Reduplication as Echo: Evidence from Bontok and Chumash

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1 Introduction[1]

In the recent OT literature there have been two approaches to reduplication. Within standard OT, reduplication is driven by a set of morpheme-specific constraints that require the base of the reduplicant and the reduplicant itself to sound the same (McCarthy and Prince 1995a); within this approach reduplication is part of the grammar, a set of constraints that regulate how an abstract morpheme (RED) surfaces. Within direct OT (Golston 1996), reduplication is supposed to result from distinctively violating a general constraint FILL which normally functions to prohibit epenthesis (Prince and Smolensky 1993); this approach treats reduplication the same way that it treats other morphemes, as pure markedness in terms of distinctive constraint violations. We argue here that neither approach is adequate and propose a different approach based on distinctively violating a well-established constraint *ECHO which forbids concatenation of similar groups of sound (Yip 1993, 1998; cf. Dressler 1976; Menn & McWhinney 1984; Stemberger 1981; Golston 1995; Plag 1998). This new approach has parallels both to the standard approach, in placing emphasis squarely on the similarity relation inherent in reduplication and on the direct OT approach, in treating reduplication (and all other types of morpheme) in terms of distinctive constraint violation. A similar approach to ours can be found in O'Bryan 1999, which we have only recently come in possession of.

We draw on two languages with rich reduplicative systems, Bontok and Chumash, to point out the inadequacies of existing approaches and to support our alternative approach. Our central claim is that reduplication is tied to specific morphemes or sets of morphemes and is not to be confused with any part of the grammar.

2 Bontok and Chumash

Bontok and Chumash are quite typical of languages with reduplication, but they also supply some twists that make analysis difficult. In this section we provide a review of the basic facts, relying principally on Thurgood (1997) for Bontok and on Applegate (1972, 1976) and Wash (1995) for Chumash.

Bontok has three reduplicants of different prosodic size, each of which is used to signal a difference in meaning and the difference in meaning is connected to a difference in size (Thurgood 1997).[2] In the following we annotate the sizes using L for light (CV) syllable, H for heavy (CVC) syllable and Ft for foot (a pair of syllables):

(1) Bontok reduplicants

Intensive	L	ka—kamaŋan	'to hurry a lot'
		la—laydən	'to like very much'
Progressive	H	ʔik—ʔikkan	'is doing'
		ləb—ləbək	'is pounding'
Repetitive	Ft	yaŋgu—yaŋgu	'keep dancing (like men)'
		sagni—sagni	'keep dancing (like women)'

Thurgood (1997) treats the repetitive case as involving a foot template HL, but we reject this on typological grounds: HL syllables are unattested in stress systems cross-linguistically (Hayes 1995). We have no evidence from Bontok on this directly because stress in Bontok is not predictable but contrastive: 'on many occasions the position of the primary stress ... is the minimal difference between a pair of words' (Reid 1963:22). Reid gives the following examples:

(2) Contrastive stress in Bontok

ga'yaŋ	'a type of spear'	'gayaŋ	'crow'
ʔi'lit	'outskirts, edge'	'ʔilit	'eggs of head-lice'
ba'wi	'repent'	'bawi	'field shelter'
bu'kal	'wild pig'	'bukal	'disperse'

We look forward to uncovering evidence for a more exact characterization of foot in Bontok but for the time being we will simply assume that the morphology uses a disyllabic foot for the reduplicant meaning REPETITIVE. Little hinges on this matter for present purposes.

What is very clear from Bontok is that distinct reduplicants bear distinct meanings. The sole acoustic cue for the meaning INTENSIVE is reduplication of a *light* syllable; the sole cue for PROGRESSIVE is reduplication of a *heavy* syllable; and the sole cue for REPETITIVE is reduplication of *two syllables*.

It will thus be important to clearly tie the meaning of each reduplicant with its prosodic size. Specifically, we cannot separate the grammatical process of reduplication in Bontok from the individual morphemes it is used to instantiate.

The various reduplicants are part of the lexicon, where they are paired to idiosyncratic meanings, not part of the grammar.

Reduplication in Chumash comes in two main types, monomorphemic and polymorphemic. Polymorphemic reduplication involves a base and a reduplicant, each with its own meaning: e.g., *pon-pon'* 'trees' where reduplication marks plural. This type of reduplication is well treated in McCarthy and Prince (1995a) and we will not dwell upon it here. Monomorphemic reduplication, the other major type found in Chumash, is not discussed in McCarthy and Prince (1995a) and we will argue that it is not readily analyzable in that framework. This is because monomorphemic reduplication involves a *single morpheme* whose syllables echo one another. As we will see, there is no simple way of analyzing such reduplication using constraints that regulate the similarity of a base and a reduplicant because in monomorphemic reduplication the base and the reduplicant are the same thing.

Like reduplication in Bontok, reduplication in Chumash comes in a number of shapes and sizes. To keep the parallels with Bontok clear, we will use similar terminology wherever possible, parenthesizing Applegate's terminology for those familiar with it. Three of these shapes are identical to those we see in Bontok involving a light syllable (CV), a heavy syllable (CVC) and a foot (Ft) (in the case of Chumash, two light syllables only):

(3) Chumash monomorphemic reduplicants

L	walalaq'	'lichen'
	s^{h}ayayan	'ripe piñon nut'
	oxoxon	'to cough'
	taʃuʃun	'to be fragrant'
	halala	'to quarrel'
H	lewlew	'mythological creature'
	muxmux	'to crumble'
	ʃokʃok	'to be wrinkled'
	kopkop	'toad'
	qewqew	'roadrunner'
Ft	yepeyepen	'[earth] to shake'
	wuluwulun	'to shake, wiggle'
	yuluyuluk	'to be angry'
	k^{h}awak^{h}awak	'to be light (in weight)'

Applegate has three other types of reduplication: CV-reduplication, final VC-reduplication and *wuluwul* reduplication. We think these are best analyzed as variants of those already given. CV-reduplication is fairly rare but looks like this:

(4) CV reduplication

CV	teteʔ	'mother'
	pepeʔ	'older brother'
	c'ɨc'ɨ	'to be sharp'
	nonoʔ	'(very) much'

We see no difference in these forms and forms like *walalaq'* and *oxoxon* above except for the number of syllables: L-reduplication has three syllables, CV-reduplication has two. Both involve identical penultimate and final syllables and we treat them identically here. So we treat these as a subcase of L-reduplication (what Applegate calls medial reduplication).

