than OR reduplicate fully—but some (as in Klamath) or all (as in Gothic) OR clusters simplify anyway. This is particularly intriguing since obstruent + sonorant clusters are generally assumed to be the least marked among complex onsets (e.g. Morelli 1999): it is not obvious why relatively unmarked clusters should be singled out for less than full onset transfer, while more deviant clusters (like the obstruent + obstruent, sonorant + sonorant, and sonorant + obstruent clusters of Klamath) are faithfully copied. Under selective copy, as in Attic Greek, there does not seem to be strong pressure to reduplicate at all—clusters other than OR simply do not participate—but OR clusters do, and always by copy of the obstruent only.

I suggest that these patterns are readily explained if requirements of base-reduplicant correspondence are sensitive to the relative perceptual similarity of correspondent strings. I argue in §3 below that the perceptual difference between O_1R_2V and O_1V is smaller than the perceptual difference between C_1C_2V and C_1V in the general case (i.e. when C_1 is not an obstruent, or C_2 is not a sonorant), and smaller than the difference between C_1C_2V and C_2V . If this is true, $O_1R_2V \rightarrow O_1V$ is the cluster simplification map resulting in the smallest possible difference between base and reduplicant.⁷ Sufficient and selective copy are then open to the following interpretation.

Under both sufficient copy and selective copy, cluster simplification is required by the ranking of an anti-cluster phonotactic above MAX_{BR-C} . However, clusters are protected from simplification if simplification would result in too great a perceptual difference between base and reduplicant. In the case of sufficient copy, the phonotactic demand for cluster simplification is subordinated to the requirement that base and reduplicant be sufficiently similar; thus, O_1R_2V maps to O_1V , but all other clusters are faithfully copied. In the case of selective copy, the

⁷ Because the point of interest here is cluster simplification under reduplication, I limit the discussion to simplification through consonant deletion (and note, the only options are deletion of C_1 , or deletion of C_2). As far as I know, there are no reduplication patterns in which clusters are simplified via vowel epenthesis (as in the hypothetical system $[[pira]_R[pra]_B]$, $[[sile]_R[sle]_B]$, $[[situ]_R[stu]_B]$).

demand for reduplication is sacrificed in order to satisfy the demand of sufficient similarity between base and reduplicant—if there is no way for a particular cluster to simplify and still be similar enough to its base, reduplication fails. Again, O_1R_2V maps to O_1V , but no other clusters participate in reduplication.

The analysis presented in §4 formalizes these interpretations of blind criterion copy, sufficient copy, and selective copy as the interactions of correspondence, markedness, and reduplicative constraints.

3. PERCEPTUAL SIMILARITY

To support the analysis of partial onset transfer developed below, the relationships of perceptual similarity asserted in (6) must be proved:

$$(6) \Delta(C_1C_2V-C_1V), \Delta(C_1C_2V-C_2V) > \Delta(O_1R_2V-O_1V)$$

where $\Delta(X - Y)$ = perceived difference between X and Y,
and $(C_1C_2V-C_1V) \neq (O_1R_2V-O_1V)$

That is, it must be shown that the perceptual difference between $O_1R_2V-O_1V$ is smaller than that between $C_1C_2V-C_1V$ in the general case, and smaller than that between $C_1C_2V-C_2V$.

Below I offer evidence in support of (6) for the case when $C_1C_2 \neq O_1R_2$ is the set of sibilant fricative + stop (ST) clusters, providing the following result:

$$(7) \{\Delta(S_1T_2V-S_1V), \Delta(O_1R_2V-R_2V), \Delta(S_1T_2V-T_2V)\} > \Delta(O_1R_2V-O_1V)$$

The evidence comes from alliterative verse and imperfect puns, both phenomena in which the rules governing the situation (the constraints of the verse system, or the principles of humor) require the language user to establish an imperfect correspondence relationship—i.e. correspondence between strings that are similar but non-identical. The evidence thus rests on the assumption that examination of which strings are placed in such intentionally imperfect correspondence relationships, and with what frequency, can provide insight into language users' judgments of relative similarity.

3.1 English imperfect puns

In an imperfect pun, such as *Napoleon Blown-apart*, the pun word (here, *Blown-apart*) corresponds to a phonologically similar but non-identical target word (here, *Bonaparte*).⁸ I follow Zwicky & Zwicky (1986) in treating imperfect puns as a source of evidence bearing on phonological similarity.

I make the following assumptions about the nature of imperfect puns. First, because the target word is usually not made explicit in the pun's context, the pun word must be sufficiently similar to the target that the target can be inferred—this is what makes the difference between an

⁸ Note that perfect puns, in which the pun and target are phonologically identical but lexically distinct, are of course not relevant here.

amusing pun and one that is just puzzling. Further, there is a positive correlation between pun-target similarity and the goodness of the pun: although puns may be bad for a variety of reasons (objectionable subject matter, artificial context, winking delivery, etc.), truly funny puns are generally those in which the phonological relationship between pun and target is unforced, subtle but quickly recognizable on examination. Finally, I assume that most puns are good-faith attempts at humor, and that the goodness of a particular pun category can be roughly quantified by calculating its degree of representation in a large corpus of imperfect puns.

An imperfect pun corpus was constructed as follows. I obtained a set of 1,924 puns collected by Arnold and Elizabeth Zwicky, which had been preserved in the Arnold M. Zwicky papers at the Western Historical Manuscript Collection.⁹ These puns appear to be exclusively from Crosbie (1977), a book of pun jokes organized in dictionary format.¹⁰ 605 of these 1,924 were eliminated on the grounds that they were perfect puns, stress puns, clever definitions as opposed to puns, etc.; I then added 645 imperfect puns that I collected from a variety of magazines, newspapers, novels, radio, television, and advertising materials, including two books of slogans (Sharp 1984; Urdang and Robbins 1984). Thus the corpus contains a total of 1,964 imperfect puns, coded as illustrated by the examples below:

(8) Corpus coding: examples

pun word	target word	pun segment	target segment	context	pun type	context
<i>Blown-apart</i>	<i>Bonaparte</i>	l	∅	b o	∅~R/O_V	medial
<i>surgeon</i>	<i>sturgeon</i>	∅	t	s_3 ^v	∅~T/S_V	medial
<i>raise</i>	<i>praise</i>	∅	p	# r	∅~O/#_R	initial
<i>Stabitha</i>	<i>Tabitha</i>	s	∅	# t	∅~S/#_T	initial

The examples in (8) show the four pun types of interest for the analysis here: ∅~R/O_V (*Blown-apart–Bonaparte*), which bears on the similarity of O₁R₂V to O₁V; ∅~T/S_V (*surgeon–sturgeon*), which bears on S₁T₂V–S₁V; ∅~O/#_R (*raise–praise*), which bears on O₁R₂V–R₂V; and ∅~S/#_T (*Tabitha–Stabitha*), which bears on S₁T₂V–T₂V.

Following Frisch, Broe, & Pierrehumbert (1997), degree of representation in the pun corpus was determined by calculating the ratio of the frequency of a pun type in the corpus to the frequency that would be expected if pun types occurred at random.

Observed frequency in the pun corpus was calculated by dividing the number of instances of a particular pun type by the total number of instances of its general type. For example, the frequency of O₁R₂V–O₁V puns was calculated by dividing the number of these puns by the total number of puns characterized by word-medial insertion or deletion of any segment:

⁹ WHMC, 23 Ellis Library, University of Missouri–Columbia, Columbia, MO 65201. Many thanks to Arnold and Elizabeth Zwicky for allowing me to use their materials, and to Arnold Zwicky and WHMC reference librarian John Konzal for help in locating them.