Final -VC reduplication seems to involve an echo word-finally:

(5) -VC monomorphemic reduplication

takak	'quail'
tʃʰuyuy	'to slide (intrans.)'
waqaq'	'frog'
mak'ak'	'to stutter'
oqtokok	'to toast'

Such reduplication is marginal, both mono- and polymorphemically (Applegate 1972:277). The final -VC always creats a heavy syllable, so we treat this as a subtype of H-reduplication in which the echo occurs finally rather than initially.

Wuluwul reduplication is described by Applegate as involving two identical CVC sequences separated by a vowel of the same quality:

(6) Wuluwul monomorphemic reduplication

wuluwul	'lobster'
yowoyow	'mythological creature'
welewel'	'pigeon species'
mayamay'	'to be multicolored'
tiq'itiq'	'blackberry'

We note, however that these forms begin with an echoed CVCV just like the Ft-reduplicated forms above: cf. *wuluwul* 'lobster' with *wuluwulun* 'to shake, wiggle'. The difference is the overall length of the word: the words in 6 have three syllables, while the Ft-reduplicated words in 4 above have four syllables. For this reason we treat froms like wululwul as a subtype of the Ft-reduplicants.

To summarize: the common types of reduplication in Chumash reduce to three, once we ignore differences in length and locus of affixation. Interestingly, these are very similar to the prosodic types we find in Bontok:

(7) Common reduplication in Chumash

L	halala	(based on hala)
	tete?	(based on te?)
H	lewlew	(final H)
	takak	(initial H)
Ft	wuluwul	(based on wul)
	wuluwulun	(based on wulun)

Most of these types of reduplication are found with polymorphemic reduplication as well and we follow Applegate in wanting to treat both types of reduplication with the same theoretical toolbox. What should be immediately clear from Chumash is that the echo so characteristic of reduplication need not occur between a reduplicant and a base: rather, it can and does occur within the same morphological element. Nor is this limited to Chumash (see Moravcsik 1978).

Reduplication is often tied to specific lexical items and is not well-treated as a general part of the grammar. In Bontok reduplicative size is tied to affixes with distinct meanings; in Chumash reduplicative size is tied to roots with distinct meanings. It is essentially a distinctive feature that distinguishes certain roots from others.

3 Reduplication as Constraints

The shape of the reduplicant in standard OT is constrained in three ways. First, there is the faithfulness family, MAX and DEP. MAX-BR ('maximize base-reduplicant') requires that bases and reduplicants share the same number of segments, just as MAX-IO ('maximize input-output') requires that outputs have the same number of segments as inputs. MAX bans deletion in the regular grammar and forces total copy in the reduplicative grammar. DEP-BR ('depend base-reduplicant') requires that every segment in the reduplicant have a corresponding segment in the base, just as DEP-IO ('depend input-output') requires that every segment in the output depend on some segment in the input (McCarthy and Prince 1995a, 264).[3] Thus DEP is meant to ban epenthesis in the regular grammar and to ban prespecified material in reduplicants in the reduplicative grammar.

It is worth noting that these faithfulness constraints do not care whether or not the corresponding segments sound alike—MAX and DEP only require that correspondents have the same number of segments: [pil-tagti] and [tag-tagti] fare equally well as reduplications of [tagti] in terms of MAX-BR and DEP-BR as long as the segments of the reduplicant stand in a correspondence relation to segments in the base.

A second family of constraints, IDENT-BR(F) ('identity between base and reduplicant for feature F) guarantees that corresponding segments in the reduplicant and base sound the same. This is the constraint responsible for making [pil-tagti] a worse instance of reduplication than [tag-tagti]. A similar constraint IDENT-IO(F) ('identity between input and output for feature F) regulates the phonetic similarity of input and output segments in the non-reduplicative part of the grammar.

Finally, there is a family of constraints that regulates the overall *size* of the reduplicant, RED=L, RED=H, and so on (e.g., McCarthy and Prince 1995a:267). These constraints were well-researched in pre-OT work in prosodic morphology (Marantz 1982; McCarthy and Prince 1986, 1990; Steriade 1988; Crowhurst 1991, et alii) and the results of that research provide important background for the present discussion.

Together these three families of constraints (segmental correspondence, featural correspondence and reduplicant size) guarantee that the reduplicant will look pretty much like a prosodically defined portion of the base. Note that this type of analysis posits only a tenuous connection between the size of a reduplicant (RED=σ_{μ},) and the fact that it sounds like its base (IDENT-BR(F)); between the size of the reduplicant (RED=σ_{μ},) and the number of segments shared by reduplicant and base (MAX-BR); and so on. We will see below that this leads to some problems, but in some ways the separation proves useful because it allows a satisfying factorial typology (Prince and Smolensky 1993):

(8) Factorial typology

MAX-BR	>>	RED=L	Total reduplication
RED=L	>>	MAX-BR	Partial reduplication

As shown above, ranking MAX-BR above templatic constraints results in total reduplication; the opposite ranking results in partial reduplication. As both types of reduplication are well attested in the languages of the world, this is a satisfying result.

DEP-BR is supposed to keep out reduplicants with fixed segments, but it clearly cannot do this: it is only able to count segments, not to check the featural composition of those segments ('Every segment of the reduplicant has a corespondent in the base'). If it could do the latter it would be an IDENT-BR(F) constraint, not a Faithfulness constraint. So DEP-BR must just check that the reduplicant is not longer than the root. We can see it violated in something like *fancy-schmancy*: [fænsi] has 5 segments and [ʃmænsi] has 6; the fact that [ʃm] and [f] are featurally distinct has nothing to do with DEP-BR.

So how does this type of analysis work for Bontok and Chumash? We'll argue here that although it handles many aspects of reduplication well, the standard OT approach encounters problems with other aspects of reduplication. In Bontok the problem is in relating the size of the reduplicant to distinct meanings and in Chumash the problem is in treating monomorphemic reduplication. We begin with the former.

3.1 The problem with Bontok

The three reduplicative affixes of Bontok are not easily handled on the standard OT account because the templates that regulate size (RED=H, RED=L, etc.) are not linked in any way to the meaning of the morpheme in question. To handle the Bontok data we must annotate different constraints with particular semantic tags to indicate which constraint applies to which morpheme. An explicit account of Bontok would need to have constraints like the following:

(9) Annotated constraints in Bontok

INT =RED= L PROG =RED = H REP =RED = FT

These constraints stipulate what is obviously an idiosyncrasy of Bontok, part of the arbitrary pairing of sound and meaning. All three parts of the equation must be linked in the constraint hierarchy. Let us see why this is so. Suppose we were to try pairing the meanings with the size requirements in the lexicon and omitting the RED part, or putting it elsewhere in the grammar:

(10) Partial Bontok lexicon (first try)

INT = L PROG = H REP = FT

A constraint like MAX-BR now has no way of targeting *these* morphemes because there is nothing in them that makes them reduplicative. If we leave RED out of the lexicon Bontok will have no surface reduplication and the MAX-BR constraints will spin idly in the grammar. Now suppose that we try taking the size part out of the lexical representation:

(11) Partial Bontok lexicon (second try)

INT=RED PROG=RED REP=RED

Now the grammar has no way of pairing the right meanings with the required prosodic shape. Nothing will guarantee that 'is doing' will be [ʔik—ʔik.kan] rather than [ʔi—ʔik.kan] or [ʔik.ka—ʔik.kan]. The only other solution is to pull the meaning part out of the lexicon:

(12) Partial Bontok lexicon (third try)

RED=L RED=H RED=FT

This suffers again from the problem that the grammar has no way of lining up the right meaning with the right prosodic size. We need to know that L-syllable reduplication means one thing while H-and Ft–reduplication mean other things.

Perhaps this will all be clearer in a tableau. Consider how the grammar will evaluate various candidates arising from the progressive for [ləbək] 'pound':

(13) Bontok [ləb—ləbək] 'is pounding'

RED—ləbək	RED=L	RED=H	RED= FT
lə—ləbək		*	*
ləb—ləbək	*		*
ləbə—ləbək	*	*	

The first candidate is the right form, the second would be the right form for an intensive and the third form would be the right form for the repetitive. As the tableau now stands there is no way for the grammar to select [lə—ləbək] if it means 'to pound very much', but to select [ləb—ləbək] if it means 'is pounding' but to select [ləbə—ləbək] if it means 'keep pounding'. All three candidates tie because they fare equally well on the constraints. The point is that the prosodic size of the reduplicant covaries with its meaning and the problem is that the grammar doesn't yet make this link. To get all of this to work, we have to key the constraints on reduplicant size to distinct meanings. All this can be done in the lexicon (as suggested above), or some of it can be put into the grammar, as sketched out below:

(14) Bontok [ləb—ləbək] 'is pounding'

RED—ləbək | Int	RED=L | Int	RED=H | Prog	RED=Ft | Rep
☞ lə—ləbək			
ləb—ləbək	*!		
ləbə—ləbək	*!		

Here we have linked reduplication to a meaning in the lexicon and linked that meaning to a prosodic size restriction in the grammar. Other approaches are possible, but they all suffer from the same problem. Standard OT derives a lot of its explanatory power from the requirement that constraints be universal well-formedness conditions (Prince and Smolensky 1993). If we now abandon this idea wholesale by using constraints to encode idiosyncrasies of the sound-meaning relationship (e.g., that REPETITIVE is signaled by reduplicating a foot), the otherwise principled division between idiosyncratic lexicon and universal grammar is lost. This has been proposed elsewhere in OT (Hammond 1997, Russell 1997), but it deviates enormously from standard models of how grammar works. Indeed, in the models where it has been proposed the entire distinction between lexicon and grammar goes away.

3.2 The problem with Chumash

Chumash presents a related difficulty for the standard OT model: the existence of monomorphemic reduplication *muxmux* 'to crumble' alongside polymorphemic reduplication *xšapxšap* 'rattlesnake (pl)'.[4] Recall the basic setup for reduplication in McCarthy and Prince (1995a), which always involves a base (B) and reduplicant (R), whose similarity and shape are related by a set of BR correspondence rules in the general grammar. Thus the very essence of the analysis requires that reduplication occur across morphemes, one copying the other. This works well for polymorphemic reduplication but not for monomorphemic reduplication.

Despite a sizable chunk of text devoted to Chumash, McCarthy and Prince 1995a do not discuss what to do with monomorphemic reduplication, so we must try some proposals of our own, straw men being better than no men at all. Our first attempt will be to use only the base and lose the reduplicant (RED):

(15) Chumash monomorphemic reduplication (first try)

/muxmux/	MAX-IO	MAX-BR
☞ muxmux		
puxmux	*!	

This works, but the reduplicative aspect of *muxmux* is now completely coincidental (underlying in fact) and all of the strong similarities between monomorphemic and polymorphemic reduplication that Applegate and Wash discuss go unexplained. Essentially, such an analysis must claim that L-, H- and Ft-reduplications are *derived* when they involve more than one morpheme and *underlying* when they involve only one morpheme. This cannot be the right solution and we will not consider it further.

The only other solution we see is to use RED without a base, which has no compelling candidates either:

(16) Chumash monomorphemic reduplication (second try)

/RED/	MAX-IO	DEP-IO	MAX-BR
muxmux	*!	******	
☞ RED			

The output here wouldn't sound like anything. Again, MAX-BR spins idly in the grammar without a base to link to, just as it must if it has a base but no reduplicant, as sketched above.

We take it as obvious, then, that monomorphemic reduplication is incompatible with analyses which require that a reduplicant be distinct from its base. Since the parallels between monomorphemic and polymorphemic reduplication are so strong in Chumash (Applegate 1972, 1976; Wash 1995), it seems that the standard OT approach to reduplication is not well suited to this langauge.