¹⁰ The puns' origins are not indicated in the materials I have, but in fairly extensive checking I have never failed to find a pun in my copy of Crosbie (1977).

$$(9) \left(\frac{\emptyset \sim R / O _ V}{\emptyset \sim X / \# \dots _ \dots \#} \right) = \text{observed frequency of } O_1R_2V-O_1V \text{ puns}$$

Note that the denominator includes $\emptyset \sim R / O _ V$, as well as $\emptyset \sim T / S _ V$ and puns like *sinned–singed*, *fanny–fancy*, *rose–roads*, etc. The observed frequency of $S_1T_2V-S_1V$ puns was similarly determined, by dividing $\emptyset \sim T / S _ V$ by $\emptyset \sim X / \# \dots _ \dots \#$.

The frequency of $O_1R_2V-R_2V$ puns was determined by dividing the number of these puns by the number of puns characterized by word-initial insertion or deletion of any segment:

$$(10) \left(\frac{\emptyset \sim O / \# _ R}{\emptyset \sim X / \# _} \right) = \text{observed frequency of } O_1R_2V-R_2V \text{ puns}$$

In this case the denominator includes all $O_1R_2V-R_2V$ puns, plus all $S_1T_2V-T_2V$ puns and all puns like *posing–opposing* and *bourbon–urban*. Likewise, the frequency of $S_1T_2V-T_2V$ puns was calculated by dividing $\emptyset \sim S / \# _ T$ by $\emptyset \sim X / \# _$.

To determine the expected frequencies of the relevant pun types, I counted the number of English word pairs corresponding to each pun type—e.g. for $O_1R_2V-O_1V$ puns, I counted the number of word pairs like *go–grow*, *pay–play*, etc. appearing in the CELEX database (Baayen, Piepenbrock and van Rijn 1995)¹¹—and used these counts to perform the calculations just as described above for the observed frequencies. Because most of the puns in the corpus are on pairs of words (as opposed to phrases, or nonce forms), it is not unreasonable to expect that, all else being equal, degree of representation in the pun corpus should correspond to the number of available word pairs for any particular pun type.

The table below shows the observed (O) and expected (E) frequencies, calculated as described above, for the four pun types of interest:

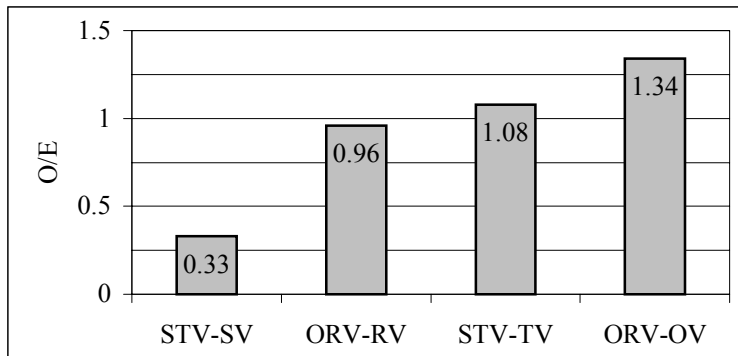
(11) Imperfect pun corpus results

<i>comparison</i>	<i>calculation</i>	O = <i>pun corpus</i>	E = <i>CELEX</i>	O/E
$O_1R_2V-O_1V$	$\emptyset \sim R / O _ V$	<u>117</u>	<u>923</u>	
	$\div \emptyset \sim X / \# \dots _ \dots \#$	265	2801	
	=	44.15%	32.95%	1.34
$S_1T_2V-S_1V$	$\emptyset \sim T / S _ V$	<u>7</u>	<u>226</u>	
	$\div \emptyset \sim X / \# \dots _ \dots \#$	265	2801	
	=	2.64%	8.07%	0.33
$O_1R_2V-R_2V$	$\emptyset \sim O / \# _ R$	<u>41</u>	<u>1125</u>	
	$\div \emptyset \sim X / \#$	163	4286	
	=	25.15%	26.25%	0.96
$S_1T_2V-T_2V$	$\emptyset \sim S / \# _ T$	<u>11</u>	<u>268</u>	
	$\div \emptyset \sim X / \#$	163	4286	
	=	6.75%	6.25%	1.08

¹¹ Many thanks to Colin Wilson for writing and running the scripts necessary to make these counts.

The last column in the table is the observed frequency divided by the expected frequency (O/E) for each pun type. These O/E values are used to establish overrepresentation and underrepresentation in the pun corpus, as follows. When $O/E = 1$, the proportion of a pun type in the corpus is equivalent to the proportion of relevant word-pairs in English: thus, the pun type occurs with the frequency that would be expected if pun-target pairs were selected randomly from among English word pairs. When O/E is greater than 1, the pun type is overrepresented in the corpus, with respect to the set of English word pairs of the relevant type—i.e. there are more of these puns in the corpus than expected, all else being equal. Finally, when O/E is less than 1, the pun type is underrepresented in the corpus—i.e. there are fewer of these puns in the corpus than would be otherwise expected. Note that zero is the lower limit on O/E values. The O/E values for each pun type are displayed graphically in (12):

(12) O/E values, by pun type



Observe that the O/E values for $O_1R_2V-R_2V$ and $S_1T_2V-T_2V$ cluster around 1; this signals that these pun types are about as frequent as would be expected if pun choice is essentially random. In contrast, $S_1T_2V-S_1V$ is underrepresented ($O/E = 0.33$), and $O_1R_2V-O_1V$ is overrepresented ($O/E = 1.34$). If it is correct that degree of representation in the pun corpus correlates with pun goodness, and that more similar pun-target pairs are better than less similar ones, these results can be interpreted as supporting the following scale of relative similarity:

$$(13) \quad \Delta(S_1T_2V-S_1V) > \{\Delta(O_1R_2V-R_2V), \Delta(S_1T_2V-T_2V)\} > \Delta(O_1R_2V-O_1V)$$

That is, analysis of the imperfect pun corpus supports the relative similarity relationships asserted above in (7), if the assumptions spelled out above concerning the nature of imperfect puns are true.

3.2 Alliterative verse

The scale of relative similarity in (13) is bolstered by evidence from the alliterative verse systems of early Germanic and Irish, described below, assuming that alliterative constraints require words in certain metrical positions to begin with sounds that are sufficiently similar to signal an alliterative pairing. If this is correct, then the facts of what alliterates with what reflect judgments of relative similarity. That is, if a $C_1C_2V-C_1V$ or $C_1C_2V-C_2V$ pair does not alliterate, that pair must be less similar than a pair that does, since the alliterative standard of "similar enough" rules out alliteration in the first case but not the second.

In early Germanic verse, stressed syllables of half-lines alliterate as follows. Vowel-initial words alliterate with any vowel-initial word. Consonant-initial words alliterate with any word beginning with the same consonant, except that initial *s* + stop (ST) clusters alliterate only with themselves (Kuryłowicz 1971).¹² For example, *prV*- alliterates with *pV*-, *plV*-, and *prV*-, whereas *stV*- alliterates only with *stV*- and not with any other *s*-initial form—i.e. not with *sV*-, *spV*-, *skV*-, *smV*-, *snV*-, or *slV*-. Assuming that alliterative possibilities bear on perceptual similarity as described above, Germanic verse provides support for the similarity scale in (14):

$$(14) \quad \{\Delta(S_1T_2V-S_1V), \Delta(O_1R_2V-R_2V), \Delta(S_1T_2V-T_2V)\} > \Delta(O_1R_2V-O_1V)$$

That is, because only $O_1R_2V-O_1V$ pairs alliterate, these must be more similar than all non-alliterating cluster-singleton pairs.