As with Bontok, the problem lies in the fact that reduplicants are morphemes (part of the lexicon) not well-formedness constraints (part of the phonology). They must be part of the lexical representation of a morpheme, not part of the general grammar.

3.3 The problem more generally

We discuss other problems with the Red + Base analysis here, though they are not specific to the Bontok or to the Chumash data. Nonetheless, it will be worth a short diversion to look at other shortcomings of the standard model.

First, there is the basic notion of economy. The standard account is based on constraints whose only function is to analyze reduplication. This is actually a retreat from earlier analyses that involved templates and spreading (Marantz 1982, McCarthy and Prince 1986, and many others). These analyses treated reduplication as the introduction of a segmentally empty prosodic template (CV string, syllable, foot, etc.), the likes of which were independently required elsewhere, in syllabification, footing, root-and-pattern morphology and the like. But with the introduction of BR constraints this generality is lost: these constraints are conspicuously ad hoc, designed only to get a specific type of morpheme to surface correctly. McCarthy and Prince (1995a) go to some lengths to argue that BR constraints are the same type of constraints as their newly minted correspondence constraints MAX-IO, DEP-IO and IDENT-IO(F), but this is cold comfort. The problem is that an entirely new set of constraints is needed to handle reduplication—and that many of these constraints are tied to specific morphemes (e.g., INTENSIVE, PROGRESSIVE, REPETITIVE in Bontok) in ways that other OT constraints (ONSET, NOCODA, etc.) are not.

Second, there is a representational issue. Underlying forms in OT are generally given as unsyllabified, unsyllabified strings of root nodes linked to features or, in the case of floating features, of unsyllabified strings of features (Zoll 1998). They typically look like this (taking them randomly from the litereature): /naŋkep/, /k^{w}aja/, /muuluumul/, /mpat/ /osampi/, /ark-ark/, /t-n-ak-ol/, /ulampoy/, /bɛd/, /um/, /no-N-kama-i/, /takaaruiʔ/. Then there's the underlying form of all reduplicants: /RED/. Unlike the underlying forms of other morphemes, the underlying form of reduplicants is the same for all languages and is completely abstract, with no phonetic or phonological content whatsoever. It is completely *sui generis*, unlike anything else in the lexicon. This should give us pause. It looks like an underlying form (sort of), but it is really a sort of index that allows certain morphemes within a language to be subject to constraints (RED=σ, MAX-BR, DEP-IR, etc.) that other morphemes are invisible to. At best it is a promisory note for an explicit analysis.

Third, there is a problem with a factorial typology of MAX-BR and some other constraints. We begin with *ECHO (Yip 1993, 1998). The most obvious surface characterization of reduplication is that the reduplicant copies some portion of the base. Interestingly, such copying is often prohibited in languages: when the morphology or syntax bring together strings of like-sounding morphemes, one of them is often deleted or changed. Yip (1998) offers the English plural possessive as a morphological case:

(17) *ECHO

cat-s	(plural)	
cat-s	(possessive)	
cat-s	(plural possessive)	*cat-s-s

Other languages satisfy *ECHO by changing the shape of one of the offending morphemes. Thus in Italian, the string [si-si] is changed to [si-zi] to avoid violating *ECHO. Numerous cases from the literature are discussed in Stemberger 1981, Yip 1993, 1998 and Golston 1995.

Now to the factorial typology. The problem is that IDENT-BR(F) and *ECHO are in direct conflict with one another since IDENT-BR(F) demands that adjacent morphemes sound the same while *ECHO prohibits it. Let's begin our factorial typology with IDENT-BR(F) ranked fairly low, below *ECHO and MAX-BR. Now suppose *ECHO outranks MAX-BR. There will be no reduplication at all, even in a language with reduplicative morphemes: reduplicated forms like *polko-polko, pol-polko, po-polko* and the like will violate *ECHO and be rejected:

(18) *ECHO>> MAX-BR >> IDENT-BR(F)

/RED + polko/	*ECHO	MAX-BR	IDENT-BR(F)
☞ marga-polko			*****
marg-polko		*!	****
polko-polko	*!		

The first candidate wins because it has no adjacent homophones and yet has an equal number of segments in the reduplicant and base. The second candidate loses because the reduplicant has less segments than the base. The last candidate stands no chance at all because it has adjacent homophones. The result is clear, if a bit surprising: the factorial typology predicts a type of 'reduplication' in which the reduplicant always has the same *number* of segments as the base but never has the *same segments* as the base. No such morphological formation has ever been attested to our knowledge, so we take the prediction to be a bad one. Now let's rerank the top two constraints and see what the next part of the factorial typology brings us:

(19) MAX-BR >> *ECHO >> IDENT-BR(F)

/RED + polko/	MAX-BR	*ECHO	IDENT-BR(F)
☞ marga-polko			*****
marg-polko	*!		****
polko-polko		*!	

This ranking has the same effect: it produces reduplicants with the right number of wrong segments. This is because MAX-BR always passes on more than one candidate with the right number of segments, leaving it to lower-ranked constraints like *ECHO to decide which is the best. *ECHO will *never* select a form in which the reduplicant sounds like the base, so we arrive at the same result as before: a language in which reduplicants have the right number of segments, but the wrong segments.

A related problem arises when we factor in constraints against insertion. Consider two types of constraint, those that ban insertion of segments and those that ban insertion of syllables. If either type of constraint outranks Max-BR we get an odd type of language. If a ban on segment insertion is more important than base-reuplicant identity we get a language which copies as little of the base as possible. If a ban on syllable insertion is more important than base-reduplicant identity we should get a language in which none of the base is reduplicated. We start with the latter case.

Building on work by Selkirk (1981) Noske (1984) and Broselow (1995), Zoll (1993, 1998) proposes a constraint against epenthesis she calls *STRUC(σ) as follows:[5]

(20) *STRUC(σ) No syllables.