The alliterative system of Early Irish is quite similar to that of early Germanic, with one primary difference: *sm*- acts in early Irish like *sp*-, *st*-, *sk*-, allowing only self-alliteration (Murphy 1961). This provides at least suggestive evidence that *smV-sV* is less similar than any other $O_1R_2V-O_1V$ pair—i.e. less similar than any of *snV-sV*, *slV-sV*, *swV-sV*, or $T_1R_2V-T_1V$. This is relevant to the observation that, in Klamath and Ancient Greek, SR onsets pattern with non-OR onsets, whereas in Gothic, all OR onsets pattern together: if the perceptual difference between $S_1R_2V-S_1V$ is greater than that between $T_1R_2V-T_1V$, then the variable behavior of SR, but not TR, with respect to reduplicative $C_1C_2V \rightarrow C_1V$ mappings is not unexpected.

3.3 Summary, and a planned experiment

Taken together, the evidence from intentional imperfect correspondence provides support for the similarity scale in (15):

$$(15) \quad \{\Delta(S_1T_2V-S_1V), \Delta(O_1R_2V-R_2V), \Delta(S_1T_2V-T_2V)\} > \Delta(O_1R_2V-O_1V)$$

However, as noted above, this conclusion holds only if certain interpretive assumptions about imperfect puns and alliteration are true: namely, if representation in the pun corpus correlates positively with the degree of similarity between pun and target; and if cluster-singleton pairs that do enter into alliterative relationships are more similar than pairs that do not. In addition to being open to interpretation, the evidence from imperfect puns and alliterative verse is also incomplete for present purposes: because it comes from languages in which the only \neg OR clusters are /*sp*, *st*, *sk*/, it cannot bear on the relative similarity of $C_1C_2V-C_1V$ and $C_1C_2V-C_2V$ pairings for \neg OR clusters other than ST, e.g. stop + fricative, stop + stop, nasal + nasal, etc.—i.e. clusters which are essential to the analysis of onset transfer in Klamath and Greek.

A perceptual experiment currently in the stimuli preparation stage will address these issues.¹³ In a discrimination task following the methodology of Tserdanelis (2001), native English speakers are asked to identify whether the members of a stimuli pair are the same or

¹² Note that /*sp*, *st*, *sk*/ are the only non-OR onset clusters of Germanic.

¹³ This work is in collaboration with Keith Johnson of the Ohio State University, to whom I am deeply grateful for generous advice and practical support.

different. Both $[C_1C_2V]-[C_1V]$ and $[C_1C_2V]-[C_2V]$ pairs are presented, for cluster types including stop + sonorant, fricative + sonorant, fricative + stop, stop + fricative, and stop + stop: for example, subjects will discriminate between [pra] and [pa], between [psa] and [sa], and so on. Reaction time in this task is interpreted as a measure of relative similarity: longer reaction times indicate that the same versus different decision is fairly difficult, and therefore that the stimuli pair is relatively similar; shorter reaction times indicate that discrimination is easier, and that the stimuli pair is relatively different. Thus, the reaction time results from this task will allow for the fairly straightforward projection of a scale of relative similarity for a large set of $[C_1C_2V]-[C_1V]$ and $[C_1C_2V]-[C_2V]$ pairs, thereby providing more complete and definitive evidence with respect to the similarity claims argued above.

4. ANALYSIS

For several reasons, the typology of partial onset transfer is difficult to reconcile with any constraint set containing CONTIGUITY (Kenstowicz 1994; McCarthy and Prince 1995), which prohibits skipping and splitting in correspondence relationships—and specifically penalizes $C_1C_2V \rightarrow C_1V$ reduplication. Conspicuously unattested is a blind criterion pattern in which base clusters are simplified by copy of the rightmost cluster member, as in hypothetical *ta-sta*, *li-sli*, *re-pre*. Because such a pattern respects CONTIGUITY's preference for copy of a contiguous substring of the base, its absence from the typology casts doubt on the reality of CONTIGUITY as a correspondence constraint active in shaping reduplicative patterns.

Equally problematic is the pattern of CONTIGUITY violations actually observed in the typology. CONTIGUITY-violating $O_1R_2V \rightarrow O_1V$ maps occur with unexpected freedom: in sufficient copy patterns, clusters other than OR are copied fully ($C_1C_2V \rightarrow C_1C_2V$), in satisfaction of CONTIGUITY; in selective copy patterns, clusters other than OR are not copied at all ($C_1C_2V \rightarrow V$), again with no CONTIGUITY violation. General-case $C_1C_2V \rightarrow C_1V$ maps are observed only if $O_1R_2V \rightarrow O_1V$ —i.e. only in the blind criterion patterns of Sanskrit and Old Irish, in which violation of CONTIGUITY is forced by sonority-driven onset selection, or by a left-anchoring requirement.

I suggest that the standard notion of CONTIGUITY is wrong-headed. CONTIGUITY is string-based: it compares correspondent strings, determines whether segments have been added or removed, and assesses violations accordingly—all string-equivalent insertions and deletions are penalized equally. But correspondence constraints serve the purpose of minimizing the difference between correspondent strings—without their mitigating influence against markedness constraints, outputs would be phonotactically perfect, and perfectly unrecognizable as exponents of their inputs—and I assert (following Steriade (1999)) that the relevant notion of difference in correspondence relationships is perceptual, not string-based. Because sounds affect and are affected by their neighbors, string-identical insertions and deletions are not necessarily of perceptually equal significance: for example, the evidence presented in §3 suggests that $O_1R_2V-O_1V$ are more similar than $S_1T_2V-S_1V$, although both pairs are instantiations of $C_1C_2V-C_1V$, and both are guilty of one CONTIGUITY violation. I propose to replace CONTIGUITY with a family of context-sensitive MAX constraints that penalize skipping in proportion to the resulting magnitude

of perceptual difference between correspondent strings.¹⁴ These constraints are the subject of the following section.

4.1 Enforcing perceptual similarity through correspondence constraints

As argued in §3, there is evidence in support of the following scale of relative similarity:

$$(16) \quad \{\Delta(S_1T_2V-S_1V), \Delta(O_1R_2V-R_2V), \Delta(S_1T_2V-T_2V)\} > \Delta(O_1R_2V-O_1V)$$

For the purposes of this analysis, several extensions to (16) must be accepted (with the promise of support or contradiction from the forthcoming experimental work described in §3.3). First, although the evidence given in §§3.1 and 3.2 above only covers OR and ST clusters, it must be assumed that the pattern is more general, such that $O_1R_2V-O_1V$ is more similar than any other $C_1C_2V-C_1V$ or $C_1C_2V-C_2V$ pair—that is, not just more similar than $S_1T_2V-S_1V$ and $S_1T_2V-T_2V$. Second, it must be assumed that there is an internal division among OR clusters with respect to the $C_1C_2V \rightarrow C_1V$ map: namely, $T_1R_2V-T_1V$ is more similar than $S_1R_2V-S_1V$. As noted in §3.2, this assumption receives support from the alliterative system of Old Irish, in which *sm-* only self-alliterates. These extensions to (16) are summarized in (17):

$$(17) \quad \{\Delta(C_1C_2V-C_1V), \Delta(C_1C_2V-C_2V)\} > \Delta(S_1R_2V-S_1V) > \Delta(T_1R_2V-T_1V) \\ \text{where } (C_1C_2V-C_1V) \neq (O_1R_2V-O_1V), (S_1R_2V-S_1V)$$

The similarity scale in (17) can be rewritten as follows, separating difference from context:

$$(18) \quad \left\{ \begin{array}{c} \Delta(C_1C_2V-C_1V) \\ = \\ \Delta(C-\emptyset)/C_V \end{array} \right\}, \left\{ \begin{array}{c} \Delta(C_1C_2V-C_2V) \\ = \\ \Delta(C-\emptyset)/\#_C \end{array} \right\} > \left\{ \begin{array}{c} \Delta(S_1R_2V-S_1V) \\ = \\ \Delta(R-\emptyset)/S_V \end{array} \right\} > \left\{ \begin{array}{c} \Delta(T_1R_2V-T_1V) \\ = \\ \Delta(R-\emptyset)/T_V \end{array} \right\}$$

That is to say, the difference between a sonorant and nothing in the T_V context is smaller than the difference between a sonorant and nothing in the S_V context, and so on. Adopting Steriade's (1999) P-map proposal, I assume that similarity scales such as the rewritten one in (18) project correspondence constraints and their rankings, as shown by the diagram in (19):

(19) Projection of correspondence constraints

<i>similarity scale</i>	$\Delta(C-\emptyset)/C_V, \quad \Delta(C-\emptyset)/\#_C > \Delta(R-\emptyset)/S_V > \Delta(R-\emptyset)/T_V$
<i>correspondence constraints</i>	$MAX_{BR-C}/C_V, \quad MAX_{BR-C}/\#_C \gg MAX_{BR-R}/S_V \gg MAX_{BR-R}/T_V$

The context-sensitive MAX-C constraints shown in (19) penalize base-reduplicant correspondence relationships between consonants and zero—i.e., they penalize failure to copy base segments—in specific segmental contexts, with the penalty proportionate to the perceptual difference resulting from failure to copy. The table in (20) illustrates violation and satisfaction of each context-sensitive MAX-C constraint:

¹⁴ Note that CONTIGUITY also regulates splitting maps; I suggest that this portion of CONTIGUITY should be replaced with context-sensitive DEP constraints, although this is not addressed further here.

(20) Violation patterns: context-sensitive MAX-C constraints

<i>Outputs</i>	MAX _{BR} -C_V	MAX _{BR} -C/#_C	MAX _{BR} -R/S_V	MAX _{BR} -R/T_V
a. [[p ₁ a ₃] _R [p ₁ r ₂ a ₃] _B]				*
b. [[r ₂ a ₃] _R [p ₁ r ₂ a ₃] _B]		*		
c. [[s ₁ a ₃] _R [s ₁ l ₂ a ₃] _B]			*	
d. [[l ₂ a ₃] _R [s ₁ l ₂ a ₃] _B]		*		
e. [[s ₁ a ₃] _R [s ₁ t ₂ a ₃] _B]	*			
f. [[t ₂ a ₃] _R [s ₁ t ₂ a ₃] _B]		*		

MAX_{BR}-R/T_V is violated only by the form in (a), which maps base T₁R₂V into reduplicant T₁V. MAX_{BR}-R/S_V is violated only by the form in (c), which maps S₁R₂V into S₁V. MAX_{BR}-C_V is violated by every form which maps general-case C₁C₂V (i.e. C₁C₂V other than S₁R₂V and T₁R₂V) into C₁V; the only such form shown in (20) is (e). Finally, MAX_{BR}-C/#_C is violated by any form that maps C₁C₂V onto C₂V: here, these are (b), (d), and (f).

Note finally that the constraints in (19) represent only the fragment of the context-sensitive MAX family relevant to the analysis of partial onset transfer; definition of context-sensitive MAX constraints on other sound sequences, and their rankings, is left for further work.

4.2 Enforcing reduplication

Recall that in Attic Greek, base OR clusters reduplicate with a fixed vowel, [e]—as in [ge-grap^ha]—while base clusters other than OR do not reduplicate, and the output surfaces with a bare [e]—as in [e-ktona]. This raises the question of whether forms like [e-ktona] are reduplicated, i.e. analyzable as [[e₃]_R[k₁t₂o₃n₄a₅]_B]¹⁵, or simply prefixed, i.e. analyzable as [[e₆][k₁t₂o₃n₄a₅]]. The present analysis is constructed such that the constraints answer this question: [[e₃]_R[k₁t₂o₃n₄a₅]_B] and [[e₆][k₁t₂o₃n₄a₅]] are both candidates for the output of perfect-inflected /ktona/.

Among the constraints choosing among these candidates are two morphological realization constraints, one favoring reduplication and one favoring prefixation:

- (21) REDUPLICATE
An output of morphological category X contains some pair of segments in base-reduplicant correspondence.
- (22) PREFIX *e*-
An output of morphological category X has the prefix *e*-.

¹⁵ Note that, following the guidelines established by Alderete et al (1997) for diagnosing phonological versus morphological fixed segmentism, I assume that fixed segmentism in Greek reduplication (as well as in Gothic and Old Irish) is correctly analyzed as phonological—i.e. produced by a ranking in which IDENT-BR constraints on vowel features are interleaved with vowel markedness constraints such that [e] emerges as the optimal reduplicative correspondent for any base vowel.

REDUPLICATE penalizes non-reduplicated outputs belonging to the specified morphological category; it is violated by Greek $[[e_6][k_1t_2o_3n_4a_5]]$ but not by $[[e_3]_R[k_1t_2o_3n_4a_5]_B]$. PREFIX *e-* has exactly opposite priorities: it is violated by $[[e_3]_R[k_1t_2o_3n_4a_5]_B]$ but not by $[[e_6][k_1t_2o_3n_4a_5]]$. With the fixed ranking REDUPLICATE » PREFIX *e-*, reduplication is established as the preferred realization of the morphological category in question, with prefixation the allomorph that surfaces when reduplication is rendered untenable by higher-ranking constraints.

Note that, in treating reduplication as the product of a violable constraint, rather than as the surface realization of an underlying abstract morpheme, this proposal follows the spirit of Zuraw (2000) and Yip (2001), among others. I leave unaddressed in this draft the constraints active in determining specific properties of the reduplicating allomorph (i.e. that it is a prefix, that it is a single open syllable, and so on).

4.3 Enforcing cluster simplification

By its nature, full copy results in an output form that has twice the number of complex onsets contained in the base. In this way, reduplication conflicts with the phonotactic bias against consonant clusters, expressed here as the constraint C/V:

- (23) C/V
Every consonant is prevocalic.

C/V assesses a violation for every consonant in the output that precedes another consonant. Thus, forms of shape [CCVCCV] violate C/V twice; forms of shape [CVCCV] and [VCCV] violate C/V only once. For the theoretical context of C/V, as opposed to *COMPLEX (Prince and Smolensky 1993), see Steriade (1997).

Satisfaction of C/V through partial onset transfer entails violation of MAX_{BR}-C, the standard constraint banning failure to copy base segments:

- (24) MAX_{BR}-CONSONANT (= MAX_{BR}-C) (cf. McCarthy and Prince 1995)
Every [-syllabic] element of the base has a correspondent in the reduplicant.