If this constraint dominates MAX-BR we have type of situation seen in (21). The first candidate has the same number of syllables as the input (two) and thus beats the other candidates which have one or more syllables that are lacking in the input. This is a bizarre prediction—that some language would realize reduplication as zero-affixation—and one that does not support the standard analysis.

(21) *STRUC>> MAX-BR

/RED + polko/	*STRUC(σ)	MAX-BR
☞ polko		*****
po-polko	*!	***
polko-polko	*!	
marga-polko	*!*	
polko-polko	*!*	

A final problem involves the interaction of MAX-BR and DEP-IO (McCarthy & Prince 1995a, 264), which prohibits insertion of segments not found in an underlying form.

(22) DEP-IO: Every segment of the output has a correspondent in the input.

Given this definition, every segment in a reduplicant violates DEP-IO because no segment in a redupliant has a correspondent in the input. The same logic makes Max-IO completely oblivious to the reduplicant:

> Crucially, MAX-IO does not militate against the omission of input segments in the reduplicant. This is because *the reduplicant has no input segments* of its own to which it might potentially be faithful. This is the essense of reduplication: a reduplicative affix has no input segments, hence escapes from the 'gravity foreces' of faithfulness. (Kager 1999, 207)

So what happens if we accept that segments in a reduplicant have no correspondents in the input?[6] If MAX-BR outranks DEP-IO there is no effect; but if DEP-IO outranks MAX-BR we get the following situation:

(23) DEP-IO>> MAX-BR

/RED + polko/	DEP-IO	MAX-BR
☞ polko		*****
po-polko	*!*	***
polko-polko	*!****	

This yields results similar to those discussed earlier: the best reduplicant is the one that reduplicates nothing.

Introducing a highly ranked templatic requirement on the reduplicant (RED=σμμ) alleviates this somewhat but still leads to a wrong prediction. If that constraint dominates DEP-IO (which dominates MAX-BR), we get a language which reduplicates a syllable with as few of the segments of the base as possible:

(24) RED=σ >> DEP-IO>> MAX-BR

/RED + polko/	RED=σ	DEP-IO	MAX-BR
polko	*!		*****
☞ po-polko		**	***
pol-polko		***!	**

The first candidate now loses because it doesn't have a syllable-sized reduplicant. And the second wins out over the third because it satisfies the template with *less* inserted segments. But this goes directly against a major finding in reduplication,—that the reduplcant 'is as big as it can be and yet not exceed the template' (McCarthy & Prince 1995b, 336). According to this finding we would expect candidate three to win over candidate two. The hypothetical language in (24) does not exist, showing that a factorial typology which includes RED=σ, DEP-IO and MAX-BR does not fit the facts as we know them.

One more. If we let a templatic constraint like RED=σ be ranked above or alongside MAX-BR we get a case where the base shrinks to monosyllable size to match the reduplicant. Take the case in which RED=σ and MAX-BR are equally highly ranked:

(25) RED=σ, MAX BR >> MAX-IO

/RED + polko/	RED=σ	MAX-BR	MAX-IO
polko	*!	*****	
po-polko		*!**	
pol-polko		*!*	
☞ pol-pol			**

The problem now is that the reduplicant and base must be the same size and the reduplicant must be small: this is more important than the base remaining true to its underlying form, with the result that the base shrinks to fit the reduplicant. Again, no such language exists, turning the factorial typology against the analysis.

Thus a factorial typology using MAX-BR makes for some highly unlikely predictions. It predicts languages in which reduplicants surface with the same number of segments as the base, but not the same segments (18, 19). It predicts languages whose reduplicants surface as zero affixes (21, 23). It predicts language whose reduplicants surface with as little of the base copied as the templatic constraints permit (24), contra what we know to be true of reduplicating languages generally. And it predicts languages that reduce the base to match the size of the reduplicant (25).

There are many things right about the standard OT analysis of reduplication, and we should preserve them in future models. Chief among these is that there must be some mechanism which guarantees that reduplicative structures involve the copying or echoing of some sequence of sounds, covered in the standard theory by faithfulness and identity constraints. Second, there must be some way of ranking, relative to other constraints in the grammar, whatever constraint is responsible for this similarity relation. And finally, there must be some way of regulating the prosodic size of a reduplicant.

4 Reduplication as FILL

In direct OT (Golston 1996, Golston & Wiese 1998, Archangeli 1999, O'Bryan 1999, Hiller 2000, Yasuda 2000) morphemes are represented not by strings of sounds but by the constraints they violate, i.e. directly in terms of markedness. Within this framework Golston (1996) proposes that reduplication is a morphological process whose distinguishing characteristic is the insertion of sounds that are not part of an underlying form. That is, reduplication is treated as distinctive violation of the constraint FILL (or its equivalent in the correspondence model, DEP-IO). The lexical representation for progressive in Bontok would thus directly pair the meaning with the constraint violated (see Golston & Wiese 1998 for details):

(26) Reduplication as violation of FILL-H

FILL-H
prog

The basic idea, taken from Marantz (1982), is that a reduplicative affix is an empty piece of prosodic structure, here an empty heavy syllable. The phonetic form of such an empty piece of prosody is provided by processes that spread the sounds of the base onto the reduplicant. The sound-meaning pairing is given directly with the sound part (the constraint that is distinctively violated) at the top and the meaning that consistently results in violation of it (PROGRESSIVE in this case) at the bottom, resurrecting the Saussurian sign in a box. This analysis suffers from none of the drawbacks of the standard OT analysis.

But it has insuperable flaws of its own. Foremost among these is that distinctive violation of FILL should result not in reduplication but in *epenthesis*. Although the Bontok form [ləb—lə.bək] 'is pounding' contains the requisite violation of FILLHEAVY it is not clear why [eʔ—lə.bək] or [ig—lə.bək] or the like would not be a better way of saying 'is pounding'. There is in this analysis no principled way to guarantee that distinctive violation of FILL will be met by copying material from the base onto the reduplicant rather than merely inserting the least offensive filler.