MAX_{BR}-C assesses a violation for every consonant in the base that does not have a correspondent in the reduplicant. Thus, $[[C_1V_3]_R[C_1C_2V_3]_B]$ and $[[C_2V_3]_R[C_1C_2V_3]_B]$ both violate MAX_{BR}-C once, while $[[V_3]_R[C_1C_2V_3]_B]$ violates MAX_{BR}-C twice. $[[C_1C_2V_3]_R[C_1C_2V_3]_B]$ does not violate MAX_{BR}-C, and neither does non-reduplicated $[[V_4][C_1C_2V_3]]$. Note that MAX_{BR}-C establishes a harmonic ordering across output candidates having one instance of failure to copy, two instances, and so on; MAX_{BR}-C does not distinguish between candidates having an equal number of instances of failure to copy—this is the work of the context-specific MAX-C constraints.

4.4 Remaining constraints

The constraints crucial to the analysis of blind criterion copy—i.e. copy of the leftmost segment of the base, as in Old Irish, or copy of the less sonorous member of the base-initial cluster, as in Sanskrit—are defined in (25) and (26):

- (25) LEFT-ANCHOR-BR (= L-ANCHOR) (McCarthy and Prince 1995)
Any element at the left edge of the base has a correspondent at the left edge of the reduplicant.

L-ANCHOR assesses a violation when the leftmost elements of base and reduplicant are not in correspondence. Thus, L-ANCHOR is violated by $[[C_2V_3]_R[C_1C_2V_3]_B]$ and $[[V_3]_R[C_1C_2V_3]_B]$, but not by $[[C_1V_3]_R[C_1C_2V_3]_B]$ or $[[C_1C_2V_3]_R[C_1C_2V_3]_B]$; and of course, not by non-reduplicated forms.

- (26) BESTONSET
For two syllables $\sigma_\alpha, \sigma_\beta$ with onset consonants standing in base-reduplicant correspondence, the onset of the reduplicant must contain a consonant in correspondence with the least sonorous consonant of the onset of the base.

BESTONSET is violated by $[[C_1V_3]_R[C_1C_2V_3]_B]$ when C_1 is more sonorous than C_2 , and by $[[C_2V_3]_R[C_1C_2V_3]_B]$ when C_2 is more sonorous than C_1 ; BESTONSET is satisfied by $[[C_1C_2V_3]_R[C_1C_2V_3]_B]$, because by necessity the less sonorous consonant of the base onset has a correspondent in the onset of the reduplicant. Note that BESTONSET is employed instead of previous proposals for the analysis of sonority-driven reduplication in Sanskrit, e.g. Gnanadesikan (1995), Morelli (1999). The necessity of this move is discussed in §4.5.1.

The final constraint figuring in the analysis is the phonotactic ONSET:

- (27) ONSET (cf. Prince and Smolensky 1993)
Every vowel is preceded by a consonant.

ONSET is violated by the vowel-initial forms $[[V_3]_R[C_1C_2V_3]_B]$ and $[[V_4][C_1C_2V_3]]$.

Finally, note that all constraints not specifically mentioned above are presumed inviolable: for example, I do not consider candidates in which consonant clusters are simplified in the base, as these would be ruled out by undominated MAX_{IO}-C.

4.5 Factorial typology

The constraints defined in the sections above were submitted to a factorial typology calculation, using software (Hayes n.d.) that allowed the a priori rankings of the context-sensitive MAX-C constraints to be specified. The inputs and output candidates included in the calculation are in (28):

- (28) The candidate set
- a. Inputs: $/C_1C_2a_3/$, $[+X]$ — where $/pra/$ represents $C_1C_2 = TR$, $/sla/$ represents $C_1C_2 = SR$, and $/sta/$ represents $C_1C_2 = \neg OR$
 - b. Outputs: full transfer $[C_1C_2a_3-C_1C_2a_3]$, C_1 -copy $[C_1a_3-C_1C_2a_3]$, C_2 -copy $[C_2a_3-C_1C_2a_3]$, vowel copy $[a_3-C_1C_2a_3]$, and prefixation $[e_4-C_1C_2a_3]$

Note that all reduplicated outputs have a copy vowel, $[a]$, while the non-reduplicated prefixed outputs have the affixal vowel $[e]$. Vowel quality is not at issue here; the $[a]/[e]$ distinction is

employed only to make it easier to distinguish on the page the vowel copy forms ($[a_3-C_1C_2a_3]$) from the prefixed forms ($[e_4-C_1C_2a_3]$). Also included in the typology was an input with a singleton onset, $/C_1a_2/$, with three possible outputs: copy of the base consonant $[C_1a_2-C_1a_2]$, vowel copy $[a_2-C_1a_2]$, and prefixation $[e_3-C_1a_2]$. Only $[C_1a_2-C_1a_2]$ ever surfaces as the optimal candidate, regardless of constraint ranking; this is the desirable result, given the cross-linguistic data presented above in §2.

The factorial typology calculation produced eleven outcomes, which are summarized in the sections below.

4.5.1 *Blind criterion*

The constraint rankings for the blind criterion patterns, Old Irish and Sanskrit, are shown below in (29) and (30). Constraints belonging to a single ranking stratum are in boxes; stratum-internal ranking is non-crucial.

(29) Old Irish = $[sa-sta]$, $[sa-sla]$, $[pa-pra]$

REDUPLICATE, ONSET, C/V, L-ANCHOR, MAX-C/# C

»

PREFIX $e-$, MAX-C, BESTONSET, MAX-C/C_V, MAX-R/S_V, MAX-R/T_V

(30) Sanskrit = $[ta-sta]$, $[sa-sla]$, $[pa-pra]$

REDUPLICATE, ONSET, C/V, BESTONSET, MAX_{BR}-C/C_V

»

PREFIX $e-$, MAX-C, L-ANCHOR, MAX-C/# C, MAX-R/S_V, MAX-R/T_V

The differences in ranking that crucially distinguish Old Irish and Sanskrit are highlighted. In both cases, C/V, REDUPLICATE, and ONSET are all undominated by any relevant constraints. Thus, the only viable candidates are reduplicated, with a singleton onset in the reduplicant: that is, the only candidates to satisfy the top-ranked constraints are $[C_1a-C_1C_2a]$ and $[C_2a-C_1C_2a]$. Exactly which member of the base cluster is copied is determined by the relative rankings of L-ANCHOR and BESTONSET (and by necessity, the relative rankings of MAX-C/#_C and MAX-C/C_V). When L-ANCHOR is ranked above BESTONSET, the leftmost member of the base cluster is copied, as in Old Irish:

(31) Old Irish

		L-ANCHOR	MAX-C/# C	BESTONSET	MAX-C/C_V
/sta/, [+X]	☞ sa-sta			*	*
	ta-sta	*!	*!		
/sla/, [+X]	☞ sa-sla				
	la-sla	*!	*!	*	
/pra/, [+X]	☞ pa-pra				
	ra-pra	*!	*!	*	

But when the rankings are reversed, as shown in the tableau in (32), the less sonorous member of the cluster is copied, as in Sanskrit:

(32) Sanskrit

		BESTONSET	MAX-C/C V	L-ANCHOR	MAX-C/# C
/sta/, [+X]	sa-sta	*!	*!		
	☞ ta-sta			*	*
/sla/, [+X]	☞ sa-sla				
	la-sla	*!		*	*
/pra/, [+X]	☞ pa-pra				
	ra-pra	*!		*	*

Note that, when active, BESTONSET essentially forces selection of the lowest sonority singleton onset for the reduplicant, from among the choices presented by the base: e.g. if the choices are a stop and a fricative, as with the input /sta/, the stop is selected; but if the choices are a fricative and a liquid, as with the input /sla/, the fricative is selected.