To compound the problem, it seems that some languages have morphemes that would be well expressed as just this type of violation of FILL. Take German, which is standardly analyzed as having no underlying schwa (there are no minimal pairs in which schwa contrasts with some other vowel). Despite the lack of a schwa phoneme, a number of morphemes are marked solely by the addition of schwa: e.g., *ge-ə* 'I go' vs. *ge-st* 'you go' vs. *ge-t* '(s)he goes'. If we analyze the first singular morpheme as a distinctive violator of FILL, as seems reasonable in direct OT, we can no longer treat reduplication in the same way because it has a different outcome: copy rather than epenthesis. So it looks like we want to have distinctive violation of FILL in direct OT, but that it will result in something *other* than reduplication. This leads again to rejecting the idea that reduplication is just distinctive violation of FILL. Something else is required to make the epenthetic material echo the base.

There is a conceptual problem with this analysis as well. A major point about direct OT is that it replaces underlying forms with desiderata, intentional surface violations of well-formedness constraints. But FILL (and PARSE) would seem to require reference to an underlying form (Prince & Smolensky 1993, 85):

(27) FILL: Syllable positions must be filled with underlying segments.

PARSE and FILL have no place in direct OT because there is no principled distinction in that theory between surface forms and underlying forms.

5 Reduplication as echo

The most obvious surface characterization of reduplication is that some portion of the base is echoed. As we have already seen, others have noted that such copying is often prohibited in languages: when the morphology or syntax bring together strings of like-sounding morphemes, one of them is often deleted or changed or the construction is avoided altogether. This we take to be the crux of the matter: some languages use distinctively what other languages avoid. Menn & McWhinney (1984) state the matter with characteristic pith:

> The languages of the world frequently show evidence of conspiracies to avoid the 'accidental' repetition of phoneme strings across morphs. These conspiracies are intriguing, since many languages also use the contrary strategy of reduplication—which deliberately repeats material within morphs (Moravcsik 1978, Wilbur 1973) in order to mark certain grammatical contrasts, achieve emphasis, and express relations iconically. Thus we see languages formally

sanctioning 'deliberate' repetition of all or part of a morph, even while going out of their way to prohibit 'accidental' repetition.

In direct OT we may use *ECHO both to avoid adjacent homophones ('accidental' repetition) and to model reduplication ('deliberate' repetition), which involves distinctive (meaninful) violation of *ECHO; a similar conclusion has been reached independently by Todd O'Bryan (1999). Distinctive violation of *ECHO plays essentially the same role as IDEND-BR(F), requiring the base and the reduplicant to sound the same. Templatic requirements will be treated as distinctive violations of *STRUC (Zoll 1993, 1998), eliminating the need for ad hoc, morpheme-specific constraints like RED=H and eliminating the need for referencing underlkying forms distinct from surface forms, i.e. eliminating the need for distinctive violation of FILL. There is no difficulty in analyzing languages like Bontok that contain a number of reduplicating morphemes of different sizes. Nor does distinctive violation of *ECHO require two distinct morphemes, so there should be no problem in handling monomorphemic reduplication of the type found in Chumash. So let us turn to our case studies and look more closely at reduplication in Bontok and Chumash.

5.1 Reduplication in Bontok

Bontok has an extensive amount of verb reduplication and a small amount of noun reduplication. We begin with the former. The Bontok data below show reduplicants shaped L, H, and Ft, depending on the meaning of the reduplicant in question:

(28) Intensive (L)

kamaŋan	'hurry'	ka—kamaŋan	'hurry a lot'
laydən	'like'	la—laydən	'like very much'

(29) Progressive (H)

ʔikkan	'do'	ʔik—ʔikkan	'be doing'
payʔən	'put'	pay—payʔən	'be putting'

(30) Repetitive (Ft)

yaŋgu	'dance (m)'	yaŋgu—yaŋgu	'keep dancing (m)'
sagni	'dance (f)'	sagni—sagni	'keep dancing (f)'
ʔanap	'look for fish'	ʔana—ʔanap	'keep looking for fish'
pattuŋ	'play the gong'	pattu—pattuŋ	'keep playing the gong'

The three reduplicative morphemes found in Bontok can be presented as distinctive violations of *STRUC.

As we have seen, Zoll (1993, 1998) has proposed a constraint against epenthesis she calls *STRUC(σ) that keeps to a minimun the number of syllables in a given output form. Generalizing this to moras gives us a constraint against lengthening:[7]

(31) *STRUC(μ) No moras.

A light syllable violates each constraint once; a heavy syllable violates *STRUC(σ) once and *STRUC(μ) twice. Two syllables violate *STRUC(σ) twice and *STRUC(μ) twice (or more depending on the weight of the syllables).

(32) Markedness of L, H and Ft in terms of *STRUC

	*STRUC(σ)	*STRUC(μ)
L	*	*
H	*	**
Ft	**	**

Turning now to representation, we can borrow the idea that reduplication introduces prosodic structure (Marantz 1982) and that the introduction of such structure can be a desideratum for a given morpheme (Golston 1996) and represent the Bontok reduplicants as distinctive constraint violations of *STRUC:

(33) Desiderata for Bontok reduplicants

*ECHO	*STRUC(σ)	*STRUC(μ)
int	int	int

*ECHO	*STRUC(σ)	*STRUC(μ)
prog	prog	prog prog

*ECHO	*STRUC(σ)	*STRUC(μ)
rep	rep rep	rep rep

The desiderata for INTENSIVE are that it echo the base (*ECHO) and that it introduce an extra syllable and an extra mora (i.e., a light syllable). For PROGRESSIVE the desiderata require echoing the base and introducing an extra syllable and two extra moras (i.e., a heavy syllable). And for REPETITIVE we are to echo the base with two extra syllables and two extra moras.

We can understand the notation as instructions to the speaker, a caveat emptor to whoever is intending to say the intensive, progressive or repetititve forms of a verb:

> To signal the meaning INTENSIVE in this language you'll need to do a number of things that you will find unnatural. But you can't signal INTENSIVE in Bontok by simply breathing through your nose. So here's a list of the difficulties you'll encounter: (i) you need to echo yourself and (ii) you need to do so in one syllable and (iii) you need to do so in one mora. If you're planning on signalling PROGRESSIVE you'll have to do what you did for INTENSIVE but add in two moras. To signal REPETITIVE add an extra syllable.

A tableau for ləb—ləbək 'is pounding' looks like this (focusing only on the reduplicative part of the problem):

(34) Bontok [ləb—ləbək] 'is pounding'

prog-pound	*ECHO	*STRUC(σ)	*STRUC(μ)
mar—ləbək	<prog>!	prog	prog prog
lə—ləbək	prog	prog	prog <prog>!
ləbə—ləbək	prog	prog *!	prog prog
☞ ləb—ləbək	prog	prog	prog prog

The first candidate loses because it doesn't contain an echo—it's not reduplication of anything. The second loses because it doesn't violate *STRUC(μ) enough, the third because it violates *STRUC(σ) too much. This leaves the final candidate as the winner because it echoes the base, adds one syllable and two moras, as desired.

Noun reduplication parallels verb reduplication and exhibits the same sizes of reduplicant: L, H and Ft. We won't therefore spend much time on them except to note that they are susceptible to the same type of analysis. Representative examples follow:

(35) L-reduplication

'lima	'arm'	li—'lima	'arms'
si'ki	'leg'	si—si'ki	'legs'

(36) H-reduplication

ʔinˈti	'sugar candy'	ʔin—ʔinˈti	'herb with sweet smell'
ˈbutu	'animal testicles'	but—ˈbu tu	'sword fern'
ʔaˈkusan	'adornment'	ʔak—ʔaˈkusan	'ground orchid'
ʔaˈma	'father'	ʔam—ʔaˈma	'married father'

ʔiˈna	‘mother’	ʔin—ʔiˈna	‘married mother’
ʔaˈpu	‘grandparent’	ʔap—ʔaˈpu	‘person with grandchild’
ʔaˈnak	‘child’	ʔan—ʔaˈnak	‘one of a group of children’

(37) Ft-reduplication

ʔamʔaˈma	‘married father’	ʔamʔa—ʔamʔaˈma	‘old man’
ʔinʔiˈna	‘married mother’	ʔinʔi—ʔinʔiˈna	‘old woman’

Plurals formed by L-reduplication are quite rare. Except for a few kinship terms and terms “associated with humans such as paired body parts” (Reid 1993:1), Bontok never developed the category plural for nouns. Similarly with the other categories: none is productive enough to warrant full treatment here, although the structures that result aren’t in any way problematic for the account we propose.

A number of advantages accrue to the analysis proposed here. First, the distinctive violation of *ECHO does the same work as MAX-BR AND IDENT-BR(F) in McCarthy & Prince 1995a, allowing us to eliminate these reduplication-specific constraints from the [8]grammar of natural languages. Similarly, distinctive violation of the *STRUC constraints does the work of RED=σ, RED=σ_{μ}, RED=$\sigma_{\mu\mu}$ and so on, allowing us to eliminate another family of ad hoc constraints from OT.

Thus whereas the standard OT analysis of reduplication requires a small army of new constraints all specific to reduplication, the direct OT analysis uses distinctive violation of *existing* constraints. This has two benefits. The first, as we’ve just seen, is a reduction in the number of constraints needed for the grammars of natural languages. The second is that the markedness of reduplication is made explicit in the analysis (reduplication violates *ECHO), rather than left as an interesting footnote.

Most importantly, using distinct violation of *ECHO avoids the problems with the factorial typology discussed above. Recall that if *ECHO, MAXBR and DEP-BR outrank Ident-BR(F) we get reduplication of the form *marga-polko*, with the right number of wrong segments. Under the direct OT analysis presented here this unwelcome result cannot arise: *ECHO cannot interact with MAX-BR, DEP-BR and IDENT-BR(F) because the latter are banished from the grammar. The bad prediction simply does not arise.

Finally, using *ECHO and *STRUC instead of FILL allows us to treat reduplication in direct OT just as other types of morphology are treated: as desiderata that do not involve reference to a split between underlying and surface forms. It looks as though PARSE and FILL (or their correspondent cousing MAX and DEP) can be dispensed with entirely in direct OT.[9]

5.2 Reduplication in Chumash

Turning back to Chumash now, recall that the peculiar trait of reduplication in this language is that it occurs in monomorphemic words. Models of reduplication that require a reduplicant distinct from the base (as the model in McCarthy & Prince 1995a seems to do) are ill-suited to such data because the reduplicant and the base are in this case tautomorphemic.

In the direct OT analysis proposed here monomorphemic reduplication is represented as a violation of *ECHO plus additional violations of well-formedness constraints that specify the rest of the phonetic content of the root in question. Take *halala* 'to quarrel'. Let's start with a representation of this word just in terms of sonority peaks and distinctive features and see what constraints it violates.

(38) halala

	x		x		x	Vowel
	x		x		x	Glide
	x	x	x	x	x	Liquid
	x	x	x	x	x	Nasal
x	x	x	x	x	x	Obstruent
sg	lo	lat	lo	lat	lo	
h	a	l	a	l	a	

Each of the features here (sg, lo, lat) involves movement of articulators from their normal state in quiet breathing. Communication burns calories and the three features (sg, lo, lat) violate constraints that ban (h, a, l) in various languages of the world. Worse, some of these features are misaligned (McCarthy & Prince 1993) from the left edge of the root: (sg) is perfectly well-aligned but the laterals are both at least one sonority peak[10] away from the left edge. And all but the first vowel is at least one sonority peak away from the left edge. Finally, part of the word repeats itself (lala), in violation of *ECHO.

We thus get the following constraint violations for this word in standard OT:

(39) Constraints violated by *halala*

	NO SG	NO LO	ALIGN LAT	*STRUC (σ)	*STRUC (μ)	*ECHO
halala	*	***	***	***	***	*

The tableau above is to be read as follows: The word *halala* violates NOSG once because of its initial consonant; it violates NOLO thrice because of its three lo vowels; and it violates ALIGNLAT three times: once for the first [l], twice for the second. The word has three syllables, three moras and a godawful echo.