BESTONSET is an unorthodox constraint in that it conflates markedness and faithfulness, and on the face of things this may seem unnecessary, as there are more obvious ways to derive copy of the less sonorous member of the base cluster. For example, Gnanadesikan (1995) achieves copy of the least sonorous member of a base cluster through the action of a family of μ/X constraints requiring segment classes to be parsed as moras: thus, consonants filling onset (i.e. nonmoraic) slots are penalized in proportion with their sonority. The difficulty with this proposal (and others like it) for solving the Sanskrit problem is that it has extremely undesirable consequences for the factorial typology of onset transfer.

For example, consider the following outcome generated by the present constraint set, minus BESTONSET, plus $\mu/\text{liquid} \gg \mu/\text{fricative} \gg \mu/\text{stop}$, a fragment of Gnanadesikan's μ/X family: [ta-sta], [e-sla], [pa-pra], [ta-ta], [e-sa] — that is, a system in which bases containing a stop onset, either alone or in a cluster, are reduplicated, while bases which lack a stop onset are prefixed. The constraint ranking that generates this pattern is shown below:

(33) Language Q = [ta-sta], [e-sla], [pa-pra], [ta-ta], [e-sa]

C/V, μ/liquid , $\mu/\text{fricative}$
»
ONSET
»
μ/stop , L-ANCHOR, MAX-C, MAX-C/# C, MAX-C/C V, MAX-R/S V, MAX-R/T V
»
REDUPLICATE, PREFIX e-

With C/V undominated, the only viable candidates are reduplicated or prefixed, onsetless or with a singleton onset: [C₁a₃-C₁C₂a₃], [C₂a₃-C₁C₂a₃], [a₃-C₁C₂a₃], or [e₄-C₁C₂a₃] for the cluster-initial inputs; and [C₁a₂-C₁a₂], [a₂-C₁a₂], or [e₃-C₁a₂] for the inputs with simple onsets. The tableau

below containing the relevant portion of the constraint hierarchy shows how the outcome set is generated:

(34) Language Q = [ta-sta], [e-sla], [pa-pra], [ta-ta], [e-la]

		μ/liquid	μ/fricative	ONSET	μ/stop	L-ANCHOR
/sta/, [+X]	sa-sta		**!		*	
	☞ ta-sta		*		**	*
	a-sta		*	*!	*	*
	e-sta		*	*!	*	
/sla/, [+X]	sa-sla	*	**!			
	la-sla	**!	*			*
	a-sla	*	*	*		*!
	☞ e-sla	*	*	*		
/ta/, [+X]	☞ ta-ta				**	
	a-ta			*!	*	
	e-ta			*!	*	
/sa/, [+X]	sa-sa		**!			
	a-sa		*	*		*!
	☞ e-sa		*	*		

With ONSET ranked above μ/stop and L-ANCHOR, but below μ/liquid and μ/fricative, inputs containing a stop in the onset reduplicate, by copy of the stop; but inputs lacking a stop in the onset do not reduplicate, and instead are prefixed (which avoids violation of L-ANCHOR).

The outcome set discussed above is one of many unattested patterns generated by the constraint set containing the μ/X family; similar results obtain if the μ/X family is replaced by *SONORANTSIMPLEONSET » *FRICATIVESIMPLEONSET » *STOPSIMPLEONSET, or by a constraint requiring singleton onsets to be non-sonorous, and assessing increasing numbers of violations as sonority increases. In short, unless the choice of which segment to copy in order to minimize onset sonority is relativized to those segments actually present in the base, the analysis predicts extremely unusual patterns in which forms reduplicate or do not, or simplify or do not, based solely on whether to do so would result in a reduction in the number of "undesirable" onsets.

4.5.2 Sufficient copy

The constraint ranking for the sufficient copy pattern exemplified by Klamath is shown below:

(35) Klamath = [sta-sta], [sla-sla], [pa-pra]

REDUPLICATE, ONSET, BESTONSET, L-ANCHOR, MAX-C/#_C, MAX-C/C_V, MAX-R/S_V
»
PREFIX e-, C/V
»
MAX-C, MAX-R/T_V

With REDUPLICATE and ONSET undominated, the only realistically possible outputs are reduplicated, and with at least a singleton onset: i.e., the viable candidates are [C₁a-C₁C₂a], [C₂a-C₁C₂a], and [C₁C₂a-C₁C₂a]. The question of which complex onsets emerge in the reduplicant, and which complex onsets are simplified, is settled by the relative ranking of C/V with respect to the context-sensitive MAX-C constraints (these constraints are highlighted in the diagram above). When C/V dominates only MAX-R/T_V, as in Klamath, only TR clusters are compelled to simplify under reduplication, while all other onsets are fully copied:

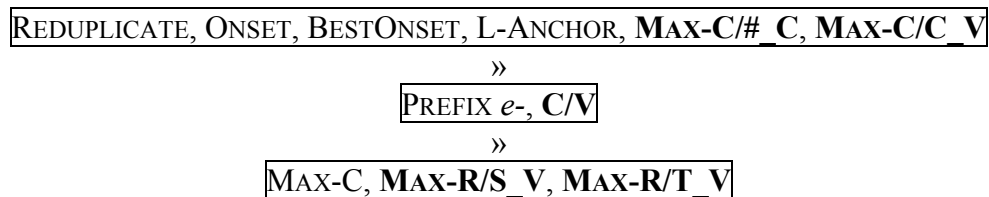
(36) Klamath

		MAX-C/# C	MAX-C/C V	MAX-R/S V	C/V	MAX-R/T V
/sta/, [+X]	☞ sta-sta				**	
	sa-sta		*!		*	
	ta-sta	*!			*	
/sla/, [+X]	☞ sla-sla				**	
	sa-sla			*!	*	
	la-sla	*!			*	
/pra/, [+X]	pra-pra				**!	
	☞ pa-pra				*	*
	ra-pra	*!			*	

High-ranking context-sensitive MAX-C constraints protect all clusters other than TR from the demands of C/V. However, because C/V dominates MAX-R/T_V, it has the power to assert its preference for simple onsets in just the case of base TR; C/V is satisfied at the cost of violating only the low-ranked correspondence constraint regulating preservation of a sonorant in the T_V context.

The difference between Klamath and Gothic is only the reranking of C/V with respect to MAX-R/S_V:

(37) Gothic = [sta-sta], [sa-sla], [pa-pra]



With MAX-R/S_V now ranked below C/V, all OR clusters—not just TR—are simplified under reduplication:

(38) Gothic

		MAX-C/#_C	MAX-C/C_V	C/V	MAX-R/S_V	MAX-R/T_V
/sta/, [+X]	☞ sta-sta			**		
	sa-sta		*!	*		
	ta-sta	*!		*		
/sla/, [+X]	sla-sla			**!		
	☞ sa-sla			*	*	
	la-sla	*!		*		
/pra/, [+X]	pra-pra			**!		
	☞ pa-pra			*		*
	ra-pra	*!		*		

With both MAX-R/S_V and MAX-R/T_V dominated by C/V, no OR cluster is protected from cluster simplification; thus, the $O_1R_2V \rightarrow O_1V$ mapping is obligatory. As in Klamath, clusters other than OR are protected by high-ranking context-sensitive MAX-C constraints.