The point of representation as pure markedness is that there is only one best way of violating the constraints in (35) and no others, which is to say [halala].

To see this let us turn the violations incurred by [halala] into distinctive violations or desiderata. Using 'q' for *quarrel*, the desiderata are as follows:

(40) Desiderata for Chumash *halala* 'to quarrel'

	NO SG	NO LO	ALIGN LAT	*STRUC (σ)	*STRUC (μ)	*ECHO
halala	q	qqq	qqq	qqq	qqq	q

The notation may now be read as instructions to the speaker:

> To signal the meaning 'quarrel' in this language you'll need to do a number of things that your mouth and mind won't find easy to do. These things are so difficult they are actually ungrammatical in some languages. But here's what you have to do: you need to spread your glottis open once, lower your tongue three times and lift one side of your tongue to the molars. Some of these things can be done right away at the beginning of the word, but some must be delayed. The lateral tongue movement, in particular, will be postponed after three syllable peaks (the grammar will figure out which ones as shown below). One last thing: this word will echo itself in some way. This word has a lot of problems but it's supposed to be that way.

To see how this works within an OT grammar, let's run a bunch of possibilities by and see which of them delivers all of the desiderata in (40) without bringing in additional desiderata to confuse the hearer. To keep the discussion simple we'll just concentrate on a few of the desiderata:

(41) Derivation of Chumash *halala 't*o quarrel'

	NO SG	ALIGN LAT	*STRUC (σ)	*STRUC (μ)	*ECHO
alala	<q>!	qqq	qqq	qqq	q
☞ halala	q	qqq	qqq	qqq	q
lahala	q	qq<q>!	qqq	qqq	<q>
halalama	q	qqq	qqq*!	qqq*	q
halalal	q	qqq*!**	qqq	qqqq	q

The first candidate is too good to be true: it fails to violate NOSG, which is a desideratum for the meaning 'quarrel'. It's *not marked enough* and thus isn't the best way to signal 'quarrel'. The second candidate has the requisite violation of NOSG as well as all of the other desiderata; it isn't perfect but it isn't supposed to be. The third candidate is too good again: it has too few misalignments of lateral and doesn't echo itself—this makes it too well-formed to signal 'quarrel'. The fourth candidate has all the desired peculiarities but it has additional peculiarities that are not desiderata, including an extra syllable and an extra mora; it is less well-formed than it is supposed to be and thus not a good pick for signalling 'quarrel'. The final candidate loses on the same grounds, with unasked for violations of ALIGN-LAT and *STRUC(μ)—it's not good enough to mean 'quarrel'.

The bulk of the analysis follows standard OT lines (Prince & Smolensky 1993). All we are arguing for here is how the shape of the reduplicant is to be specified in the lexicon. Following Golston 1996 and O'Bryan 1999, we're proposing that reduplicating morphemes are represented in the lexicon as sets of constraint violations just like non-reduplicative morphemes. All morphemes are represented in the lexicon, not in the grammar proper.

6 Conclusion

We have tried to show that a close examination of reduplication in Bontok and Chumash poses problems for current views of reduplication.

The direct OT analysis based on FILL (Golston 1996) is fatally flawed because it cannot distinguish reduplication from epenthesis. This is true regardless of the language in which reduplication occurs. That analysis is also internally inconsistent in so far as it uses a constraint (FILL) that requires comparing an input string to an output string , something direct OT is supposed to get rid of.

The standard OT analysis of reduplication is ill-suited to a langauge like Bontok in which different sizes of reduplicant carry different meanings. Nor can it readily be extended to monomorphemic reduplication in Chumash, since reduplicated forms there fail to distinguish the base from the reduplicant. It is necessary in these languages to tie reduplication to individual morphemes, something which is best done in the lexicon, not in the grammar.

We have proposed a direct OT analysis based on distinctive violation of *ECHO (cf. O'Bryan 1999) and *STRUC (Zoll 1993, 1998). Reduplication always involves violation of *ECHO—that cannot be at issue. We have merely elevated this from an observation to a defining characteristic: reduplication *is* echo. The choice of *ECHO over FILL avoids the problems which beset that analysis and provide a surface true characterization of reduplication purely in terms of markedness.

Notes

1. Each of the authors contributed equally to this project and are listed in alphabetical order.

2. Thurgood uses templates and rules, showing that heavy syllable reduplication in Bontok interacts with two phonological processes, gemination and metathesis. Gemination occurs in order to make a reduplicant heavy; metathesis in order to avoid a glottal stop in the coda. [Chumash also

avoids glottal stops in the coda in reduplication, replacing them with [h] according to Applegate 1976:278.] These sorts of phenomena are easily modeled in OT (standard or direct) but we will not detail them here due to space limitations.

3. This constitutes the basic theory. The full theory includes constraints that require reduplicant and (underyling) root to sound the same. The extended part of the theory falls beyond the scope of this paper.

4. Applegate (1972, 1976) uses the terms *lexical* (monomorphemic) and *syntactic* (bimorphemic); Walsh (1995) uses *lexical* and *productive*.

5. Early OT had FILL constraints against adding features, segments, onsets, nuclei, codas, moras and syllables.(Prince & Smolensky 1993, McCarthy & Prince 1993ab). In correspondence theory this has been changed to DEP-IO constraints like DEP-μ-IO (Kager 1999, 156).

6. In the extended model of correspondence theory (McCarthy & Prince 1995a, 358ff.) there is a related notion, Input-Reduplicant Correspondence. This would mean that reduplicants *do* have correspondents in the input (contra Kager's interpretation). But this raises a different problem: what distinguishes the relation between input and reduplicant (IR) from the relation between input and base (IB)? Both cases relate an input to an output (R or B), so why should only one case (input-base) be subject to input-output faithfulness? The simple definitions of faithfulness put forth in correspondence theory would not seem to allow for nice interpretations of this kind.

6. Kager proposes a similar constraint (1999, 156): Dep-μ-IO: Output moras have input correspondents.

7. The German data discussed above can then be simply treated as violation of NOSCHWA.

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