In contrast, the difference between Klamath and full transfer of all base clusters is a reranking in the other direction—promotion of MAX-R/T_V above C/V:

(39) Full transfer = [sta-sta], [sla-sla], [pra-pra]

REDUPLICATE, ONSET, BESTONSET, L-ANCHOR, MAX-C,
MAX-C/#_C, MAX-C/C_V, MAX-R/S_V, MAX-R/T_V

»

PREFIX e-, C/V

With C/V now ranked below all of the context-sensitive MAX-C constraints, all base clusters are reduplicated in full:

(40) Full transfer

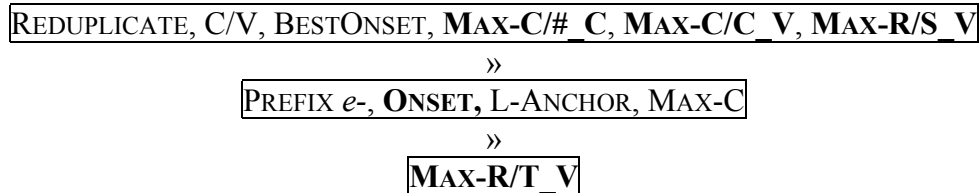
		MAX-C/#_C	MAX-C/C_V	MAX-R/S_V	MAX-R/T_V	C/V
/sta/, [+X]	☞ sta-sta					**
	sa-sta		*!			*
	ta-sta	*!				*
/sla/, [+X]	☞ sla-sla					**
	sa-sla			*!		*
	la-sla	*!				*
/pra/, [+X]	☞ pra-pra					**
	pa-pra				*!	*
	ra-pra	*!				*

With this constraint ranking, all base clusters are protected from simplification, and full onset transfer is observed across the board.

4.5.3 Selective copy I: reduplication only

As noted above, forms like Greek [e-ktona] can be analyzed as either $[[e_3]_R[k_1t_2o_3n_4a_5]_B]$, with vowel reduplication only; or as prefixed $[[e_6][k_1t_2o_3n_4a_5]]$. I consider first the analysis in which all Greek forms are reduplicated; the constraint ranking for this case is shown below:

(41) Attic Greek = [a-sta], [a-sla], [pa-pra]



With REDUPLICATE and C/V undominated, the only viable candidates are those that are reduplicated, and in which the reduplicant has a simple onset or is onsetless: i.e., $[C_1a-C_1C_2a]$, $[C_2a-C_1C_2a]$, and $[a-C_1C_2a]$. The question of which clusters are copied in part, and which are not copied at all, is settled by the ranking of ONSET with respect to the context-sensitive MAX-C constraints (the crucial constraints are highlighted in the diagram above):

(42) Attic Greek

		MAX-C/# C	MAX-C/C V	MAX-R/S V	ONSET	MAX-R/T V
/sta/, [+X]	sa-sta		*!			
	ta-sta	*!				
	☞ a-sta				*	
/sla/, [+X]	sa-sla			*!		
	la-sla	*!				
	☞ a-sla				*	
/pra/, [+X]	☞ pa-pra					*
	ra-pra	*!				
	a-pra				*!	

With ONSET ranked above MAX-R/T_V, TR clusters are forced to reduplicate in order to provide an onset consonant for the reduplicant. Clusters other than TR are protected from the demands of ONSET by higher-ranked context-sensitive MAX-C constraints, and thus no portion of these clusters is copied.

Note the affinity between the reduplication patterns of Attic Greek and Klamath: in Greek, only TR clusters reduplicate, and the remaining OR clusters—i.e. SR—do not; in Klamath, only TR clusters simplify, while the remaining OR clusters do not. In both cases, REDUPLICATE is undominated; in Klamath, ONSET is also undominated, and the ranking of C/V with respect to the context-sensitive MAX-C system determines the reduplicative behavior of individual clusters. In Attic Greek, C/V is undominated, and it is the ranking of ONSET with respect to the context-sensitive MAX-C constraints which determines the reduplicative behavior of individual clusters.

Given the existence of this parallel between Attic Greek and Klamath, and the observation that in Gothic, all OR clusters simplify while –OR clusters are fully copied, it seems reasonable to predict a selective copy language in which all and only OR clusters reduplicate. I'll call this language "pseudo-Greek;" it emerges when MAX-R/S_V is demoted below ONSET:

(43) Pseudo-Greek = [a-sta], [sa-sla], [pa-pra]

REDUPLICATE, C/V, BESTONSET, MAX-C/#_C, MAX-C/C_V
»
PREFIX e-, ONSET, L-ANCHOR, MAX-C
»
MAX-R/S_V, MAX-R/T_V

With this constraint ranking, all OR clusters reduplicate via the $O_1R_2V \rightarrow O_1V$ map:

(44) Pseudo-Greek

		MAX-C/#_C	MAX-C/C_V	ONSET	MAX-R/S_V	MAX-R/T_V
/sta/, [+X]	sa-sta		*!			
	ta-sta	*!				
	☞ a-sta			*		
/sla/, [+X]	☞ sa-sla				*	
	la-sla	*!				
	a-sla			*!		
/pra/, [+X]	☞ pa-pra					*
	ra-pra	*!				
	a-pra			*!		

Finally, consider the result when ONSET dominates none of the context-sensitive MAX-C constraints. In this case, no portion of any base cluster is copied, and only the base vowel has a correspondent in the reduplicant:

(45) Vowel copy = [a-sta], [a-sla], [a-pra]

REDUPLICATE, C/V, BESTONSET, MAX-C/#_C, MAX-C/C_V, MAX-R/S_V, MAX-R/T_V
»
PREFIX e-, ONSET, L-ANCHOR, MAX-C

With ONSET powerless to compel reduplication of any consonant belonging to a base cluster, only base vowels are reduplicated:

(46) Vowel copy

		MAX-C/#_C	MAX-C/C_V	MAX-R/S_V	MAX-R/T_V	ONSET
/sta/, [+X]	sa-sta		*!			
	ta-sta	*!				
	☞ a-sta					*
/sla/, [+X]	sa-sla			*!		
	la-sla	*!				
	☞ a-sla					*
/pra/, [+X]	pa-pra				*!	
	ra-pra	*!				
	☞ a-pra					*

4.5.4 Selective copy II: reduplication plus prefixation

We turn now to the prefixing analysis of Attic Greek forms like [e-ktona]; the constraint ranking for Greek under this analysis is shown below:

(47) Attic Greek = [e-sta], [e-sla], [pa-pra]

C/V, L-ANCHOR, BESTONSET, MAX-C/#_C, MAX-C/C_V, MAX-R/S_V	»
REDUPLICATE, ONSET	»
PREFIX e-, MAX-C, MAX-R/T_V	

With C/V and L-ANCHOR undominated, the only viable candidates are [C₁a-C₁C₂a] and [e-C₁C₂a]—i.e., the output must be either reduplicated, with a singleton onset that corresponds to the segment at the left edge of the base; or it must be prefixed—because [e-C₁C₂a] is not reduplicated, it vacuously satisfies L-ANCHOR. Which of these candidates surfaces as optimal for any individual base cluster depends on the relative rankings of REDUPLICATE and ONSET with respect to the context-sensitive MAX-C constraints (the crucial constraints are highlighted in the diagram above):

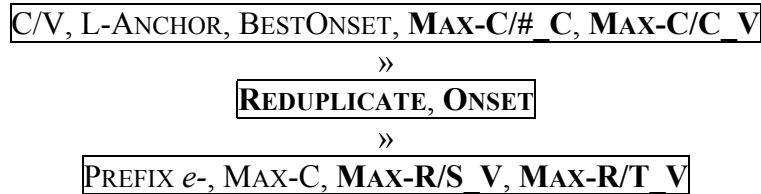
(48) Attic Greek

		MAX-C/#_C	MAX-C/C_V	MAX-R/S_V	REDUPLICATE	ONSET	MAX-R/T_V
/sta/, [+X]	sa-sta		*!				
	☞ e-sta				*	*	
/sla/, [+X]	sa-sla			*!			
	☞ e-sla				*	*	
/pra/, [+X]	☞ pa-pra						*
	e-pra				*!	*!	

High-ranking MAX-C constraints protect clusters other than OR from reduplication; thus, these forms surface with a prefixed vowel. However, with MAX-R/T_V ranked below REDUPLICATE and ONSET, TR clusters are compelled to reduplicate, thereby providing an onset for the reduplicative vowel.

Pseudo-Greek emerges when MAX-R/S_V is ranked below REDUPLICATE and ONSET:

(49) Pseudo-Greek = [e-sta], [sa-sla], [pa-pra]



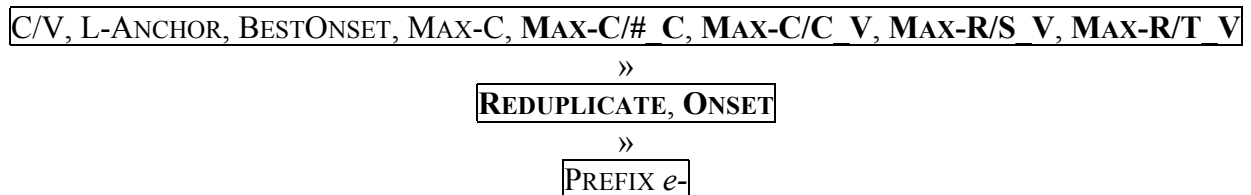
Now all OR onsets reduplicate via the $O_1R_2V_3 \rightarrow O_1V_3$ map, while clusters other than OR trigger prefixation of a non-reduplicating syllable:

(50) Attic Greek

		MAX-C/# C	MAX-C/C V	REDUPLICATE	ONSET	MAX-R/S V	MAX-R/T V
/sta/, [+X]	sa-sta		*!				
	☞ e-sta			*	*		
/sla/, [+X]	☞ sa-sla					*	
	e-sla			*!	*!		
/pra/, [+X]	☞ pa-pra						*
	e-pra			*!	*!		

Finally, when REDUPLICATE and ONSET are both outranked by all context-sensitive MAX-C constraints, no member of any base cluster is reduplicated—prefixation applies across the board:

(51) Prefixation only = [e-sta], [e-sla], [e-pra]



The partial tableau below illustrates exactly how this outcome is derived:

(52) Prefixation only

		MAX- C/# C	MAX- C/C V	MAX- R/S V	MAX- R/T V	REDUPLICATE	ONSET
/sta/, [+X]	sa-sta		*!				
	☞ e-sta					*	*
/sla/, [+X]	sa-sla			*!			
	☞ e-sla					*	*
/pra/, [+X]	pa-pra				*!		
	☞ e-pra					*	*

Here, with all context-sensitive MAX-C constraints dominating REDUPLICATE and ONSET, prefixation regardless of base cluster type becomes the strategy that best-satisfies the constraint hierarchy.

5. DISCUSSION

In the view taken here, the typology of reduplicative onset transfer reflects states of compromise reached in the face of conflicting forces: a demand that output forms be reduplicated, phonotactic pressure against consonant clusters and for onset consonants, and the requirement that correspondent strings be perceptually similar to within acceptable levels. The perceptual similarity requirement is encoded as the action of the context-sensitive MAX-C constraints; violable morphological and markedness constraints interact with these MAX constraints to produce all and only the attested patterns of onset transfer. The claim, in broad strokes, is that phonological processes occur more freely when the result of the process sounds quite similar to the original form.

I noted above two reasons to be suspicious of CONTIGUITY as standardly formulated: it is responsible for the prediction of apparently unattested patterns of partial onset transfer; and it penalizes all ABC → AC mappings equally, although the typology of onset transfer indicates that O₁R₂V → O₁V has a privileged status in reduplication. These complaints are made more concrete on examination of the factorial typology of the constraints above, replacing the context-sensitive MAX-C constraints with CONTIGUITY:

(53) Factorial typology, replacing context-sensitive MAX-C constraints with CONTIGUITY

Language	Outcome pattern			Ranking
Klamath	sta-sta	sla-sla	pa-pra	—
Gothic	sta-sta	sa-sla	pa-pra	L-ANCH, BESTONS, ONS, RED » C/V, PREFIX » MAX-C, CONTIG
Attic Greek 1	a-sta	a-sla	pa-pra	—
Attic Greek 2	e-sta	e-sla	pa-pra	—
pseudo-Greek 1	a-sta	sa-sla	pa-pra	—
pseudo-Greek 2	e-sta	sa-sla	pa-pra	L-ANCH, BESTONS, C/V » ONS, RED » PREFIX, MAX-C, CONTIG
Old Irish	sa-sta	sa-sla	pa-pra	L-ANCH, ONS, RED, C/V » BESTONS, PREFIX, MAX-C, CONTIG
Sanskrit	ta-sta	sa-sla	pa-pra	BESTONS, ONS, RED, C/V » L-ANCH, PREFIX, MAX-C, CONTIG
full transfer	sta-sta	sla-sla	pra-pra	CONTIG, MAX-C, L-ANCH, BESTONS, ONS, RED » C/V, PREFIX
vowel copy	a-sta	a-sla	a-pra	—
prefixation	e-sta	e-sla	e-pra	CONTIG, MAX-C, C/V, L-ANCH, BESTONS » RED, PREFIX, ONS
—	ta-sta	la-sla	ra-pra	CONTIG, RED, C/V, ONS » MAX-C, PREFIX, L-ANCH, BESTONS
—	ta-sta	sla-sla	pra-pra	CONTIG, RED, BESTONS, ONS » C/V, PREFIX » L-ANCH, MAX-C
—	ta-sta	a-sla	a-pra	CONTIG, RED, BESTONS, C/V » L-ANCH, PREFIX, MAX-C, ONS
—	ta-sta	e-sla	e-pra	CONTIG, BESTONS, C/V » ONS » L-ANCH, MAX-C » RED, PREFIX

Languages predicted but unattested, and languages attested but not predicted, are indicated with dashes in the appropriate location. Note that elimination of CONTIGUITY from the constraint set eliminates all of the wrongly predicted languages, but still leaves Klamath and Greek without an explanation. More accurate predictions notwithstanding, if the proposal to remove CONTIGUITY from the set of universal constraints, and to replace it with context-sensitive MAX and DEP constraints, is to be taken seriously, analyses in which CONTIGUITY places a vital role (e.g. Kenstowicz 1994; Lamontagne 1996) must be reexamined; work on this front continues.

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January 2, 2002